MILK CONSUMPTION PATTERNS AND NUTRITIONAL STATUS OF CHILDREN (24-59 MONTHS) FROM DAIRY AND NON-DAIRY HOUSEHOLDS IN NAKURU COUNTY, KENYA

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A thesis submitted to Graduate School in partial fulfilment for the requirements of the Masters of Science degree in Nutritional Sciences of Egerton University

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DECLARATION AND RECOMMENDATION

DECLARATION

I declare that this thesis is my original work and has not been presented in this or any other University for the award of a certificate, diploma, or degree.

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RECOMMENDATION

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DEDICATION

I dedicate this work to the best of mums in the world Naomi Nyabate Ogenche and all mothers out there who support their children's efforts.

This work is also dedicated to all children who are tomorrow's future.

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ABSTRACT

Milk is a rich source of proteins and contains all the essential amino acids and other nutrients. However, only 13% of children below five years in Kenya consume milk and milk products. This study aimed at determining the milk consumption patterns and nutritional status of children aged 24-59 months from smallholder dairy households (DHs) and non-dairy households (NDHs) from peri-urban (Bahati) and rural (Olenguruone) areas in Nakuru County, Kenya. A cross-sectional survey was conducted targeting 216 randomly selected households with primary caregivers and children (24-59 months). Semi-structured questionnaires were used to collect data on demographic characteristics of the study population, children's dietary intake, dietary diversity, milk consumption patterns and nutritional status. Focus group discussions (FGDs) were conducted to complement the data collected from questionnaires. Data was analysed using the Statistical Package for Social Sciences (SPSS) version 20 and Statistics and Data (STATA) version 12 softwares. Themes were computed from the FGD notes and used to corroborate the quantitative data.

The prevalence of milk consumption among children from DHs and NDHs in peri-urban area was 57.4% and 40.3% whereas in rural area it was 80.3% and 72.2% respectively. However, there were no significant differences between the proportion of children who consumed milk. The amount of milk consumed by children from DHs in rural area was significantly (P=0.002) higher (338.3±245.7 mls) compared to that of children from NDHs (207.7±109.7 mls). On the contrary, children from NDHs (235.0±69.7 mls) in peri-urban area consumed more milk than those from DHs (195.1±97.0 mls) though there was no significant difference. These amounts of milk were low compared to the WHO minimum recommended intakes of 500mls per day. Multivariate analysis indicated that: children from the peri-urban area were likely to be underweight (P=0.003), stunted (P=0.006) and wasted (P=0.006) compared to those from the rural area; younger caregivers were likely to have underweight (P=0.040) children and caregivers who were single likely to have stunted (P=0.019) children. Findings from the FGDs showed that milk was considered as an important component in the diets of young children. In conclusion, the study indicated that although children in both DHs and NDHs consumed milk, the actual amounts consumed did not meet the minimum recommended amounts of 500mls per day. Therefore, integrated interventions including nutrition education and behaviour change communication are needed to promote milk consumption in children so as to contribute to their nutrient intake.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

ASF	Animal Source Food
CDDS	Children's Dietary Diversity Score
DD	Dietary Diversity
DHs	Dairy Households
GDP	Gross Domestic Product
GoK	Government of Kenya
FAO	Food and Agriculture Organisation
FFQ	Food Frequency Questionnaire
FGD	Focus Group Discussion
HAZ	Height-for-Age Z-score
HFA	Height-for- Age
HH	Household
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
IDF	International Dairy Federation
ILRI	International Livestock Research Institute
IYCF	Infant and Young Child Feeding
KDB	Kenya Dairy Board
KDHS	Kenya Demographic and Health Survey
KNBS	Kenya National Bureau of Statistics
MDD	Minimum Dietary Diversity
MoALF	Ministry of Agriculture, Livestock and Fisheries
MoMS	Ministry of Medical Services
MPHS	Ministry of Public Health and Sanitation
NACOSTI	National Commission for Science, Technology and Innovation
NDHs	Non-dairy Households
RELOAD	Reducing Losses Adding Value
RNI	Recommended Nutrient Intakes
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
SSA	Sub-Saharan Africa
STATA	Statistics and Data
UNICEF	United Nations Children's Fund

USA	United States of America
USD	United States Dollar
WAZ	Weight-for-Age Z-score
WFA	Weight-for- Age
WFH	Weight-for- Height
WHO	World Health Organisation
WHZ	Weight-for-Height Z-score

CHAPTER ONE
INTRODUCTION

1.1 Background of study

The prevalence of malnutrition among children below five years in Africa and Asia is high rendering it a public health concern (Fanzo and Hawkes, 2018). Globally, approximately 149 million children in the world were stunted in 2018 (UNICEF *et al.,* 2019), a reduction from 255 million in 1990 (UNICEF *et al.,* 2015). The decline was more pronounced in Asia where the stunting rate dropped from 38.2% in 2000 to 22.7% in 2018. Africa has made slow progress in reducing malnutrition with 30.0% of the children stunted in 2018 down from 38.0% in 2000 (UNICEF *et al.,* 2019). Regionally, the progress in reducing malnutrition has been slow particularly in Sub-Saharan Africa (SSA) due to slower economic growth and reduced Gross Domestic Product (GDP) (FAO *et al.,* 2015; FAO *et al.,* 2019). The Kenya Demographic Health Survey (KDHS) (2014) reported that 26% of children aged below five years were stunted, 11% underweight, 4% wasted and 4% overweight (KNBS and ICF, 2015). In Nakuru County, it was reported that 27.6% of the under-fives in Nakuru County were stunted, 10.2% underweight, 4.5% wasted and 4.0% overweight. The prevalence of micronutrient deficiencies in children (6-59 months) in Kenya was 21.8%, 9.2%, 83.3% in iron, vitamin A and Zinc respectively (MoH, 2011). These deficiencies have adverse effects on human health besides affecting the productivity and economic growth in developing countries (Prado and Dewey, 2012; Prado and Dewey, 2014; Oruamabo, 2015).

The World Health Organization (WHO) recommends that children from the age of six months be timely initiated on a variety of foods, in adequate amount and increasing frequency with age, besides continued breastfeeding (Dewey, 2005). However, infants and young children in developing countries are fed on diets that do not meet these recommendations (Ruel, 2003). Consumption of low quality diets that lack diversity is a major factor attributed to malnutrition in children aged below five years (Dewey, 2005). WHO recommends that children aged 6-23 months should consume foods from four out of seven food groups in order to achieve a minimum dietary diversity (MDD) (WHO, 2008; WHO, 2010). This is because a diet that is highly diversified is associated with adequate intake of both macronutrients and micronutrients (Kennedy *et al.,* 2011). However, diets consumed by young children in Kenya just like in most developing countries are mainly plant based, bulky with high fiber and phytates that lower the bioavailability of micronutrients (Nicholson *et al.,* 2003; Neumann *et al.,* 2007; Walton *et al.,* 2012; Dewey, 2013). According

to Jin and Iannotti, (2014) these diets are also deficient in Animal Source Foods (ASFs) that are rich sources of essential micronutrients and macronutrients that are important for alleviating under-nutrition among children aged below five years, particularly in the developing countries. Young children should be fed frequently on small amount of ASFs including meat, poultry, fish, eggs and milk (Dewey, 2005). Milk is a rich source of proteins and contains all the essential amino acids and other nutrients including vitamins A, D, B_6, B_{12}, B_2, calcium, phosphorus, magnesium, iodine and zinc (Dror and Allen, 2014; Rawlins *et al.,* 2014).

While milk consumption could contribute significantly to the quality of diets consumed by young children, SSA experiences approximately 27.2 % milk losses along the dairy value chain (FAO, 2011). Annual farm level milk losses in Uganda, Ethiopia, Tanzania and Kenya were 8.4, 28.6, 46.4 and 54.2 million litres, respectively in 2003. Most of the milk losses are incurred in the small scale informal sector compared to the formal dairy sector (Lore *et al.,* 2005). These losses contribute to food lost for households, especially for children below five years who are more vulnerable to malnutrition.

Measures aimed at curbing malnutrition tend to identify opportunities that increase both income generation and food production. Livestock ownership has been documented as a possible channel out of poverty and malnutrition (Rawlins *et al.,* 2014). It directly or indirectly affects the nutritional status of children in developing countries (Hoddinott *et al.,* 2014; Jin and Iannotti, 2014). Livestock are a source of ASFs that provide essential nutrients needed for child growth and development. In addition, the sale of animal products provides income which could also be used to purchase a variety of other foods (Muriuki, 2011; Rawlins *et al.,* 2014). Despite this likelihood that agricultural interventions are significant drivers of nutritional improvements in developing countries, there still exists little evidence linking nutritional outcomes to agriculture (Wyatt *et al.,* 2013; Hoddinott *et al.,* 2014; Jin and Iannotti, 2014).

In an attempt to avert malnutrition, the Reducing Losses Adding value (RELOAD) Project which is an African-German research network aims at reducing post-harvest losses and fostering value addition in the East African food value chains. One of its objectives is securing global nutrition by increasing agricultural production. This will avail food, alleviate poverty and improve nutrition status (Affognon *et al.,* 2014). The RELOAD project in Kenya targets the entire meat and milk commodities with Egerton University pursuing the dairy

value chain. The implementation of this project includes: estimating the milk losses along the dairy value chain, establishing milk handling, storage, utilization, use of spoiled/rejected milk, development of new enriched dairy products, preservation technology, marketing and branding of dairy products.

This was study embedded in the RELOAD project and sought to determine milk consumption patterns and nutritional status of children (24-59 months) from smallholder dairy households (DHs) and non-dairy households (NDHs) in peri-urban and rural areas. These households were of interest because the study sought to establish whether ownership of a dairy cow is associated with milk consumption and subsequently better nutritional status of the children. The study findings will guide the development of nutrition interventions that target promoting milk consumption by children from smallholder farmers in Nakuru County.

1.2 Statement of problem

Milk is an important component of the diet, however its consumption has been on the decline in many countries. This is despite its known benefits including contribution to the intake of proteins which contain essential amino acids and micronutrients. Smallholder households in SSA experience milk losses estimated at 4.5% to 27.2%. These milk losses are among other factors that contribute to the intake of poor quality diets that are limited in ASFs. Consequently, this denies households the nutritional benefits of milk more so for children aged below five years who depend on caregivers for their feeding thus increasing their vulnerability to malnutrition. The results from the 2014 KDHS indicated that the diets of children were not diverse and that only 13% of the under-fives in Kenya were fed on milk and milk products. Nakuru County is the second highest milk producer in the country, producing approximately 297 million litres of milk per year. However, the annual per capita milk consumption in urban and rural areas in Nakuru stands at 55.2 and 50.2 litres respectively. This is below the annual per capita milk consumption of 220 litres recommended by FAO. In addition, 27.6% of the under-fives in Nakuru County were stunted, 10.2% underweight, and 4.5% wasted. Thus, there was need to establish milk consumption patterns and nutritional status of children aged 24-59 months from smallholder DHs and NDHs in Nakuru County. The DHs and NDHs were both considered in this study in order to establish whether ownership of a dairy cow had an influence on the milk consumption patterns of children in peri-urban and rural areas.

1.3 Broad objective

The overall objective of this study was to determine milk consumption patterns and nutritional status of children aged 24-59 months from smallholder DHs and NDHs in peri-urban (Bahati) and rural (Olenguruone) areas in Nakuru County.

1.3.1 Specific objectives

The specific objectives of the study were:

i. To determine the socio-demographic characteristics of smallholder DHs and NDHs in peri-urban and rural areas with children aged 24-59 months.
ii. To determine the dietary diversity of children aged 24-59 months from smallholder DHs and NDHs in peri-urban and rural areas.
iii. To determine the milk consumption patterns of children aged 24-59 months from smallholder DHs and NDHs in peri-urban and rural areas.
iv. To assess the nutritional status of children aged 24-59 months from smallholder DHs and NDHs in peri-urban and rural areas.
v. To establish the association between socio-demographic characteristics, children's dietary diversity, milk consumption patterns and nutritional status of children aged 24-59 months from smallholder DHs and NDHs in peri-urban and rural areas.

1.4 Research questions

i. What are the socio-demographic characteristics of smallholder DHs and NDHs in peri-urban and rural areas with children aged 24-59 months?
ii. What is the dietary diversity of children aged 24-59 months from smallholder DHs and NDHs in peri-urban and rural areas?
iii. What is the milk consumption patterns of children aged 24-59 months from smallholder DHs and NDHs in peri-urban and rural areas?
iv. What is the nutritional status of children aged 24-59 months from smallholder DHs and NDHs in peri-urban and rural areas?
v. What is the association between socio-demographic characteristics, children's dietary diversity, milk consumption patterns and the nutritional status of children aged 24-59 months from smallholder DHs and NDHs in peri-urban and rural areas?

1.5 Justification of the study

To address concerns over food and nutrition outcomes, policy makers are promoting investments aimed at increasing agricultural production. This is with the ultimate goal of ensuring that enough food is produced to feed the population in developing countries (Conway, 2012; FAO, 2013). There has been emphasis on the importance of food security globally due to the unpredictable, rising global food prices and food losses associated with increased hunger among poor households (Thompson and Amoroso, 2014). Agricultural interventions such as dairy intensification is one of the ways that can be used to address nutrient deficiencies through increased milk consumption (Wyatt *et al.,* 2013). Other benefits of dairy production lie in the increased availability of ASFs for own consumption, for sale and purchase of other nutritious foods and as a source of income for the households (Rawlins *et al*., 2014). Regardless, limited studies in the developing countries show the association between agriculture and nutritional outcomes (Wyatt *et al*., 2013; Hoddinott *et al.,* 2014; Jin and Iannotti, 2014). Thus, this study determined the milk consumption patterns and nutritional status of children (24-59 months) from smallholder DHs and NDHs in a peri-urban and rural area in Nakuru County. Based on the findings of this study, RELOAD Project will come up with interventions that will promote milk consumption at household level especially among young children. This will lead to improvements in the quality of diets consumed by children and consequently their nutritional status.

1.6 Scope of the study

This study targeted smallholder DHs and NDHs with at least a primary caregiver and one child aged between 24-59 months from both peri-urban (Bahati) and rural (Olenguruone) areas in Nakuru County. Children aged 24-59 months were selected to participate in the study so as to prevent the confounding effect of the contribution of breast milk with the nutritional status of children since at the age of 24 months most children have stopped breastfeeding. The study areas were purposively selected by the RELOAD project as they were regions with high milk production within Nakuru County.

1.7 Limitations of the study

The study was a one-point cross-sectional survey hence it was not possible to capture the long term/ seasonal effects of milk consumption on the nutritional status of the children. In addition, the amount of milk consumed by children were only based on a single 24-hour

recall thus limiting the ability of the study to measure the impact of seasonal variation on the amount of milk consumed by the children (24-59 months).

1.8 Operational definitions of terms

Mother: biological female parent of index child of the study who was selected for interview. In cases where the mother was not around the indexed child's caregiver was be interviewed.

Primary caregiver: refers to the person who is mainly in charge of food preparation and feeding of the index child selected from the sampled dairy and non-dairy households. This could also include the mother.

Children: this refers to children aged 24-59 months.

Children's dietary diversity: refers to the number of foods/ food groups consumed by a child over a given period of time (the previous twenty four hours). Four out of seven food groups are recommended for children by WHO.

Milk consumption: refers to milk intake that is obtained from a cow and not any other dairy animal.

Forms of milk: this refers to the different states in which milk was consumed by the children aged 24-59 months either as fresh milk, milk added to another beverage, milk by-products, milk added to cereals/vegetables or any other as stated by respondent.

Milk consumption patterns: this refers to the different forms in which cow milk was consumed, the frequency of consumption and the quantities of milk consumed.

Milk losses: refers to milk that spills, gets spoiled or has reduced its quality before it reaches the consumer. In this study milk losses referred to the rejected milk at collection centers.

Combined uses: refers to multiple ways in which money earned from the sale of milk or crops was utilized. For instance, in this study the earnings were used for; business expansion, renting farms, keeping the money as savings, purchasing chicken and cows, paying electricity, water bills, loans and house rent.

Household: refers to a group of all persons living under the same roof who eat from the same pot and have one adult member as the head.

Farm households: these are households that practice agriculture; crop farming and/or livestock rearing. The study involved both dairy and non-dairy households.

Peri-urban households: refers to households within close proximity to Nakuru town.

Rural households: refers to households not within Nakuru town or its proximity.

Smallholder dairy household: refers to households that practice agriculture by rearing dairy cows and grow crops on small scale.

Smallholder non-dairy household: refers to households that practice agriculture mainly farming i.e. grow crops on small scale and do not rear dairy animals.

Nutritional status: the physiological state of an individual that results from the relationship between nutrient intake and requirements from the body's ability to digest, absorb and use these nutrients. In this context the children's nutritional status was determined by taking anthropometric measurements (weight and height).

Anthropometric measurements: this is a technique used in determining an individual's nutritional status by measuring body dimensions such as weight and height. In this context the children's measurements was determined.

Physical disability: for this study it referred to a child with a limitation on their mobility and/or are not able to stand on their own.

Malnutrition: refers to insufficient, excessive or imbalanced consumption of dietary energy and nutrients. It manifests itself in three forms; over-nutrition, under-nutrition and micronutrient malnutrition. In this context malnutrition means under-nutrition.

Under-nutrition: refers to a combination of an inadequate intake of total energy, micronutrients and/or proteins. This was assessed through nutrition status indicators namely stunting, wasting and underweight.

Stunting: refers to children with Z-score values below -2 standard deviations (SD) and below -3 SD from the reference population for HAZ.

Underweight: refers to children with Z-score values below -2 standard deviations (SD) and below -3 SD from the reference population for WHZ.

Wasting: refers to children with Z-score values below -2 standard deviations (SD) and below -3 SD from the reference population for WAZ.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of literature related to the study including: the link between agriculture and nutrition, dairy milk production, consumption and its contribution to children's dietary diversity and nutritional status. A conceptual framework is further presented at the end of the chapter to describe the relationship between the study variables.

2.2 Link between agriculture and nutrition

Agriculture is the backbone of Kenya's economy (Wagah *et al.,* 2015) and the foundation of many livelihoods in the rural areas (Ruel *et al.,* 2013; Wanjala and Njehia, 2014). Agriculture contributes to almost 26% of the Gross Domestic Product (GDP) in Kenya, with approximately 80% of the population earning a living from it (MoALF, 2015; Wagah *et al.,* 2015). Agriculture is also the major source of revenue with agricultural exports contributing close to two thirds of the total domestic exports (MoALF, 2015). The livestock sector alone contributes up to 12% of the total GDP and 40% of the agricultural GDP. Smallholder dairy farming in Kenya is the largest in Sub-Saharan Africa with about 4.2 million dairy cattle and 1.8 million smallholder farmers (KDB, 2014). These smallholder farmers own 1 to 3 cows that produce nearly 80% of the marketed milk (Muriuki, 2011). The International Livestock Research Institute (ILRI) also estimated that 40% of these smallholder dairy farmers rely on dairy production for their income (Shreenath *et al.,* 2011).

Furthermore, agriculture has the potential to improve nutritional outcomes through the consumption of food, provision of income, agricultural policies, food prices and maternal engagement in agriculture (Wagah *et al.,* 2015). Agricultural interventions focussing on increasing food production alongside income generation could directly improve nutritional status through either increased consumption of foods produced or purchased (Wyatt *et al.,* 2013; Rawlins *et al.,* 2014) or the investment on health care. In the past, under-nutrition was considered to occur due to lack of food thus, early agricultural interventions concentrated on increasing food production. This was to ensure that the poor had more nutritious food in terms of protein, micronutrients and caloric components. It was later realized that increasing food production alone while overlooking accessibility to the food was not adequate to eliminate under-nutrition. Other interventions such as food transfers and income generation were thus initiated to supplement the earlier interventions (Masset *et al.,* 2011). Therefore,

agricultural interventions need to be more nutrition sensitive with more emphasis on production of nutrient dense foods that have high micronutrient bioavailability (Ruel *et al.,* 2013; Das *et al.,* 2014). Therefore, improving agricultural performance can have positive impacts on nutritional outcomes (Gulati *et al.,* 2012). Several studies have reported on the impact of agricultural interventions on children's nutritional status and indicated positive influences on consumption of specific foods (Masset *et al.,* 2011; Ruel *et al.,* 2013; Olney *et al.,* 2015; FAO, 2017; Pandey *et al.,* 2016; Bouis and Saltzman, 2017; Osei *et al.,* 2017; Ruel *et al.,* 2018). However, the association between agricultural production, consumption and nutritional outcomes are not yet well established (Das *et al.,* 2014; Wagah *et al.,* 2015: Ruel *et al.,* 2018; Bird *et al.,* 2019).

2.3 Dairy milk production and consumption

Worldwide, 770 billion litres of milk were produced in 2013 and this was projected to increase by 177 million tonnes in 2025 (FAO, 2016). Milk production rose from 800 to 818 million tonnes in 2014 and 2015 respectively. While Asia produces 29% of the world's milk, Africa produces the least (5%). Despite the increase in global milk production the amount produced does not meet the global demand of close to 7400 million people with an annual per capita global milk consumption of 111.3 litres (IDF, 2016).

Dairy production in Kenya is largely concentrated in the Central and Rift Valley regions with smallholder farmers being the main producers (Wanjala and Njehia, 2014). The total annual milk production grew from 3.2 billion litres in 2003 to 5.2 billion litres in 2013 (KDB, 2014). This production however, is still far below that of high global producer regions like Asia, European Union and America (IDF, 2016). Nakuru County is among the highest milk producers in Kenya. This is illustrated in Table 1 where milk production increased by 98.1% in 2013 and 2.2% in 2014 from 146,387,103 litres in 2012. Nevertheless, milk consumption in the county is still low (MoALF, 2013).

Table 1: Milk production in Nakuru County

Year	2012	2013	2014
Amount in litres	146,387,103	290,040,806	296,398,663
Rank in Country	7	2	2

Source: MoALF, 2015

Milk consumption in Kenya equally increased from 523 to 541 million litres between 2013 and 2014 (MoALF, 2015) and 615.9 to 650.3 million litres between 2015 and 2016

(KNBS, 2017). Even with the increased milk consumption, Kenya's per capita milk intake is 100 litres which is below the recommended 220 litres by FAO (MoALF, 2013) and lower than the global average (111.3 litres) (IDF, 2016). The annual per capita milk consumption rate in both the rural (19 litres) and urban (125 litres) areas in Kenya has been attributed to high incomes (MoALF, 2013). Further, a survey done by small dairy development in 2002 showed that the annual per capita consumption of milk in Nairobi, Nakuru urban and Nakuru rural was 57.6, 55.2 and 50.4 litres respectively (Muriuki, 2011). This shows that milk consumption is not taken in adequate amount compared to the recommended intakes hence this could have implications on the quality of diets consumed by the population more so the young children who are more vulnerable.

2.4 Commercialization of milk versus consumption

In developed countries like USA, dairy farming is on large scale and highly mechanized with marketing of milk done through cooperatives. All of the milk and dairy products accounted for 42% of the total commodity marketing by USA agricultural cooperatives (Ling, 2009; IDF, 2016). In developing countries, India has the most organized milk marketing system that is owned by small scale producers. The dairy producers are linked to urban markets through the development of rural milk sheds that collect milk which is channeled to the cooperatives and processed before being transported to the urban markets (Rajendran and Mohanty, 2004). In Uganda, of the total milk produced annually, it is estimated that only 70% of it is marketed while the remaining 30% is consumed on the farm. Informal and formal marketing channels exists with the informal channels accounting for about 80% of the total milk trade in Uganda. Key players in this channel include the mobile traders/hawkers, transporters, and milk bars (Elepu, 2007).

In Kenya, before the liberalization of the dairy industry in 1992 KCC enjoyed monopoly of the Kenya Dairy Market. Emergence of the numerous small scale to medium scale dairy processors has made the milk market become very competitive (Muriuki, 2003; Muriuki, 2011). Currently the New KCC, Brookside Dairy Limited, Githunguri Dairy Farmers Cooperative and Sameer Dairies are the major processors of milk in Kenya (KDB, 2014; Nassiuma and Nyoike, 2014). Despite the extensive formal marketing network in Kenya, 90% of the marketed milk is not processed or packaged but instead bought by the consumer in raw form. The informal market has continued to thrive mainly because the consumers prefer fresh raw milk that is boiled before consumption and the unwillingness to

pay the costs of processing and packing (Muriuki, 2003; Muriuki, 2011; Njarui *et al.,* 2011; Sagwe, 2012; MoALF, 2013; KDB, 2014). On-farm consumption (non-marketed milk) accounts for about 45% of the milk produced and the remaining 55% is marketed through through cooperatives, traders, hotels and milk bars. Inefficient milk marketing is largely responsible for a large proportion of milk that is retained by producers for home consumption. The large milk processors are concentrated in Nairobi and the dairy regions of central highlands and Rift Valley region (Muriuki, 2011; MoALF, 2013; Tavenner and Crane, 2018). Studies show that pasteurized milk is consumed in much smaller amounts except in Nairobi due to the higher prices. Further the formal markets are expected to grow as household income increases (SDP, 2004; Muriuki, 2011; Njarui *et al.,* 2011).

Limited information exists about the levels of milk commercialization by smallholder farmers in Kenya (Nassiuma and Nyoike, 2014; Wanjala and Njehia, 2014). Milk commercialization in Kenya is mainly documented by the Ministry of Agriculture, Livestock and Fisheries (MoALF), the Kenya Dairy Board (KDB) and the Kenya National Bureau of Statistics (KNBS) while other researchers, research institutions and NGO's also contribute to this information through their publications. However, this data is not collected on regular basis, varies across regions and has no sampling frame thus inadequate for policy making as per international best practices (Nassiuma and Nyoike, 2014). These challenges create uncertainties in determining marketing systems that are more efficient and effective for long term sustainability of the industry.

2.5 Children's dietary diversity

Dietary diversity (DD) is defined as the consumption of a variety of foods over a given period of time and is usually used as a proxy for nutrient adequacy in an individual's diet (Kennedy *et al.,* 2011). DD is associated with adequate nutrient intake of essential nutrients, (Ruel, 2003; Kennedy *et al.,* 2007) improved nutrition and health (Sibhatu *et al.,* 2015). Intake of a variety of diversified foods has been recommended in most dietary guidelines internationally (Ruel, 2003). However, low DD is common among the poor population from developing countries where their diets are based mainly on starchy staples with little or no animal products (Ruel, 2003; Dewey, 2013).

Adequate nutrition is critical for children's growth and development (Dewey, 2005; de Onis *et al.,* 2012) therefore, children below five years need more foods that are nutrient dense compared to adults. Hence, children need to be fed on a variety of foods to ensure that

all their nutrient needs are met (Dewey, 2013). The guidelines for feeding non-breastfed children recommend that children's daily diets should include vitamin A, C, B's and folate (Dewey, 2005). Further, diets lacking ASFs cannot meet all the nutrient needs for children 6-24 months (Neumann *et al*, 2002). Children (6-23 months) also need to consume foods from at least four out of seven food groups to achieve the minimum recommended dietary diversity (WHO, 2010).

However, children in developing countries, are fed on diets that lack most of the micronutrients (vitamin B_1, B_2, B_3, B_6, B_{12}, A, C, E, folate, calcium, iron and zinc) during the complementary feeding period (Dewey, 2013). A study on infant and young child feeding practices in Ethiopia showed that only 7% of the children received a minimum diverse diet while less than a quarter of the children in India, Uganda and Zimbabwe met the recommended MDD (Jones *et al.,* 2014). Similar results were found in another study on DD among children aged 6-23 months in Ethiopia where only 10.8% of children attained the MDD (Aemro *et al.,* 2015). In yet another study by Aguayo and Menon (2016) conducted in Afghanistan, Bangladesh, India, Nepal and Pakistan, less than 25% of the children aged 6-23 months were found to be fed on diets that met the minimum frequency and diversity requirements. The 2014 KDHS showed that in Kenya like other developing countries DD was poor with less than half (41%) of the children aged 6-23 months being fed within the recommended MDD. This same group of children was mainly fed on foods made from grains (80%), fruits and vegetables (64%) with the consumption of ASFs being notably low (flesh foods 21%, eggs 17%, milk and milk products 13%) (KNBS and ICF, 2015).

The relationship between DD and nutritional status has also been demonstrated in a other studies in developing countries. A cross-sectional survey in Ghana indicated significant differences in the DD and nutrient intakes of children aged 6 to 18 months, with the children's DD improving as energy and nutrient intake also increased. In the same study, DD was found to be significantly associated with weight for age (WAZ), length for age and weight for length Z scores (Nti, 2011). Another study by Jones *et al.* (2014) which investigated the infant and young child feeding practices and their associations with child nutritional status revealed that indicators of DD were positively associated with height for age Z score (HAZ) in Bangladesh, Ethiopia, India and Zambia. These studies clearly depict the relationship between children's dietary diversity and the nutritional status but it is not clear whether milk contributes to dietary diversity and nutritional status. The present study

identified the DD, milk consumption patterns and nutritional status of children from dairy and non-dairy households in peri-urban and rural areas.

2.6 Milk consumption patterns among young children

The recommended milk intake for children (6-59 months) is approximately 500 mls per day in developed countries (WHO and FAO, 2004; Dror and Allen, 2014). The forms in which milk is consumed in these countries include: plain fresh cow/goat milk, plain fresh milk added to cereals or other beverages, flavored milk and milk drinks such as milk shakes, malted milk and eggnog (Sebestian *et al.,* 2010). Despite the recommendation, national surveys conducted in the developed countries showed a decline in milk consumption among the children. Overall consumption of milk among young children decreased from 218 kcals/day to 170 kcals/day between 1989 and 2008 (Dror and Allen, 2014). On the contrary, consumption of dairy products in most African countries is common. For instance, in northern Nigeria 82% of all households consume at least one dairy product (mostly sour or evaporated milk) weekly. Smallholder dairy producers in Ethiopia used approximately 68% of their total milk production for human consumption in form of fresh milk, butter, cheese and yoghurt (Teklehaymanot, 2015).

An exploratory survey conducted in Rift Valley, Kenya in 2010 by Shreenath *et al.,* (2011) assessed child nutrition among smallholder farmers. The study categorized the households into three groups; the no milk production, emerging that produced less than six litres in a day and advanced group that produced more than six litres in a day. Findings revealed that the amount of milk given to the children increased with increased production but this was consistent for children in the age groups 12-18 and 18-24 months. However, children aged 6-12 months from the no milk production group in the same study consumed more milk than the other groups, (Table 2). The findings from the study allude to the fact that milk availability does not necessarily translate into consumption. Forms in which milk is commonly consumed in Kenya include; plain fresh milk, cream of milk added to vegetables, fermented as *Mursik*, and milk added to porridge or as milk tea (Wyatt *et al.,* 2013), yoghurt, cheese (KNBS and ICF, 2015).

Table 2: Average daily consumption of fresh milk by children in cups

Age of children	No milk	Emerging	Advanced
6-12 months	1	0.71	0.5
12-18 months	0.5	0.5	1.14
18-24 months	0.3	1.25	2.17

Source: Shreenath *et al.,* 2011

WHO recommends that complementary feeding in children should commence at six months (WHO, 2010), however 27% and 13% of the children in Kenya are introduced to solid and semi-solid at ages 4-5 and 2-3 months respectively (KNBS and ICF, 2015). The 2014 KDHS also indicated that 11.7% of children aged 2-3 months and 29.6% of children aged 4-5 months where introduced to milk (fresh, tinned or powdered animal milk) (KNBS and ICF, 2015). Another survey in Kenya that explored the infant and young child feeding practices among the rural dairy farmers showed that cow's milk was introduced earliest to children from the advanced group i.e. at 3.5 months and latest in the no milk production group (6 months). The reasons cited by mothers for giving their children milk include: enabled physical growth, cognitive ability, pleasant physical appearance, children became healthy and their hair would not turn brown (Wyatt *et al.,* 2013).

Although the discussed studies indicate the different forms in which milk is consumed by Kenyan children, the actual amount of milk consumed are inadequate thus failing to meet the WHO recommended intake of 500mls per day indicated in Table 3. The present study examined the milk intakes by the children from both DHs and NDHs and further determined the amount, the frequency and different forms in which the milk was consumed.

Table 3: Nutrition composition of cow milk and their recommended nutrient intakes

Milk components	In 250ml* cow milk	RNI** 6-11 months	12-23 months	24-59 months	2 cups milk provide 50% RNI or more
Energy (Kcal)	165	700	900	1500	No
Protein (g)	8	13	14	16	Yes
Thiamine (mg)	0.1	0.3	0.5	0.6	Yes
Riboflavin(mg)	0.4	0.4	0.5	0.6	Yes
Niacin (mg)	0.2	4	6	8	No
VitaminB6 (mg)	0.1	0.3	0.5	0.6	Yes (young children)
VitaminB12(µg)	0.9	0.7	0.9	1.2	Yes
Folate (µg)	12.5	80	150	200	No
Vitamin C (mg)	3	30	30	30	No
Vitamin A (µg)	95	190	200	200	Yes
Calcium (mg)	288	400	500	600	Yes
Phosphorus(mg)	300	275	460	500	Yes
Magnesium (mg)	30	54	60	76	Yes
Potassium (mg)	380	700	2000	2100	Yes (young children)
Iodine (mg)	0.05	0.09	0.09	0.09	Yes
Iron (mg)	0.2	7.7	4.8	5.3	No
Zinc (mg)	1.3	0.7	1.7	2	Yes

**250ml is equivalent to 1 cup of milk*

***RNI= the estimated average requirements taken from WHO FAO Vitamin and Mineral Requirements in Human Nutrition, 2004.* Source: Sadler *et al.,* 2009

2.7 Dairy cow milk consumption and nutritional status of children

During early childhood, adequate nutrition is necessary for development into full human potential. The essential nutrients such as energy, proteins, fatty acids and micronutrients available during this crucial period lay a lifetime foundation for appropriate child growth and development (Prado and Dewey, 2012). During this time, children are most vulnerable to the permanent effects of stunting and negative cognitive outcomes attributable to malnutrition which spill over to adulthood. This cycle of malnutrition further continues even to the next generation (Tinajero and Loizillon, 2012). Inadequate nutrition can occur in children as a result of poor infant feeding practices and or the lack of physical/economic access to nutritious foods (Maggie *et al.,* 2010). Therefore, it is important to ensure that children attain adequate nutrition (Dewey, 2013).

Cow's milk contains the essential nutrients required for growth and development of children. The addition of milk in diets allows the plant protein to be fully utilized for growth by providing the essential amino acids. Further, protein from milk will only be fully utilized when the energy requirements of an individual are first met otherwise the protein will be utilized to provide energy (Mahan and Escott-Stump, 2008). Whole milk is a good source of fat that is key in diets of children for provision of essential fatty acids and enhancement of the absorption of fat soluble vitamins (Dewey, 2005). Milk and milk products are also an important source of calcium and children cannot attain the minimum calcium requirements on a plant based diet (Neumann *et al.*, 2002).

A study in Latin America showed that milk intake was associated with better growth in children especially for those aged 12-36 months (Ruel, 2003). Similarly, a randomized control feeding intervention study carried out in Embu district, Kenya among school going children (6-14 years) aimed at testing the association of ASF intake on children's growth and nutrition. The children received mid-morning snacks in school supplemented with meat and milk while fat was added to all the feedings (plain *githeri* + fat, plain *githeri* + meat, plain *githeri* + milk) but the control group received no feeding. Findings indicated that children from all feeding groups had increased weight gain than the control group. Further, it was observed that milk consumption was associated with increased height for young children and already stunted children (Neumann, 2007). In addition, a livestock intervention done in Ethiopia that aimed at assessing the impact on the nutritional status in younger children indicated that children had a higher nutritional status during the intervention period as compared to those who didn't receive any milk (Sadler *et al.,* 2012). This studies shows that milk has a contribution on nutrition status, however the independent relation of milk and diets of children towards growth and nutrition was still not clear.

Other studies that examined dairy cow ownership revealed its association with nutritional status of children. Nicholson *et al.* (2003) study conducted in Coast region in Kenya indicated a positive relationship between child nutritional status and dairy cow ownership. The study found that the relationship between child's height and milk consumption was significant. However, cow ownership did not have any statistical significance on weight for height Z-score (WHZ). Another study found that children from households that owned dairy cows had higher height for age Z-scores (HAZ) compared to children from households that did not own dairy cows (Staal, 2010). These results are

consistent with those from Hoddinott *et al*. (2014) who found that in rural Ethiopia dairy cow ownership had a statistically significant impact on HAZ but not on WHZ. The study further indicated that a single cow ownership increased HAZ scores in children (6-24 months) and reduced the likelihood of stunting. Results from these studies imply that dairy cow ownership has positive impact on longer term child nutritional status (indicated by HAZ) but minimal or no impact on short term nutritional status (indicated by WHZ).

The findings from these studies show that there are associations between cow milk consumption and nutritional status of children though not conclusive. The present study determined whether cow milk consumption among children (24-59 months) from smallholder DHs and NDHs had an influence on their nutritional status.

2.8 Trends in children's nutritional status

Malnutrition contributes to approximately 45% deaths among young children in the world (Black *et al.,* 2013). Stunting rates among under-fives children has been declining in the developing countries but remains high in Africa and Asia. The prevalence of underweight among under-fives has also declined worldwide from 36% in 1990 to 16% in 2011 (de Onis *et al.,* 2012; Oruamabo, 2015). Regionally the prevalence of underweight reduced by 56% in Latin America and Caribbean, 41% in Asia, 28% in Oceania and 22% in Africa between 1990 to 2011. Stunting rates have also dropped in Asia, Latin America and the Caribbean with more than 40% decline whereas in Africa and Oceania the reduction rates lie at 10-15%. Trends show that globally in 2011, 26% of the children aged below five years were stunted, 16% of them underweight and 8% wasted. More than 90% of these children live in Africa and Asia. Furthermore 7% of the under-fives worldwide were overweight in 2011 while in Africa the number of children who were overweight increased from 4% in 1990 to 7% in 2011 (de Onis *et al.,* 2012).

The current joint child malnutrition estimates indicate that as of 2018 Asia attained great progress in the reduction of stunting from 38.2% in 2000 to 22.7%. However, rates of stunting in Africa declined at a lower rate from 38.0% to 30.0% within the same period. Regions with the highest prevalence of stunting include Eastern Africa (35.2%), Middle Africa (32.1%), Western Africa (29.2%) and Southern Africa (29.3%) (UNICEF *et al.,* 2019). In 2018, 49 million of the world's children were wasted with 68% of them living in Asia and 28% in Africa. Globally, 40 million children were overweight with 47% and 24% of them in Asia and Africa, respectively (UNICEF *et al.,* 2019). Trends in Kenya show that there has

been a decline in the rates of malnutrition over the years. The prevalence of stunting among children below five years in Kenya declined from 38% in 1998 to 26% in 2014. Similarly, the prevalence of wasting, underweight and overweight declined from 7% to 4%, 18% to 11% and 6% to 4% during the same period respectively (KNBS and ICF, 2015). Despite the decline in prevalence of malnutrition, many children are still affected (de Onis and Branca, 2016). Besides the rates of stunting and underweight decreasing, at the same time the population of children below five years has also been increasing in the developing countries causing a lag in the proportion of malnourished children (de Onis *et al.,* 2012; UNICEF *et al.,* 2016).

Micronutrient deficiencies are also prevalent among children below five years with 18.1% and 20.2% of them having iron deficiency in the world and Africa, respectively. Worldwide vitamin A deficiency affects 33.3% and 41.6% of the children below five years in the world and Africa, respectively (Black *et al.,* 2013). Estimates of micronutrient deficiencies in Kenya reveal that 21.8%, 9.2% and 83.3% of the children (6-59 months) had iron, vitamin A and zinc deficiencies in 2011, respectively (MoH, 2011).

2.9 Factors associated with nutritional status of children aged below five years

The UNICEF's conceptual framework of malnutrition outlines a number of factors that are linked to malnutrition. Inadequate intake of food and diseases are the immediate causes implying that food has a direct association with nutrition outcomes. Other causes include inadequate access to health services, social and care environment; inadequate maternal & child feeding and care practices; household food insecurity and national structures, policies and resources that influence malnutrition (MoMS and MPHS, 2009; UNICEF, 2016). Malnutrition occurs in most parts of the world in the form of under-nutrition. The main reasons for under-nutrition, especially in children is poverty, lack of food, illness, inappropriate feeding practices, lack of care and poor hygiene and sanitation (UNICEF *et al.,* 2010).

Black *et al.,* (2013) stated that socio-economic and political factors are determinants to optimum growth and development. It was further argued that mother's education is associated with better child care practices and reduced incidences of stunting. Similarly, a study by Joshi *et al.,* (2011) revealed that mothers' education, socio-economic status, occupation and dietary knowledge were factors that were significantly associated with the nutritional status of children aged 4-14 years in Nepal. Contrary to this, a cross-sectional

study in Ethiopia discovered that the education status of the mothers did not have any statistical association with the nutritional status of children (6-23 months) (Fekadu *et al.,* 2015). In Kenya, the nutritional status of children is attributed to factors such as poor micronutrient levels in the mothers, subsequent low birth weights, poor infant feeding practices, inaccessibility to sanitation and safe hygienic practices, malaria and HIV/AIDS (KNBS and ICF, 2015). A study in Ethiopia by Mengistu *et al.,* (2013) indicated that 47.6% of the children were stunted, 30.9% were underweight and 16.7% wasted. Child age, family income, feeding and family planning were the key factors found to be associated with stunting. In another study in Ethiopia seeking to determine the factors associated with the nutritional status of children (6-23 months), breastfeeding, diarrhea and DD were found to be significantly associated with underweight and wasting (Fekadu *et al.,* 2015). The study however was not able to establish whether diarrhea resulted to poor nutritional status or if the diarrhea came as a result of the poor nutrition. Appropriate age of complementary feeding initiation, bottle feeding and dietary diversity were also significantly associated with stunting.

These findings indicate that poor feeding practices including low DD has implications on the children's nutritional status amongst other factors. This is so in spite of the increased commitment by WHO and UNICEF to promote appropriate feeding practices for all infants and young children (WHO and UNICEF, 2003).

2.9.1 Socio- demographic factors associated with nutritional status of children

Socio-demographic factors define a person's/ populations' overall position to which attainments in the social and economic aspect contribute. When used in children studies they refer to the socio-demographic characteristics of the parent or family. Socio-demographic factors include age, sex, education, employment status, income and wealth. Maggie *et al.,* (2010) attributed poor nutrition with poverty, little or no parental education, unstable working conditions or unemployment. Additionally, this was more evident in developing countries who are struggling with great socio-economic disadvantages, lack of food and poor education (Black *et al.,* 2013).

One alternative of increasing food production and household income in some regions in SSA is dairy production and marketing. According to Nicholson *et al.,* (2003) livestock ownership is a possible link out of poverty and malnutrition for the majority of the poor who live in developing countries. This is through the sale of animal products which also increases household income. Similarly, in East Africa dairy production by the smallholder farm

families is considered as a source of cash/ income and means of increasing nutrient intake. This has particularly been observed in the highlands of Kenya and Tanzania where dairy farming increased milk production and household income (Nicholson *et al.,* 2003; Staal, 2010). This income can be used to purchase food and health care thus increasing nutrient availability to household members (Rawlins *et al.,* 2014). In addition, the tendency of households to spend extra income on food and health related issues are dependent on the gender controlling the income. In households where the female control household resources their consumption preferences tend to favour the basic needs and child welfare (Rawlins *et al.,* 2014). Das *et al.,* (2014) also indicated that projects having clear effects on improved dietary intake or nutritional status were likely to be those in which women played a critical role in the intervention.

In Kenya smallholder dairy farmers dominate the industry at the production level. They are over a million and they contribute to more than 70% gross market production from farms. Dairy farming as well contributes to the livelihoods of the people engaged throughout the dairy value chain and to the nutritional wellbeing of many rural populations (Muriuki, 2011). This is also evidenced by studies that showed that dairy cow ownership had positive impacts on both milk consumption and child growth (Nicholson *et al.,* 2003; Staal, 2010; Hoddinot *et al.,* 2014; Jin and Iannotti, 2014).

Another study in Cambodia that tried to determine whether consumption of ASFs and DD reduced stunting in children illustrated a significant association. The study further looked at the association between socioeconomic characteristics and the nutritional status in children and it was discovered that children from wealthy households were less likely to be underweight and stunted as compared to children from poor households. The same was revealed when consumption of food groups was determined and children from wealthy households were more likely to consume a wide variety of food groups. Similarly, children whose mothers had attained high levels of education were more likely to consume ASFs, milk products than those whose mothers had only received lower levels. Again these children were less likely to be stunted and underweight as compared to children whose mothers had low levels of education (Darapheak *et al.,* 2013).

These studies showed that most socio-demographic factors were linked with child nutritional status though it was not clear from all studies whether this relationship was on stunting, wasting, underweight or all components of nutrition. The researcher therefore

established this in the current study by covering all components of child nutrition status. Another question that this study addressed was whether the use of income from the sale of dairy/crop produce was for purchase of food.

2.9.2 Knowledge of caregivers on food consumption

Primary caregivers' knowledge on nutrition and health care practices plays a critical role in the quality care given to children in terms of food choices, number of meals, amounts to be fed and timing (Okochil, 2016). The knowledge may be obtained from formal education, community health services, mass media, families and friends (Gavgani, *et al.,* 2013; Quaidoo *et al.,* 2018). Caregivers who are conversant with nutrition and health issues are more likely to adopt good practices especially on the type and quality of diet fed to children (Negash *et al.,* 2014; Fekadu *et al.,* 2015; Chege and Kuria, 2017; Ickes *et al.,* 2017). Studies have shown that mothers' education is associated with better health and nutritional status of children since these mothers have knowledge on appropriate child care and feeding practices coupled with better decision making on seeking health care (Black *et al.,* 2013; Mengistu *et al.,* 2013; Semali *et al.,* 2015; Christian *et al.,* 2016; Chege and Kuria, 2017; Solomon *et al.,* 2017). Additionally, in other studies, mothers' education was inversely related to stunting, wasting and underweight levels in children (KNBS and ICF, 2015; Semali *et al.,* 2015; Tette *et al.,* 2016). Interventions geared towards improving nutrition outcomes in children have incorporated nutrition education and shown positive correlations between nutrition knowledge, practices and outcomes (Olney *et al.,* 2015; Murty *et al.,* 2016; Ickes *et al.,* 2017; Osei *et al.,* 2017; Kumar *et al.,* 2018). Therefore, it is key to ensure that caregivers have the required nutritional knowledge to promote nutrition and health in children since the development of the next generation relies on them (Okochil, 2016; FAO, *et al.,* 2019).

2.10 Theoretical framework

This study's theoretic frame work on the relationship between dairy milk consumption and children's nutritional status is based on the conceptual framework adapted from Jin and Iannotti, (2014) and the agricultural household models by Singh *et al.,* (1986). Jin and Iannotti illustrate that livestock ownership can influence intake of ASFs by children both through household production and purchase of other high quality foods. Consequently, ASFs intake which are rich in several nutrients contributes to nutritional status of the child (Jin and Iannotti, 2014). Figure 1 demonstrates the relationship between livestock ownership and nutritional outcomes of children. Pathway A predicts that livestock ownership results to

child ASF intake; B predicts that child ASF intake results to child nutritional status; C predicts the direct relationship of livestock ownership to the child nutritional status and C' predicts the relationship of livestock ownership to the child nutritional status while controlling for child ASF intake.

Singh's model assumes that a household maximizes utility depending on total income, available time, land, production technology and capital. The nutritional status for children is also considered as a household utility component such that its demand is similar to the demand for items such as food and non-food items. The model further provides guidelines as to the variables that influence child nutritional status whether directly or indirectly. For instance, morbidity which is an explanatory variable for child nutritional status affects the child directly. On the other hand, the estimated impacts of dairy cow ownership on nutritional outcomes are indirectly linked (external) (Singh *et al.,* 1986).

This theoretic framework recognizes that there are many possible causes of child nutrition status and that some have direct association while others indirectly influence the nutritional status of children. The present study established the relationship between milk consumption and child nutritional status from the smallholder dairy and non-dairy households.

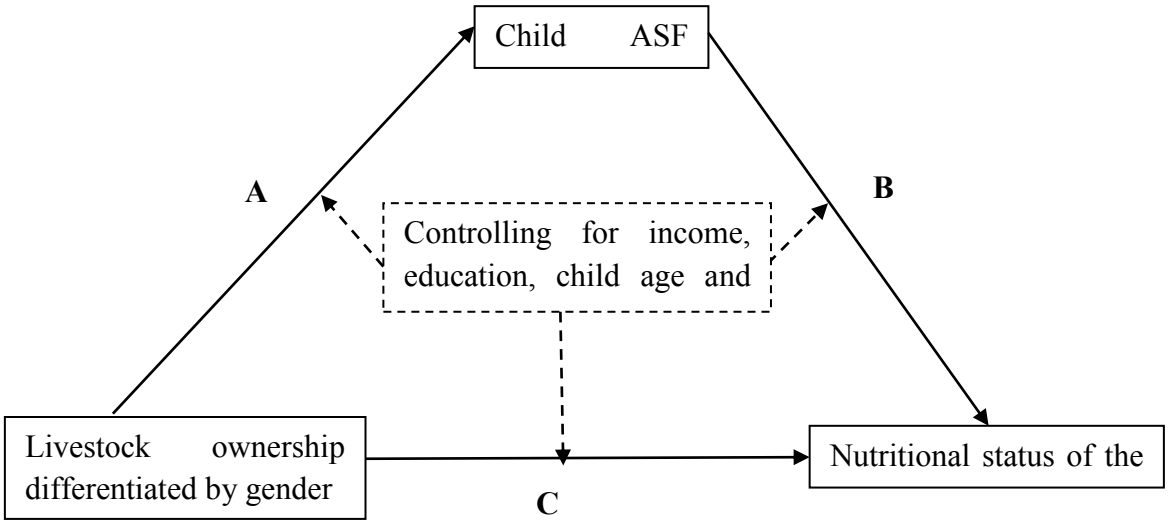

Figure 1: Hypothesized pathway of livestock ownership, ASF intake and nutritional status of children.

Source: Jin and Iannotti, 2014.

2.11 Conceptual framework of the study

The conceptual framework (as illustrated in Figure 2) is founded on the theoretic framework that tried to explain the influence of livestock production on the intake of ASFs by children and consequently their nutritional status. In the present study, the conceptual framework shows the probable relationship between dairy milk consumption and child nutritional status. The independent variables i.e. socio-demographic characteristics of the farm households are presumed to be the influence of child nutrition status (dependent variable). Child DD and milk consumption patterns which are the intermediate variables provide the causal link between the independent variables and the dependent variables. The farm household socio-demographic characteristics determined the availability and/or accessibility of food including milk for the child. For instance, dairy cow ownership determined the availability of milk; land ownership the availability of space for crop production which translated to food and education level determined the feeding practices and food choices. Other variables like age, sex, income/employment and marital status also determined the food choices that influenced the nutrition status of children. The data collected was analyzed and relationships established as illustrated below in Figure 2.

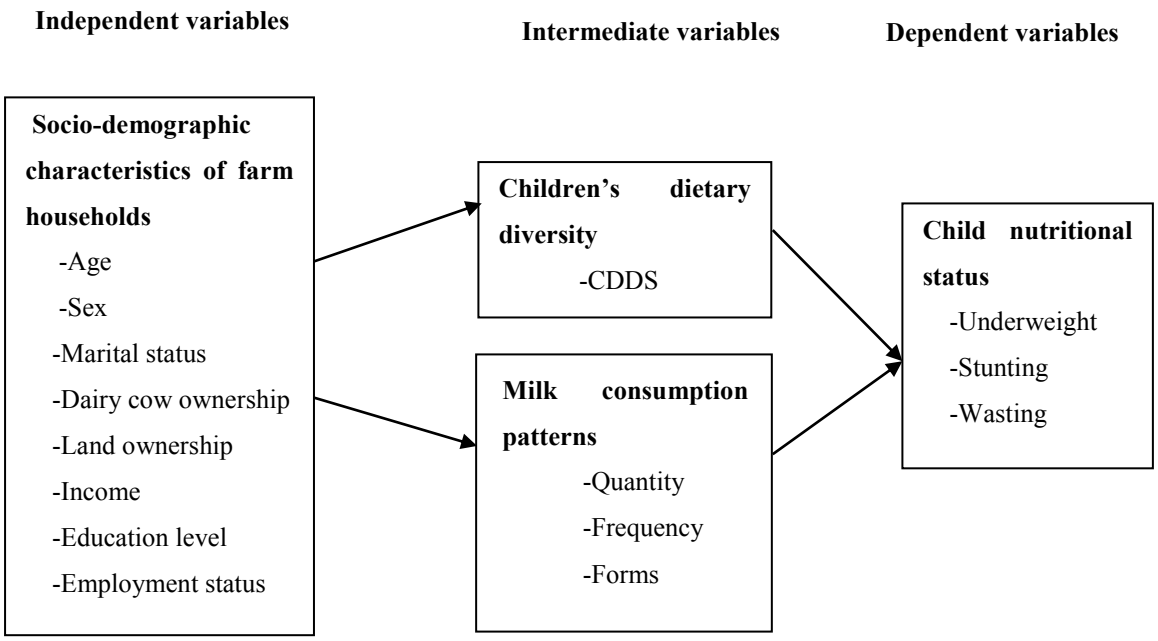

Figure 2: Relationship between socio-demographic characteristics, children's dietary diversity, milk consumption patterns and nutritional status of children

CHAPTER THREE
METHODOLOGY

3.1 Introduction

This chapter describes the methodology that was used in the study including: the research design, study area, study population, sample size determination and sampling procedures, data collection tools and procedures, ethical considerations and data analysis.

3.2 Research design

A cross-sectional design was adopted for the study where data was collected at one point in time (Mugenda and Mugenda, 2003) among the smallholder DHs and NDHs in peri-urban (Bahati) and rural (Olenguruone) areas, in Nakuru County. The cross-sectional survey allowed for the collection of data on socio-demographic characteristics, children's DD, milk consumption patterns and nutritional status.

3.3 Study area

The study was conducted in Bahati and Olenguruone areas located in Nakuru County (formerly the Rift Valley Province). Nakuru County covers an area of 7495 square kilometres with an estimated population of 1,603,325 persons from different ethnic groups, religions and cultures (County Government of Nakuru, 2018). The County lies approximately 140 km North West of Nairobi City and is located between longitude 35º28`; 35º36` east and latitude 0º13; 1º10` south. The County has a bimodal rainfall pattern which ranges from 500 to 1800mm. Temperatures in the County range from 29.3ºC between December and March to 12ºC in June and July (GoK, 2013).

The County's major economic activity is agriculture given that it has a conducive climate for farming, horticulture and dairy farming. Olenguruone is located in Kuresoi South, Sub-county of Nakuru County. It lies at an altitude of 2100-2500 metres above sea level. The temperature ranges from 10ºC to 28ºC, with annual mean rainfall of 1200 mm. Bahati is located in Bahati Sub-county which lies at an altitude of 1700-2500 metres above sea level. It receives an average rainfall of between 800-1600 per year (GoK, 2013).

3.4 Study population

The target population of this study comprised of the smallholder DHs and NDHs in peri-urban (Bahati) and rural (Olenguruone) areas with primary caregivers and children aged 24-59 months. Children aged 24-59 months were selected for the study because at this age most of them have stopped breastfeeding and rely on family foods, therefore they are at risk

of nutrition deficiencies if the family foods they are fed on are not diversified. In households with more than one child aged 24-59 months, the youngest child was selected because they are more vulnerable to malnutrition since they mostly depend on the caregiver for feeding and care.

3.4.1 Inclusion and exclusion criteria

Inclusion criteria

Study participants included smallholder DHs and NDHs with at least a primary caregiver and a child aged 24-59 months permanently residing in Olenguruone or Bahati areas. Dairy households only reared dairy cow/s and had been owning and milking them in the last 4 years. Non-dairy households practised crop farming and did not keep any cow/s or had not milked in the last 4 years. These participants consented to participate in the study.

Exclusion criteria

The following were excluded from the study: smallholder DHs and NDHs with children aged below 24 or above 59 months; households that did not practise crop or dairy farming; households that reared other dairy animals other than cows; households with primary caregivers and/or children that were not permanent residents or who are only visiting the study areas. Children with physical disabilities were excluded to avoid limitations during the collection of anthropometric data while breastfeeding children were excluded to prevent the confounding effect of cow milk with the contribution from breast milk. Participants who did not give their consent to participate in the study were also excluded from the study.

3.5 Sample size determination

The sample size for this study was calculated using the Student's T-test (Jekel *et al.,* 2001):

$$n = \frac{(Z_\alpha + Z_\beta)^2 \cdot 2 \cdot \bar{p}(1-\bar{p})}{(\bar{d})^2}$$

Where;

n= the desired sample size

Z_α= the standard normal deviation of 1.96 for a confidence level of 95%

Z_β= 80% desired power= 0.84

$\bar{p}$ = variance expressed as $p(1- p)= 0.5$

$\bar{d}$= difference to be detected between the two groups (0.2)

$\frac{(1.96 +0.84)^2 (2) [0.5(1-0.5)]}{(0.2)^2} = 98$ i.e. 98 per group (dairy/ non-dairy) x2= 196

10% attrition rate= 19.6≈ 20 = 20+ 196 = 216 i.e. 108 DHs and 108 NDHs

3.6 Sampling procedure

Multi-stage sampling technique was used to obtain the required sample. In the first sampling stage, Olenguruone and Bahati areas were purposively selected because they are regions of high milk production in Nakuru County. In the second sampling stage, purposive sampling was also used to select locations from the two study areas. Five locations were selected in Olenguruone area namely; Kaplamai, Amalo, Chepteuch, Kapsimbeiywo and Kiptagich while Bahati and Dundori locations were selected for Bahati area. A list of all smallholder farm households was obtained from the respective extension officers in Olenguruone and Bahati and used to generate the sampling frames for the smallholder DHs and NDHs. The sample size was proportionately sub-divided to Olenguruone and Bahati areas as shown in Figure 3.

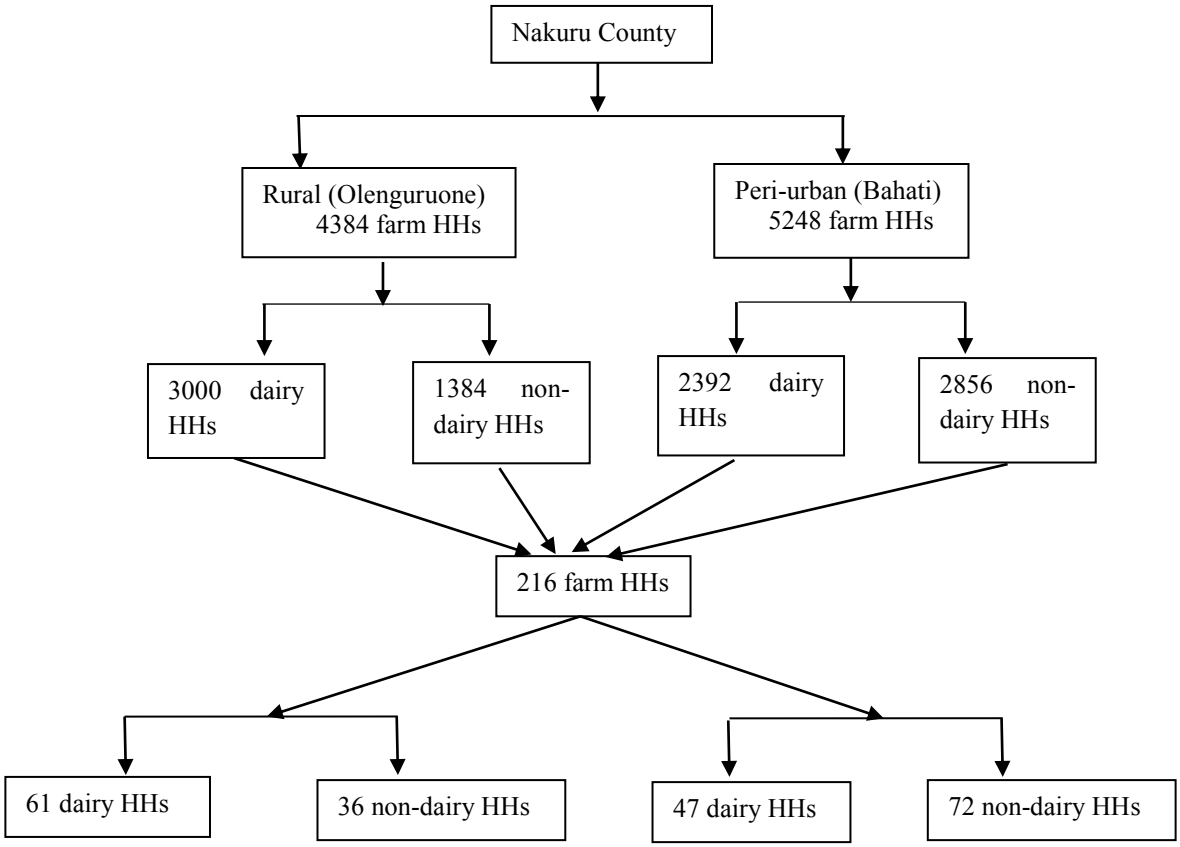

Figure 3: The sampling procedure used in the study

Source: Adapted from MoALF, 2017

Proportionate sampling

Proportionate sampling of the DHs and NDHs was calculated as follows;

Total DHs= 108

In rural = 3000/5392*108= 60.09 ≈61

In peri-urban = 108-61= 47

Total NDHs= 108

In rural = 1384/4240*108= 35.25 ≈36

In peri-urban = 108-36= 72

Proportionate sampling was used in generating the required sample size per area in both Olenguroune and Bahati before the households were selected. For instance, each of the five locations in Olenguruone had approximately twelve DHs and seven NDHs, respectively. Finally, the households with caregivers and their children aged 24-59 months were selected from the sample in each area using simple random sampling technique until the desired sample size was attained. A table of random numbers generated from the Statistical Package for Social Sciences (SPSS) version 20 was used in the selection of households. In households

where there was more than one child aged 24-59 months, the youngest child was selected as the index child. The selection of only one child was done to avoid repetition and over representation of the household data as well as child feeding practices where meals tend to be the same.

3.7 Data collection tools

Quantitative and qualitative methods of data collection were used in this study. Quantitative data was collected using the semi-structured questionnaire while qualitative data was collected using the Focus group discussions (FGDs). Since the study participants were from different ethnic backgrounds, the questionnaires and FGD guides were developed in English and translated into Kiswahili language which was used in the administration of the interviews. The translation of the questionnaires and FGD guides was done by bilingual experts from the Linguistics Department in Egerton University. Then back-translation of the tools was done and reviewed by the bilingual experts to confirm whether they retained the same meaning after translation. Data collected was also translated to English for analysis and inferences.

3.7.1 Socio-demographic questionnaire

The semi-structured questionnaire was used to capture the socio-demographic characteristics of the smallholder DHs and NDHs which included: the ages and sex of all household members, education level, employment status, marital status, the size of farm owned by each household, farming practices, ownership of dairy cows, income from sale of crops and dairy cow produce and the uses of the income from the sales.

3.7.2 The qualitative 24-hour dietary recall

A qualitative 24-hour dietary recall adapted from Gibson's and Ferguson's (2008) was used to assess the dietary intake of the children. A single 24-hour recall was conducted with the respondents who were asked to mention all the foods and drinks consumed at or outside the home by the index children 24 hours prior to the survey. The time each food was taken and ingredients that constituted each food or drink were also considered.

3.7.3 Dietary diversity questionnaire

Data collected from the 24-hour dietary recall was used to fill in the dietary diversity questionnaire consisting of sixteen food groups namely; cereals; white roots and tubers; vitamin A rich vegetables and tubers; dark green leafy vegetables; other vegetables; vitamin A rich fruits; other fruits; organ meat; flesh meats; eggs; fish and sea food; legumes, nuts and

seeds; milk and milk products; oils and fats; sweets and spices, condiments and beverages (Kennedy *et al.,* 2011). The dietary diversity questionnaire was used to gather information with regards to the children's DD.

3.7.4 Food frequency questionnaire (FFQ)

The food frequency questionnaire (FFQ) is a tool consisting of a list of foods and/or beverages and the participants are asked how often they consumed those foods/ beverages over a specified period of time i.e. daily, in a week, month, year or never (FAO, 2018). In this study the FFQ focussed on the frequency of consumption of milk and other milk products the previous day prior to the survey and over the past seven days. This information enabled the researcher to illustrate the frequency of consumption of the different forms of milk by children aged 24-59 months. Forms in which milk was consumed by the children were categorised as: fresh milk, milk tea, milk with cereals, vegetables cooked with milk and other milk products (Sadler *et al.,* 2012). A 500 ml graduated measuring jug was used to estimate the amount of milk consumed by the children from the study households over the last 24 hours.

3.7.5 Children's anthropometric measurement form

This form was used to record the anthropometric measurements of the children aged 24-59 months including weight and height. The ages of children were also recorded in the form in months.

3.7.6 Focus group discussion (FGD) guide

Focus group discussion (FGD) is a qualitative research technique that seeks to understand peoples' perceptions and interpretations on their practices (Mugenda and Mugenda, 2003). It comprises of about six to ten homogenous individuals having a guided discussion on common issues or topics (de Negri and Thomas, 2003).

Two FGD's were conducted separately for mothers and fathers (who had children aged 24-59 months) in both peri-urban and rural areas using FGD guides. The FGD guides contained questions regarding child feeding practices, key decision makers in the household in terms of food choices, milk use, sale, consumption and the use of money from sale of crops and animal produce. Participants were purposively selected and they included both dairy and non-dairy farmers picked from households not participating in the household data collection. Women were included in the FGDs because they are mainly involved with food preparation, child feeding and in other instances are also the household heads. Men were also considered

as they are mostly the household heads and key decision makers who influence food choices and food availability. In some instances, men are also the children's primary caregivers.

3.8 Data collection equipment

Standardized equipment (from Seca Gmbh & Co KG, Hamburg, Germany) including the Seca weighing scale and Stadiometre were used for measuring the weights and heights of children aged 24-59 months.

3.9 Training of research assistants

Data was collected by the researcher and two research assistants with university education and nutrition knowledge. The research assistant were fluent in English, Kiswahili and either Kalenjin or Kikuyu which were the local vernacular languages spoken in Olenguruone and Bahati, respectively. Prior to commencement of the survey the research assistants were trained on the use of the survey tools and how to take accurate anthropometric measurements.

3.10 Data collection procedures

Village guides from the agriculture extension offices in Bahati and Olenguruone assisted the researcher to identify and access the sampled households. The guides also assisted with the mobilising of FGD participants. An informed consent was sought from the participants prior to the commencement of data collection. The researcher explained and ensured that participants understood the consent. The village guides who helped the researcher identify the participants also helped in translating the consent to vernacular in cases where participants were illiterate. In cases where the participants were illiterate they embossed their thumb print on the consent form. Data was collected by the researcher using semi-structured questionnaires through face to face interviews with the participants in the privacy of their homes. Probing was done to ensure that the participants understood each question in order to solicit the right responses.

3.10.1 Assessment of socio-demographic characteristics

Socio-demographic characteristics (ages, sex, education level, employment status, marital status, farm size, farming practices, ownership of dairy cows, income from sale of crops and dairy cow produce and uses of the income) of the study households were captured through face to face interviews with the participants and answers recorded.

3.10.2 Assessment of children's dietary diversity

Administration of the qualitative 24-hour dietary recall involved asking the primary caregivers to recall all foods and drinks that their children had consumed in the previous 24 hours either at home or away from home. The primary caregivers were further asked to explain the time of day when each meal or/and drink was taken by the child, describe all ingredients used in the meal and the place where the meal was taken. Further probing was done to find out snacks and drinks consumed by the children in between meals. Data collected from the 24-hour dietary recall was used to fill the dietary diversity questionnaire. The responses were recorded as yes implying consumption of any food from the sixteen different food groups listed or no in cases where no food from the food groups were consumed.

3.10.3 Assessment of children's food frequency

A recall of the number of times, the amount and the form in which milk was consumed at each feed was used to generate data on the frequency of milk consumption by the children (24-59 months). The respondents were requested to provide the cups that their children normally used for milk consumption and water was used to estimate the amount of milk consumed at each feed using a graduated 500 ml measuring jug.

3.10.4 Anthropometric measurements assessment

Anthropometric measurements of the children aged 24-59 months including weight and height were taken following standardized procedures (Cogill, 2003). The anthropometric measurements were taken with minimum clothing, no shoes and in both privacy and presence of a caregiver. The measurements were recorded immediately in each questionnaire to prevent loss of data. The height measurements of the children were taken using a stadiometer. The stadiometer was placed on a hard flat surface and the children made to stand upright against the stadiometer without shoes. The children's feet were placed together at the centre of the foot board and against the back of the stadiometer. The head piece was then moved down to touch the child's head at a Frankfurt position. The height measurements of the children were taken three times, recorded to the nearest 0.1cm and an average calculated.

Prior to taking the weight measurements, the Seca scale was calibrated using a known weight. The scale was placed on a flat surface and then adjusted to zero before weighing the children with minimal clothing and no shoes. The weight measurements of the children were taken three times, recorded to the nearest 0.1 kg and an average computed.

The ages of the children were verified by examining documentary evidence provided by the caregivers including the children's clinic/health card, birth certificates and baptismal cards. In cases where these documents were not available the primary caregivers were engaged in a recall to determine which season or event of year when the children were born. The ages were then approximated by use of a calendar of events that was prepared according to occurrences of events for each study area. The ages of the children were recorded in months. The ages of the children were confirmed prior to proceeding with the household interviews and taking of the anthropometric measurements.

3.10.5 Conduction of focus group discussions

The participants for each FGD sat in a circle with the moderator (researcher) facilitating the discussion in Kiswahili. The note taker (research assistant) took notes of the discussion. After the welcome and introduction sessions the moderator sought consent from participants to participate in the FGD and take audio recording. Thereafter, the moderator involved the group in questions while ensuring that each participant got an opportunity to contribute in the discussion. The note taker recorded all the responses in verbatim form while the FGD session was being recorded. Each FGD lasted between thirty minutes to one hour. The FGDs were conducted after completion of household data collection in each area.

3.11 Pre-testing

Pre-testing of data collection tools is important because it enables researchers to identify any weakness and problems prior to the actual data collection. Pre-testing is also done to ensure that items in the tools have the same meaning to all respondents (Mugenda and Mugenda, 2003). In this study a pre-test was conducted in an area (Nessuit) with similar characteristics (milk production) as the intended study area (Olenguruone and Bahati). The pre-test was carried out among 7 smallholder farm households with primary caregivers and their children aged 24-59 months in (Nessuit) Njoro, Nakuru County. This represented 3% of the study sample size and was within the recommended 1-10% of the recommended sample for pretesting (Mugenda and Mugenda, 2003).

3.12 Reliability and validity

Reliability entails the consistency and accuracy of a research instrument after repeated trials (Kothari, 2004). In this study internal consistence technique was used to determine the reliability of the tools that were used in assessing the concept of the study. Data from the pre-

test was subjected to Cronbach's alpha coefficient whereby a coefficient of 0.70 or above indicated that the tools had a high internal consistency (Mugenda and Mugenda, 2003).

Validity is the degree to which the tool measures what it is intended to measure i.e. the results actually represent the concept under the study (Kothari, 2004). In this study, validation of the tools was done to ensure that they are consistent with the study variables. Content validity of the tools was determined by experts from the Departments of Human Nutrition and Dairy, Food Science and Technology in Egerton University. Face validity was done through translation of the tools into the Kiswahili by bilingual experts from Egerton University. The translated tools were pre-tested then reviewed by the same experts.

3.13 Ethical considerations

The researcher obtained permission to conduct research from the Board of Postgraduate School, Egerton University (Appendix XI). Ethical approval to conduct the study was obtained from the Egerton University's Research Ethics Review Committee (Appendix XII). This enabled the researcher to acquire a research permit from the National Commission for Science, Technology and Innovation (NACOSTI) (Appendix XIII-XIV). The researcher also informed all relevant authorities in the County concerning the study (Appendix XV-XVI). Further the researcher informed the area chiefs of each study site about the study for ease access to the community. A written informed consent was also sought from the participants prior to data collection (Appendix VII-VIII).

3.14 Data management and analysis

The quantitative data collected from the study was cleaned, coded and entered into the SPSS computer software version 20 which was used for data analysis. The data was tested for normalcy prior to analysis using Kolmogorov-Smirnov test and was found to be normally distributed ($P>0.05$). STATA software was used to conduct the multivariate analysis using the Multivariate Probit Model.

Data on the intake of milk by children from the FFQ was used to determine whether the amount of milk consumed by children met the RNI based on WHO recommendations (Table 3). The estimated ratios of fresh milk as indicated in Table 4 was used to determine the quantities of milk consumed by children (24-59 months). The consumption of other forms of milk by children (24-59 months) including milk tea, milk consumed with cereals, cooked with vegetables and other milk products, the consumption was determined as the total number of intakes per day (Sadler *et al.,* 2012).

Table 4: Milk consumption measurement methodology

Form of Milk	**Measurement Technique**	**Estimated Milk Portion**
Plain milk	Graduated measuring jug	100%
Milk tea	Number of times consumed	___
Milk with cereal	Number of times consumed	___
Vegetables cooked with milk	Number of times consumed	___
Other milk products	Number of times consumed	___

Source: Adapted from Sadler *et al.,* 2012.

Data collected from the 24-hour dietary recalls was used to fill the children's dietary diversity questionnaire, which in turn was used to construct the CDDS of the children aged 24-59 months. The CDDS was computed by summing up the responses from the sixteen food groups consumed by the children from the dietary diversity questionnaire over the previous 24 hours into seven food groups. The seven food groups include: grains, roots and tubers; legumes and nuts; dairy products; flesh foods; eggs; vitamin A rich fruits and vegetables; other fruits and vegetables (Kennedy *et al.,* 2011; WHO, 2010). A score of 1 was given if the children consumed any food from each of the food groups while a score of 0 was given if no food was consumed from any of the food groups. The total number of food groups consumed was then summed up and children who had consumed foods from at least four out of the seven food groups were considered to have received the MDD (WHO, 2008; WHO, 2010). This guideline was used as a proxy for children 24-59 months in this study there being no guidelines for older children.

Anthropometric data including weight, height and age were used to generate the Z-scores using the WHO Anthro version 3.2.2 software (WHO, 2018). The weight for height (WHZ), height for age (HAZ) and weight for age (WAZ) Z-scores were based on the WHO (2006) growth standards. According to this classification, children with Z-score values below -2 standard deviations (SD) and below -3 SD from the reference population for WHZ, HAZ and WAZ are considered to be moderately and severely wasted, stunted and underweight, respectively (WHO and UNICEF, 2009).

Descriptive statistics including means and frequencies were computed for the socio-demographic data, nutritional status, children's dietary diversity and milk consumption patterns. Inferential statistics were used to establish the relationships between socio-demographic characteristics, children's dietary diversity, milk consumption and nutritional

status. Chi-square test was used to compare differences between DHs and NDHs in peri-urban and rural areas for the categorical data while *t*-tests were used to compare means of the continuous data at a significance level of α=0.05. Multiple linear regression tests were performed to test the relationship between socio-demographic characteristics, child dietary diversity and milk consumption patterns of children.

The relationship between socio-demographic characteristics, child dietary diversity, milk consumption patterns and nutritional status of children was analysed using a Multivariate Probit Model (using STATA version 12). The model illustrates the influence of a set of explanatory variables simultaneously on each of the different response measures while allowing the error terms to be freely correlated (Green 2003; Golob *et al*., 2005). Multivariate analysis has greater power than Univariate to detect effects because it takes into account the correlations between dependent variables. This study adopted Multivariate probit model so as to establish the influence of a number of explanatory variables on each of the different nutrition status indicators (underweight, stunting and wasting) while allowing the unobserved factors to be freely correlated (Belderbos *et al*., 2004; Lin *et al*., 2005). Multivariate probit model is characterized by a set of *n* binary dependent variables *yi* with observation subscripts suppressed as used in this study (Lin *et al*., 2005). The model is specified as shown in Equation 1:

$$Y_{im}^{*} = \beta_m X_{im} + \varepsilon_{im} \qquad (1)$$

Where Y_{im}^{*} (m = 1,….,k) represent the unobserved latent variable of underweight, stunting and wasting by the i^{th} child (i = 1,…,n) (24-59 months), k are the selected variables that affect nutritional status of children. X_{im} is a 1 × k vector of observed variables that affect the nutritional status of children (24-59 months), these include socio-economic status, child dietary diversity and child milk consumption patterns. β_m is a k × 1 vector of unknown parameters to be estimated ε_{im}, m = 1, …, M are the error terms distributed as multivariate normal, each with a mean of zero, and variance-covariance matrix V , where V has values of 1 on the leading diagonal and correlations.

Equation 1 is a system of m equations as shown in Equation 2 below;

$$Y_1^{*} = X_1\beta_1 + \varepsilon_1 y_1 = 1 \quad if \quad Y_1^{*} \succ 0 \;\; Y_1 = 0 \;\; otherwise$$

$$Y_n^{*} = X_n\beta_n + \varepsilon_n y_n = 1 \, if \quad Y_n^{*} \succ 0 \;\; Y_n = 0 \;\; otherwise \qquad (2)$$

This system of equations is jointly estimated using maximum likelihood method. The implicit functional form of the empirical model is specified as follows in Equation 3:

$$Y^{*}_{n} = f_{X}(B_0 + B_1 Loc + B_2 HHsize + B_3 Cc'\,Age + B_4 Csex + B_5 CAge + B_6 CcEdn + B_7 Ccocp + B_8 Fsize + B_9 Lwn + B_{10} MS + B_{11} CDDS + B_{12} Cmilk + B_{13} Mfq) + \varepsilon \quad (3)$$

Where:

B_0=constant or intercept which is the value of dependent variable when all the independent variables are zero; *Loc*= Location; *HHsize*= Household size; *Cc Age'*= Caregivers' age; *Csex*= Child's sex; *C Age*=Child' age; *Cc Edn*= Caregivers' education; *Ccocp*= Caregivers' occupation; *Fsiz*e= Farm size; *Lwn*= Land ownership modes; *MS*= Marital status; *CDDS*= CDDS; *Cmilk*= Child milk intake; Mfq= Milk frequency; ε= error term.

Detailed notes were generated from the FGD notes and voice recordings taken during the FGDs. The notes were then coded into common themes that were used to corroborate the results from the quantitative data. The information was described by and across FGDs while quotes that were representative of the participants' views included in the description and interpretation of the findings. Responses were weighed whereby the number of people who gave a response to a particular question counted and responses that were frequently given considered in the interpretation. Similarly, responses that were based on personal experiences were also taken into consideration. Conclusions were drawn from findings of the FGDs and recommendations made (de Negri and Thomas, 2003). Data from the FGDs enabled the researcher understand the child feeding practices, key decision makers in the household in terms of food choices, milk use, sale or/ and consumption practices and the use of money from sale of crop and animal produce. A summary of data analysis is presented in Table 5.

Table 5: Summary of data analysis

Objectives	Independent variables	Dependent variables	Statistical analysis
1. To assess the socio-demographic characteristics of smallholder dairy and non-dairy households with children aged 24-59 months.	Age, sex, income, education, dairy cow ownership, land ownership, employment		Means, SD, frequencies, Chi-square, T-test
2. To determine the dietary diversity of children aged 24-59 months.	Children's dietary diversity score (CDDS)		Means, SD, frequencies, Chi-square, T-test
3. To determine the milk consumption patterns of children aged 24-59 months.	Forms of milk, frequency, quantity of milk consumed		Means, SD, frequencies, Chi-square, T-test
4. To determine the nutritional status of children aged 24-59 months.	WFH, HFA, WFA		Means, SD, frequencies, Chi-square, T-test
5. To establish the association between socio-demographic characteristics of smallholder dairy and non-dairy households, CDDS, milk consumption patterns and the nutritional status of children aged 24-59 months.	Age, sex, income, education, dairy cow ownership, land ownership, employment, forms of milk, milk quantities, frequency, children's dietary diversity	WFH, HFA, WFA	Multiple linear regression test, Multivariate Probit Test
FGD			Themes

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter illustrates the results and discussions with reference to the study objectives as stated in chapter one. The aspects analysed and discussed include; socio-demographic characteristics of the households, socio-economic status of the primary caregivers, child dietary diversity, milk consumption patterns by children (24-59 months), their nutritional status and associations among the different variables. The study was conducted in 216 households amounting to 100% response rate.

4.2 Socio-demographic characteristics among smallholder DHs and NDHs in peri-urban and rural areas

A total of 216 caregivers with children aged 24-59 months were interviewed from both the smallholder DHs (n=108) and NDHs (n=108). All caregivers (n=216) were female and were either the index child's biological mother, grandmother, elder sibling or aunt. The ages of the caregivers ranged from 25-40 years with a mean± SD age of 34.6±10.5 (DHs) and 26.9±10.5 (NDHs) in peri-urban whereas in rural area the mean ages were 30.1±9.2 (DHs) and 26.2±9.7 years (NDHs), respectively (Table 6). The mean age of caregivers from DHs was significantly higher (P=0.000) than that of caregivers from the NDHs in peri-urban but no significant differences were noted in the rural area. The average age of the children in smallholder DHs and NDHs was 40.5±10.5 and 40.4±8.6 in peri-urban area while in rural area it was 41.5±10.7 and 37.7±11.7 months respectively. More than half of the children (63.8% in DHs and 55.6% in NDHs) from the peri-urban area were female compared to the rural area where they were male (62.3% in DHs and 58.3% in NDHs). However, there were no significant differences between the sex of children in DHs and NDHs in both peri-urban and rural areas.

The mean household size in DHs (5.7±1.9) from peri-urban area was significantly (P=0.027) higher than those from NDHs (4.9±1.7). However, no significant difference was noted in household size between DHs (5.4±1.8) and NDHs (4.9±1.7) in rural area (Table 6). The average household sizes in this study were higher compared to the national mean of 3.20 (urban area) and 4.40 (rural area) in Kenya (KNBS and ICF, 2015). Similarly, the mean household sizes of the current study were slightly higher than those of a study in Eastern Kenya where the mean household size was 4.85 and 5.52 persons in the urban and rural areas

respectively (Njarui *et al.,* 2011). Household size influences food availability, consumption patterns, access to social and economic support and labour availability (Kibua, 2014).

Majority of the primary caregivers in peri-urban (89.4% in DHs and 88.9% in NDHs) and rural areas (91.8% in DHs and 97.2% in NDHs) were married (Table 6). A few of the primary caregivers (peri-urban: 10.6% in DHs and 11.1% in NDHs; rural areas: 8.2% in DHs and 2.8% in NDHs) were separated. According to Bikuba (2011) households that have married couples are likely to be more productive due to increased labour and shared responsibilities unlike households with single parents.

A higher proportion of primary caregivers in smallholder NDHs had attained primary level of education (65.3% in peri-urban area and 63.9% in rural area) as compared to DHs where majority of the participants had attained secondary level of education (46.8% in peri-urban area and 44.3% in rural areas). In the peri-urban area 2.1% and 4.2% of the caregivers from smallholder DHs and NDHs, respectively were reported to have no education. Additionally, 4.9% of the caregivers from smallholder DHs in the rural area had no education while 2.8% of those from NDHs had at least preschool education. The above rates of caregivers with no education was higher than that of Nakuru County where 1.9% of women were found to have no education. However, the proportion of caregivers in the current study with no education was lower than the national level of 7% (KNBS and ICF, 2015). There was a significant difference (P=0.041) in the education levels between primary caregivers from the smallholder DHs and NDHs in peri-urban area but no significant difference (P=0.051) in rural area. The study findings indicate that most of the primary caregivers had attained a lower level of education with others having no education at all. Educated women are likely to get better paying jobs with high income which has an influence on health and nutrition of the children (Kibua, 2014). Mothers' education is associated with better health and nutritional status of children because mothers have knowledge on child care, nutrition needs and health seeking behaviours (Black *et al.,* 2013; Mengistu *et al.,* 2013; Semali *et al.,* 2015).

The main occupation of the primary caregivers was farming in both peri-urban (61.8% in DHs and 52.8% in NDHs) and rural areas (70.5% in DHs and 72.2% in NDHs) from and NDHs respectively. This was followed by business in peri-urban area (10.6% in DHs and 11.1% in NDHs) and in rural area (8.2% in DHs and 11.1% in NDHs). Salaried employment was third with 10.6% (DHs) and 0.0% (NDHs in the peri-urban area and 11.5% (DHs) and 5.6% (NDHs) in rural area. Unemployment rate in peri-urban area was 10.6% in

DHs and 26.4% in NDHs whereas in rural area the rate was 9.8% in DHs and 8.3% in NDHs. There was a significant difference (P=0.023) in the types of occupation among smallholder DHs and NDHs in peri-urban area, however there was and no significant difference (P=0.588) in rural area. Similarly, 31.3% of the women in Kenya are employed in the agricultural sector with another 27.5% in domestic service (KNBS and ICF, 2015). These results concur with other studies that report that close to 80% of the Kenyan population rely on agriculture for a living (MoALF, 2015; Wagah *et al.,* 2015). According to FAO economic lives of smallholder farmers from nine developing countries revealed that wage labour or employment in other non-farm sector contributed more to income than farming. This was attributed to the fact that income earned from crop and livestock production was not adequate to meet the needs of the smallholder farmers (FAO, 2015).

Table 6: Socio-demographic characteristics of smallholder DHs and NDHs in peri-urban and rural areas

Characteristic	Peri-urban			Rural		
	DHs n=47	NDHs n=72		DHs n=61	NDHs n=36	
	Mean ± SD		*P†*	Mean ± SD		*P†*
Caregivers age (years)	34.6±10.5	26.9±10.5	0.000***	30.1±9.2	26.2±9.7	0.054
Children's age (months)	40.5±10.5	40.4±8.6	0.981	41.5±10.7	37.7±11.1	0.106
Household size	5.7±1.9	4.9±1.7	0.027**	5.4±1.8	4.9±1.7	0.186
	%		*P¥*	%		*P¥*
Children's sex						
Male	36.2	44.4	0.370	62.3	58.3	0.699
Female	63.8	55.6		37.7	41.7	
Marital status						
Married	89.4	88.9	1.000	91.8	97.2	0.407
Single	10.6	11.1		8.2	2.8	
Age of caregivers (years)						
18-24	8.5	31.9	0.001***	21.3	38.9	0.114
25-40	85.1	55.6		63.9	58.3	
41-55	6.4	2.8		4.9	0.0	
> 55	0.0	9.7		9.8	2.8	
Education level						
No education	2.1	4.2	0.041**	4.9	0.0	0.051
Preschool	0.0	1.4		0.0	2.8	
Primary	42.6	65.3		37.7	63.9	
Secondary	46.8	27.8		44.3	25.0	
Tertiary	8.5	1.4		13.1	8.3	
Occupation						
Unemployed	10.6	26.4	0.023**	9.8	8.3	0.588
Salaried employment	10.6	0.0		11.5	5.6	
Casual	2.1	6.9		0.0	2.8	
Farmer	61.7	52.8		70.5	72.2	
Retired	4.3	2.8		0.0	0.0	
Business	10.6	11.1		8.2	11.1	

DHs-Dairy households, NDHs-Non-dairy households, *P¥* value derived from χ^2 test, P*†* value derived from t test, **,***= significant at α=0.05 and α=0.01, respectively

4.2.1 Farm size and ownership among smallholder DHs and NDHs in peri-urban and rural areas

Ownership of land in this study was mainly through; purchasing and renting. Other smallholder farmers used family land or farms without title deeds (Table 7). In the peri-urban area, most smallholder farmers owned land which had title deeds (DHs=57.4% and

NDHs=38.9%) or rented farms (DHs=34.0% and NDHs=55.6%). On the other hand, majority of the smallholder farmers in the rural area owned land with title deeds (DHs=69.4% and NDHs=72.1%) while only 3.2 % (DHs) of them had farms without title deeds (Table 7). On the contrary land in Tanzania is publicly owned by the state although its citizens can lease or own it through right of occupancy (Bikuba, 2011). Land is an important asset required by rural households to carry out their economic activities (Bikuba, 2011). Therefore, land ownership affects food consumption as it determines the level and pattern of agricultural production (World Bank, 2007).

The average farm size of smallholder DHs and NDHs in the study was 1.5±2.1 hectares, with a maximum farm size of 18 hectares (0.5%) and a minimum of 0.13 hectares (2.3%). In peri-urban area the average farm size was 1.3±2.2 (DHs) and 0.5±0.4 (NDHs) while in rural area 2.7±2.8 (DHs) and 1.6±1.8 (NDHs) hectares (Table 7). These findings are consistent with those reported in other studies which indicated that smallholder farmers in developing countries own less than two hectares (FAO, 2015; Sibhatu *et al.,* 2015). Similarly, in Kenya most smallholder farmers own an average of 0.47 hectares of land as compared to middle-sized farmers who own approximately 1.20 hectares (FAO, 2015).

Table 7: Farm size and ownership

Characteristics	**Peri-urban (%)**			**Rural (%)**		
	DHs (n=47)	NDHs (n=72)	*P*ǂ	DHs (n=61)	NDHs (n= 36)	*P*ǂ
Land ownership						
Titled	57.4	38.9	0.120	72.1	69.4	0.436
No tittle	4.3	1.4		3.3	0.0	
Rented	34.0	55.6		8.2	16.7	
Family	4.3	4.2		16.4	13.9	
Farm size in hectares						
<1	53.2	77.8	0.013**	9.8	30.6	0.063
1-5	44.7	22.2		83.6	63.9	
6-10	-	-		4.9	5.6	
>10	2.1	0.0		1.6	0.0	
Acreage	**Mean ± SD**		***P†***	**Mean ± SD**		***P†***
Per Location	1.3±2.2	0.5±0.4	0.019**	2.7±2.8	1.6±1.8	0.028**
Total land	1.5± 2.1					

DHs-Dairy households, NDHs-Non-dairy households, *P*ǂ value derived from χ^2 test, P† value derived from t test, **, ***= significant at α=0.05 and α=0.01, respectively

4.2.2 Milk production by smallholder DHs and NDHs in peri-urban and rural areas

The average number of cows owned by the smallholder farmers was lower in peri-urban (1.4 ± 0.6) than in rural areas (1.8 ± 0.9). Further analysis showed that most of the smallholder farmers in the peri-urban (70.2%) and rural areas (47.5%) owned one cow (Table 8). The number of cows owned has an impact on the quantity of milk produced and consequently its consumption. Most of the smallholder DHs produced 1-10 litres of milk daily in both peri-urban (76.1%) and rural (86.9%) areas with an average production of 7.3 ± 5.4 and 7.4 ± 5.3 in peri-urban and rural areas respectively. This milk production rate was similar to the average productivity per cow in Kenya which was estimated to be 7-8 litres per day but low compared to the global productivity of 40 litres per cow in a day (MoALF, 2013). A study by Bikuba (2011) in Tanzania reported that average milk production per cow in a day was lower (5.27 litres) than that reported in this study. Another study in Ethiopia indicated that the mean daily milk yield per cow was higher (13.89 ± 4.41 litres) than the amount reported in the current study (Lemma *et al.,* 2017).

Table 8: Dairy cow ownership and milk production in peri-urban and rural areas

Characteristics	**Peri-urban (%)** n=47	**Rural (%)** n=61
	Mean ± SD	Mean ± SD
Cows	1.4±0.6	1.8±0.9
No of cows	**%**	**%**
One	70.2	47.5
Two	23.4	36.1
Three	6.4	9.8
Four	-	4.9
Five	-	1.6
Milk production (litres/ day)		
0	6.5	-
1-10	76.1	86.9
11-20	15.2	8.2
21-30	2.2	4.9

4.2.3 Milk purchase and sources of purchase by smallholder DHs and NDHs

In the peri-urban area, 6.5% of the smallholder DHs did not produce any milk at the time of the survey since their cow/s were in calf and dry (Table 8). However these households either purchased milk from nearby shops or local farmers while others obtained the milk from other family members. The proportion of smallholder NDHs (97.2% and

97.2%) who purchased milk was significantly (*P*=0.000) higher than those who purchased from DHS (4.3% and 0.0%) in both peri-urban and rural areas, respectively. Only a few (1.4%) of the NDHs in peri-urban area did not purchase any milk at all thus implying that children from these households were limited when it came to milk consumption. In both peri-urban and rural areas, most (62.5% and 86.1% respectively) of the smallholder NDHs purchased milk from the local farmers while a few bought it from other family members and nearby shops however there was no significant difference (*P*=0.965) in the source of milk (Table 9). The above findings suggest that households prefer milk purchased from the informal market. This maybe because of the low prices since the milk has not undergone any processing that would lead to high prices. Similarly, it was reported that 90% of the milk in Kenyan is sold through informal markets (Muriuki, 2003: Muriuki, 2011; MoALF, 2013).

Table 9**:** Milk purchase and sources among the smallholder DHs and NDHs in peri-urban and rural areas

Characteristics	**Peri-urban (%)**			**Rural (%)**	
	DHs	NDHs	*P*ǂ	DHs	NDHs
	n=47	n=72		n=61	n=36
Milk purchase	4.3	97.2	0.000***	0.0	97.2
	DHs	NDHs	*P*ǂ	DHs	NDHs
Source of milk	n=47	n=72		n=0	n=36
Local farmers	2.2	62.5	0.965	-	86.1
Family	0.0	1.4		-	11.1
Shops	2.2	27.8		-	2.8
Dairy cooperatives	0.0	6.9		-	-
No purchase	0.0	1.4		-	-

DHs-Dairy households, NDHs-Non-dairy households, *P*ǂ value derived from χ^2test, ***= significant at α=0.01

4.2.4 Uses of milk among smallholder DHs and NDHs in peri-urban and rural areas

The proportion of smallholder DHs who sold their milk to the dairy cooperatives on a daily basis was significantly (*P*=0.000) higher in the peri-urban (76.6%) and rural (59.0%) areas compared with the NDHs (2.8% in peri-urban and 8.3% in rural). Milk was retained for household consumption by 100% of DHs and 98.6% of NDHs in peri-urban whereas all (100%) smallholder DHs and NDHs in rural area retained milk for household consumption. Only 8.5% of the smallholder DHs in peri-urban area used their milk in rearing calves (Table 10). Other studies in Kenya also revealed that milk produced by smallholder farmers was

mainly sold, retained for household consumption and calf rearing (Muriuki, 2003; Muriuki, 2011). Similar results were also reported in a study in Southern Ethiopia where the milk produced was mainly used for home consumption, feeding the calves and the remaining amount sold to the local markets (Azeze and Hajji, 2016).

The amount of milk sold to the dairy collection centres by smallholder DHs ranged between 1-10 litres (66.0% peri-urban area and 54.1% rural area). On the other hand, fewer smallholder NDHs (1.4% in peri-urban area and 5.6% in rural area) sold the same amount of milk (1-10 litres). While 2.1% of DHs in peri-urban area sold between 21-30 litres of milk, 1.4% of the NDHs in peri-urban sold more than 31 litres of milk. The amounts sold by DHs were significantly higher (P=0.000) than amounts sold by NDHs in both peri-urban and rural areas. Amount of milk retained for household use were mainly 1-10 litres (91.5% DHs and 68.1% NDHs) in peri-urban and (95.1% DHs and 88.9% NDHs) rural areas. These amount of milk were significantly higher in DHs as compared to NDHs in both peri-urban (P=0.003) and rural (P=0.034) areas (Table 10). The results reveal that equal amount (1-10 litres) of milk from most households were either sold or used for home consumption. This was attributed to the fact that the milk produced in the morning was mainly sold while that produced in the evening was mainly retained for home consumption, a consistent practise reported in a study by Shreenath *et al.,* (2011). However, this practise is not the same in Ethiopia where most of the milk (approximately 85%) was used for home consumption and what was left sold to local markets (Hoddinott *et al.,* 2014; Azeze and Haji, 2016).

Table 10: Daily uses of milk among smallholder DHs and NDHs in peri-urban and rural areas

Characteristics	Peri-urban (%)			Rural (%)		
	DHs n=47	NDHs n=72	*P*ǂ	DHs n=61	NDHs n=36	*P*ǂ
Daily uses						
Sold	76.6	2.8	0.000***	59.0	8.3	0.000***
HH use	100.0	98.6	0.417	100.0	100.0	-
Calf rearing	8.5	0.0	0.012**	0.0	0.0	-
Amount (litres)						
Sold						
0	21.3	97.2	0.000***	42.6	94.4	0.000***
1-10	66.0	1.4		54.1	5.6	
11-20	10.6	0.0		3.3	0.0	
21-30	2.1	0.0		-	-	
>31	0.0	1.4		-	-	
HH use						
<1	8.5	31.9	0.003***	0.0	11.0	0.034**
1-10	91.5	68.1		95.1	88.9	
11-20	-	-		3.3	0.0	
21-30	-	-		1.6	0.0	
Calf rearing						
0	91.5	100.0	0.012**	100	100	
<10	8.5	0.0		-	-	

DHs-Dairy households, NDHs-Non-dairy households, *P*ǂ value derived from χ^2 test, **,***= significant at α=0.05 and α=0.01, respectively

4.2.5 Forms in which milk was consumed in the smallholder DHs and NDHs

In this study all households retained milk on a daily basis and consumed it in the form of milk tea, sour milk, *Mursik,* porridge cooked with milk and also taken as plain fresh milk. Smallholder DHs consumed milk in the form of milk tea (peri-urban=100%, rural=100%) and as fresh milk (peri-urban=78.7%, rural=93.4%). Similarly, smallholder NDHs mostly consumed the milk in the form of milk tea (peri-urban=98.6%, rural=100%) and as fresh milk (peri-urban=52.8%, rural=88.9%). The intake of *Murisk* in smallholder DHs was significantly higher (*P*=0.009) than that of NDHs in rural area while intake of fresh milk significantly higher (*P*=0.004) in DHs than NDHs in peri-urban area (Figure 4). In developed countries like the United States plain fresh milk was the most common form in which milk was consumed by all age groups (Sebestian *et al.,* 2010). Similar findings where milk was mainly consumed in households in the form of milk tea or as plain fresh milk have been reported in other studies in Kenya (Njarui *et al.,* 2011; Shreenath *et al.,* 2011; Wyatt *et al.,* 2013). However, like in the current study these studies did not quantify the amounts of milk that

were used in preparing the milk tea. A study in Ethiopia reported contrary results where milk was commonly consumed in the sour or fermented forms that were prepared traditionally (Yilma *et al.,* 2011; Teklehaymanot, 2015). However, other studies in Ethiopia revealed that most of the milk was consumed in the form of fresh whole milk (Azeze and Haji, 2016), 84% of smallholder dairy producers consumed boiled milk while another 8.5% consumed fermented milk (*ergo*) (Lemma *et al.,* 2017). These results indicate that in Kenya the most preferred form in which milk is consumed among households is milk tea. Therefore, milk is an important component of diets consumed in Kenya especially where other ASFs are limited.

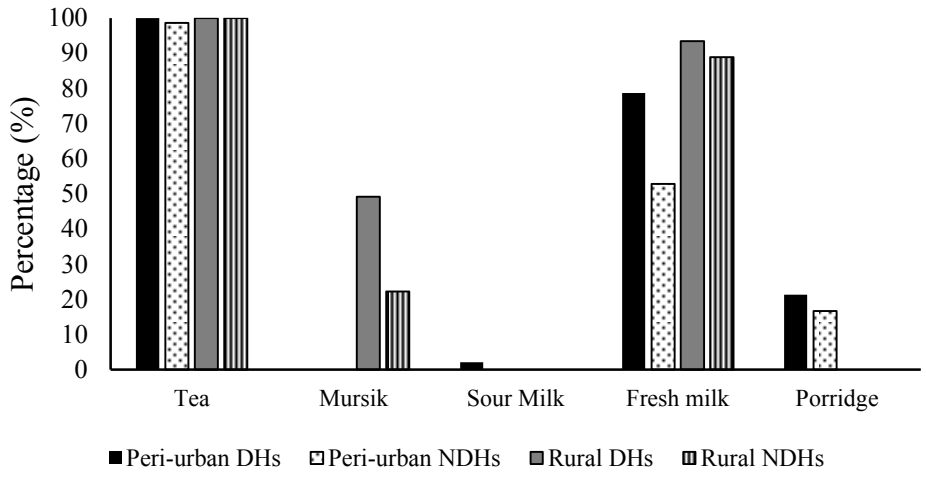

Figure 4: Forms in which milk was consumed by smallholder DHs and NDHs in peri-urban and rural areas.

DHs-Dairy households, NDHs-Non-dairy households

4.2.6 Milk sales by smallholder DHs and NDHs in peri-urban and rural areas

In this study 76.6% and 54.7% of the smallholder DHs in peri-urban and rural areas respectively sold their milk in the previous month (Table 11). Despite the smallholder NDHs not owning cows most of them purchased milk (Table 9) whereas a few (2.8% in peri-urban area and 5.6% in rural area) of them sold it (2.8% in peri-urban and 5.6% in rural areas) while in its fresh form. A significant higher (P=0.000) proportion of smallholder DHs sold milk than the NDHs in both peri-urban and rural areas. In the month prior to the survey, 41.7% of the smallholder DHs in peri-urban and 42.9% of those in rural area sold 101 to 200 litres of milk. On the other hand, half of the smallholder NDHs in both peri-urban and rural areas sold very little amount milk (<100 litres). Despite the fact that the smallholder DHs in

rural area had more cows than their counter parts from the peri-urban area, only 2.9% of them sold over 500 litres of milk in the previous month. The amount of milk sold by the smallholder DHs was significantly higher (P=0.002) than that of the NDHs in rural area however there were no significant differences (P=0.295) in peri-urban area. More than half of the smallholder DHs in the peri-urban (52.8%) and rural (65.7%) areas earned between Ksh 1001-4999 from the sale of milk in the previous month prior to the survey. However, in rural area very few of them (8.6%) earned over Kshs 10,000 as compared to peri-urban where 25% of the smallholder DHs earned over Kshs 10,000. On the other hand, smallholder NDHs in both peri-urban and rural areas earned between Kshs 1001 to over 30,000 despite them being few compared to DHs. The income earned from the sale of milk was significantly higher (P=0.030) in DHs than NDHs in peri-urban area. Similarly, DHs from rural area earned a higher income compared to NDHs though the difference was not significant (P=0.309) (Table 11). The high amount of milk sold and high income earned by DHs could be attributed to the fact that they had the dairy cows while the NDHs relied on purchased milk for sale and income. In Tanzania a study by Bikuba (2011) found that 81.58% of small-scale dairy farmers earned an income from milk sales amounting to 500, 000 Tshs to 600,000 Tshs per year (Kshs 35,714 –Kshs 42,857) which was lower compared to findings from this study.

Table 11: Milk sales by smallholder DHs and NDHs in peri-urban and rural areas

Characteristics	**Peri-urban (%)**			**Rural (%)**		
	DHs n=47	NDHs n=72	*P*ǂ	DHs n=61	NDHs n=36	*P*ǂ
HHs selling	76.6	2.8	0.000***	54.7	5.6	0.000***
Amount (litres)	DHs n=36	NDHs n=2	*P*ǂ	DHs n=35	NDHs n=2	*P*ǂ
<100	33.3	50.0	0.295	37.1	50.0	0.002***
101-200	41.7	0.0		42.9	0.0	
201-300	8.3	0.0		11.4	0.0	
301-400	5.6	0.0		0.0	50.0	
401-500	5.6	0.0		5.7	0.0	
> 500	5.6	50.0		2.9	0.0	
Income (Kshs)						
< 1000	-	-	0.030**	2.9	0.0	0.309
1001-4999	52.8	50.0		65.7	50.0	
5000-9999	22.2	0.0		22.9	0.0	
10000-29999	22.2	0.0		8.6	50.0	
> 30000	2.8	50.0		0.0	0.0	

DHs-Dairy households, NDHs-Non-dairy households, *P*ǂ value derived from χ^2test, **,***= significant at α=0.05 and α=0.01, respectively

4.2.7 Uses of money from the sale of milk by smallholder DHs and NDHs

Most of the smallholder DHs in both peri-urban (61.1%) and rural (60.0%) areas used money they earned from milk sales for purchasing food (27.8%) followed by payment of fees (20%) (Table 12). Similarly, a study in Kenya by Shreenath *et al*., (2011) showed that income from milk sales was primarily used in purchase of food with the remainder used in paying fees and purchasing other dairy inputs. On the contrary, a study in Ethiopia reported that income acquired from the sale of milk was mainly used to cover the costs of the animal feeds (Lemma *et al.,* 2017).

Smallholder NDHs from peri-urban area used the money generated from the sale of milk to purchase food (50%) and in combined uses (50%) while NDHs in rural area mainly used the money to purchase crop inputs (50%) and in combined uses (50%) (Table 12). There was a significant difference (*P*=0.032) in use of income between the smallholder DHs and NDHs in peri-urban area but no significant difference (*P*=0.054) in rural area.

Table 12: Uses of income from sale of milk by smallholder DHs and NDHs

Characteristics	Peri-urban (%)			Rural (%)		
	DHs n=36	NDHs n=2	*P*ǂ	DHs n=35	NDHs n=2	*P*ǂ
Food purchase	61.1	50.0	0.032**	60.0	0.0	0.054
Fee payment	27.8	0.0		20.0	0.0	
Crop inputs purchase	-	-		5.7	50.0	
Livestock inputs purchase	8.3	0.0		5.7	0.0	
Combined uses	2.8	50.0		8.6	50.0	

DHs-Dairy households, NDHs-Non-dairy households, *P*ǂ value derived from χ^2test, **= significant at α=0.05

4.2.8 Use of income from the sale of crops by smallholder DHs and NDHs

In the peri-urban area money earned from the sale of crops was mainly used for combined uses (50% in DHs and 36.7% in NDHs) and payment of fees (31.3% in DHs and 30.0% in NDHs). On the other hand, in rural area money earned from the sale of crops was mainly used for purchasing food (44.4% in DHs and 27.8% in NDHs), payment of fees (22.2% in DHs and 27.8% in NDHs) and combined uses (27.8% in NDHs) (Table 13).

These findings indicate that food was the main commodity purchased from the income earned from crop and milk sales. Similarly, another study indicated that in developing countries, a larger portion of smallholder farmer's income is used to purchase food (FAO, 2015). Findings from the FGDs revealed that unlike men, women were not able to distinguish the different uses of incomes from milk or crop sales. Men mentioned that the money received from milk sales was used for paying school fees, purchasing household goods, meeting other household needs and purchasing cow feeds while money received from the sale of crops used in purchasing food.

Table 13: Uses of income from the sale of crops by smallholder DHs and NDHs

Characteristics	Peri-urban (%)			Rural (%)		
	DHs n=16	NDHs n=30	*P*ǂ	DHs n=36	NDHs n=18	*P*ǂ
Food purchase	6.3	26.7	0.112	44.4	27.8	0.743
HH assets purchase	0.0	6.7		8.3	5.6	
Fee payment	31.3	30.0		22.2	27.8	
Crop inputs purchase	-	-		8.3	11.1	
Livestock inputs purchase	12.5	0.0		-	-	
Combined uses	50.0	36.7		16.7	27.8	

DHs-Dairy households, NDHs- Non-dairy households, *P*ǂ value derived from χ^2test.

4.2.9 Rejected milk, reasons for rejection and uses of rejected milk

In the rural area, none of the smallholder DHs and NDHs had their milk rejected by the dairy cooperatives. The FGD discussions also showed that in rural areas milk was rarely rejected at collection centres. On the contrary, milk from 14.9% of the smallholder DHs from the peri-urban area was rejected for sale at the collection centers although none was rejected from the NDHs . Similarly, a study in Ethiopia revealed that 0.93% of the milk produced by small-scale dairy farmers was rejected for sale (Azeze and Haji, 2016). Milk collection centres such as the dairy cooperatives have systems of quality control for milk received from individual farmers. The milk delivered at the collection centres undergoes quality control tests and when the milk fails the tests it is rejected and returned to the farmers (Ndungi *et al.,* 2016). Rejection of milk contributes to post harvest losses amounting to 6% of total production (Muriuki, 2003).

Reasons for milk rejection at collection centres included; the cow being sick (14.3%) (for example suffering from mastitis), milk having stayed for a long time before being taken to collection centres hence got spoilt (42.9%), milk obtained from a pregnant cow that was eight months or more (28.6%) while other smallholder DHs claimed that the milk was spoilt and didn't know why (14.3%) (Figure 5 A). Additionally, other reasons reported in the FGDs for milk rejection at collection centres included; lack of cleanliness in milk handling or personal hygiene, adulteration, mixing of milk produced in the morning and evening, presence of preservatives in the milk, milk containing colostrum and types of containers used to collect milk that are not washed thoroughly leading to milk spoilage '*We mostly have plastic containers 'mezzicans' or just the ordinary plastic bottles that we use in collecting our milk'* female FGD Olenguruone. *'The collecting container may have been dirty resulting in milk spoilage hence the milk fails the test*' male FGD Olenguruone. While addition of water/wheat flour to milk came up as one of the reasons for milk rejection at the collection centres in the women FGD the men strongly denied this. They claimed that water was only added before discarding spoilt/rejected milk but never added to the milk collected for sale '*milk is never poured directly we have to add water in it then discard it and this is our culture*' men FGD Olenguruone. They went ahead to elaborate their claims '*we do not add water into cow's milk after milking then sell the milk since in our culture we believe that is underestimating your cows' capacity. It is a taboo and the cow will eventually stop producing milk and die*' men FGD Olenguruone.

Several studies conducted in Kenya, Uganda, Tanzania, Ethiopia and Syria aimed at characterizing the post-harvest milk and dairy losses revealed similar results. Milk was lost at market level in these countries due to unhygienic handling practices, electric failures from the cooling centres and transport delays to the market (Lore *et al.,* 2005; Azeze and Asrat, 2015; Azeze and Haji, 2016).

In this study, most households (42.9%), converted rejected milk into dairy products e.g. *Mursik,* others (28.9%) drank it or prepared milk tea with it, 14.3% of them sold it to their neighbours while another 14.3% disposed it off (Figure 5B). Similar findings with regards to how rejected milk was used were reported from the FGDs conducted with both the male and female participants. Likewise, a study conducted in Kenya showed that rejected milk was disposed off, fermented, sold to the neighbours or fed to domestic animals (Ndungi *et al.,* 2016). Another study by Azeze and Haji (2016) in Ethiopia indicated that milk rejected due to udder infections such as mastitis was either disposed off, fed to other animals or consumed in the households after processing.

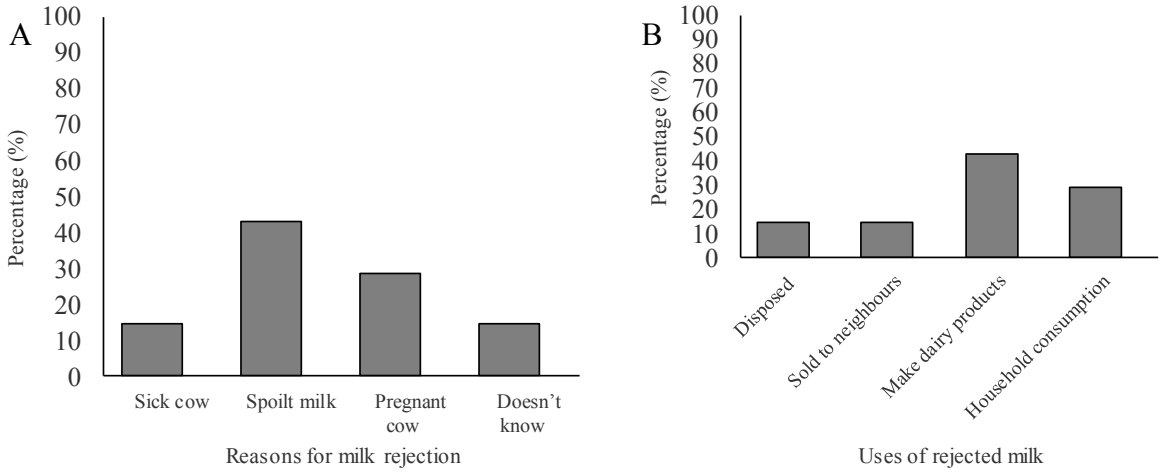

Figure 4: Reasons for milk rejection (A) and uses of the rejected milk (B).

4.3 Consumption of foods from different food groups by children 24-59 months in smallholder DHs and NDHs

All children (n=216) from smallholder DHs and NDHs in both rural and peri-urban areas consumed grains, roots and tubers (Table 14). Most of them consumed vitamin A rich fruits and vegetables (peri-urban area=76.6% DHs and 86.1% NDHs; rural area=75.4% DHs and 83.3% NDHs) and other fruits and vegetables (peri-urban area 95.7% DHs and 100% NDHs; rural area 91.8% DHs and 94.4% NDHs). The above results concur with findings

from other studies which have indicated that children are mainly fed on plant diets (Nicholson *et al.,* 2003; Neumann *et al.,* 2007; Walton *et al.,* 2012; Dewey, 2013).

A lower proportion of children from NDHs (18.1%) than DHs (19.1%) in peri-urban consumed flesh foods while in rural area fewer children from DHs (9.8%) consumed flesh foods compared to NDHs (11.1%). There were no significant differences in the intake of flesh foods between children in DHs and NDHs from peri-urban (P=0.881) and rural (P=0.842) areas. A significantly lower (P=0.043) proportion of children from the NDHs (6.9%) consumed eggs than those from DHs (19.1% in peri-urban area. Similarly, fewer children from NDHs (2.8%) than DHs (3.3%) consumed eggs however there was no significant difference (P=0.891). Income from the sale of milk in DHs could be used to purchase eggs thus explaining why more children from DHs consumed eggs compared to those from NDHs. Research has also illustrated that the sale of animal products provides income that could be used to purchase other foods (Herrero *et al.,* 2013; Wyatt *et al.,* 2013; Rawlins *et al.,* 2014) (Table 14). Despite the low intake of eggs and flesh foods, milk consumption among the children aged 24-59 months was high. The prevalence of milk consumption by children from smallholder DHs and NDHs in peri-urban was 57.4% and 40.3% respectively. On the other hand, 80.3% and 72.2% of the children from smallholder DHs and NDHs consumed milk in rural area, respectively. This consumption rate was higher than the national level of 13% as reported in the 2014 KDHS (KNBS and ICF, 2015). A recent study conducted in Zambia also showed that consumption of milk and milk products was 17.8% and 14.5% among children aged 6-23 and 24-59 months respectively (Marinda *et al.,* 2018).

These results were consistent with findings from the FGDs where both women and men stated that children aged two years and above were commonly fed on *Ugali*, green bananas, pumpkin, Irish potatoes, porridge made with milk, fresh milk, milk tea, *Mursik,* vegetables and rice. Based on this study's findings children were commonly fed on starchy staples which are high in fiber and phytates which lower the bioavailability of micronutrients (Dewey, 2013). Consumption of these diets increases the risk of nutrient deficiencies, which consequently affect human health, productivity and economic growth (Black *et al.,* 2013; Oruamabo, 2015). Lack of knowledge by caregivers could have possibly resulted to the poor feeding habits of children in the smallholder DHs and NDHs. Studies have shown that lack of nutrition knowledge contributes to poor feeding practices in under-fives (Christian *et al.,*

2016; Chege and Kuria, 2017; Solomon *et al.,* 2017) hence the need for nutrition education interventions to enable them adopt appropriate child feeding practices.

Table 14: Consumption of foods from different food groups by children 24-59 months from smallholder DHs and NDHs

Food groups	**Peri-urban (%)**			**Rural (%)**		
	DHs n=47	NDHs n=72	*P*ǂ	DHs n=61	NDHs n=36	*P*ǂ
Grains, roots and tubers	100.0	100.0	-	100.0	100.0	-
Legumes and nuts	44.7	59.7	0.108	49.2	38.9	0.325
Flesh foods	19.1	18.1	0.881	9.8	11.1	0.842
Eggs	19.1	6.9	0.043**	3.3	2.8	0.891
Dairy products	57.4	40.3	0.067	80.3	72.2	0.357
Vitamin-A rich fruits & vegetables	76.6	86.1	0.183	75.4	83.3	0.360
Other fruits & vegetables	95.7	100.0	0.078	91.8	94.4	0.627

DHs-Dairy households, NDHs- Non-dairy households, *P*ǂ value derived from χ^2 test, **= significant at α=0.05

4.3.1 Dietary diversity of children 24-59 months in smallholder DHs and NDHs

Children (6-23 months) who consumed foods from at least four out of the seven food groups are considered to have received the MDD (WHO, 2008; WHO, 2010). Findings from the study indicated that the mean CDDS was 4.1±1.1 and 4.1± 0.9 for children from all smallholder DHs and NDHs respectively. This indicated that these children consumed diverse diets though these diets were low in ASFs that are essential for growth and development. On the contrary studies in developing countries reported a lower mean CDDS (<4) among children below five years (Chege and Kuria, 2017; Dangura and Gebremedhin, 2017; M'Kaibi *et al.,* 2017; Marinda *et al.,* 2018).

Most of the children from smallholder NDHs in both peri-urban (79.2%) and rural (77.8%) areas attained a higher MDD than those from DHs in both peri-urban (61.7%) and rural areas (73.8%) (Figure 6). This rate is higher than the national levels as indicated by the 2014 KDHS where only 41% of children 6-23 months were fed on a MDD (KNBS and ICF, 2015). Contrary to finding from the current study, children from other developing countries were fed on diets that did not meet the MDD requirements. For instance, only 7% of children in Ethiopia and less than a quarter of children in India, Uganda and Zimbabwe met the recommended MDD (Jones *et al.,* 2014). Another study also indicated that in Afghanistan, Bangladesh, India, Nepal and Pakistan less than 25% of the children aged 6-23 months were

fed diets that met the minimum frequency and diversity requirements (Aguayo and Menon, 2016). A recent study in Zambia reported results that were consistent with the above findings where 35.6% and 48.6% of children aged 6-23 and 24-59 months had met the MDD (Marinda *et al.,* 2018). Findings from the current study suggest that attaining a MDD alone doesn't translate to diets that have all the required nutrients. Diets that are limited in ASFs cannot meet all the nutrient needs for under-fives (Neumann *et al*, 2002; Dewey, 2005). There is need for interventions that are geared towards improving the MDD with more emphasis on ASFs intake in Nakuru County.

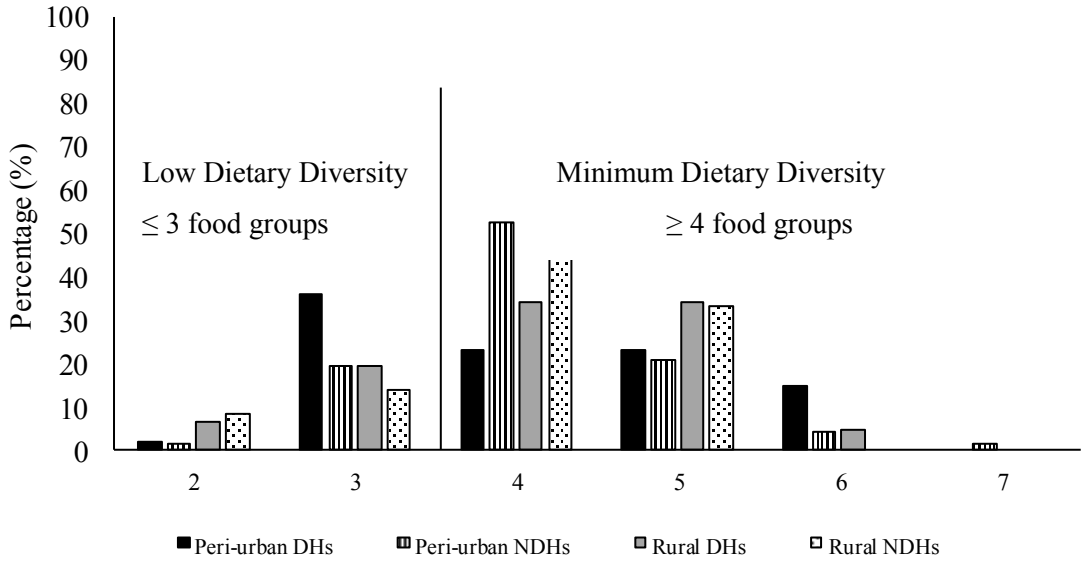

Figure 6: Child dietary diversity from smallholder DHs and NDHs

DHs-Dairy households, NDHs- Non-dairy households, P_{χ^2}=0.017** in peri-urban and P_{χ^2} =0.574 in rural area, P_{χ^2} value derived from χ^2 test, **= significant at α=0.05

The following were raised in the FGDs as challenges faced during child feeding in both peri-urban and rural areas; lack of money to purchase the food commodities, "*Income matters a lot*" (male FGD Olenguruone), poor knowledge on appropriate food preparation practices i.e. they didn't know what they ought to feed the children and when they are at work they don't get enough time to engage in feeding their children as required. Children brought up by either single parents or grandparents was mentioned as a challenge because "*when one is a single parent they don't pay full attention to child feeding due to the multiple responsibilities. Due to old age it is tedious for the grandparents to feed children, they may also make poor feeding choices because they only feed what they can cook*" male FGD

Olenguruone. Men from Bahati FGD stated that interference from the mother in-law who introduced different foods from what the children's mothers wanted to feed them. In Olenguruone it was noted that there was lack of different varieties of foods to feed children. Both men and women stated that certain foods did not grow well in their area hence they were not available to them for consumption. For instance, maize took a whole year to grow and be ready for human consumption. They also lacked variety of vegetables and fruits and getting these foods from other nearby towns was very expensive. This could explain why children aged two years and above were mainly fed on starchy staples and milk which was readily available to them. Interventions should also target increasing or improving the households' income sources so as to enable them purchase the foods not locally available to them. The community should also be educated on fostering home gardens so as to increase their food varieties.

4.4 Milk consumption patterns of children from smallholder DHs and NDHs

4.4.1 Amount of milk consumed by children 24-59 months

Milk consumption patterns of children aged 24-59 months from smallholder DHs and NDHs in peri-urban and rural areas were assessed by examining their milk intakes i.e. the amount consumed and the frequency of consumption. Children from smallholder DHs in rural area consumed a significantly (P=0.002) higher amount of milk (338.3±245.7) compared to those from NDHs (207.7±109.7). However, in peri-urban area children from NDHs (235.0±69.7) consumed more milk than those from DHs (195.1±97.0) though there was no significant difference (Figure 7). The amount of milk consumed by children in this study did not meet the minimum recommended intakes of 500mls of milk per day for children aged 24-59 months (WHO and FAO, 2004). This finding suggests that children from rural area consume a higher amount of milk than those in peri-urban area. This could be attributed to the fact that smallholder households in rural area had more cows (Table 8). Additionally, higher percentage of smallholder households from peri-urban area sold their milk as compared to rural area (Table 11).

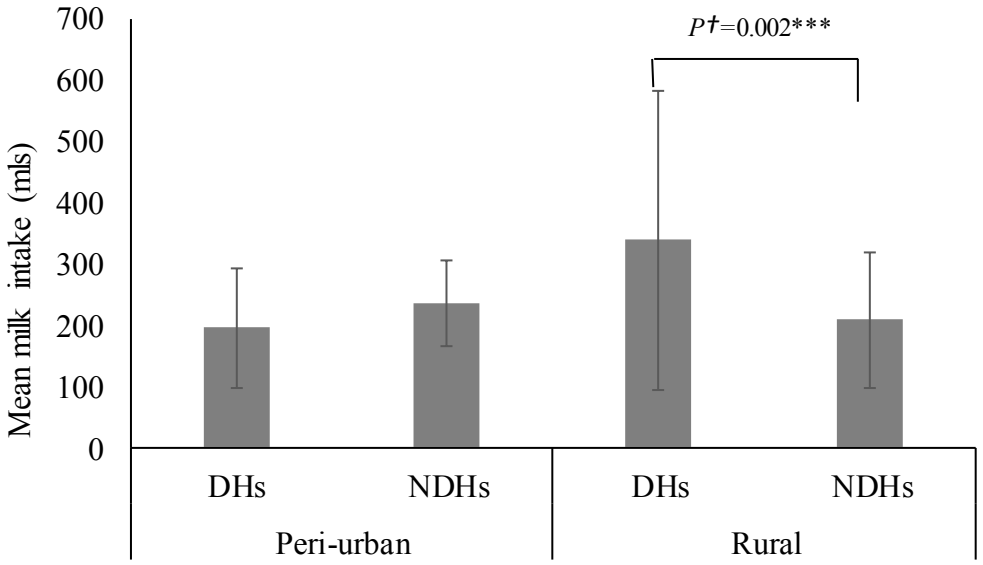

Figure 7: Mean milk intake by children (24-59 months) from smallholder DHs and NDHs
DHs-Dairy households, NDHs- Non-dairy households, Data are mean ± standard deviations, *P†* value derived from t test, ***= significant at α=0.01

In this study only 13.1% of the children (24-59 months) from smallholder DHs and 5.6% from NDHs in rural area consumed 500mls or more in the previous day. None of the children from the smallholder DHs and NDHs in the peri-urban area had consumed the minimum of 500mls of milk in the past 24 hours. Additionally, an intake of 500mls of milk by children aged 24-59 months contributes to 50% or more of the RNIs of calcium, proteins and other micronutrients (WHO and FAO, 2004) (Table 3). In rural area the proportion of children who met 50% or more RNIs from consuming at least 500mls of milk were only 13.1% in DHs and 5.6% in NDHs (Figure 8). These results indicate that milk consumption by children is still low and does not meet the minimum recommended intake.

A study conducted in Kenya showed that the amount of fresh milk given to children increased with increase in milk production. Children (12-18 months) from households that produced ≥6 litres of milk per day consumed more milk than children from households that did not produced or produced less amounts of milk (Table 2) (Shreenath *et al.,* 2011). Another cross-sectional study conducted in Kenya found that children aged 5-14 years from dairy member groups had a median milk intake of 200g/d while those from non-dairy member groups had a median milk intake of 37g/d in a day. However, in the above study, the amount of milk consumed by children might have been under reported in cases where they

were not available to verify their intake estimation (Walton *et al.,* 2012). Findings from another study in Ethiopia showed results that were similar to the current study where 68.1% of the children (2-5 years) consumed 250mls of milk in a day (Teklehaymanot, 2015). Like the current study, these studies also indicate a challenge that exists in meeting the minimum recommended 500 mls in children aged 24-59 months.

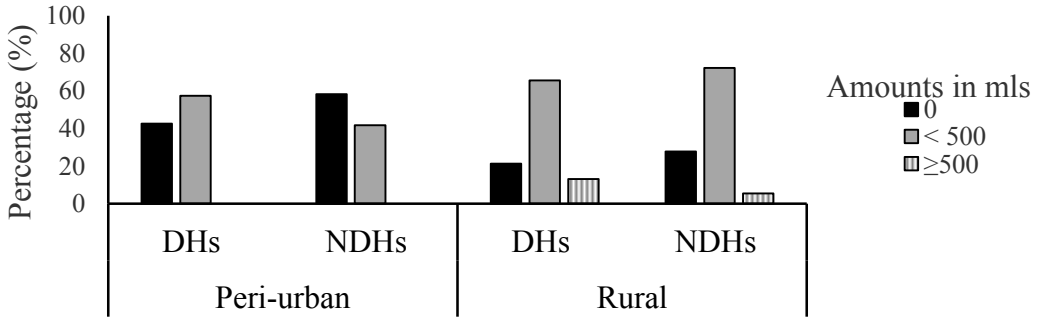

Figure 8: Amount of milk consumed by children 24-59 months
DHs-Dairy households, NDHs-Non-dairy households

4.4.2 Milk consumption by children 24-59 months from smallholder DHs and NDHs disaggregated by age categories

Further analyses were performed to determine the amount of milk consumed by children from smallholder DHs and NDHs disaggregated by age categories (24-36, 37-48 and 49-59 months). The findings showed that a higher proportion of younger children (24-36 months) consumed more milk compared to older children from the 37-48 and 49-59 months age categories from both smallholder DHs and NDHs (Table 15). Few children (6.5% (24-36 months) and 0.9% (37-48 months)) from smallholder DHs had consumed ≥500mls of milk while only 1.9% (24-36 months) in NDHs had consumed a similar amount of milk. There was a significant difference in milk intakes among children from different age categories in DHs (P=0.036) and NDHs (P=0.007) (Table 15).

Table 15: Milk intake by child age categories in DHs and NDHs

Characteristic	DHs (%) n=108				NDHs (%) n=108			
Age (months)	0 mls	<500 mls	≥500 mls	*P*ǂ	0 mls	<500 mls	≥500 mls	*P*ǂ
24-36	8.3	22.2	6.5	0.036**	13.9	29.6	1.9	0.007***
37-48	12.0	21.3	0.9		22.2	16.7	0.0	
49-59	10.2	18.5	0.0		12.0	3.7	0.0	

DHs-Dairy households, NDHs-Non-dairy households, *P*ǂ value derived from χ^2 test, **,***= significant at α=0.05 and α=0.01, respectively

Similarly, younger children (24-36 months) from the peri-urban and rural areas had consumed more milk compared to older children (37-48 and 49-59 months). None of the children from peri-urban area consumed ≥500mls of milk whereas their counter parts from rural area (9.3% (24-36 months) and 1.0% (37-48 months)) had consumed ≥ 500mls of milk in the previous day. There was a significant difference in milk intakes among the children age categories in peri-urban (*P*=0.036) and rural areas (*P*=0.002) (Table 16). These results from Table 15 and 16 reveal that younger children are likely to consume high amounts of milk than older children. It was also evident that a higher proportion of the older children compared to younger children from DHs and NDHs or peri-urban and rural areas did not consume milk at all. Therefore, interventions aimed at improving milk consumption by children should consider amounts and inclusion of all children below five years. Contrary to these findings, another study in Kenya showed that older children (12-18 and 18-24 months) consumed more milk as compared to younger children (6-12 months) (Table 2) (Shreenath *et al.*, 2011).

Table 16: Milk intake by child age categories in peri-urban and rural areas

Characteristic	Peri-urban n=119 (%)				Rural n=97 (%)			
Age (months)	0 mls	<500 mls	≥500 mls	*P*ǂ	0 mls	<500 mls	≥500 mls	*P*ǂ
24-36	15.1	24.4	-	0.036**	6.2	27.8	9.3	0.002***
37-48	26.1	14.3	-		6.2	24.7	1.0	
49-59	10.9	9.2	-		11.3	13.4	0.0	

DHs-Dairy households, NDHs-Non-dairy households, *P*ǂ value derived from χ^2 test, **,***= significant at α=0.05 and α=0.01, respectively

Despite the low milk consumption by children (24-59 months) FGD findings indicated that both men and women from peri-urban and rural areas knew the benefits of consuming cow's milk. They considered milk a rich source of protein, calcium, phosphorus and iron. They stated that milk provided energy to children and that they were satisfied once

they were fed on milk. They also said that milk provides children with protection from diseases and it is a complete food as well "*According to our culture milk is termed as a balanced diet so we believe that milk has all the nutrients*" (male FGD Olenguruone). The women stated that inclusion of cow's milk in children's diets enabled the children have good health. They also stated that it made the child become strong, helps in brain development and improves the immunity of the child. When asked what challenges would hinder children's milk consumption the women stated that other mothers didn't have cows so they had to buy milk. Due to financial constraints women would mostly afford to purchase milk for preparing milk tea for the whole family and at times leave some for the children to consume. The family tea comprised of more water than milk e.g. one would buy one cup (one cup is equivalent to 300mls) and make tea for close to six people. Thus it was difficult for women to decide on whether to use the milk in preparing tea for the whole family or give it to the children. The women also complained that sometimes when the cow was not satisfied it would not produce milk or when the cow was dry i.e. at eight months' pregnancy where they stopped milking. During this period the dairy households were also forced to buy milk or do without milk. Men on the other hand stated that children were given priority on cow milk consumption in their community. They further said that milk was not a challenge for them except on rare occasions when there was a shortage. However, in such rare circumstances children would not miss cow's milk as they are given the first priority '*Even if there is shortage of milk, children have to be provided*' men FGD Olenguruone.

4.4.3 Frequency of consumption of foods and fluids containing milk among children (24-59 months) from smallholder DHs and NDHs

Forms in which milk was consumed by the children included; plain fresh milk, milk tea, milk added in porridge, vegetables prepared with milk and cereals consumed with milk. A significantly higher (P=0.039) proportion of children from DHs (57.5%) than NDHs (41.7%) from peri-urban area were reported to have consumed fresh cow's milk the previous day. Similarly, in rural area more children from DHs (78.7%) than NDHs (72.2%) consumed milk in the previous day, however there were no significant differences (Table 17). Furthermore, on average DHs in peri-urban had 1.4 ±0.6 cows while those in rural area had 1.8±0.9 (Table 8) suggesting that the more the number of cows the more the milk consumed by children.

Other forms of milk consumed by children 24-59 months in the previous day are shown in Table 17. Findings from this study indicated that milk tea was commonly consumed by children aged 24-59 months in smallholder DHs and NDHs in both peri-urban and rural areas. In the rural area, a few of the children (8.2% in DHs and 5.6% in NDHs) had been fed on porridge cooked with milk, once the previous day. Their counterparts in the peri-urban area (2.1% in DHs and 2.8% in NDHs) had consumed porridge cooked with milk thrice in the previous day. In this study, *Ugali* was the main cereal that was consumed with milk. It was fed up to three times the previous day among children in the rural area in both DHs and NDHs as compared to the peri-urban area where it was fed more than three times to children in DHs. There was a significant difference (P=0.001) in the frequency of consumption of cereals with milk between the DHs and NDHs in the peri-urban area. Vegetables cooked with milk were mostly consumed by children from the rural area in both DHs and NDHs.

Similarly, studies done in Kenya showed that typical diets of both adults and children (6-60 months) included milk tea, *Mursik*, cream added to vegetables and fresh milk added to *Ugali* and porridge. Fresh milk was consumed with or after meals (Shreenath *et al.,* 2011; Wyatt *et al.,* 2013). A study in Ethiopia revealed that the common forms of milk consumed by children 2-5 years were as boiled whole milk (25.7%) and butter milk (74.3%) (Teklehaymanot, 2015).

Table 17: Frequency of consumption of foods and fluids containing milk among children (24-59 months) from smallholder DHs and NDHs

		Peri-urban (%)			Rural (%)		
Food/ fluid	No of times	DHs n= 47	NDHs n=72	*P*ǂ	DHs n=61	NDHs n=36	*P*ǂ
Fresh milk	0	42.6	58.3	0.039**	21.3	27.8	0.683
	1	51.1	41.7		54.1	55.6	
	2	6.4	0.0		19.7	16.7	
	3	-	-		3.3	0.0	
	>3	-	-		1.6	0.0	
Milk tea	0	17.0	5.6	0.061	4.9	0.0	0.437
	1	23.4	38.9		19.7	22.2	
	2	42.6	40.3		49.2	38.9	
	3	12.8	15.3		21.3	36.1	
	>3	4.3	0.0		4.9	2.8	
Porridge	0	80.9	86.1	0.830	91.8	94.4	0.627
	1	14.9	9.7		8.2	5.6	
	2	2.1	2.8		-	-	
	3	2.1	1.4		-	-	
	>3	-	-		-	-	
Cereals	0	57.4	51.4	0.001***	27.9	25.0	0.940
	1	19.1	44.4		49.2	52.8	
	2	19.1	1.4		18.0	19.4	
	3	2.1	2.8		4.9	2.8	
	>3	2.1	0.0		-	-	
Vegetables	0	100.0	100.0		90.2	94.4	0.652
	1	-	-		8.2	5.6	
	2	-	-		1.6	0.0	
	3	-	-		-	-	
	>3	-	-		-	-	

DHs-Dairy households, NDHs- Non-dairy households, *P*ǂ *value* derived from χ^2 test, **,***= significant at α=0.05 and α=0.01, respectively

4.4.4 Frequency with which milk products were consumed by children (24-59 months) over a week

While *Mursik,* yoghurt and sour milk were not consumed by children from DHs and NDHs from rural and peri-urban areas on the previous day, they were reported to have been consumed by the children at least one or more times during the previous week. Yoghurt and sour milk were commonly consumed by children from DHs and NDHs in the peri-urban area while *Mursik* was mainly consumed by children from DHs and NDHs from the rural areas.

Yoghurt and sour milk were purchased ready made from the shops while *Mursik* was locally made in the households by women. A higher percentage of children from NDHs (5.6%) consumed *Mursik i.e.* over three times in the past week as compared to those from DHs (4.9%). Equally, yoghurt was consumed by a higher percentage of children from DHs (8.5%) compared to NDHs (4.2%) (two times in the past week) while sour milk 2.8% (NDHs) and 2.1% (DHs) two and three times over the past week respectively (Figure 9). This implies that dairy cow ownership does not necessarily translate into milk consumption.

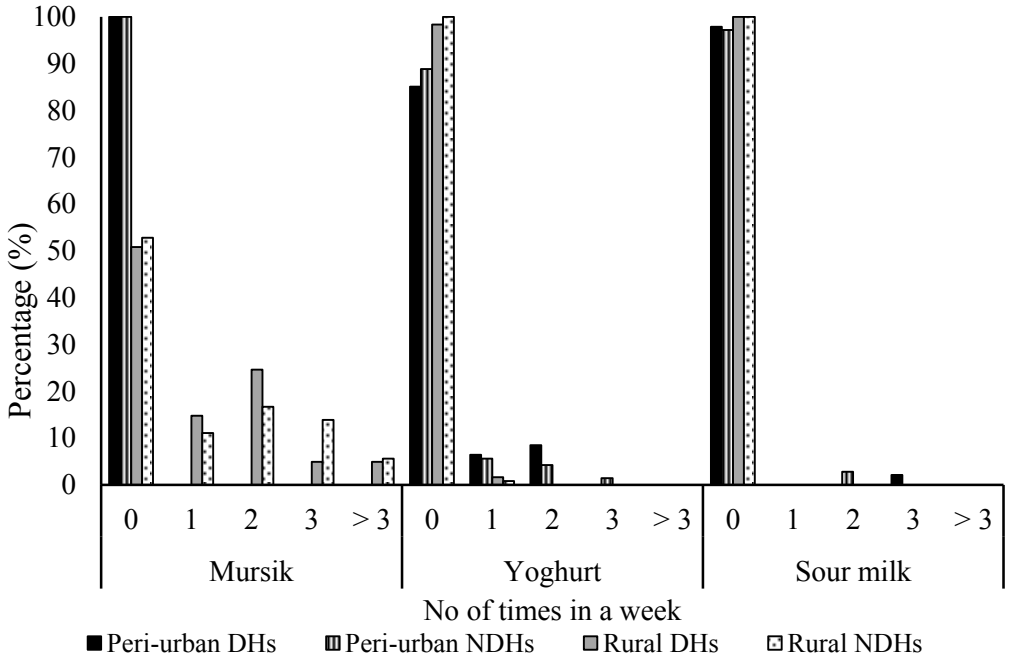

Figure 9: Frequency of consumption of milk products by children (24-59 months) from smallholder DHs and NDHs

DHs-Dairy households, NDHs- Non-dairy households

4.5 Nutritional status of children (24-59 months) from smallholder DHs and NDHs

Nutritional status is an important indicator of children's health. It allows for identification of children that are at increased risk of growth faltering, mental impairment and mortality (KNBS and ICF, 2015). Findings in the study show that a higher proportion of children from smallholder DHs and NDHs in peri-urban area were underweight and stunted while wasting was more prominent among children from smallholder DHs in the rural area. A significantly higher (P=0.032) percentage of children in the peri-urban area were underweight (27.8% in DHs and 25.5% in NDHs) as compared to those in the rural area

(9.8% in DHs and 19.4% in NDHs). Similarly, a significantly higher proportion (P=0.016) of children from NDHs (50.0%) as compared to DHs (27.6%) in the peri-urban area were stunted unlike in the rural area where the rates of stunting were lower (16.7% in NDHs and 19.7% in DHs) (Table 18). However, there was no significant difference in the rural area. The prevalence of stunting in children from the peri-urban area was higher than that of Nakuru County's (27.6%), the National level (26%) as reported in the 2014 KDHS (KNBS and ICF, 2015) and Africa's level of 32% in 2015 (de Onis and Branca, 2016). A higher percentage of children from peri-urban area were underweight and stunted possibly due to unemployment, farm size and number of cows. Unemployment limits access to nutritious food and health care. Similarly, in other studies it is one of the many factors that is linked to malnutrition (Maggie *et al.,* 2010; FAO, 2013; FAO *et al.,* 2015). Secondly, most of the smallholder households in rural area had larger farm sizes and more cows compared to those in peri-urban area. The small farm sizes limited the peri-urban households in terms of agricultural productivity consequently affecting food consumption (Bikuba, 2011; Chagamoka *et al.,* 2018). Agricultural productivity contributes to better nutrition through raising income and reducing the cost of food for consumers (FAO, 2013). Additionally, more cows translated to more milk production which meant more milk consumption and more income from sale as well (Jin and Iannoti, 2014).

Table 18: Nutritional status of children (24-59 months) in DHs and NDHs

Nutritional status	Peri-urban (%)			Rural (%)		
	DHs n= 47	NDHs n=72	*P*ǂ	DHs n=61	NDHs n=36	*P*ǂ
Underweight						
Normal	74.5	59.7	0.032**	88.5	80.6	0.314
Moderate	25.5	27.8		9.8	19.4	
Severe	0.0	12.5		1.6	0.0	
Stunting						
Normal	72.3	50.0	0.016**	80.3	83.3	0.233
Moderate	19.1	20.8		14.8	5.6	
Severe	8.5	29.2		4.9	11.1	
Wasting						
Normal	97.9	94.4	0.362	93.4	94.4	0.056
Moderate	2.1	5.6		6.6	0.0	
Severe	-	-		0.0	5.6	

DHs-Dairy households, NDHs-Non-dairy households, *P*ǂ *value* derived from χ^2 test, **= significant at α=0.05

4.6 Associations between socio-economic characteristics, child dietary diversity, milk intake and nutritional status of children

4.6.1 Determinants of milk intake among children 24-59 months

Multiple linear regression test was done to determine whether there were any significant associations between caregivers' age, occupation, education level, children's sex and age, dairy cow ownership, CDDS, location and amount of milk consumed by children. The linear regression model showed that the variables contributed to 18.4% of the amount of milk consumed by children. The model was significant (*P*=0.001) at a level of α=0.005 in predicting the daily milk intakes by children. Out of all predictor variables dairy cow ownership (*P*=0.019) and children's age (*P*=0.001) were significant predictors of child milk intake in a day (Table 19). The results suggest that dairy cow ownership contributed significantly to the amount of milk consumed by children. In addition, amount of milk consumed decreased with increasing age of the children. Studies done previously have similarly reported higher milk consumptions in households with increased dairy productivity (Nicholson *et al.,* 2003; Bikuba, 2011; Walton *et al.,* 2012; Hetherington *et al.,* 2017). Likewise, in Ethiopia it was discovered that cow ownership increased the likelihood of milk consumption in children 6-24 months by 22.5% points using probit (Hoddinott *et al.,* 2014). Similarly, in Kenya consumption of cows' milk by children increased with dairy intensification (Shreenath *et al.,* 2011; Walton *et al.,* 2012) however these studies did not test

for any associations limiting comparisons with the current study. On the other hand, another study done in Kenya showed that female owned/ co-owned livestock was significantly correlated (r=0.176, $P < 0.01$) with child ASF intake (defined as poultry, eggs, meat, fish, milk or dairy products) (Jin and Iannotti, 2014).

Table 19: Determinants of milk intake among children 24-59 months

	B Coefficients	**Std. Error**	***P***
(Constant)	634.94	130.66	0.000
Location	-45.89	30.42	0.134
Age	10.97	22.17	0.622
Education level	-32.16	20.18	0 .113
Occupation	-6.14	9.46	0.517
Dairy cow ownership	75.77	31.77	0.019**
CDDS	-45.99	42.88	0.286
Children's Sex	-47.30	30.21	0.120
Children's age	-66.13	19.69	0.001***

(r^2=18.4%, *P*=0.001), **,***= significant at α=0.05 and α=0.01, respectively
Age, education and occupation denote the caregivers' variables

4.6.2 The relationship between socio-economic characteristics, child dietary diversity, milk intake and child nutritional status

The results from Table 20 (lower panel), on correlation coefficients of error terms indicate that there was a positive correlation between underweight, stunting and wasting in children. A likelihood ratio test based on the log-likelihood values indicated a significant correlations χ^2 (39) = 61.47; probability > χ^2 = 0.0123 justifying that the explanatory power of the Multivariate Probit Model had a strong effect. Variables that were significantly correlated to nutrition status of children included; location, caregivers' age and caregivers' marital status.

Children living in the peri-urban area were more likely to be underweight (*P*=0.003), stunted (*P*=0.006) and wasted (*P*=0.006) as compared to those living in the rural area. This could be attributed to the fact that most people in rural areas depend on agriculture which generates income and provides access to a wide variety of foods (Ruel *et al.,* 2013). Households in rural areas might also be more food secure than those in peri-urban area, who are more prone to inflation of food prices (Chagomoka *et al.,* 2018; Jennings *et al.,* 2015; Tuffrey and Espeut, 2015). However, according to the 2014 KDHS, the rates of underweight, stunting and wasting were higher in the rural areas as compared to the urban areas (KNBS and ICF, 2015). Therefore policy formulation and implementation should focus on

strengthening agricultural activities in peri-urban areas as a measure to improve food security and reduce child malnutrition.

Younger primary caregiver's in the current study were likely to have children who were underweight (P=0.040) as compared to the older caregivers. This could be attributed to the fact that older caregivers have more experience in child care practices thus the likelihood of children under five years being malnourished increases with decrease in caregivers' age (Semali *et al.,* 2015; Kibua, 2014). Similarly, findings from another study conducted in Africa, Asia and Latin America revealed significant associations between child stunting rates and young maternal age (Yu *et al.,* 2016).

Children whose caregivers were separated from their husbands were likely to be stunted (P=0.019) whereas those with caregivers who were married were likely to be wasted (P=0.019). Therefore, malnutrition in children is a grim public health concern that cuts across all households regardless of the marital status of the caregivers. Families are critical in providing support and nurturing children since they are the first environment that children interact with from birth (Maggie *et al.,* 2010). Although child care is assumed to be exclusively a mother's responsibility, it should entail the entire family and community (Tinajero and Loizillion, 2012).

Table 20: Association between socio-economic characteristics, child dietary diversity, milk intake and child nutritional status

	Underweight			Stunting			Wasting		
Variable	Coef.	Std. Err.	*P*>z	Coef.	Std. Err.	*P*>z	Coef.	Std. Err.	*P*>z
Location	0.785	0.262	0.003***	0.624	0.226	0.006***	0.290	0.433	0.006***
Household size	-0.004	0.072	0.956	-0.050	0.064	0.429	-0.081	0.111	0.429
Caregivers' age	-0.028	0.014	0.040**	-0.011	0.011	0.301	0.029	0.021	0.301
Child's sex	0.127	0.216	0.558	0.095	0.197	0.629	0.105	0.417	0.629
Child's age	-0.008	0.011	0.488	0.015	0.010	0.138	-0.017	0.021	0.138
Caregivers' education	-0.134	0.134	0.320	-0.237	0.121	0.051	-0.253	0.237	0.051
Caregivers' occupation	0.061	0.217	0.777	0.323	0.203	0.112	-0.132	0.386	0.112
Farm size	-0.005	0.052	0.930	-0.065	0.060	0.281	0.110	0.049	0.281
Land ownership modes	0.009	0.009	0.287	0.007	0.008	0.342	-0.164	0.145	0.342
Marital status	-0.286	0.414	0.490	-0.853	0.365	0.019**	0.960	0.717	0.019**
CDDS	0.027	0.113	0.812	-0.044	0.106	0.679	0.330	0.213	0.679
Child milk intake	0.001	0.001	0.251	0.000	0.001	0.803	0.001	0.001	0.803
Milk frequency	-0.045	0.312	0.886	0.135	0.301	0.655	0.305	0.413	0.655
_cons	0.130	0.936	0.890	0.329	0.894	0.713	-3.785	1.560	0.713
Rho 2	0.6649***								
Rho 3	0.2513***			0.1178***					
Observations								216	
Log Likelihood								-219.11396	
Wald $\chi2$ (39)								61.47	
Prob > $\chi2$								0.0123	

Likelihood ratio test of rho21 = rho31 = rho32 = 0: $\chi2$ (3) = 87.7395, Prob > $\chi2$ = 0.0000, **,***= significant at α=0.05 and 0.01, respectively

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter gives conclusion derived from the study findings regarding milk consumption patterns and nutritional status of children (24-59 months). Thereafter, the recommendations for interventions and future research follow.

5.2 Conclusions

i. The main source of income for caregivers in smallholder DHs and NDHs from both peri-urban and rural areas was farming. However, a high proportion of caregivers from the smallholders NDHs in peri-urban area were unemployed.

ii. Overall children from both smallholder DHs and NDHs in peri-urban and rural areas attained a MDD. However, their diets were dominated by starchy staples, vitamin A rich fruits & vegetables and other fruits & vegetables. Consumption of ASFs such as the flesh foods and eggs by children was notably low.

iii. The prevalence of milk intake was high with more children from smallholder DHs and NDHs in rural area consuming milk compared to those in the peri-urban area. Despite the high prevalence of milk consumption, the actual amount of milk consumed by children from both smallholder DHs and NDHs in peri-urban and rural areas was low compared to the minimum recommended amount of 500mls/day by WHO.

iv. The most preferred form in which milk was taken by children from all smallholder DHs and NDHs in both peri-urban and rural areas was milk tea.

v. The frequency of consumption of milk and dairy products was low among children from smallholder DHs and NDHs in the peri-urban and rural areas.

vi. Overall the prevalence of underweight and stunting was high among children from smallholder DHs and NDHs in the peri-urban area than the rural area.

vii. There was an association between location, caregivers' age, marital status and the nutritional status of children. Children from peri-urban area were more likely to be underweight, stunted and wasted compared to those from rural areas. Children with young caregivers and caregivers who were separated from their husbands were also more likely to be undernourished.

viii. There was an association between dairy cow ownership, children's age and amount of milk consumed by children. Ownership of a dairy cow was associated with increased

amount of milk consumed by children while an increase in children's age was associated with a decrease in the amount of milk consumed by children.

5.3 Recommendations

i. The Bahati and Kuresoi South Sub-County health team and nutritionists to conduct nutrition education interventions in order to sensitize the primary caregivers on the importance of dietary diversification. Key emphasis should be on consumption of ASFs and other micronutrient rich foods so as to ensure that children have adequate nutrient intake for optimum growth and development.

ii. Nakuru County Government through the Ministry of Agriculture and Ministry of Health need to develop strategies that incorporate nutrition and agriculture targeting smallholder households to promote both milk production and consumption among children. Other initiatives (e.g. school/hospital campaigns) need to be placed to ensure that children not only consume milk but in the required amount that would contribute to them meeting the recommended nutrient intake.

iii. There is need for the National government to develop policies that advocate for milk consumption by children below five years as means of meeting one of the big four Agendas (Food Security and Nutrition).

iv. Nakuru County Government and other stakeholders in both private and public sector should use multiple approaches including; food prioritization, dietary diversification, IYCF and income generating activities, in order to reduce child malnutrition. Additionally, other key players comprising of individuals, community leaders, health providers, implementers, partners and policy makers should combine efforts tailored towards alleviating child malnutrition.

5.4 Suggestions for Future Research

i. There is need for longitudinal studies that incorporate seasonality in its scope where milk consumption and dietary diversity of children can be examined during both the rainy and dry seasons so as to realize their effect on children's nutritional status.

ii. More studies targeting older children (24-59 months) with focus on dietary intakes and dietary diversity should be done since this group of children solely depends on family foods and caregivers for their feeding thus poor feeding practices might have negative implication on their nutritional status.

iii. Besides dietary assessments, biochemical assessments (urinary and blood tests on micronutrient levels) should be carried out to further determine the contribution of milk to the nutrient intake and consequently the nutritional status of children.

iv. Intervention and follow up studies are required to monitor and evaluate the consumption of milk and other ASFs in children in relation to their nutritional status.

v. More studies should be conducted to show the nutrition-agriculture linkages and how agriculture can be leveraged to improve nutrition outcomes.

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APPENDICES

Appendix I: Socio-demographic Questionnaire

RELOAD
REDUCING LOSSES
ADDING VALUE

Milk consumption patterns and nutritional status of children (24-59 months) from dairy and non-dairy households in Nakuru County

QUESTIONNAIRE

Zone_____ **Location**_____ Questionnaire ID_____

INSTRUCTIONS

* Do not write your name or identity number on this questionnaire

* You are required to circle the option that is applicable to you. Where no options are provided, give brief explanation in the space provided

(List all household members with household head indicated as the first in line 1)

1.	2. Relation to HH head	3. Sex 1.M 2.F	4. D.O.B D/M/Y	5. Age (in yrs)	6. Ever attended School. 1.Yes 2.No	7. Highest level of education 1.preschool 2.primary 3.secondary 4.tertiary 98.DK 99.N/A	8. Religion 1.christian 2.muslim 3.traditional 4. hindu 96. others	9. Occupation 1.unemployed 2.Salaried employment 3.Casual 4. Farming 5.Farm worker 6.Housekeeping 7. Business 96.others (specify)
Line		M F	dd/mm/yy		Y N	level		
1		1 2			1 2			
2		1 2			1 2			
3		1 2			1 2			
4		1 2			1 2			
5		1 2			1 2			
6		1 2			1 2			
7		1 2			1 2			
8		1 2			1 2			
9		1 2			1 2			
10		1 2			1 2			

Land ownership

10. How many hectares of land do you own?_____

11. What is the mode of ownership of the land? (in case of several pieces of land choose the largest and ask)

1. Titled 2. No tittle deed 3. Rented 4. Communal 5. Family 6. Other (specify)_____

Dairy cow ownership

12. Does household have dairy cow/s?

1. Yes 2. No

13. If Yes in 12 how many cows? _____

14. If yes in 12 how much milk do you produce from your cattle in a day (in litres)?_____

15. If yes in 12 how much milk do you produce from your cattle in the (Morning) (in litres)?_____

16. If yes in 12 how much milk do you produce from your cattle in the (Evening) (in litres)?_____

17. If No in 12 does household purchase milk?

1. Yes 2. No

18. What is the source?

1. Local farmers 2. Packet milk 3. Milk ATM 4. Others Specify _____

19. How is the milk used? (select all that apply)

a. Dispatched to industrial dairy factories/collection centres/Locally_____
b. Retained for direct use of the household
c. Preparation of milk products for use or local sale
d. Used in calf rearing

20. How much milk is used in the following (in litres):

a Dispatched to industrial dairy factories/collection centres_____

b Retained for direct use of the household_____

c Preparation of milk products for use or local sale_____

d Used in calf rearing_____

21. In which form is milk consumed in household? (select all that apply)

a. Tea
b. Dairy products (specify)_____
c. Raw milk
d. All the above
e. Others (specify)_____

Sale of Cow Milk/milk products

22. During the last month, did you or anyone in your household sell any cow milk/milk products?

1. Yes
2. No

If Yes:

23. What type of milk was sold and how much of each type was sold?

Type of Milk Sold	**Amount of Milk Sold (liters)**

24. How much money did you receive from the sale of milk last month?

_____

25. What did you use the money for?

a. Purchase of food
b. Purchase of household assets
c. Payment of fees
d. Cover medical costs
e. Buying crop inputs
f. Buying livestock inputs

Other

(specify)_____

_____

26. Do you have cases of rejection for milk dispatched to the collection centres?

1. Yes 2. No

27. If yes in 4.1 what are the reasons/frequency of the milk rejection?

_____

_____

28. What do you do with the rejected milk? (select all that apply)

a. Dispose it

b. Sell it to the neighbours

c. Make dairy products from the milk

d. Consumed in HH

e. Others Specify

_____

_____

Sale of crop

29. What crop did you plant during the last season? _____

30. During the last planting season, did you or anyone in your household sell any crop?

1. Yes 2. No

31.If yes in what form?

1. Raw/unprocessed crop products
2. Processed
3. By products as animal feeds
4. Others (specify)_____

32. What did you use the money for?

g. Purchase of food
h. Purchase of household assets
i. Payment of fees
j. Cover medical costs
k. Buying crop inputs
l. Buying livestock inputs
m. Other

(specify)_____

_____

Appendix II: Children's 24 hour dietary recall

N/B: This will be used to derive the children's dietary diversity

Please describe the foods (meals and snacks) that you ate or drank yesterday during the day and night, whether at home or outside the home. Start with the first food or drink of the morning.

Write down all foods and drinks mentioned. When composite dishes are mentioned, ask for the list of ingredients. When the respondent has finished, probe for meals and snacks not mentioned.

TIME	PLACE TAKEN	FOOD TAKEN	INGREDIENTS

Appendix III: Dietary Diversity Questionnaire

33. Yesterday during the day or night, did child drink/eat any food group items?

No.	Food Groups	Examples	Yes=1 No=0
a.	Cereals	corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + *insert local foods e.g. ugali, porridge or paste*	
b.	White roots and tubers	white potatoes, white yams, cassava or any other foods made from roots or tubers	
c.	Vitamin A rich vegetables and tubers	pumpkin, carrot, squash, or sweet potato that are orange inside + *other locally available vitamin a rich vegetables (e.g. red sweet pepper)*	
d.	Dark green leafy vegetables	Dark green leafy vegetables such as cassava leaves, bean leaves, kale, spinach, pepper leaves and amaranthas leaves	
e.	Other vegetables	other vegetables (e.g. tomato, onion, eggplant) + *other locally available vegetables*	
f.	Vitamin a rich fruits	ripe mango, ripe papaya, dried fruits and 100% fruit juice made from these + *other locally available vitamin a rich fruits*	
g.	Other fruits	other fruits, including wild fruits and 100% fruit juice made from these	
h.	Organ meat	liver, kidney, heart or other organ meats or blood-based foods	
i.	Flesh meats	beef, pork, lamb, goat, rabbit, game, chicken, duck, other birds, insects	
j.	Eggs	eggs from chicken, duck, guinea fowl or any other egg	
k.	Fish and seafood	fresh or dried fish or shellfish	
l.	Legumes, nuts and seeds	dried beans, dried peas, lentils, nuts, seeds or foods made from these (e.g. peanut butter)	
m.	Milk/ milk	cheese, yogurt, milk or other milk products	

	products		
n.	Oils and fats	oil, fats or butter added to food or used for cooking	
o.	Sweets	sugar, honey, sweetened soda or sweetened juice drinks, sugary foods such as chocolates, candies, cookies and cakes	
p.	Spices, condiments, beverages	spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages	
q.	CDDS		

34. Is child still breastfeed?

1. Yes 2. No

35. If Yes, how many times did the child breastfeed yesterday?_____

Appendix IV: Milk Frequency Questionnaire for the Child

36. Milk consumption	a)Time taken	b)Type taken	c Amount taken (ml)
a. At what time did you first give cow's milk to this child yesterday, what type of milk was it, and how much did the child drink?			
b. At what time did you give the child cow's milk the second time, what type was it, and how much did the child drink?			
c. The third time?			
d. The fourth time?			
e. The fifth time?			
37. Tea with Milk consumption	a)Time taken	b)Type taken	c Amount taken (ml)
a. At what time did you first give tea to this child yesterday, what type of tea was it (family or special), and how much did the child drink?			
b. At what time did you give tea to this child the second time, what type of tea was it, and how much did the child drink?			
c. The third time?			
d. The fourth time?			
e. The fifth time?			
38. Other beverages with Milk consumption	a)Time taken	b)Type taken	c Amount taken (ml)
a. At what time did you first give other beverages with milk (_____) to this child yesterday, what type of tea was it (family or special), and how much did the child drink?			
b. At what time did you give _____to this child the second time, what type of tea was it, and how much did the child drink?			

c. The third time?			
d. The fourth time?			
e. The fifth time?			

Milk products consumption

39. Last week, how many times did your child eat foods made from milk?

a. Mursik	b. Yoghurt	c. Sour milk	d. Others (specify) _____	e. Others (specify) _____
0 times	0 times	0 times	0 times	0 times
1 time	1 time	1 time	1 time	1 time
2 times	2 times	2 times	2 times	2 times
3 times	3 times	3 times	3 times	3 times
>3 times	>3 times	>3 times	>3 times	>3 times

Food consumed with milk

40. Yesterday, how many times did your child eat cereal/rice with milk?

1. 0 times
2. 1 time
3. 2 times
4. 3 times
5. >3 times

41. Yesterday, how many times did your child vegetables cooked with milk?

1. 0 times
2. 1 time
3. 2 times
4. 3 times
5. >3 times

Appendix V: Children's Anthropometric Measurements Form

Date of interview_____

Zone_____ Location_____

42. Child NO .....

43. Child's age (in months) .....

44. Sex ……

ANTHROPOMETRIC INDICES FOR CHILDREN 24-59 months

MEASUREMENTS	**1st**	**2nd**	**3rd**	**Average**
45. Weight (kg)				
46. Height (cm)				

Appendix VI: Focus Group Discussion Guide

RELOAD
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ADDING VALUE

Milk consumption patterns and nutritional status of children (24-59 months) from dairy and non-dairy households in Nakuru County

Date of Interview:_____ Zone:_____

Location:_____ Group type:_____

1. Who is the decision maker on the food choices in the household? Who decides what the children eat?
2. What are the common child feeding practices?
   -Are their meals prepared separately from family meals and from what age?
   - Does culture contribute to feeding practices?
3. At what age are children introduced to complementary foods?
   -What is given as complementary foods?
   - What age is cow's milk given?
   - What are the benefits of cow's milk to child diet?
4. What are the challenges/hindrances in
   -Child feeding practices?
   -Child/children's milk consumption?
5. Are there outreaches/ dissemination of information regarding child feeding practices to the community/ area?
6. Who makes decisions on how milk is
   - produced in the household?
   -Utilised?
   -Sold?
7. How is the money from sale of crops/milk used?
8. Who is in-charge of the money?
9. What are the reasons for milk rejection at collection centres?
10. How is the rejected milk utilised in this community/area?

Appendix VII: Consent Form for household Participants

Milk consumption patterns and nutritional status of children (24-59 months) from dairy and non-dairy households in Nakuru County

Zone:_____ Location:_____ Form ID:_____

Dear Respondent,

Introduction; This questionnaire has been designed to solicit information for purely academic purposes. This is to enable Catherine Sarange Ogenche a student pursue her Master of Science degree in nutritional sciences in Egerton University. As part of the course requirements I am currently conducting a research study. "Milk consumption patterns and nutritional status of children (24-59) months from dairy and non-dairy households in Nakuru County".

Purpose; This survey will enable me identify the relationship between milk consumption and the nutritional status of under-fives. This will promote milk consumption at household level thus preventing losses and improve nutritional status of the family members especially children in Nakuru County. To meet these objectives, I kindly request you to participate in this study through your time in providing the information required.

Risks and Discomforts; Other than taking some of your time there are no anticipated risks. Discomforts may arise where the respondent's child measurement will be taken (weight and height) but the mother will be asked to willingly consent and allow the researcher to proceed.

Benefits; You may not get any direct benefits from the study but this will promote milk consumption at household level thus preventing losses and improve nutritional status of the family members especially children in Nakuru County.

Compensation; There are no costs for you to participate in this study and no payments will be made for participation in the study.

Privacy and Confidentiality;

I'd like you to speak freely and share with me your thoughts, opinions and experiences as they are very important in this study. Be assured of confidentiality of your responses and the information given will be kept in secure place where only the researcher will have access. Codes rather than participant's names will also be used in the questionnaires. The mothers

who are the respondents will be interviewed in the privacy of their homes with only the researcher. Anthropometric measurements will also be done in the privacy of their homes in presence of mother and /or father. Any information that identifies you individually or your family will not be included. If we write a report or article about this research project, your identity will not be disclosed.

Participation and Withdrawal from study; Participation in the study is voluntary and you may refuse to answer any questions. There are no penalties or consequences if you choose not to participate at any point during this interview.

Contact information; ***If you have any questions, concerns or complains about the study or your part in it please feel free to contact;***

Catherine Sarange	Dr. Lydiah Waswa
Egerton University	Egerton University
Human Nutrition Department	Human Nutrition Department
Tel. No: 0710311618	Tel. No: 0722684551

Email; ksarange@yahoo.com / salsarange@gmail.com

Consent declaration;

If you agree to take part in the study please endorse your name and sign below it. By signing this consent form, you will not give up any of your legal rights. We will give you a copy of the signed consent to keep.

Do you accept to take part in the study?

Yes ☐ No ☐

Names: _____ _____

Signature/thumb print: _____ Date: _____

Appendix VIII: Consent Form for FGD Participants

RELOAD
REDUCING LOSSES
ADDING VALUE

Milk consumption patterns and nutritional status of children (24-59 months) from dairy and non-dairy households in Nakuru County

Dear Respondent,

Introduction; This FGD will be conducted by Catherine Sarange Ogenche a student pursuing her Master of Science degree in nutritional sciences in Egerton University. As part of the course requirements I am currently conducting a research study. "Milk consumption patterns and nutritional status of children (24-59) months from dairy and non-dairy households in Nakuru County".

Purpose; This survey will enable me identify the relationship between milk consumption and the nutritional status of under-fives. This will promote milk consumption at household level thus preventing losses and improve nutritional status of the family members especially children in Nakuru County. To meet these objectives, I kindly request you to participate in this study through your time in providing the information required. I will also need to take an audio recording of the FGD to enable me at a later time derive detailed notes. Photos will be taken for accountability of the FGD exercise however this is not mandatory for one to participate.

Risks and Discomforts; Other than taking some of your time there are no anticipated risks. Discomforts may arise where participants in one way or another may give information that maybe unpleasant to you or disclose information that may identify you/others however this will be discouraged as much as possible.

Benefits; You may not get any direct benefits from the study but this will promote milk consumption at household level thus preventing losses and improve nutritional status of the family members especially children in Nakuru County.

Compensation; There are no costs for you to participate in this study and no payments will be made for participation in the study. However we will offer snacks for refreshment to every participant.

Privacy and Confidentiality;

I'd like you to speak freely and share with me your thoughts, opinions and experiences as they are very important in this study. Be assured of confidentiality of your responses, photos

and audio recording. The information given will be kept in secure place where only the researcher will have access. Codes rather than participant's names will also be used in the FGD notes. Any information that identifies you individually or your family will not be included. If we write a report or article about this research project, your identity will not be disclosed.

Participation and Withdrawal from study; Participation in the study is voluntary and you may refuse to answer any questions. There are no penalties or consequences if you choose not to participate at any point during this FGD.

Contact information; ***If you have any questions, concerns or complains about the study or your part in it please feel free to contact;***

Catherine Sarange	Dr. Lydiah Waswa
Egerton University	Egerton University
Human Nutrition Department	Human Nutrition Department
Tel. No: 0710311618	Tel. No: 0722684551

Email; ksarange@yahoo.com / salsarange@gmail.com

Consent declaration;

If you agree to take part in the study FGD please endorse your name and sign below it. By signing this consent form, you will not give up any of your legal rights. We will give you a copy of the signed consent to keep.

Do you accept to take part in the study?

Yes ☐ No ☐

Do you allow the researcher to take audio recording of the FGD discussion?

Yes ☐ No ☐

Do you allow the researcher to take photos of the FGD session?

Yes ☐ No ☐

If you consent, sign below;

Type of FGD_____Location_____Date_____

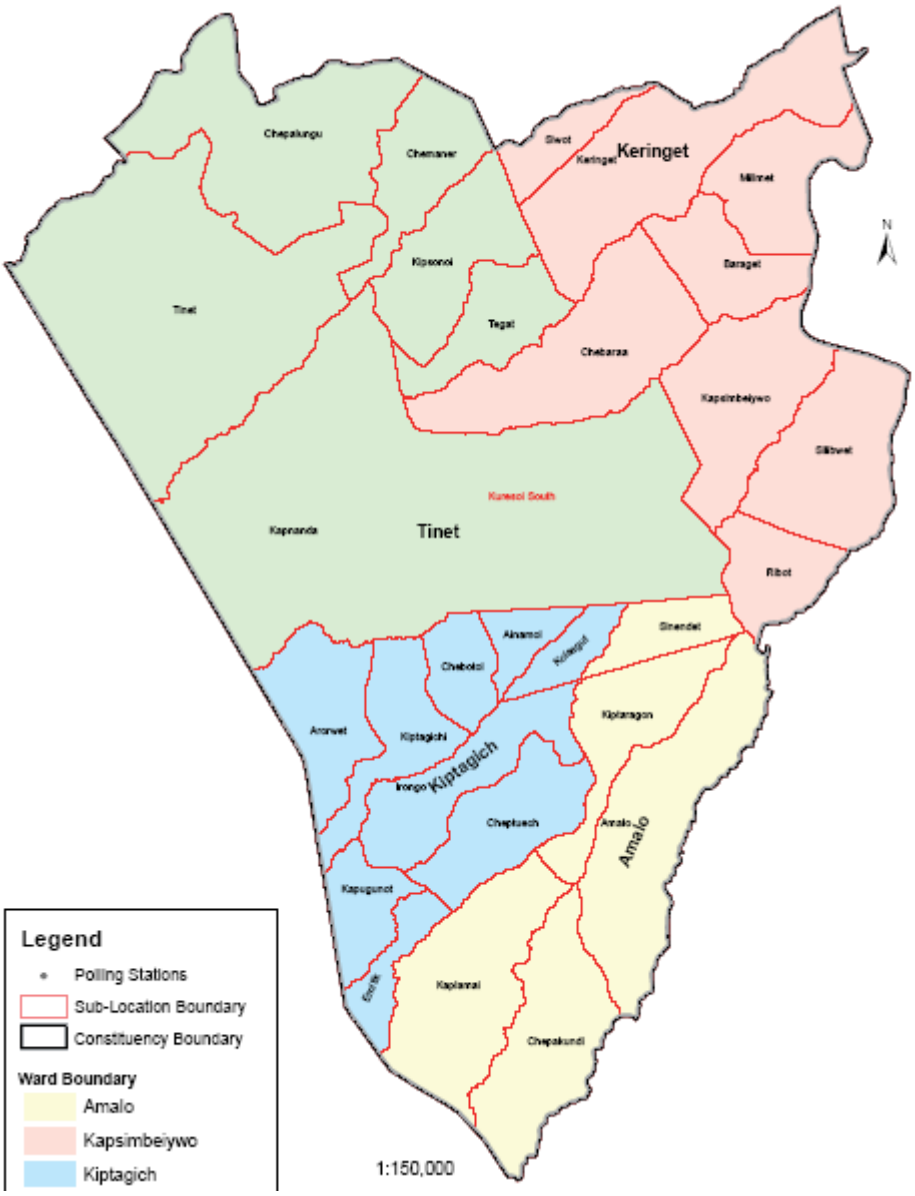
No.	Names	Signature/ Thumb print
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Moderator_____ Note taker_____

Sign_____ Sign_____

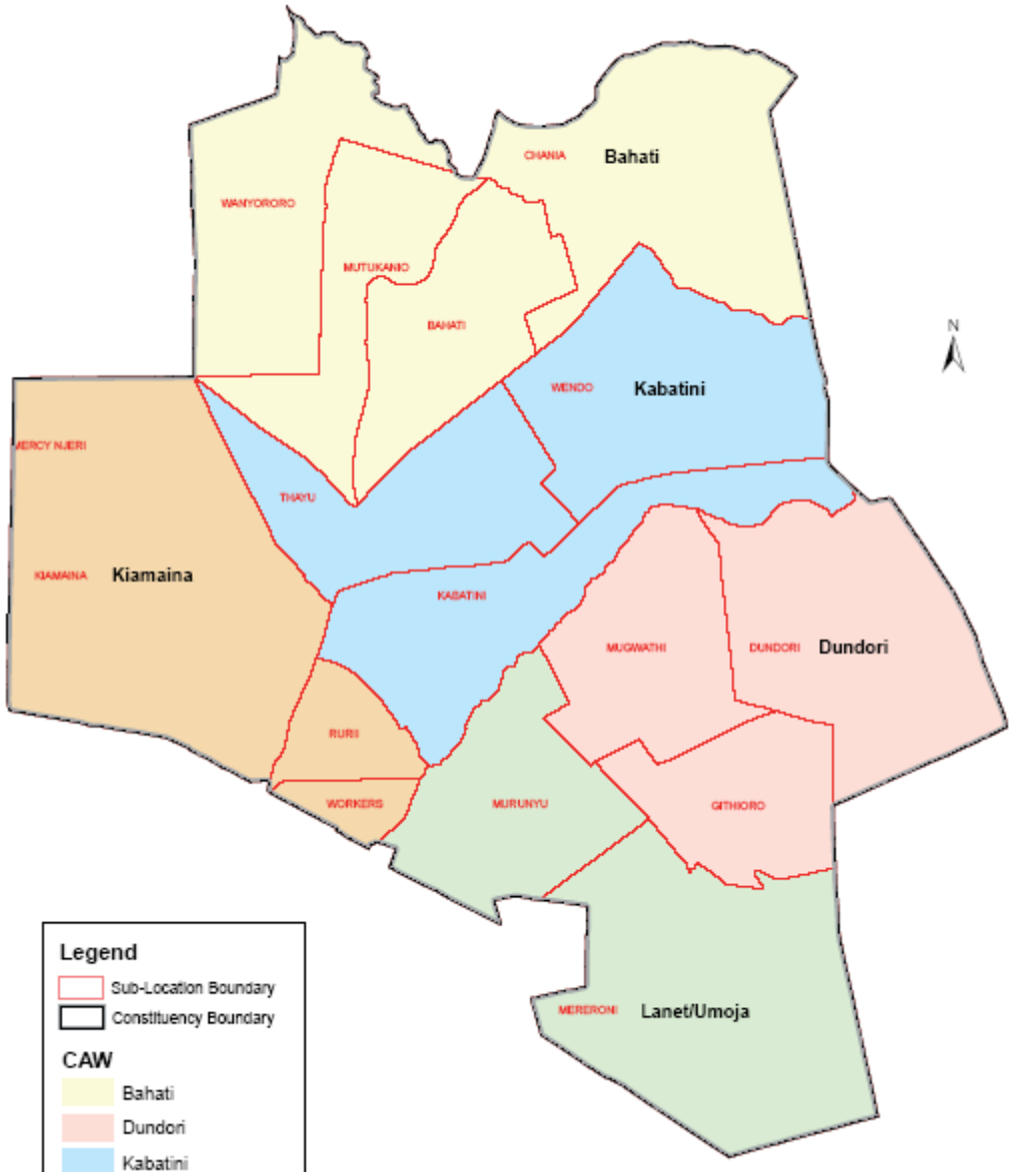
Appendix IX: Map of Olenguruone (rural area)

Kuresoi-South Sub- County



Appendix X: Map of Bahati (peri-urban area)

Bahati Sub-County



Appendix XI: Research Clearance Letter from Graduate School

EGERTON UNIVERSITY
Tel: Pilot: 254-51-2217620
254-51-2217877
254-51-2217631
Dir.line/Fax: 254-51-2217847
Cell Phone

P.O. Box 536 - 20115
Egerton, Njoro, Kenya
Email: bpgs@egerton.ac.ke
www.egerton.ac.ke

OFFICE OF THE DIRECTOR GRADUATE SCHOOL

Ref: HM18/3688/13 Date: 22nd September, 2017

The Director General
National Commission for Science Technology and Innovation,
P. O. Box 30623-00100
NAIROBI.

Dear Sir,

RE: REQUEST FOR RESEARCH PERMIT – MS. CATHERINE SARANGE OGENCHE - REG. NO. HM18/3688/13

This is to introduce and confirm to you that the above named student is in the Department of Human Nutrition, Faculty of Health Sciences, Egerton University.

She is a bona-fide registered M.Sc student in this University. Her research topic is **"Milk Consumption Patterns and Nutritional Status of Children (24-59) Months from Dairy and Non-Dairy Households in Nakuru County."**

She is at the stage of collecting field data. Please issue her with a research permit to enable her undertake the studies.

Your kind assistance to her will be highly appreciated.

Yours faithfully,

DIRECTOR, BOARD OF POST GRADUATE STUDIES
22 SEP 2017
EGERTON UNIVERSITY P.O. BOX 536, EGERTON

Prof. P.K. Cheplogoi
DEPUTY DIRECTOR, BOARD OF POSTGRADUATE STUDIES

PKC/vk

Appendix XII: Ethics Approval by Egerton University Ethical Review Board

EGERTON UNIVERSITY
DIVISION OF RESEARCH AND EXTENSION

Tel.051-2217801/08
Email: dvcre@egerton.ac.ke
Website: www.egerton.ac.ke

P. O. Box 536-20115
Egerton

RESEARCH ETHICS REVIEW COMMITTEE

EU/RE/DVC/009

21st December, 2017

Catherine Sarange Ogenche
Human Nutrition Department
Egerton University

RE: APPLICATION FOR ETHICAL APPROVAL OF RESEARCH PROJECT

Reference is made to your application for ethical clearance of your research project entitled: ***'Milk Consumption Patterns and Nutritional Status of Children (24-59) Months from Dairy and Non-Dairy Households in Nakuru County'.***

It was observed that you have addressed all the ethical issues that were raised in a committee meeting held on 24th November, 2017. Your proposal has therefore been approved for implementation.

Please further note that the Standard Operating Procedures (SOPs) requires that you submit progress reports twice in a year and a final report at the end of your study to the Committee. You are also required to obtain a Research Permit from NACOSTI before commencement of your study.

Prof. J. K. Kipkemboi
Chairman: Research Ethics Committee

JKK/po

VICE CHANCELLOR EGERTON UNIVERSITY P.O. BOX 536 EGERTON RESEARCH & EXTENSION

'Transforming Lives through Quality Education'
Egerton University is ISO 9001:2008 Certified

Appendix XIII: Research Authorization from NACOSTI

NATIONAL COMMISSION FORSCIENCE, TECHNOLOGY ANDINNOVATION

Telephone:+254-20-2213471, 2241349,3310571,2219420
Fax: +254-20-318245,318249
Email: dg@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/18/45767/20751** Date: **25th January, 2018**

Catherine Sarange Ogenche
Egerton University
P.O. Box 536-20115
EGERTON.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Milk consumption patterns and nutritional status of children (24-59) months from dairy and non-dairy households in Nakuru County"*** I am pleased to inform you that you have been authorized to undertake research in **Nakuru County** for the period ending **25th January, 2019.**

You are advised to report to **the County Commissioner, the County Director of Education and the County Director of Health Services, Nakuru County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

GP Kalerwa
GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Nakuru County.

The County Director of Education
Nakuru County.

National Commission for Science, Technology and Innovation is ISO9001:2008 Certified

Appendix XIV: Research permit

CONDITIONS

1. The License is valid for the proposed research, research site specified period.
2. Both the Licence and any rights thereunder are non-transferable.
3. Upon request of the Commission, the Licensee shall submit a progress report.
4. The Licensee shall report to the County Director of Education and County Governor in the area of research before commencement of the research.
5. Excavation, filming and collection of specimens are subject to further permissions from relevant Government agencies.
6. This Licence does not give authority to transfer research materials.
7. The Licensee shall submit two (2) hard copies and upload a soft copy of their final report.
8. The Commission reserves the right to modify the conditions of this Licence including its cancellation without prior notice.

REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH CLEARANCE PERMIT

Serial No.A 17240

CONDITIONS: see back page

THIS IS TO CERTIFY THAT:
MS. CATHERINE SARANGE OGENCHE
of EGERTON UNIVERSITY, 536-20115 Nakuru,has been permitted to conduct research in *Nakuru County*

on the topic: *MILK CONSUMPTION PATTERNS AND NUTRITIONAL STATUS OF CHILDREN (24-59) MONTHS FROM DAIRY AND NON-DAIRY HOUSEHOLDS IN NAKURU COUNTY*

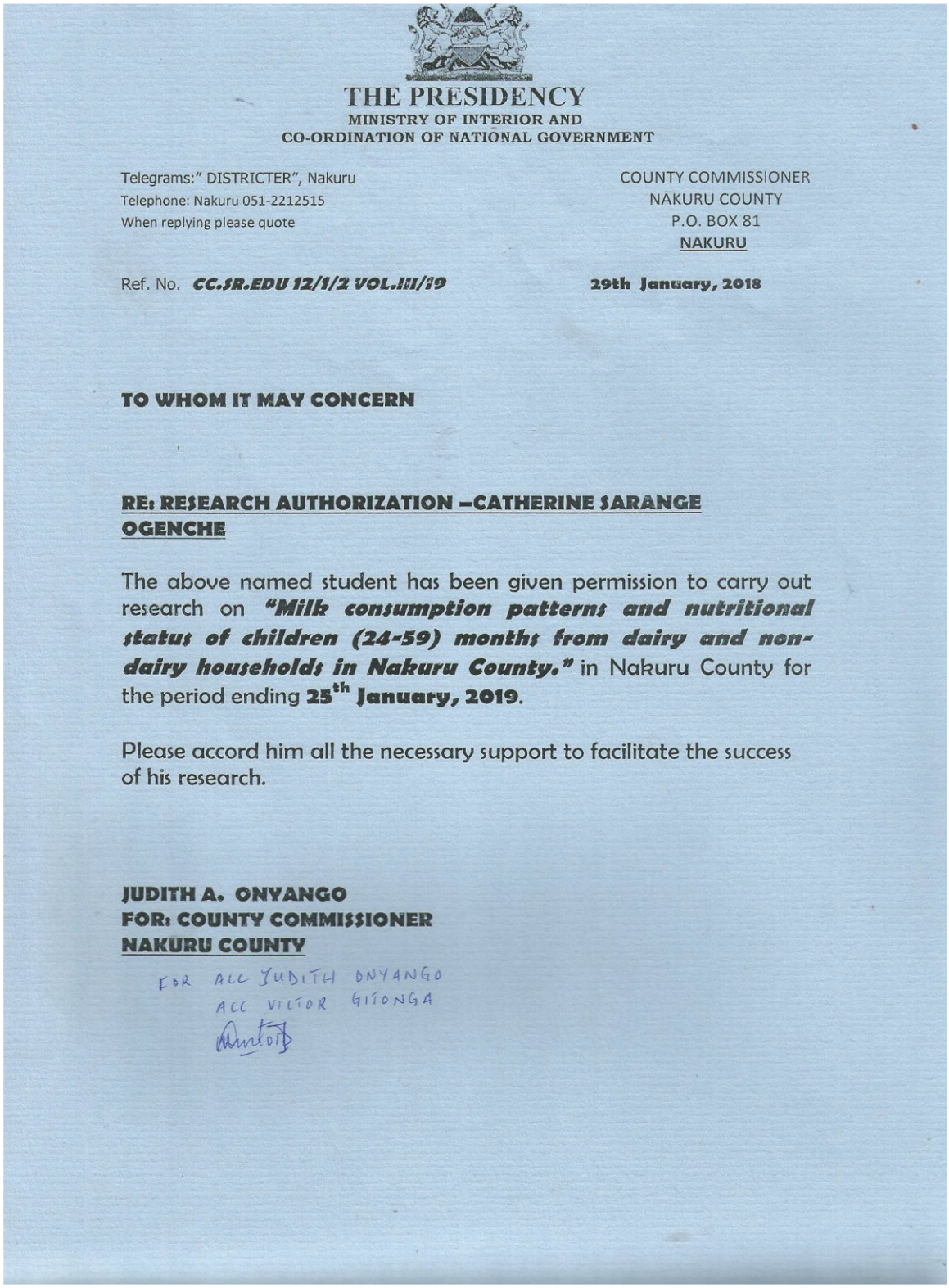
for the period ending:
25th January,2019

Permit No : NACOSTI/P/18/45767/20751
Date Of Issue : 25th January,2018
Fee Recieved :Ksh 1000

.....
Applicant's Signature

B.P Kalerwa
.....
Director General
National Commission for Science, Technology & Innovation

Appendix XV: Research Authorization from County Commissioner



THE PRESIDENCY
MINISTRY OF INTERIOR AND
CO-ORDINATION OF NATIONAL GOVERNMENT

Telegrams:" DISTRICTER", Nakuru
Telephone: Nakuru 051-2212515
When replying please quote

COUNTY COMMISSIONER
NAKURU COUNTY
P.O. BOX 81
NAKURU

Ref. No. ***CC.SR.EDU 12/1/2 VOL.III/19***

29th January, 2018

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION –CATHERINE SARANGE OGENCHE

The above named student has been given permission to carry out research on ***"Milk consumption patterns and nutritional status of children (24-59) months from dairy and non-dairy households in Nakuru County."*** in Nakuru County for the period ending **25th January, 2019**.

Please accord him all the necessary support to facilitate the success of his research.

JUDITH A. ONYANGO
FOR: COUNTY COMMISSIONER
NAKURU COUNTY

FOR ACC JUDITH ONYANGO
ACC VICTOR GITONGA

Appendix XVI: Research Authorization from MoE

MINISTRY OF EDUCATION
STATE DEPARTMENT OF BASIC EDUCATION

Telegrams: "EDUCATION",
Telephone: 051-2216917
When replying please quote

Ref.CDE/NKU/GEN/4/21/VOL.VI/67

COUNTY DIRECTOR OF EDUCATION
NAKURU COUNTY
P. O. BOX 259,
NAKURU.

29th January, 2018

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION –SARANGE OGENCHE
PERMIT NO. NACOSTI/P/18/45767/20751

Reference is made to letter NACOSTI/P/18/45767/20751
Dated 25th January, 2018.

Authority is hereby granted to the above named to carry out research on "***Milk consumption patterns and nutritional status of children (24-59) months from dairy and non-dairy households in Nakuru County***" for a period ending ***25th January, 2019.***

Kindly accord her the necessary assistance.

G.N. KIMANI
FOR: COUNTY DIRECTOR OF EDUCATION
NAKURU COUNTY

Copy to:

Egerton University
P.O Box 536-20115
EGERTON

Appendix XVII: Data collection

Data collection in Bahati, Nakuru.

Taking anthropometrics measurements

Men focus group discussion at Olenguruone Dairy Cooperative Society

Appendix XVIII: Publication

Ogenche, C. S., Muliro, P. and Waswa, L.M. (2018). Milk consumption patterns of children from dairy and non-dairy households in Nakuru County, Kenya. *International Journal of Nursing, Midwife and Health Related Cases 4(5) 1-18*. European-American Journals.