INFLUENCE OF SIZE AND CROP VARIETY OF KITCHEN GARDENS ON DIETARY DIVERSITY AND MICRONUTRIENT ADEQUACY AMONG WOMEN OF REPRODUCTIVE AGE IN KERICHO COUNTY, KENYA

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(BSc. Food Nutrition and Dietetics)

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN APPLIED HUMAN NUTRITION AT THE UNIVERSITY OF NAIROBI

DECLARATION

I, **Mercy Chepkirui**, hereby declare that this dissertation is my original work and has not been presented for any academic award in any other institution to the best of my knowledge.

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DEDICATION

It is my greatest pleasure with a joyful heart to dedicate this dissertation to my family:

My beloved mum, Nancy, for your continuous love, encouragement and prayers.

My elder brother, Collins, for your great support and encouragement.

My sister, Faith and younger brothers; Kiprotich and Kipkoech. You have always been source of inspiration to me!

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LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
CBS	Central Bureau of Statistics
CI	Confidence Interval
DDS	Dietary Diversity Score
DGLVs	Dark Green Leafy Vegetables
EAR	Estimated Average Requirements
IDA	Iron deficiency anaemia
IDD	Iodine deficiency disorder
FANTA	Food and Nutrition Technical Assistance
FAO	Food and Agriculture Organization of the United States
FDA	Food and Drug Administration
FFQ	Food Frequency Questionnaire
FGD	Focus Group Discussion
FHI	Family Health International
FVS	Food Variety Score
HDDS	Household Dietary Diversity Score
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
HH	Household
HKI	Hellen Keller International
IDA	Iron Deficiency Anaemia
IDDS	Individual Dietary Diversity Score
IU	International Units
KALRO	Kenya Agricultural and Livestock Research Organization
KDHS	Kenya Demographic Health Survey
KII	Key Informant Interview
KNBS	Kenya National Bureau of Statistics
KPHC	Kenya Population and Housing Census
KTDA	Kenya Tea Development Agency
LBW	Low Birth Weight
LSD	Least Significant Difference

MDD-W	Minimum dietary diversity-women
MODP	Ministry of Devolution and Planning
MoH	Ministry of Health
NAR	Nutrient Adequacy Ratio
NGO	Non-governmental Organization
RDA	Recommended Dietary Allowance
SDGs	Sustainable Development Goals
SSA	Sub-Saharan Africa
UNICEF	United Nations Children's Fund
USA	United States of America
VAD	Vitamin A deficiency
WDDP	Women's Dietary Diversity Project
WDDS	Women Dietary Diversity Score
WDDS-10	Ten food groups for women dietary diversity score
WHO	World Health Organization
WIC	Women, Infants and Children
WRA	Women of Reproductive Age

OPERATIONAL DEFINITION OF TERMS

Coping Strategies: The methods used by households to deal with food inadequacies.

Dietary intake: The consumption of foods and drinks of different quality and quantity by an individual. It is majorly used to refer to micronutrient intake (vitamin A, iron and zinc) in this study.

Dietary diversity: The qualitative measure of food consumption from diverse food groups which can be used as a proxy for micronutrient adequacy as applied in this study.

Dietary diversity score: The count of food groups consumed by an individual or household within a specified time period, mostly, a reference period of the past 24-hours.

Dietary patterns: The quantities, proportions, variety or combinations of foods and drinks consumed and frequency of habitual consumption.

Household: People who lived together in the same house for at least 30 days, whether related or unrelated and shared meals or have the same cooking arrangements, sleep in the same homestead and considers the same person as their household head.

Kitchen gardening: The practice of growing crops, especially fruits and vegetables, within or near the homestead, mainly for household consumption purposes.

Micronutrient malnutrition: In this context, refers to insufficient dietary intake of vitamin A, iron and zinc.

Minimum dietary diversity for women: In this study meant women who were 15–49 years of age having consumed at least five out of ten defined food groups during the previous day and night (24 hours).

Nutrient adequacy: The nutrient intake of women of reproductive compared to their recommended dietary allowance.

Nutrition Knowledge: The ability of women of reproductive age to demonstrate understanding of the ten questions asked in this study on kitchen gardening, dietary diversity, nutritional composition of foods and micronutrient needs.

Women Dietary Diversity Score: The total count of food groups consumed by women of reproductive age out of 10 food groups in a reference period of the past 24 hours.

Women of Reproductive Age: In this study, refers to women between the ages of 15 and 49 years.

ABSTRACT

Kitchen gardening promotes food availability and impact on dietary patterns of individuals. Women of reproductive age (WRA) are highly vulnerable to micronutrient deficiencies due to their reproductive role. Dietary diversification is a cost-effective intervention in combating micronutrient malnutrition but research studies and information on influence of size and crop variety of kitchen gardens on dietary diversity and micronutrient adequacy among WRA is scanty. A cross-sectional study was therefore conducted between September and October, 2018 to determine the influence of size and crop variety of kitchen gardens on dietary diversity and micronutrient adequacy among 193 women of reproductive age in Kericho County, Kenya. A semi-structured questionnaire was used to collect data. Data entry and analysis were performed using Statistical Package for Social Sciences (SPSS) version 20, Microsoft Excel and Nutrisurvey 2007 software. The mean household size for the sample population was 5.4±1.9. The highest proportion of respondents had attained primary school (47.4%), married (68.4%), and had low nutrition knowledge scores (44%). There was a positive significant association between education level and estimated monthly income (χ^2value=63.63, DF=20, $p<0.05$). A positive statistical significance was obtained between education level and nutrition knowledge scores [ANOVA (F (4,192) =6.087, *p*=0.000)]. Nutrition knowledge scores also had a positive statistical significance with women's dietary diversity scores (WDDS) (r=0.224, *p*=0.02). The average size of kitchen gardens was 67.1 ± 58.8 M^2 with 32 crops identified with a mean of 5.2 ± 2.6. Above 90% of the respondents had consumed starchy staples, dairy and dark green leafy vegetables whereas only 6.7% had consumed nuts and seeds. The mean WDDS was 5.3±1.4 with 72% of the women consuming at least five out of ten food groups. A positive significant association was found between the size of kitchen gardens and number of crops grown (r=0.392, *p*=0.000). The number of crops grown had a positive significant association with WDDS (r=0.305, *p*=0.000). The mean adequacy ratio for vitamin A, iron and zinc was 89.9%. A positive correlation was obtained between the nutrient adequacy ratios for Vitamin A (r=0.499), iron(r=0.528) and zinc (r=0.569), and WDDS. In conclusion, the size, and crop variety of kitchen gardens and nutrition knowledge affects dietary intake. Majority of WRA in Kericho County meet the recommended dietary diversity scores and micronutrient adequacy for iron and zinc. There is need to encourage households to increase their kitchen gardens' size and types of crops to target optimal food groups.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

Good nutrition is a fundamental aspect of healthy well-being and entails consumption of food items from various food groups (Kahanya, 2016). It is crucial for women of reproductive age (WRA) to have good nutrition due to their reproductive role. WRA, especially from the resource poor settings are particularly the most vulnerable to both macro and micro malnutrition with common forms being; iron, vitamin A, iodine and zinc deficiencies (Harika and Faber, 2015). World Health Organization (WHO) estimates that iron, iodine, and vitamin A deficiencies affect the health of 2000 million, 1500 million, and 250 million people respectively (Kiige, 2004). The deficiencies cause sub-clinical signs in most people and few of them reach the clinical manifestation since these deficiencies remain as "hidden hunger"(Kiige, 2004).

Many countries including Kenya have put in place interventions such as food fortification and supplementation to enhance attainment of good nutrition (Shetty, 2010). Most of the interventions have been implemented with success even though various setbacks are still encountered. For instance, the local communities who produce their own food and consume directly from the farm benefit less from fortification. Therefore, there is need for a more suitable intervention that can especially benefit the local people being more affordable and sustainable over a long-term (FAO, 2017). Nutrition-sensitive agriculture, including kitchen gardening would be an alternative option for filling this gap (FAO, 2017).

Kitchen gardening is key in production of diversified foods and increased consumption of micronutrient-rich foods (L. Bhattacharjee, 2006). It is a direct nutritional intervention with a potential of improving the dietary diversity and micronutrient intake of vulnerable groups in the society. It is as well a cheap food-based approach suitable for people with limited resources (Njuguna, 2013). The money saved from utilization of kitchen gardens could be used to purchase other foods in the household that are essential sources of vital micronutrients (Njuguna, 2013). This study therefore sought to determine the influence of kitchen gardens' size and crop variety on dietary diversity and micronutrient adequacy among women of reproductive age in Kericho County, Kenya.

1.2 Statement of the problem

In Kericho County (like many counties in Kenya), kitchen gardening has been promoted by various governmental and non-governmental organizations. Kitchen gardening is categorized as a food-based intervention that directly impacts on the food access of households. The foods grown are usually the ones rich in micronutrients, majorly vegetables and fruits. Despite the efforts which have been made in Kenya, poor dietary diversity and micronutrient deficiencies still exist as public health problems of concern due to high dependence on starchy staples (Amugsi, Lartey, Kimani-murage, and Mberu, 2016). Nationally, the proportion of WRA on poor dietary diversity equates to 61% and micronutrient deficiencies are still evident with a record of 21.9% being anaemic, 21.3% are iron deficient while 25.6% of non-pregnant WRA are deficient in iodine. Vitamin A deficiency (VAD) is another common form of micronutrient deficiency among the pregnant WRA at a proportion of 25.1% while the deficiency is 8.1% among non-pregnant WRA (KNBS, 2011). Kitchen gardening has the potential to reduce these problems if utilized efficiently. However, there is little documentation on the influence of kitchen gardens' size and crop variety on dietary diversity and micronutrient adequacy of diets among WRA in Kericho County. Such a study would act as evidence-based for scaling up or improving the utilization of kitchen gardening towards promoting adequate nutrition.

1.3 Justification of the study

The study contributes to the body of knowledge available on influence of kitchen gardens' size and crop variety on dietary diversity and micronutrient adequacy among women of reproductive age. The findings can be used by policy makers in both the national and county governments to come up with strategies on kitchen gardening, dietary diversity and micronutrient needs of women. The findings can also be used by the Ministries of Agriculture and Health in planning their activities e.g. on effective food production and ways of reducing micronutrient deficiencies, hence, promoting food security and wellbeing. The findings as well, form a basis for reference by other researchers on the same or similar fields and can be used as evidence to support projects on kitchen gardening.

1.4 Aim of the study

The aim of this study was to contribute to the knowledge available on influence of kitchen gardens' size and crop variety on dietary diversity and micronutrient adequacy among non-pregnant women of reproductive age in Kericho County.

1.5 Purpose of the study

The purpose of this study was to avail information on the influence of kitchen gardens' size and crop variety on dietary diversity and micronutrient adequacy among non-pregnant women of reproductive age in Kericho County.

1.6 Study objectives

General objective

To determine the influence of size and crop variety of kitchen gardens on dietary diversity and micronutrient adequacy among non-pregnant women of reproductive age in Kericho County.

Specific Objectives

1. To determine the demographic and socioeconomic characteristics of the study households
2. To determine kitchen garden practices- the size of kitchen gardens and types of crops grown by the study households, their utilization and challenges encountered.
3. To assess nutrition knowledge of the study sample.
4. To determine the dietary patterns (intake and dietary diversity) of the study sample.

1.7 Hypotheses and Research questions

Hypotheses

1. The size of kitchen gardens and number of crops grown by households have no significant modifying factor on the dietary diversity and micronutrient adequacy among WRA in Kericho County.
2. There is no significant association between socioeconomic characteristics and dietary intake of the study population.
3. There is no significant association between nutrition knowledge and dietary intake of the study population.

Research questions

1. What are the demographic and socioeconomic characteristics of the households?
2. What is the size of the kitchen gardens and what types of crops are grown in the kitchen gardens by the study participants' households and how are they utilized?
3. What is the dietary intake and dietary diversity of the study participants?
4. What challenges do the study participants face in keeping kitchen gardens?
5. What level of knowledge do women have on kitchen gardening, dietary diversity, nutrient composition of foods and micronutrient needs?

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Good nutrition is a global target which ensures the healthy and active life for all people (Ochieng, Afari-Sefa, Lukumay, and Dubois, 2017). It promotes overall economic productivity of the country and prevents both the direct and indirect costs of malnutrition (Beddington et al., 2016). It has been recognized that women of reproductive age (WRA) are among the most vulnerable to malnutrition globally due to their high physiological needs due to childbearing (Amugsi et al., 2016; Marangoni et al., 2016).This impacts negatively on their health state as well as the health and nutrition status of their infants (Marangoni et al., 2016; Vishma, 2016). Adverse effects such as high morbidity rate, giving birth to low-birth weight babies, inability to care for families and low economic productivity follow (Shashikantha, Sheethal, & Vishma, 2016).

Dietary diversity is a growing concern all over the world due to its positive implications on health (Oloyede, 2017). It enhances the consumption of nutritionally adequate and quality diets which improves human health (Oloyede, 2017). In Kenya, dietary diversity has remained a main challenge, especially among poor households and more so among the vulnerable population. This deprives the nutritional and overall health status of the affected. Improved nutrition leads to far-reaching benefits such as education improvement and poverty reduction (Cherop, 2017; FAO, 2010b; Kariuki, 2011; Omamo, 2016)). This involves prevention, control and treatment of all forms of malnutrition. Dietary diversification is a promising approach in solving micronutrient malnutrition through production of micronutrient-rich foods (Kariuki, 2011).

Food-based approaches are desirable means of achieving sustainable dietary diversity and attaining the dietary recommendations of all macro and micronutrients in all population groups (Gina, Razes, Ballard, and Dop, 2010; Njoya, 2010). This is particularly important for the WRA due to their high vulnerability to malnutrition. Most interventions which have been put in place target the health of pregnant and lactating women leading to neglect of the non-lactating and non-pregnant WRA (Acham, Oldewage-Theron, & Egal, 2012). Adequate preconception nutrition promotes the availability of all essential nutrients in body stores which is important for both their health as well as the pregnancy outcomes (Marangoni et al., 2016). Kitchen gardening is a food-based approach for dietary diversification (Kariuki, 2011). However, most studies have

been conducted as comparative studies among kitchen gardening and non-kitchen gardening households. Little has been done to understand the impact of kitchen gardens' size and crop variety on diet diversity and micronutrient adequacy. Hence, this study aimed to investigate the influence of kitchen gardens' size and crop variety on dietary diversity and micronutrient adequacy among the WRA in Kericho County.

2.1.1 Kitchen gardening

Kitchen gardening refers to the practice of growing diverse crops, mainly fruits and vegetables around the homestead, mainly for consumption purposes (Galhena, 2012; Mohsin et al., 2017). There are other terms which have been used in various studies to refer to kitchen gardens. For example, home gardens, backyard gardens, mixed gardens, homestead gardens or compound gardens (Galhena, 2012; Kiige, 2004; Mohsin et al., 2017). Kitchen gardens form a means of small scale production of subsistence crops planted next to family dwellings (Galhena, 2012). They have evolved over the years but still flourish today as ancient means of attaining food (Njuguna, 2013). They are not only a means of producing vegetables and fruits but also a means of rearing small animals like rabbits, chicken and non-food items like trees and flowers for beauty, fencing and other purposes. They complement food accessed by household members from field crops and those purchased, and are essential in the provision of energy foods, vegetables, fruits and animal proteins (FAO, 2016). The benefits which accrue from kitchen gardening are numerous but most importantly is the acquisition of diverse foods and boosting the overall food security of the household.

Kitchen gardening is a food-based approach which aims to increase food production. It is hence, a requisite intervention of achieving dietary diversity especially among the vulnerable members of the household such as women and children (FAO, 2017). It is a cheap and sustainable practice of food intervention unlike others which could require huge financial support from governmental and non-governmental agencies. In Kenya, the Ministry of Agriculture has taken various steps to encourage kitchen gardening. For example, it was involved in demonstration of the practice in Busia County in which agricultural officers were engaged in teaching farmers on how to practice various forms of kitchen gardening in pursuit of increasing food availability and quality (Kiige, 2004). The Ministry of Education has promoted the practice of kitchen gardening by introducing kitchen gardens in various schools and teaching on aspects of agriculture which involve kitchen

gardening. Moreover, the Ministry of Health promotes the art by involvement in education on the same in mother and child health clinics and in community-based nutrition programmes.

There are various non-governmental organizations (NGOs) which have been working towards improving food security both in Kenya and Africa as a whole by encouraging kitchen gardening. For example, an Italian NGO named "Terra Madre" started a kitchen gardens project in Africa called "A thousand Gardens in Africa" in 2010. The objective of this project was to create a thousand gardens in schools, villages and the outskirts of cities (Njuguna, 2013). James Finlay Company in Kericho entered into partnership with the project with an aim of supporting their workers adopt kitchen gardens in order to get a continuous supply of food throughout the year (Njuguna, 2013).

2.1.2 History of kitchen gardens

Kitchen gardens are the most ancient and extensive forms of food production over the world (Mohsin et al., 2017). The occurrence of several events led to the adoption of the practice. For example, in the United States of America (USA), kitchen gardens developed during the Second World War as a result of food shortage, labour and transport. As a result, people were asked to grow their own fruits and vegetables in what was called "Victory Gardens" (Njuguna, 2013). An estimate of over twenty million victory gardens was created between 1942 and 1943. Over 40 percent of vegetables and fruits were produced from the victory gardens. The same idea was adopted by the United Kingdom, Germany and Canada (Njuguna, 2013). In Germany, there existed kitchen gardens referred to as "Schrebergartens" which were located away from homes for growing of vegetables and fruits. They were started by Dr. Daniel Schreber with the purpose of being an outdoor activity for children to exercise. These gardens were rent out and used for teaching the younger generations on the importance of vegetable production.

In 1989, there was collapse of the economic support for the Cubians and Soviet bloc leading to a food shortage and the Cubians had to explore sustainable agriculture. Approximately 8000 gardens known as the "Popular gardens" for producing food for consumption in Havana were started. They became a source of nearly 50% of the vegetables consumed in Havana (Njuguna, 2013).

Kitchen gardening's introduction to schools had its origin in Europe and got to the United States of America in the 1980s. The gardens spread all over the country in early 20th century with victory gardens' intention to improve food supply during World War I and II. Recently, school gardens have been introduced with an educational component and to improve healthy eating habits. It enables hands-on experience among the children. School gardens have also developed in response to the need for food security, environmental protection and aim for better nutrition (FAO, 2010a).

Africans adopted kitchen gardens unknowingly. Most of them adopted kitchen gardens which evolved from a dumpsite or forests where the seeds of fruits and vegetables such as pumpkin were thrown and they germinated into plants. Eventually, those places were adopted as gardens for growing vegetables. Even though most Africans lacked full knowledge on kitchen gardens, they had a designated place for growing vegetables and condiments, they. For example, most of them grew onions as condiments near the homestead and kept them from destruction by animals. Thus, kitchen gardens evolved and have been embraced up to date.

2.1.3 Kitchen gardening efficiency

A typical kitchen garden should suit the needs of the household for it to be efficient. The efficiency of a kitchen garden involves various components. First, there is need to know its structure and what it can produce to meet family needs. The objectives for developing a home garden need to be understood together with the constraints involved and possible solutions to overcome. The technology to use should also be noted. For example, using mixed cropping system, use of live fences, cover cropping, and use of intensive vegetable area. For efficiency, the garden needs to be located next to the kitchen or homestead for ease of collecting vegetables, spices, fruits etc. when in need at any time and to allow ease of applying manure from the kitchen wastes (Qaiser, Shah, Taj, and Ali, 2013).

Planting a variety of crops enables the household to always have diverse and nutritious diet. It also helps in protecting against loss when other crops fail to grow in different seasons hence, enabling continuous supply of nutritive food regardless of the seasons. This can be achieved through multilayer cropping whereby crops of various heights are planted for symbiotic relationships. Planting a diversity of crops also enables a symbiotic relationship and boosts productivity. Leguminous plants such as beans provide nitrogen to non-leguminous plants such

as maize crops. Other plants such as onions and chili help in keeping away pests due to their smell.

The soil should be kept good at all times for good growth of the crops. The soils should be kept fertile and structure maintained so as to have good crops. The structure should be good to keep the crops firm and upright. It should also be well aerated to keep the air and water required for good growth. Knowledge on fertilizer application is requisite to keep the soils fertile in the garden. Manure is mostly used in kitchen gardens while chemical fertilizers are applied prior or during planting for boosting productivity. After planting, there is need to regularly apply manure, compost or chemical fertilizers in small amounts at an interval of about two weeks for soil fertility and boosting productivity.

Weed control and prevention of soil erosion are important in promoting efficiency of kitchen gardens. Planting of cover crops such as sweet potatoes and legumes help in preventing soil erosion and legumes boost fertility by fixing nitrogen in the soil. Cover crops prevent weed growth by competing with weeds for nutrients and space. Mulch materials used should be spread out 4-6 cm around the plant. Good spacing of crops should be practiced to enable good yields and prevent weeds since too much spacing allows the weeds to grow in the spaces left. Less spacing, on the other hand, leads to competition among plants for space, nutrients and light. Hence, good growth generally requires good plants' spacing.

Pests and diseases control is another aspect of promoting the efficiency of kitchen gardens. The farmer should have knowledge on the types of pests and diseases which can strike the crops. Assistance from the agricultural extension officers should be sought from time to time (FAO, 2015). Traditional ways of controlling pests and diseases are common in kitchen gardens. For example, there is the common use of ashes to prevent pests in vegetables. Good hygiene in the garden also helps in preventing pests and diseases. Plant intercropping and crop rotation prevents diseases since plants from the same family are affected by similar diseases. Plants from different families should be planted in between rows of crops from other families. For example, legumes should be planted in between crops such as maize and sorghum.

The use of live fences is as well an important practice in the kitchen garden. Apart from offering protection from animals and sometimes humans, live fences have other several advantages. For

example, useful plants such as cassava and sorghum planted close together as live fences can later be used as fodder crops.

2.1.4 Benefits of kitchen gardening

Kitchen gardening has numerous benefits which have been explored by several studies. Dilrukshi (2012) provides a good overview of these benefits which had been highlighted by earlier researchers such as Chris London-Lane (2004) and Mitchell and Hanst (Galhena, 2012). From the findings, these benefits can be categorized into three broad categories: i) Social ii) Economic iii) Environmental benefits.

i. Social benefits

Kitchen gardening has a potential of yielding social benefits which can be categorized further in details below:

a) ***Enhancing food and nutrition security***: This is a direct benefit in which gardens provide an easily available and accessible food sources which can be utilized by the households. Kitchen gardening provides a continuous supply of fresh food throughout the year. Most importantly is the provision of fresh fruits and vegetables throughout the seasons which ensures accessibility of nutritious diets all year round. This ensures that households obtain their nutritive requirement throughout the year (Galhena, 2012).

Kitchen gardening not only provides food in adequate amounts but also quality food to the family members. According to Food and Agriculture Organization (FAO), households that own kitchen gardens are able to access more than 50% of fruits and vegetables supply with staple foods such as sweet potatoes incorporated in the garden. The inclusion of livestock provides animal source protein to the diet. FAO (2016) documented the recommended dietary allowance (RDA) of several nutrients being boosted by a small vegetable garden. For example, Vitamin A is increased by 80%, Calcium-20% and Vitamin C by 100%. This is supported by a study in Indonesia which reports kitchen gardens' provision of supplemental nutrient source to the staple-based diet by providing proteins, vitamins and minerals (Galhena, 2012). The practice is also sustainable and have the capability of being transferred from generation to generation. This ensures continuous food supply throughout the years, including periods of stress such as

drought, harvest failure, unemployment and during illness of a member(s) of household (Wanjohi, 2006).

b) ***Dietary diversity and Health benefits*****:** Kitchen gardens provide a buffer to nutritional deficiencies due to their rich diversity which encourages dietary diversity and nutritional benefits (FAO, 2017; Gautam, Sthapit, & Shrestha, 2004). Furthermore, a kitchen garden ensures production of quality foods since its production is mainly organic with little use of chemical fertilizers. This is because it deals mostly with traditional vegetables which require use of less resources but are of high nutritional benefits (Gautam et al., 2004).

Diets which are of low quality, lacking major macro and micronutrients leads to diverse health risks (Galhena, 2012). The most common being micronutrient deficiencies especially in the developing world that majorly affects women and children (Allen & Benoist, 2006; Shashikantha et al., 2016). This can further lead to other infectious diseases and raised mortality rates (Galhena, 2012). Kitchen gardens involve medicinal plants and herbs which can be used in curing various illnesses, diseases and in improving health conditions (Galhena, 2012; Gautam et al., 2004).

c) ***Social Equity and Gender Balance*****:** Women are key in food production and are key participants in kitchen gardening activities in most cultures. However, they are not the only players of the activities which take place in the gardens. Through this participation, they have developed experience related to kitchen gardening which enables them to be better home and environment managers (Galhena, 2012).

According to Girigan et al (2016), a study which was conducted on home gardening found that women statuses improved due to increased consumption of vegetables. It increased the household food decision making by women as a result of women taking major part of kitchen gardening and utilizing the produce to feed their families. Women have the control to decide what to grow so as to provide food for their families. Kitchen gardens enable the female-headed households to fulfill their nutritional requirements (Galhena, 2012).

d) ***Preserving indigenous knowledge***: Kitchen gardens comprise of various plants which identify with various societies. The methods of farming and ways utilizing the produce depend on the indigenous knowledge from various societies. This knowledge is usually transferred from

generation to generation and helps in building strong ties in communities (Galhena, 2012; Wanjohi, 2006). Kitchen gardening involves both the young and the old working in the kitchen garden. This enables the older generation to instill good morals and pass the norms of the community in the process.

ii. Economic benefits

These are the benefits beyond the social aspects like food and nutrition security (Galhena, 2012). Kitchen gardening leads to financial gains, economic improvement of households as well as rural development (FAO, 2017; Galhena, 2012). It provides a supplemental source of income through the sale of surplus produce. This adds to the family income and spares the money which could have been spent on purchasing kitchen garden produce. Studies from Nepal further points out that the income obtained from sale kitchen gardens' produce could be used in purchasing other foods and can be further used in paying for education and other services. The income could also be put to savings (Galhena, 2012; Schupp, 2009).

Kitchen gardens' outputs are higher than those of field agriculture. This adds to the returns received from the households. In cases of small land sizes, kitchen gardening with involvement of livestock provides assets to the household (Galhena, 2012). Despite the fact that kitchen gardens are subsistence in nature, they can be restructured to incorporate high value fruits, vegetables and livestock which yield higher income.

iii) **Environmental benefits:**

Kitchen gardening is a method of food production which utilizes ecological friendly means of production. The involvement of a variety of plants and animals ensures a nice ecosystem which conserves natural biodiversity with a variety of species (Galhena, 2012).

A rich ecosystem enhanced by the gardens enables nutrient recycling and cross pollination by hosting birds such as honey bees and other birds which utilizes the habitat of the gardens. Nutrient recycling occur through the decomposition of plants and other litter in the gardens. The use of animal wastes also promotes soil fertility.

2.1.5 Nutrition knowledge

Nutrition knowledge refers to "knowledge and processes related to nutrition and health, diet and disease, diet and health and regarding food as the major sources of nutrients" (Bulirani, 2018). It involves understanding dietary guidelines and requirements. The dietary intake and the health status of women of reproductive age is impacted by their nutrition knowledge (Bulirani, 2018). Nutrition knowledge on proper diets is a necessity to add up on the access to nutritious diets (Omamo, 2016). Studies have shown that nutrition knowledge affects the dietary diversity of WRA. It could also affect food choice without having to check food labels and by affecting attitudes and beliefs (Soederberg and Cassady, 2015). Women have been shown to have more nutrition knowledge than men as a result of their role in food purchasing and preparation with men being less interested in nutrition (Spronk, Kullen, Burdon, and Connor, 2014). Nutrition education is an essential component which optimize the health status of women and their pregnancy outcomes (Dunneram and Jeewon, 2015).

2.1.6 Dietary intake

Dietary intake refers to the eating patterns of an individual on a daily basis involving the quantity and quality of food consumed. The quality of diet implies adequacy in terms of all the nutrients essential to the body (Muthoni, 2017). Dietary intake is influenced by various factors such as food availability, accessibility, health status, and care practices, especially for women and children. Dietary needs vary according to individual needs depending on age, gender, physical activity, and body size and health status. The physiological needs also affect dietary needs. For example, children have high dietary needs due to their high state of growth and development; women also have high physiological needs during pregnancy, breastfeeding and menstrual losses, hence high dietary demands. As illustrated by the UNICEF's conceptual framework for the causes of malnutrition, dietary intake is one of the immediate causes of malnutrition. It can be used as a proxy for nutrition status when combined with dietary diversity (Njoya, 2010).

Agricultural production in homes affects dietary intake as most households, especially in rural households, depend on home-grown food for consumption. The level of income or wealth available for food purchase influence dietary intake of individuals through improved accessibility (Kiige, 2004). The market processes enabling food availability and access are key in

ensuring that food is available for purchase at the right quantities and quality, hence, is an important component of dietary intake.

2.1.7 Methods of dietary assessment

Dietary assessment involves establishing the types and quantities of food consumed in a specific reference period. Dietary diversity and micronutrient adequacy of vitamin A, iron and zinc were the targets of dietary assessment for this study. The data obtained was analyzed using various nutrition software such as statistical package for social sciences (SPSS) and Nutrisurvey software (Badake, 2014; Cherop, 2017).

The following reviews on methods of dietary assessment used in this study:

i. Food frequency questionnaire (FFQ)

The use of food frequency questionnaires is a retrospective method of dietary intake which assesses the number of foods and/or food groups consumed during a given time period (FAO, 2018). It shows the usual intake of food by individuals, and contains a list of various foods from different food groups and frequency of consumption which can be the number of times in a day, week, month, quarterly or yearly (Committee on Dietary Risk Assessment. Food and Nutrition Board, 2002). The foods included depend on the objectives of the study. It can involve a few selected foods targeting various nutrients or a whole range of foods in all food groups (FAO, 2018). The frequency of consumption can be coded as "frequently consumed", "not frequently consumed" or "never consumed" (Njoya, 2010). They are usually self-administered but the interviewer can assist in case of illiterate interviewee or to provide clarity. FFQs collect information from a large number of interviewees (Nkirigacha, 2012). The prepared food frequency questionnaire depends on the objectives of the study. It should correspond to the set objectives and be specific to the targeted population. The use of FFQs has various advantages e.g. they allow collection of long-term dietary intake, can be used in large surveys in a relatively cheap and easy manner, and they can be self-administered (FAO, 2018; Shim, Oh, and Kim, 2014).

ii. 24-hour dietary recall

Twenty four (24)-hour dietary recall is a retrospective dietary assessment tool that provides a list of all foods and drinks consumed in the previous day and night, the time when the foods and/drinks were consumed, ingredients used and portion size served (FAO, 2018). It is normally administered by a trained interviewer to respondents who are expected to state a list of all foods and beverages consumed in the past 24 hours. After completion, the record is rechecked and the interviewee is asked to repeat the list of foods and beverages consumed to avoid missing out on any foods and drinks consumed. Some of the advantages of this method are: it gives less burden to the respondents while providing detailed information on the foods and drinks consumed (Shim et al., 2014), can be used with illiterate people and takes less time to complete than a food frequency questionnaire (FAO, 2018).

2.1.8 Dietary diversity

Dietary diversity is a qualitative measure of food consumption based on diverse food groups used as proxy for both macro and micronutrient adequacy (FAO, 2010b). It also refers to the total number of food groups consumed by a target population within a reference period (Gina et al., 2010; Kahanya, 2016; Nabwire, 2017; Rani and Rani, 2017). The reference period varies; it can be the previous day or even week (Badake, 2014). Dietary diversity was adopted from the Hellen Keller International Food frequency questionnaire that shows a well representation of consumers of a particular food (Wanjohi, 2006). Dietary diversity encompasses the attainment of safe and quality diets by every individual that provide both the macro and micronutrients in adequate amounts. At the household level, dietary diversity reflects food accessibility whereas at the individual level, it reflects dietary quality, mainly micronutrient adequacy (Badake, 2014; FAO, 2010b). This component is important in tackling hidden hunger by involving other components such as bioavailability with other crucial elements of food availability and accessibility. This can be promoted by involving food-based strategies such as kitchen gardening.

Dietary quality is a basic component described in dietary diversity (Nair, Augustine, and Konapur, 2016). It points out on nutrient adequacy which implies a diet that meets the requirements for all energy and nutrient needs (Ngala, 2015). It encompasses attainment of the set RDAs to avoid under and/or over-nutrition which are a growing global concern. No single

food can provide for nutrient adequacy except breast milk for the first 6 months. Consequently, dietary diversity is vital in meeting dietary recommendation from various food group sources (Ngala, 2015).

Dietary diversity was found as a good measure of women's diet in resource- poor settings of rural Bangladesh (FAO, USAID, and FANTA, 2016; Nabwire, 2017). It was found to be correlated with micronutrient intake of WRA (Nabwire, 2017). Other studies have found dietary diversity to be correlated with micronutrient adequacy (Muthoni, 2017). A study done in Burkina Faso indicates dietary diversity as a measure of the overall diet quality of women that correlates positively with nutrition status (Ochieng et al., 2017).

All humans require a diverse diet to meet the essential nutrient requirements. However, it has been found that most people in the developing countries depend mostly on starchy staples in their diets with minimal animal proteins and few fruits and vegetables in season (Cherop, 2017). Most studies have illustrated positive correlations between a variety of nutrients obtained through various foods and dietary diversity (Cherop, 2017).

2.1.9 Dietary diversity scores

Dietary diversity score (DDS) refers to the count of all food groups consumed by an individual or household for a given reference period, mainly the previous 24 hours, by use of a 24-hr dietary recall (Steyn, Nel, Nantel, Kennedy, and Labadarios, 2006). DDS can be categorized as individual dietary diversity score (IDDS), household dietary diversity score (HDDS), women dietary diversity score (WDDS) and child dietary diversity score (CDDS) (TY Habte and Krawinkel, 2016). HDDS measures the household's access to food, IDDS measures the diet's quality of an individual whereas WDDS and CDDS measures the nutritional quality of women's and children's diets respectively. The choice of use of any of these depends on the study in place.

A study done by FAO referred to as Women's Dietary Diversity Project (WDDP) was conducted in five countries to measure the possibility of simple dietary diversity scores in meeting the micronutrient adequacy of women using various number of food groups to measure DDS (Ruel, Deitchler, and Arimond, 2010). The findings indicated positive correlations between DDS and micronutrient adequacy in women's diets. WDDP used a 9 food groups for women dietary diversity score which includes: "starchy staples, dark green leafy vegetables, other vitamin A

rich fruits and vegetables , other fruits and vegetables, organ meat, meat and fish, eggs, legumes, nuts and seeds, and milk and milk products" (FAO et al., 2016; Muthoni, 2017). However, the use of 9-food group WDDS did not have any cut-off showing the number of food groups which the WRA should consume to be regarded as consuming sufficient micronutrient quantities. Consequently, a new DDS indicator was developed by FAO and FHI (360) in 2016 dubbed, Minimum Dietary Diversity for Women (MDD-W) in which this study was based. This was a new guideline with a simple dichotomous indicator for assessing the dietary quality for WRA and used as a proxy indicator for micronutrient adequacy unlike the earlier research which did not provide for a dichotomous indicator (Amugsi et al., 2016; Nguyen et al., 2018).

MDD-W is calculated based on ten food groups which include; "Grains, white roots and tubers (starchy staples), and plantains, pulses (beans, peas and lentils), nuts and seeds, dairy, meats, poultry and fish (flesh foods), eggs, dark green leafy vegetables, other vitamin A-rich vegetables and fruits, other vegetables and other fruits"(FAO et al., 2016). High probability for micronutrient adequacy is given as consumption of ≥5 of the 10 food groups. A minimum intake of at least 15g is necessary for a food to count as one food group (Pal, Paul, and Dasgupta, 2018). Eleven micronutrients taken into account in women's diet based on MDD-W include: "iron, zinc, calcium, vitamin A, thiamine, riboflavin, niacin, vitamin B6, folate, vitamin B12 and vitamin C" (Muthoni, 2017; Nguyen et al., 2018). This study used MDD-W indicator based on 10 food groups and referred the women dietary diversity score out of 10 food groups as WDDS-10.

2.1.10 Nutrient Adequacy

Nutrient adequacy refers to the nutrient intake of an individual compared to the recommended intake (Majili and Pacific, 2017; Ty and Krawinkel, 2016). It is an indicator used to determine how high or low an intake of a nutrient is (Majili and Pacific, 2017; Spigelski, 2004).

This study used nutrient adequacy ratio (NAR) to measure micronutrient adequacy of respondents; based on the RDA. The ideal value for NAR and mean adequacy ratio (MAR) is 100% showing perfect adequacy in which dietary intake equals to the requirements (Majili and Pacific, 2017; Ty and Krawinkel, 2016). The formula used in calculating the NAR is:

Nutrient Adequacy Ratio (NAR)={actual nutrient intake per day (24 hours)/recommended dietary allowance multiplied by 100 to get the percentage NAR (Majili and Pacific, 2017).

MAR was obtained based on the three micronutrients of interest (Vitamin A, iron and zinc) using the formula:

MAR=∑NAR/Number of nutrients;

Mean Adequacy Ratio (MAR) for Vitamin A, iron and zinc= {NAR (Vitamin A) +NAR (iron) +NAR (zinc)}/3

2.1.11 Micronutrient malnutrition

Micronutrient malnutrition is a great problem of public concern in Kenya, across all populations with the most vulnerable groups being children under the age of five and WRA (Allen & Benoist, 2006; Kennedy et al., 2010). An estimate of two billion people worldwide suffer from micronutrient malnutrition which includes both vitamin and mineral deficiencies (Borle, 2004; Nair et al., 2016; Thompson and Amoroso, 2010). Micronutrient malnutrition is commonly referred to as 'hidden hunger'. The common deficiencies include vitamin A, iron, zinc and iodine. The main cause of VAD and IDA is dietary inadequacy whereas iodine deficiency is mainly caused by inadequacies of iodine in soil and water (Vijayaraghavan, 1995). In Kenya, 25.6% of non-pregnant WRA are deficient in iodine (KNBS, 2011). It is estimated that nearly 486 million non-pregnant women are anaemic with an overall of 25% of Africa's population being anaemic (Ngala, 2015). Nationally, 21.9% of WRA are anaemic while 21.3% are iron deficient (KNBS, 2011). It is noted that Africa has highest numbers of anemia and Vitamin A deficiency affecting 25-30% of the population (Ngala, 2015). The Kenya national and micronutrient survey, 2011 reports that VAD is more common among the pregnant WRA at 25.1% than non-pregnant WRA whose rate of VAD is 8.1%. Inadequate consumption of foods rich in micronutrients is a major cause of the deficiencies.

Micronutrient malnutrition brings devastating effects such as poor physical and cognitive ability, reduced work capacity and a weak immunity to the affected population which eventually leads to poor economic performance (Nair et al., 2016; Odhiambo, 2013). In women, it results in poor pregnancy outcomes, increased mortality and morbidity rates, and reduced work productivity (Miller and Welch, 2013).These results in a vicious cycle of lower socioeconomic development

and intensified poverty among the populations affected. It has been found that nearly a third of the world's population cannot meet their physical performance and intellectual capability due to micronutrient deficiencies (Odhiambo, 2013). There is, therefore, need to defeat micronutrient malnutrition so as to realize meaningful economic development (Wanjohi, 2006).

The need to overcome mild, moderate and chronic forms of micronutrient malnutrition may not respond to single short-term interventions. It requires the involvement of whole foods with complete set of micronutrients which are sustainable. Therefore, there is need to incorporate sustainable long-term strategies by transiting smoothly from the short-term strategies such as micronutrient supplementation.

Examples of Micronutrient deficiencies

i. Vitamin A Deficiency

Vitamin A deficiency (VAD) is a major endemic micronutrient deficiency worldwide and more prevalent in developing countries (M. Faber and Laurie, 2010). Nearly half of the countries are battling the endemic especially in Africa and South-East Asia. It mostly affects children, pregnant women and lactating mothers (Harika & Faber, 2015). It is a major cause of night blindness in young children. It causes severity of illnesses and premature death. In pregnant women, adequate amounts of Vitamin A are required in the last trimester for both the mother and the unborn child. Adequate intake is therefore essential for WRA to provide enough stores during pregnancy.

There are programmes which have been put in place in Kenya so as prevent Vitamin A deficiency. Some of the programmes include the diet-based approach which involved the introduction of Orange fleshed sweet potato by Vitamin A for Africa and Kenya Agricultural and Livestock Research Organization (KALRO). Kitchen gardening is important in battling VAD as it increases the availability, accessibility and eventually consumption of Vitamin-A rich foods (M. Faber and Laurie, 2010).

ii. Iron deficiency

Iron deficiency is one of the public health problems of concern in Kenya and the world in general. It is a problem both of developing and developed countries (World Health Organization, 2008). It is the most prevalent deficiency worldwide (Gupta, Pingali, Pinstrup-andersen, Cornell, & States, 2019). It causes iron deficiency anaemia and affects nearly 2000 million people worldwide. It is considered to occur when there is greater than 5% prevalence of lower levels of haemoglobin than the set cut-offs in a population (Andago, 2004). The most vulnerable to anaemia include adolescent girls, WRA and preschool children. Approximately half of the cases of IDA arise from inadequate dietary intake (World Health Organization, 2008). Other causes could be: excessive blood loss from bleeding and by parasites, and deficiencies of Vitamins B9 and B12. IDA in women causes adverse effects such as foetal retardation, neonatal deaths, and fatigue and low birth weight (LBW) infants. Iron deficiency in women of childbearing age results in high chances of maternal mortality, prenatal and perinatal infant loss and prematurity. The infants born to iron deficient mothers are likely to have less than one half of their iron reserves (World Health Organization, 2001).

The stages of development of iron deficiency

This involves three major stages which include:

i. **Early stage-**it results in iron depletion which results in the reduction of iron stores in the body. The serum concentration is lowered and this serves as a measure of iron depletion.
ii. **Intermediate stage-**it is a stage of iron deficiency erythropoiesis which occurs as a result of depletion of iron stores and inadequate absorption of iron to replace the losses. Haemoglobin synthesis fails and hence the concentration decreases.
iii. **Late stage-iron deficiency anaemia**. It is the severe form of iron deficiency that happens when the haemoglobin levels in the body falls below the set thresholds.

2.1.11.1 Causes of micronutrient malnutrition

There are various known causes of micronutrient malnutrition/deficiencies. The causes of malnutrition have been underlined in the UNICEF conceptual framework for the causes of malnutrition as basic, underlying and immediate causes which play a big role in the causation of micronutrient deficiencies (Cherop, 2017). The immediate causes include diseases and dietary

intake. Most diseases cause anorexia and even use up the micronutrients in the system (Kiige, 1999). Other conditions such as protein energy malnutrition, diarrhea and HIV/AIDS are predisposing factors to micronutrient deficiencies such as vitamin A deficiencies. Diseases such as malaria lead to iron depletion in the body, causing anaemia. VAD is also caused by factors such as inadequate fat in the body since fat is necessary for its absorption. Parasitic infestation have also been associated with malnutrition by reducing digestion, absorption, causing chronic inflammation and leading to loss of nutrients in the body system (Hesham, Edariah, and Norhayati, 2004). It causes VAD by obstructing the absorption of Vitamin A. Worms such as Ascaris lumbricoids have particularly been associated with Vitamin A deficiency.

Iron deficiency can result from inadequate dietary intake of iron rich food sources, iron inhibitors such as phytates and calcium, parasitic infestation and inflammatory conditions. Chronic kidney failure has also been associated with anaemia. Heavy metals such as lead interfere with the haemoglobin formation process.

Zinc deficiency is caused by inadequate dietary intake of sources of zinc and low bioavailability. The deficiency of zinc in its severe form is not common and not well understood but the consequences can be devastating due to its important functions in the body (Kiige, 2004).

2.1.12 Nutrition intervention methods for addressing micronutrient malnutrition

There are three main forms of nutrition intervention; dietary diversification, fortification and supplementation (Andago, 2004). These interventions are meant to prevent micronutrient deficiencies, and complications involved and to improve the overall public health for all people (Republic of Kenya, 2017). Food-based strategies are a cheap form of intervention that are sustainable. Fortification is essential in cases where the targeted nutrient is inadequate in the environment, for instance, iodine fortification in iodine deficient environments. Supplementation is a good approach as well, though it is expensive in the long run and is highly dependent on donor funds.

a. Dietary diversification

Dietary diversification is a food-based approach that is important for achieving long-term dietary diversity and fulfilling micronutrient requirements (Gina et al., 2010; Kaibi, Steyn, Ochola, and Plessis, 2016). It is an important way of solving micronutrient deficiencies and attaining overall

improvement in dietary quality rather than dependency on a single nutrient. Agricultural production such as kitchen gardening and expansion of processing and marketing strategies enhance dietary diversity (FAO, 2017). Dietary diversity improves the synergistic interactions of nutrients that lead to increased bioavailability in the body. For example, consumption of vitamin C rich food sources enhances iron absorption (Gupta et al., 2019). Adequate consumption of a variety of fruits and vegetables provide beneficial antioxidants and phytochemicals in the diet. There is scientific evidence on the role of nutrients in disease prevention which has led to the promotion of food-based strategies. Dietary diversification approaches like gardening also serve as a way of earning money through the sale of surplus produce (Galhena, 2012).

Dietary diversification can be more feasible if nutrition education is integrated because it increases nutrition knowledge and consumption of balanced diet (Nkirigacha, 2012). Nutrition education highlights the need to consume quality diets consisting of all the essential micronutrients. This strategy is low-cost and culturally accepted, hence, should be promoted for adoption by all.

b. Supplementation

According to Food and Drug Administration (FDA), a dietary supplement refers to a product taken by mouth or through injection which contains a dietary ingredient such as vitamins, minerals and amino acids. It is a short-term approach for dealing with nutrient deficiencies in populations at high risk or during conditions such as pregnancy and in periods of acute malnutrition and inadequate food supply (Andago, 2004). Examples of supplementation include; Vitamin A supplementation and iron and folic acid supplementation (IFAS). Food and Agriculture Organization (FAO) indicates supplementation as a short-term approach which should be replaced with food-based approaches such as dietary diversity and fortification programmes (Andago, 2004).

Successful supplementation has been realized in various parts of the world. In Kenya, salt iodization has been successful in the prevention of iodine deficiency. For highly vulnerable groups such as the WRA, iodine can be administered through capsules or by injection. This would prevent iodine deficiency to a period of up to five years depending on the method of administration.

Iron deficiency anaemia (IDA) is a micronutrient deficiency of public health concern in Kenya and its prevalence is greater than 50% among women in the developing countries. Supplementation with iron ferrous sulphate is currently used in Kenya and offered mostly to pregnant women to prevent iron deficiency. WRA and children 6-18months are eligible to iron supplementation in periods of high prevalence of iron deficiency. Vitamin A supplementation is being practiced in Kenya to curb Vitamin A deficiencies. Children are eligible to Vitamin A supplementation after every 6 months in Kenya. At 6 months of age, they are offered 50,000 international units (IU) of Vitamin A capsules, at 1 year and above, they are offered 200,000IU of vitamin A. Other groups of people such as the sick and post-partum mothers are also eligible to Vitamin A supplementation.

Despite the great successes which have been realized in supplementation, this approach has various drawbacks which include;

- Poor compliance especially in regards to iron supplementation
- High costs involved
- Inaccessibility to the distribution points by various population
- Dependency on the donors who may stop funding the supplementation programmes

c. Fortification

Fortification refers to the addition of one or more essential micronutrients to a food which is commonly consumed by the targeted population, whether or not contained in the food (Allen & Benoist, 2006). Salt iodization is the common form of fortification Programme in Kenya. Other products which are fortified with various vitamins and minerals include; wheat products such as bread which are fortified with micronutrients such as B vitamins, iron and zinc. Cooking oil is fortified with vitamins A, D, E and K. Food fortification is capable of providing various micronutrients to a large population.

There are various conditions which are essential for successful fortification Programme to be successful. For example, there is need for a central processing area, need for education to enlighten people on the concepts of fortification and quality control measures should be put in place.

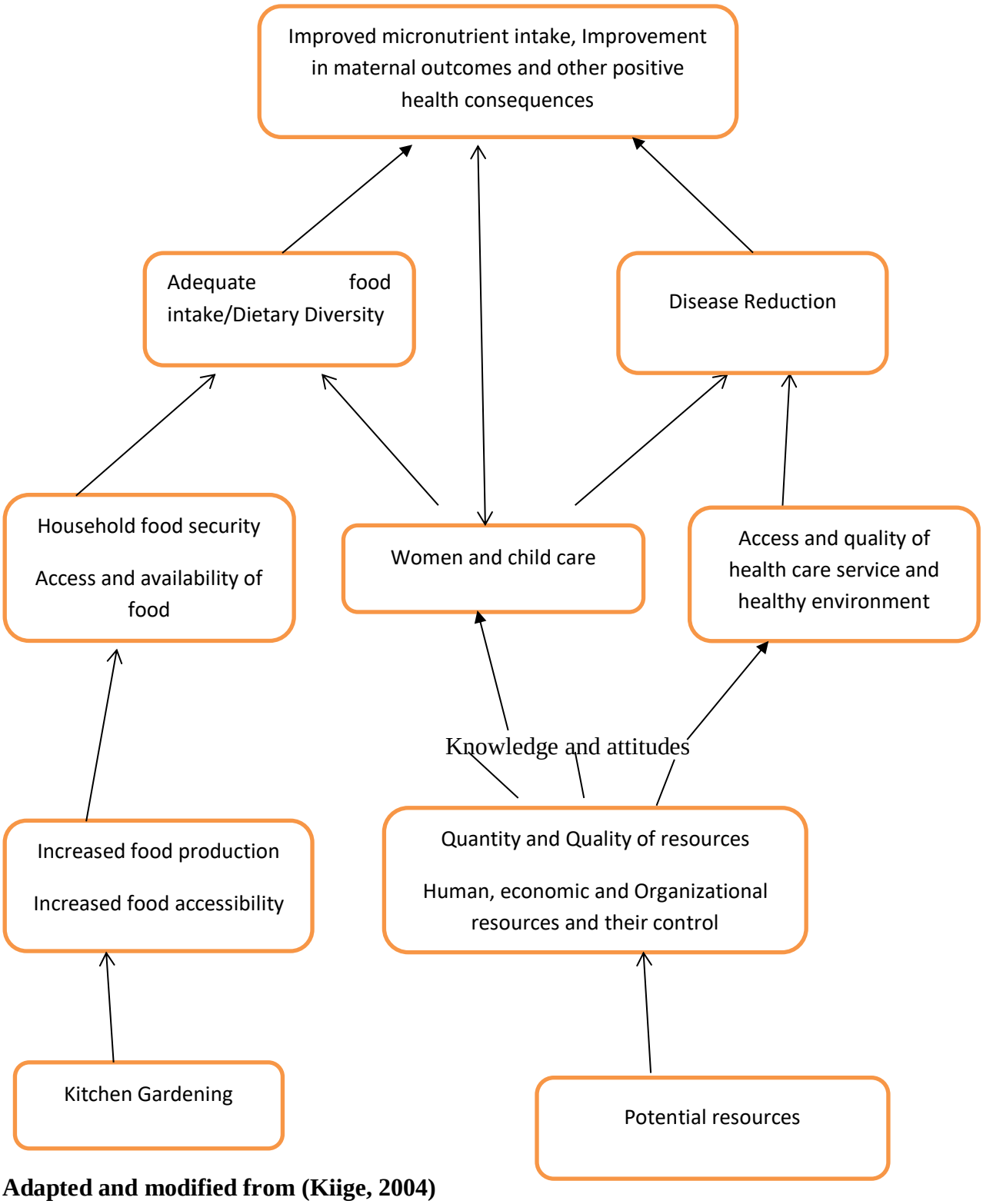
Fortification requires finances for it to be successful even though it is a cheap exercise when done in bulk and distributed to individuals. Nevertheless, the cumulative amounts contributed by each individual to keep fortification in place could be huge amounts of money nationally. Other challenges involved in fortification, especially for the developing countries include: poor coverage, inadequate finance to afford fortified foods and lack of awareness on the importance of consumption of fortified foods. This calls for a cheaper food-based approach in which kitchen gardening falls.

d. Public health interventions

These involve the prevention and control of diseases and conditions of public health concern which can cause micronutrient deficiency among individuals (Cherop, 2017). Some of these interventions include: Safe food supply, promotion of hygiene, distribution of mosquito nets, and parasites control (WHO, 2011).

2.2 Conceptual Framework

It illustrates the conceptual framework for dietary diversity and micronutrient adequacy among WRA. It shows various levels including the basic, underlying and direct levels leading to the achievement of adequate dietary diversity and micronutrient intake. The basic causes involves the potential and economic resources which affect the three groups of underlying factors that fuel up the immediate factors. Kitchen gardening is among the basic causes as it influences the underlying causes of household food security, food availability and access. The overview of the conceptual framework is illustrated in figure 2.1.



Adapted and modified from (Kiige, 2004)

Figure 2. 1: Kitchen gardening conceptual framework

2.3 Gaps in Knowledge

There is existing evidence that WRA encounter high rates of micronutrient malnutrition and poor dietary diversity (KNBS, 2011). However, the strategies which have been used to enhance micronutrient adequacy mostly entail short-term interventions such as fortification and supplementation. Effort to support adoption of long-term strategies to enhance the nutrition and well-being by not only providing adequate micronutrients but also enhancing dietary diversity is inadequate. Moreover, in cases where long-term strategies such as kitchen gardening have been encouraged, little has been done and documented for localized locations on their influence with regard to size and crop variety on the dietary diversity and micronutrient adequacy especially among the vulnerable people in the society. There is, therefore, need to determine the influence of size and crop variety of kitchen gardens on dietary diversity and micronutrient adequacy among WRA as they are among the most vulnerable groups in the society.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Study setting and methodology

3.1.1 Study area and population

This study was conducted in Kapkatet ward, Bureti Sub-County in Kericho County, Kenya (Figure 3.1). Kericho County has a total population of 758,339 people according to the 2009 Kenya Population and Housing Census (KPHC) with the majority of dwellers being the Kipsigis (Kericho County Annual Development Plan, 2018; MoALF, 2017). Kericho County was purposively selected because of its good climate which can enhance adoption of kitchen gardening throughout the seasons but the dwellers still suffer low dietary diversity.

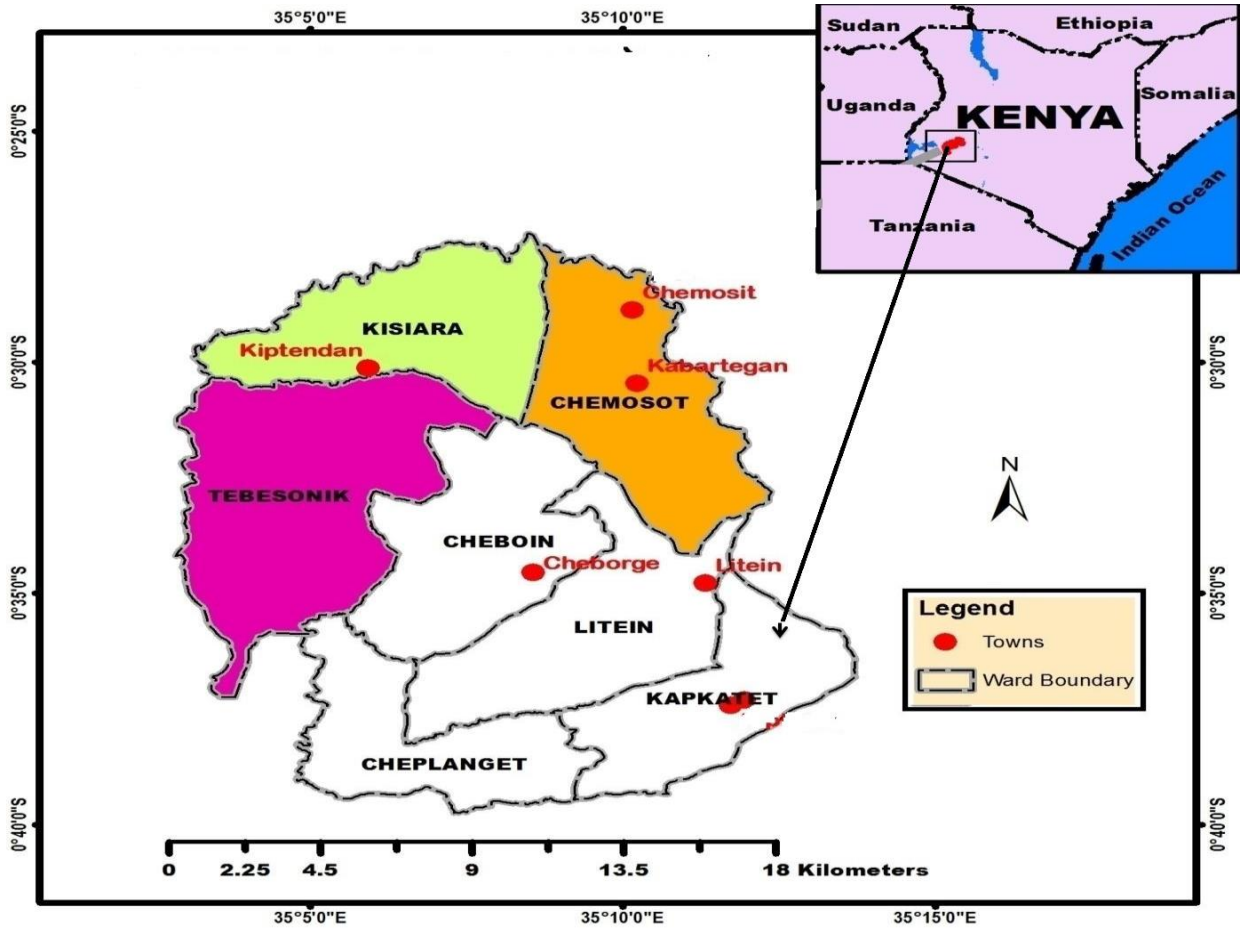


Figure 3. 1: Map showing the study area; Source: IEBC 2012

3.1.2 Position and size

Kericho County is located in the cool tropical highlands of Kenya. It lies between latitudes of 35° 02' and 35° 40' East and between the equator and longitudes 0°00′ and 0°40′South. It is 1800m latitude above the sea level. It is located in the Rift Valley which is South Western region of Kenya and it borders counties such as Bomet to the South, Uasin Gishu to the North, Nakuru to the East and South-East and Kisumu to the West, Baringo and Uasin Gishu to the North-East and Homa Bay and Nyamira to the South-East. It covers an area of 2,479 Km² with a population density of 303.5/Km² (MoALF, 2017).

3.1.3 Administrative and political units

Kericho County is subdivided into six sub-counties which include: Kipkelion East, Ainamoi, Bureti, Belgut, Kipkelion West and Soin-Sigowet; thirty wards which are sub-divided into 85 locations which are further sub-divided into 209 sub-locations (Kericho County Annual Development Plan, 2018; Kericho County government, 2014). Bureti Su-County is sub-divided into seven wards: Kapkatet, Cheplanget, Chemosot, Kisiara, Tebesonik, Cheboin and Litein (Tegutwo, 2018). The county is headed by a governor whereas sub-counties are headed by the members of national assembly, wards are headed by the members of county assembly and the locations and sub-locations are headed by chiefs and sub-chiefs respectively.

3.1.4 Climate

Kericho County has a warm and temperate climate. It experiences rainfall throughout the year with a mean of 1735mm annually. Long rains happen in April with January receiving minimal rainfall record of 71mm on average. The temperature varies from 10 to 29 degree Celsius. It has fertile soils favourable for various agricultural activities with tea farming being the main economic activity (Kericho County government, 2014).

3.1.5 Health

There are 136 health facilities, both the public and private across the County. There are three level 4 County), two level-3 (sub-county) hospitals, 9 level-2 (health centres) and 105 level-1 (dispensaries) facilities. There are several other uncategorized medical clinics. The doctor: patient ratio is 1:15,000 (Ministry of Health, 2015).

3.1.6 Education

Kericho County had a record of 461 primary schools and 130 public and private secondary schools with populations of 163,133 pupils and 30,375 students respectively in the year 2007. There are over 15 tertiary institutions in the County involving Universities, Colleges and Youth polytechnics, together with several commercial colleges.

3.1.7 Farming

The type of farming which exists is mixed type of farming involving crop and livestock farming (MoALF, 2017). The main cash crop grown is tea planted mainly in the highlands. It is sold to firms such as the Kenya Tea Development Agency (KTDA), Unilever Kenya Tea and James Finlays. The foods crops mainly grown include: maize, beans potatoes, and horticultural crops (vegetables, bananas, pineapples and tomatoes) (MoALF, 2017).The livestock kept are mainly dairy cows which produce milk for home consumption and sale. The County has fish farming being an emerging economic activity (Kericho County Annual Development Plan, 2018)

3.2 Research Methodology

3.2.1 Research Design

A cross-sectional study with an analytical component that employed a mixed methodological approach of both qualitative and quantitative nature for data collection was used.

3.2.2 Study population

Households with non-pregnant WRA, 15-49 years of age in the selected villages in Kericho County satisfied the criterion for inclusion in the study.

3.2.3 Selection of the study participants/ households

The study included households with kitchen gardens and women within the age group of 15-49 years of age who were randomly selected and accepted to participate in the study. In households with more than one WRA, only one woman was selected to represent the household. This was done by selecting the main responsible WRA in the household. Exclusion criteria was applied on those who met the inclusion criteria but for some reason(s) could not be included in the study. For instance, the physically challenged and chronically ill women in the household.

3.2.4 Sample

3.2.4.1 Sampling frame and the sampling unit

The sampling frame for this study comprised of households with kitchen gardens with non-pregnant women of reproductive age (15-49 years) whereas the sampling unit was the household.

3.2.4.2 Sample size determination

Sample size determination was done by applying the statistical formula of Fischer et al (1991) for populations greater than 10,000. The proportion of women known to have low dietary diversity and/or micronutrient deficiencies (86%) was used to determine p in sample size calculation.

$n=Z^2pq/d^2$

Whereby:

n=the desired sample size group,

Z=the standard normal deviation set at 1.96 corresponding to 95% confidence level,

p=the proportion of WRA with both low dietary diversity and/or micronutrient deficiencies=86%

q =l-p is the proportion of WRA achieving the minimum dietary diversity with no deficiencies =14%

d =degree of desired accuracy set at 0.05

$=1.96^2*0.86*0.14/0.05^2$

=184

Attrition rate =4%

96%=184

100%=100*183/95

=193

3.2.4.3 Sampling Procedure

Kericho County was selected out of the 47 counties of Kenya through purposive and convenience sampling. Out of the six sub-counties in Kericho County, Bureti sub-county was selected through purposive and convenience sampling. Kapkatet ward was selected out of the 30 wards in the sub-county purposively. From the 85 locations in the ward, Kapkatet location was selected purposively. Simple random sampling was used in selecting 4 villages out of the 26 villages in the location whereby all the names of the villages were written down on different pieces of paper, wrapped, mixed and only four pieces were picked randomly. The four villages picked were included in the study. The households were finally selected by use of systematic random sampling whereby every fifth household was sampled in every village (Figure 3.2).

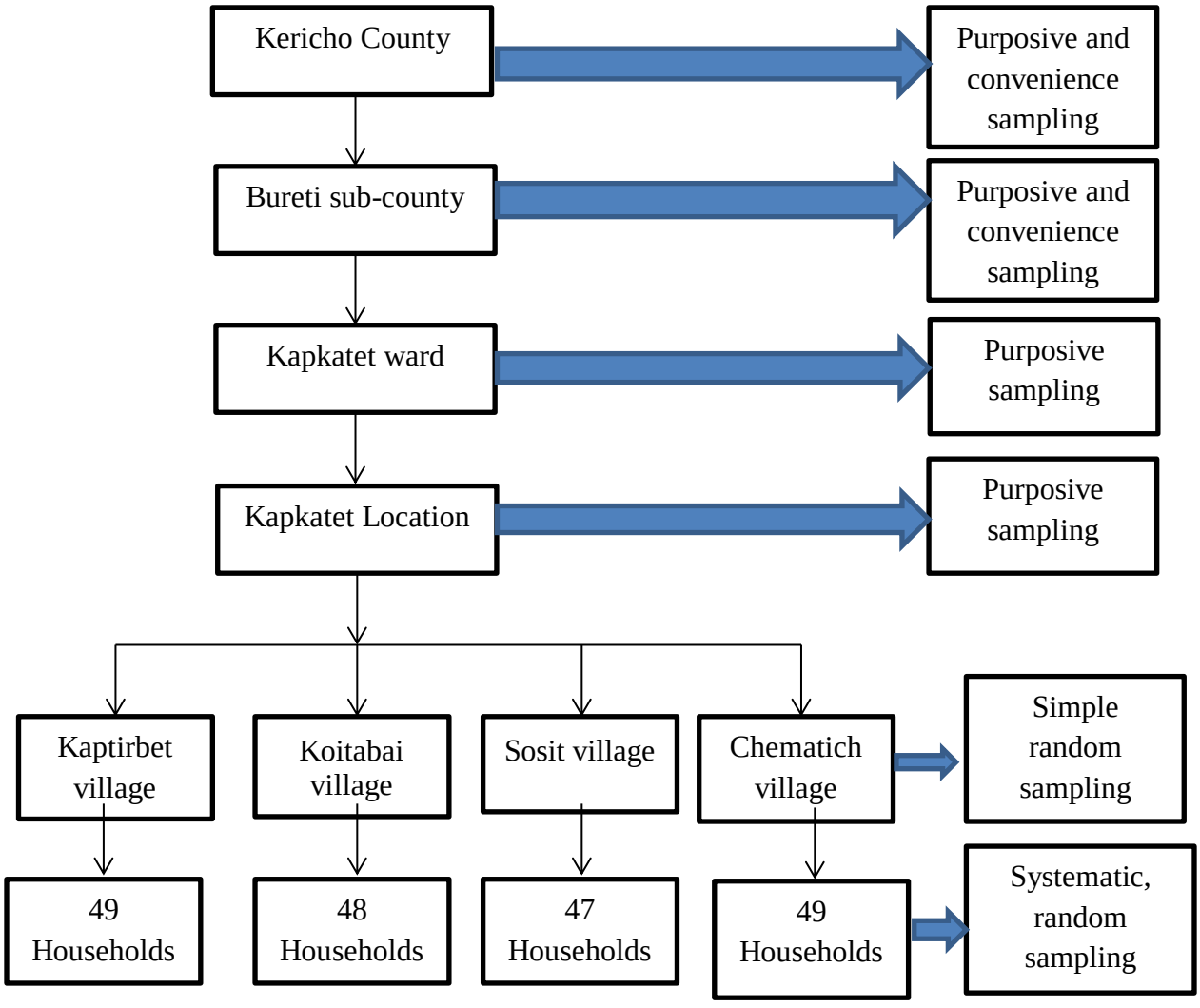


Figure 3. 2: Sampling Procedure of household selection in Kericho County

3.2.5 Techniques for data collection for every objective

Data collection was done between the months of September and October, 2018. The techniques applied for data collection varied depending on the specific objectives as described below:

Objective 1: To describe the demographic and socioeconomic characteristics of the households

A detailed pretested semi-structure questionnaire (Appendix 2) was used to collect data on the socio-economic and demographic characteristics of households. Every participant who met the inclusion criteria and gave consent was interviewed by the enumerator who filled in the questionnaire. The variables included were: age of the study participants, marital status, education level, occupation, source of income, relationship with the household head. The socioeconomic indicators included estimated monthly income, ownership of durable assets such as cars, sofa set, television, land and livestock ownership.

Objective 2: To determine the kitchen garden practices-kitchen gardens' size and types of crops grown, their utilization and challenges encountered

Semi-structured questionnaires were used in collecting information regarding kitchen garden practices which involved aspects of kitchen gardening such as the approximate size of kitchen garden, types of food crops grown and ways of utilization of kitchen garden produce (Appendix 2). The information on challenges in starting up and maintaining kitchen gardens was obtained through semi-structured questionnaires (Appendix 2) and FGDs by use of FGD question guides (Appendix 8).

Two focused group discussion sessions, each comprising of 12 participants were conducted in the study area. The discussion was guided by a FGD question guide (Appendix 8) which involved ten discussion areas involving kitchen gardening and dietary practices. All the participants and facilitators sat on a round table to allow good discussion and eye contact among participants. The discussion started by brief introduction of each member and review of the agenda. The participants endorsed voluntary participation by signing informed consent forms (Appendix 1). The discussion was guided by a moderator who probed on the discussion areas to obtain in-depth views by letting participants give their opinions on the topics discussed. Each FGD took approximately 40 minutes.

Observation checklist (Appendix 3) was used to record the variety of crops grown by the households in the kitchen gardens, impression on quality of kitchen gardens (size and colour of the crops, spacing and cleanliness in the gardens used as parameters). The cropping system (single or mixed/intercropping system) was also noted in the observation checklist (Appendix 3).

Objective 3: To assess the nutrition knowledge among study participants

The nutrition knowledge of participants was assessed using a pre-tested knowledge score card with ten open-ended questions sub-divided into sections namely: kitchen gardening, dietary diversity, nutrient composition of various foods and micronutrient deficiencies (Appendix 4).Each question in all areas had every correct answer get a yes and vice-versa. All the questions were marked out of ten and the scores obtained were translated into percentages, which mean that one point out of ten earned 10% score. This was translated as the knowledge level of the respondents with the highest score giving the highest level of knowledge and vice-versa. The minimum score by respondents was 20% and the maximum score was 100%. A score of 40% and below was regarded as low level of nutrition knowledge, while a score of 50-70% regarded as medium and a score of 80% and above was regarded as high level of nutrition knowledge (Kigaru, Loechl, Moleah, Macharia, and Ndungu, 2015).

Objective 4: To determine the dietary practices (intake and dietary diversity) of study participants.

Food frequency questionnaires (Appendix 6) were used to assess habitual consumption of various foods based on frequency of consumption. The frequencies were described as more than once per day, once per day, 3-6 times per week, once or twice per week, once per month, once per year and never. Foods which were consumed 3-6 times in a week or more were considered as regular consumption, those consumed once/twice per week and once a month were considered as moderate consumption whereas those consumed once per year considered as rarely consumed. Foodstuffs were divided into ten food groups based on the recommended MDD-W and common foods were listed in each food group. The proportion of women who achieved adequate dietary diversity (≥5 food groups) was calculated. Women who consume 5 or more of the food groups are likely to consume at least one of the animal source food and either pulse or nuts and seeds

and food items from two or more of the fruit/vegetable food groups which provide essential micronutrients (Kemunto, 2013).

MDD-W questionnaire (Appendix 5) was used to capture all the foods and drinks consumed in the past 24 hours. The respondents were asked to mention all the foods and drinks consumed in the previous 24 hours, starting with the first food eaten since waking up, till the last meal of the day within the designated 24 hours. The interviewer probed on the snacks and food eaten outside home that the respondent might have failed to mention. Information on mixed dishes were asked to understand the ingredients used. Ten food groups for women of reproductive age were used to calculate women's dietary diversity score as recommended by FAO and FHI 360 (2016) and referred as WDDS-10 in this study to reflect the use of ten food groups. The ten food groups include: "grains, white roots and tubers (starchy staples), pulses (beans, peas and lentils), nuts and seeds, dairy, meats, poultry and fish (flesh foods), eggs, dark green leafy vegetables, other vitamin A-rich vegetables and fruits, other vegetables, and other fruits"(FAO et al., 2016). All foods mentioned were classified into their respective food groups in the MDD-W questionnaire (Appendix 5). Every food group with a food/drink consumed was scored as 1 in the MDD-W questionnaire and the food groups with no food/drink consumed was scored as 0. All the scores were later summed up to give the WDDS-10 which was used as a proxy for micronutrient adequacy among WRA.

A qualitative 24-hour dietary recall tool (Appendix 7) was used to determine dietary intake for the past 24-hours. A sample of forty randomly selected respondents was used to determine the 24-hour dietary intake for women of reproductive age. The respondents were asked to state the time the meal was taken, type of meal, ingredients used and the portion sizes of the foods and beverages consumed. The estimated portion sizes and amount of ingredients used were weighed using a food weighing scale. All information obtained were recorded in appendix 7. The tools used in the 24-hour recall included; food weighing scales, measuring cylinders, cups, spoons, plates and models.

Micronutrient content of individual foods was obtained by use of Nutrisurvey software which helps in calculating all the nutrients contained in the foods recorded in the 24-hour recall. Kenya National Food composition table was used to obtain nutritional composition of food items listed

in the 24-hour recall but were not found in the Nutrisurvey software (FAO & GoK, 2018).For a food to count, the respondent was supposed to have a consumed a minimum of 15 grams.

3.2.6 Ethical and Human Rights Considerations

The participants were given explanation about the study by the enumerator and asked for their consent to participate in the study. They were assured of confidentiality of the information provided. They were as well informed that no incentives would be given for participation. Every participant was given a copy of informed consent form with their names filled in by the enumerator to prove their consent to participate in the research. The chief of the location where the research was being conducted gave approval before commencing the research.

3.2.7 Pretesting of tools

Pretesting of tools was conducted on 10 households from a different location with similar characteristics as those from the location where the study was conducted. The selection of the ten households was done randomly. The main reason for conducting a pretest was to validate that the tools used yield the right data. By pretesting the questionnaire, the clarity of the questions were determined besides; enhancing competence of research assistants in administering the questionnaire, and use of other research instruments such as 24-hour recall tools. Pretesting was also important in making any necessary adjustments in the data collection instruments and in estimating sufficient time for responding to a questionnaire.

3.2.8 Recruitment and Training of research assistants

Three research assistants who had a minimum qualification of secondary school certificate and residency in the research area were recruited and trained for two days. The training covered the objectives of the research and proper use of research instruments. The principal investigator reviewed the whole questionnaire, explained and gave clarifications required by the research assistants. The importance of accuracy in filling the questionnaire and clarity when interviewing the research participants was emphasized. Research ethics and the process of recruiting study participants and obtaining consent before commencing the study were highlighted.

3.2.9 Data quality assurance and control

Data quality assurance and control were ensured by the principal investigator through a number of ways such as: training of qualified research assistants, pre-testing of questionnaires and close

supervision of enumerators. Adequate scrutiny of the data collected was done to ensure that all areas were adequately covered and no data was missed out. The open-ended questions were pre-coded before data entry and appropriate statistical procedures were applied during data analysis.

3.2.10 Data management and analysis

All questionnaires were checked for completeness and accuracy. Data entry, cleaning and analysis were performed using statistical package for social sciences version 20, and Nutrisurvey 2007 software and Microsoft Excel. A summary of information in the FGDs was made and key findings recorded in Microsoft Word. For analysis, descriptive statistics e.g. sum, median, mean and mode were done to describe information such as the sociodemographic and socioeconomic status of households. Bivariate correlations were used to describe relationships between variables. Chi-square tests were done to describe relationships among categorical variables whereas analysis of variance (ANOVA) was used to compare means of variables with continuous dependent variables such as dietary diversity scores and categorical independent variables such as education level. Linear and binary regression tests were used to describe associations between variables, and to predict possibility of certain variables affecting dietary diversity and micronutrient adequacy of the study population.

CHAPTER FOUR: RESULTS

This chapter presents the results of the data collected on the influence of size and crop variety of kitchen gardens on dietary diversity and micronutrient adequacy of women of reproductive age (15-49years) in Kericho County. The findings of the study are reported in five sections namely:

i. Sociodemographic and Socioeconomic characteristics of the respondents
ii. Kitchen gardening practices and challenges involved in kitchen gardening
iii. Nutrition knowledge
iv. Dietary practices
v. Relationship between kitchen gardening, sociodemographic and socioeconomic characteristics, nutrition knowledge and micronutrient intake of the respondents.

4.1: Socio-demographic and Socioeconomic Characteristics of Respondents

The study established the following sociodemographic and socioeconomic characteristics: population structure, age of the respondents, and relationship of respondents to household head, education level, main occupation, household income and assets ownership by households.

4.1.1 Population structure

The sample comprised 193 households with a total population of 1045 people with males and females being 48.9% and 51.1% respectively. The household size ranged from 2 to 12 with a mean household size of 5.4±1.9 and a median of 5. Ten households with ≥10 members were outliers. Excluding the outliers (10 households with ≥10 members), the mean household size was 5.1± 1.5 with a minimum of 2 and maximum of 9. The mean age of the sample population was 22.8 years with a standard deviation of 17.5 and a median of 18.0 years. Children aged 10 years and below contributed the largest proportion of the population (28.6%) with the elderly above the 65 years constituting the smallest proportion (2.5%) (Figure 4.1). There were more males than females in pre-reproductive population (0-14years) but more elderly females than males (Figure 4.2).

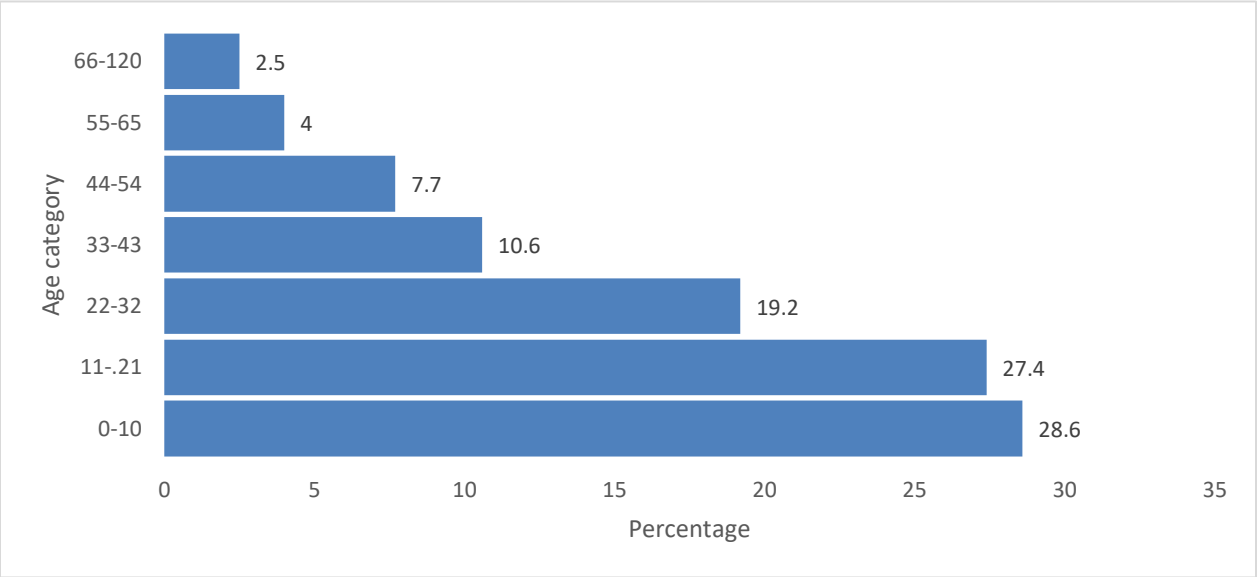


Figure 4.1: Distribution of the study population by age categories in years

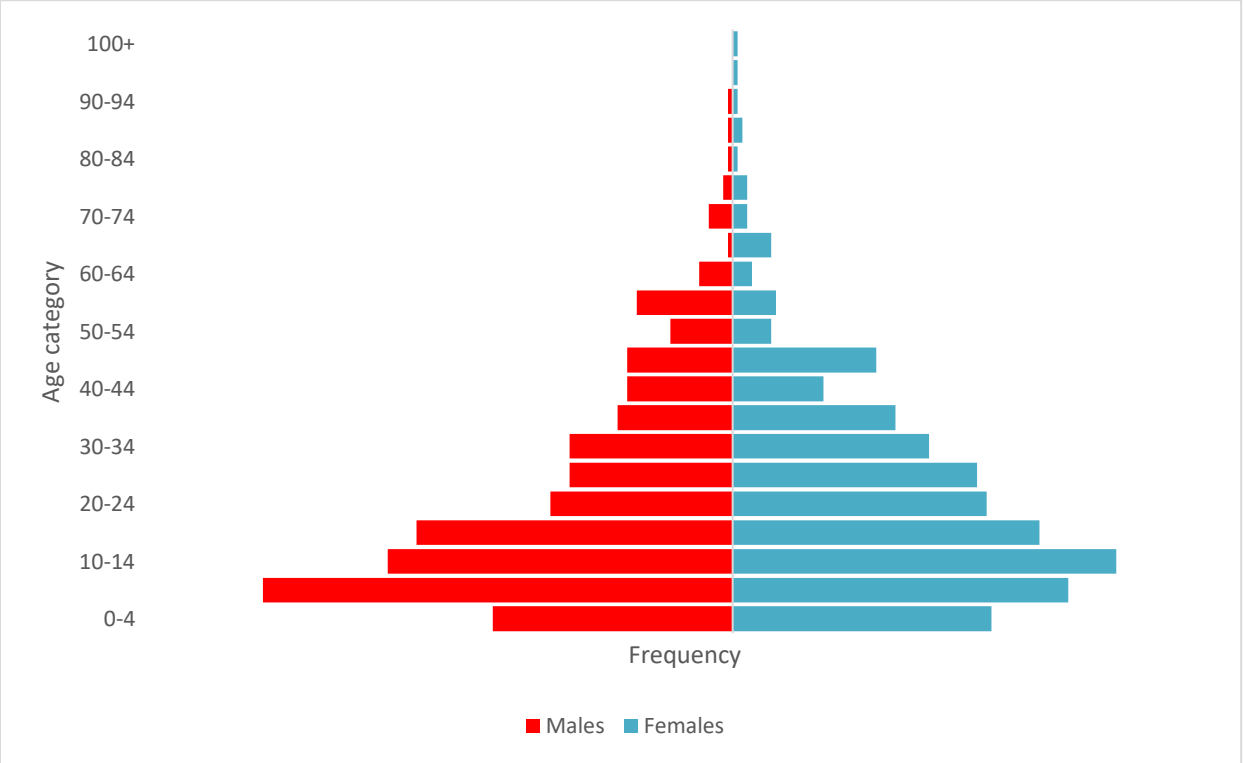


Figure 4.2: Study population pyramid by sex and age categories (in years)

4.1.2 Age of the respondents

The mean age (years) of respondents was 31.7±9 with the highest proportion (22.3%) being in the age category of 25-29 years. The minimum and maximum ages of respondents were as defined in the inclusion area. The distribution of respondents based on age category as categorized by the Kenya Demographic and Health Survey (KNBS, 2014) is shown in figure 4.3.

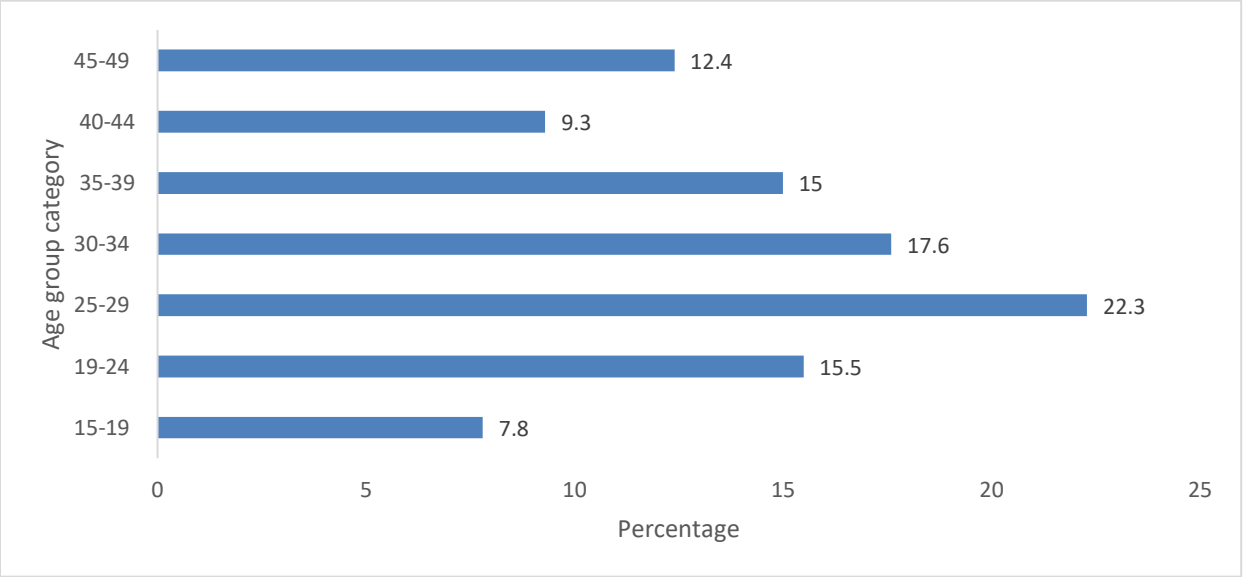


Figure 4.3: Distribution of the respondents based on their age categories

4.1.3 Marital status

Nearly two-thirds of the respondents (68.4%) were married while the separated made up the least proportion (3.4%) (Table 4.1).

4.1.4 Relationship of respondents to household head

The respondents, categorized on basis of their relationship with household heads showed the largest proportion being spouses (64.2%) (Table 4.1).

Table 4. 1: Marital status and relationship of respondents to household head

Marital status	**Percentage (n=193)**
Married	68.4
Separated	3.4
Widowed	6.2
Single/Never married	21.8
Relationship to HHH	
Head	11.4
Spouse	64.2
Daughter	21.8
Non-relative	0.5

4.1.5 Education level and Main occupation

Slightly more than a quarter (28.5%) of the respondents had attained secondary education with 22.8% having either technical/vocational training or college/university education. The highest proportion of respondents (41.5%) was farmers (Table 4.2).

Table 4. 2: Education level and main occupation of respondents

Socio-demographic characteristics	n=193 Percentage
Education level	
No education	1.0
Primary	47.4
Secondary	28.5
Technical/Vocational training	5.2
University/College	17.6
Main occupation	
Farming	41.5
Formal employment	10.4
Business	11.9
Self-employment	4.1
Housewife	4.7
Casual labor	14
Student	10.9
Unemployed	5

4.1.6 Household income

The study estimated monthly household income from all income generating sources. The estimated amounts were put in the categories shown in table 4.3. The highest proportion of

respondents (23.8%) earned Kenya shillings 5001 -10000 per month and were casual laborers (26.4%).

Table 4. 3: Percent distribution of respondents by estimated monthly income and sources of income

Estimated monthly income(Kshs)	Percentage; (n=193)
<3000	7.3
3001-5000	20.2
5001-10000	23.8
10,001-20,000	21.2
20,001-50,000	17.6
Sources of income	
Formal employment	15.5
Business	22.3
Casual labour	26.4
Sale of food crops	11.4
Sale of cash crops	20.7
Self-employment	3.6

4.1.7 Asset ownership

Land

The households who participated in the study owned land with a range of <0.5 to 107 acres with a mean land size of 2.23 acres. The respondent who owned 107 ha was an outlier and when left out in calculating the overall mean of the land size, the mean land size dropped to 1.69 acres. A small percentage (3.6%) of the respondents reported to own no land of their own. All the respondents who owned no land of their own (3.6%) were living in rental houses with spaces for practicing kitchen gardening. The highest proportion of respondents owned land between 1.1 to 2 acres (Table 4.4).

Table 4. 4: Distribution of study households by land ownership

Land ownership	
<0.5ha	35.2
0.6-1.0ha	16.6
1.1-2.0ha	26.4
2.1-3.0ha	9.3
3.1-5.0ha	6.2
≥5ha	6.2

Livestock ownership

A recording of the number of cows, goats and sheep owned by the study households showed that the mean number of cows was 2.7±3.1 ranging from 0 to 33 cows. There were 5 outliers (0.03%) which involved those who owned >9 cows. Excluding outliers, the mean dropped to 2.4 ±1.8 with a range of 0 to 8 cows. A majority (83.4%) of the respondents had no goats while 32 respondents (16.6%) owned ±1 goat, making them outliers. This was the same case with sheep ownership whereby those who owned ±1 (10.9%) sheep were outliers. The percentage of

households who owned other assets such as radio and television were noted to reflect their socioeconomic status (Table 4.5).

Table 4. 5: Other assets owned by the households

Asset	**%** **N=193**
Radio	96.9
Television	37.5
Sofa set	40.4
Motor cycle	20.7
Car	7.8
Refrigerator	4.1

4.2 Kitchen Gardening Practices

This study examined three key aspects of kitchen gardening; approximate size of the garden, types of crops planted and challenges encountered in starting up and maintaining kitchen gardening. Other aspects determined were: location of the garden from the homestead, ways of keeping the cultivated garden fertile, ways of preventing and removing weeds, pests and disease control, general impression on quality, sufficiency of kitchen garden produce and ways of utilization of the produce. More than three-quarters of the households (77.7%) had their gardens at a distance of less than 100 metres from their homesteads while the rest (22.3%) had their gardens at a distance greater than 100 metres from the homestead (Figure 4.4).

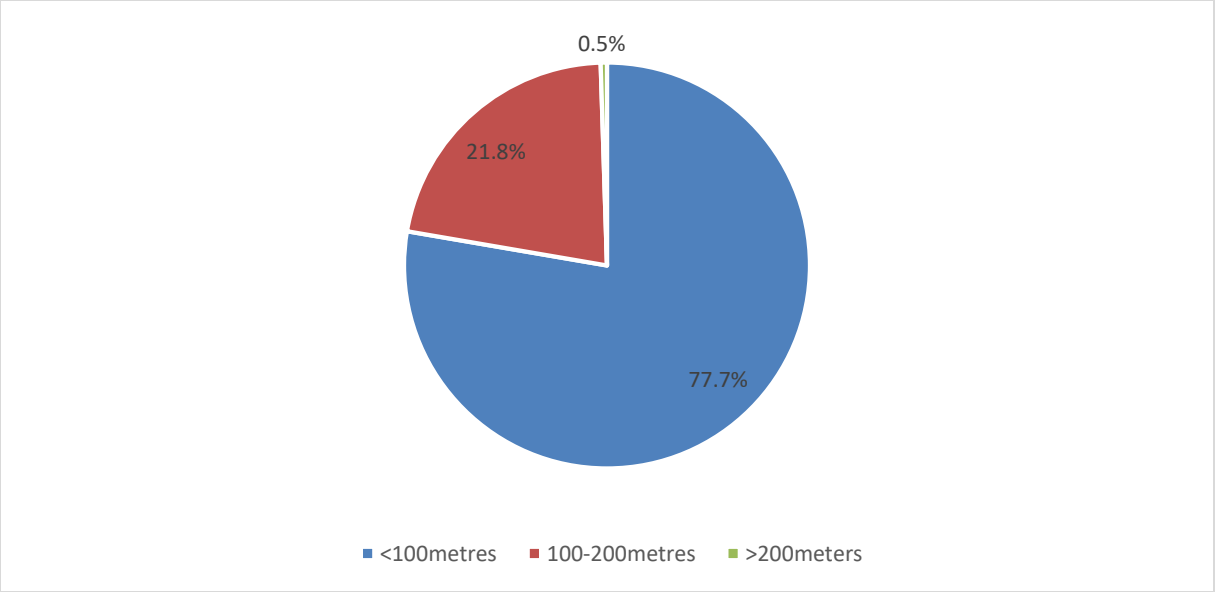


Figure 4.4: Distance of kitchen garden from the homestead

4.2.1 Approximate size of kitchen gardens

The approximate size of kitchen gardens owned by respondents had an average size of 67.1 ±58.8 M^2 with a minimum of 1 $M^2$and a maximum of 500 M^2. Those who had kitchen gardens size >200 M^2 were outliers, hence trimmed off when calculating the mean.

4.2.2 Types of crops grown in the kitchen garden

The number of crops and fruit trees grown by the households in their kitchen gardens had a total of 35 crops with a minimum of 1 and a maximum of 16 crops grown by the study households. The mean number of crops was 5.2 ± 2.6 with a median of 5 and mode of 5 crops. The top five crops commonly kept by households were kales, bananas, avocado, black nightshade and spring onions. Most of the households (89.6%) grew kales as the main crop and only a few (0.5%) equally grew slender leaf/“Mitoo” and cowpeas (Table 4.6). According to FGD, the participants reported that a kitchen garden was originally meant for growing of vegetables hence the local name “kapungut” but due to diminishing land size, other crops such as beans and fruit trees have been incorporated.

This research was conducted during a wet season of crop abundance as nearly all the crops were being grown, and fruits such as avocadoes and passion fruits were in season. According to FGD, September to December was a season with the common crops in the gardens being cabbages,

carrots, dhania and potatoes in preparation for Christmas season, when there is high demand. Further, they pointed out that January, a drought season, most gardens have few crops mainly kales which are drought resistant and fruit trees.

Table 4. 6: Summary of various crops in the kitchen gardens of respondents

Crop Name	**Percentage; N=193**
Dark green leafy vegetables	
Sukuma wiki	89.6
Black nightshade	28.5
Vine (African) spinach ("Nderemiat")	14.0
Spider plant	14.0
Spinach	11.9
African kale/"Seroch"/"Kanzera"	8.3
Amaranth	2.6
Slender leaf/Mitoo	0.5
Cowpeas/Kunde	0.5
Celery	0.5
Spring onions	25.4
Other vegetables	
Cabbage	14.0
Tomatoes	2.6
Eggplant	1.6
Pepper	1.0
Sweet pepper	2.6
Other vitamin-A fruits and vegetables	
Carrots	3.6
Pumpkin	14.5
Mango tree	2.1
Tree tomato	3.1
Beetroot	1.6

Table 4. 6: Summary of various crops in the kitchen gardens of respondents	
Crop Name	**Percentage; N=193**
Other fruits	
Banana	63.2
Avocado	55.4
Guava	13.5
Loquats	10.4
Orange tree	2.1
Pineapple	1.6
Strawberry	0.5
Pulses	
Beans	20.7
Peas	1.6
Starch staples	
Sweet potatoes (white)	5.2
Irish potatoes	4.1
yams	2.1
cassava	1.0
Sugarcane	17.1

4.2.3 Intercropping of crops

Majority (64.8%) of the respondents practiced intercropping/ mixed farming. There were a variety of crops being grown in the same garden by the study households. Fruit trees such as avocado and passion fruits were mainly intercropped in the garden because passion fruits have weak stems which intertwine around strong trees such as avocado for support.

4.2.4 Mode of utilization of crops

For most respondents (81.3%), household consumption was the main mode of utilization of kitchen garden crops whereas for 18.7%, sale was the main mode of utilization of their crops. Other modes of utilization of crops from the kitchen garden included offerings as gifts and use as animal feeds.

4.2.5 Smalls animals reared

The small animals kept by the respondents include; chicken, ducks, rabbit and bees. Majority of the households (67.9%) owned chicken (Table 4.7).

Table 4.7: Percent distribution of households by small animals kept

Small animals kept	Percent of households by small animals kept (n=193)
Chicken	67.9
Ducks	1
Rabbit	5.2
Bees	1

4.2.6 Sufficiency of the produce

Majority (65.8%) of the households had sufficient produce from kitchen gardens. Those who had insufficient produce employed various coping strategies to meet the inadequacies. According to FGD, a season of drought, mainly experienced in January, was a period of great inadequacies. Drought resistant crops such as traditional kales, African spinach and fruit trees were the major crops in the gardens during such seasons.

4.2.6.1 Coping strategies

During insufficiency of kitchen garden produce, the respondents reported to either purchase (53.4%), borrow (10.9%), reduce the portion sizes of their meals (23.8%) or skip meals in extreme cases (11.9%). The small animals reared, mainly chicken, helped most of the households during insufficiency of the garden produce. During FGD sessions, the participants reported selling part of the poultry and poultry products to acquire income for purchasing foods unavailable to the household at different periods.

4.2.7 Kitchen garden maintenance

The respondents reported various ways of keeping the gardens fertile. They mentioned the use of chemical fertilizers, green manure, compost manure, animal manure and food remains in the following percentages respectively: 45.1%, 3.6%, 0.5%, 37.8% and 1% whereas 12% did not use any method to keep their gardens fertile (Figure 4.5). Those who had chicken reported to have a benefit of using chicken manure in their gardens. This applies to those who used compost manure whereby their cattle ownership made it easier to obtain the materials for making compost manure.

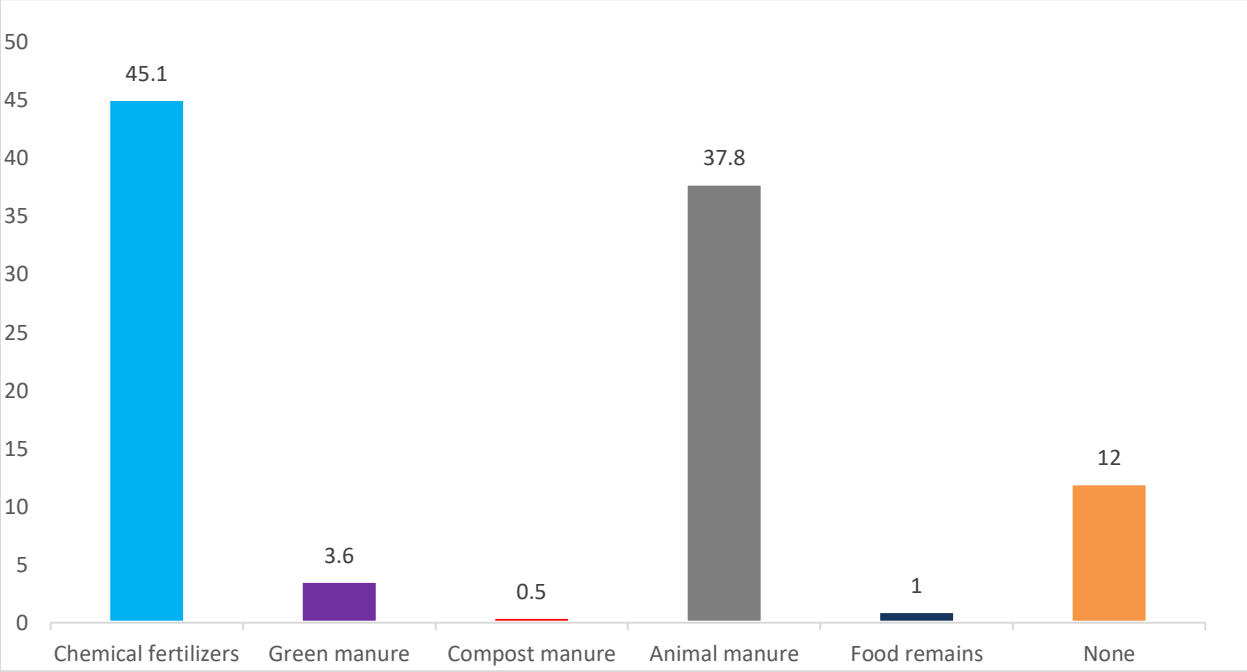


Figure 4.5: Methods employed by the respondents to keep kitchen gardens fertile

For removal of weeds, 91.7% used weeding by using a hoe, 3.1% sprayed chemicals while 5.2% used other methods of preventing and removing weeds such as use of animal wastes believed to keep the garden free from weeds for some time. According to FGD, majority of the women reported weeding at varied times depending on the crops grown. Weeding after every two weeks was pointed out as the likely duration which apply for a kitchen garden. Uprooting and use of a hoe were the main ways of weeding mentioned.

To control pests and diseases, 57.5% used chemicals, 22.3% used traditional ways such as use of ashes and rabbits' urine while the rest did not control pests and diseases (Figure 4.6).

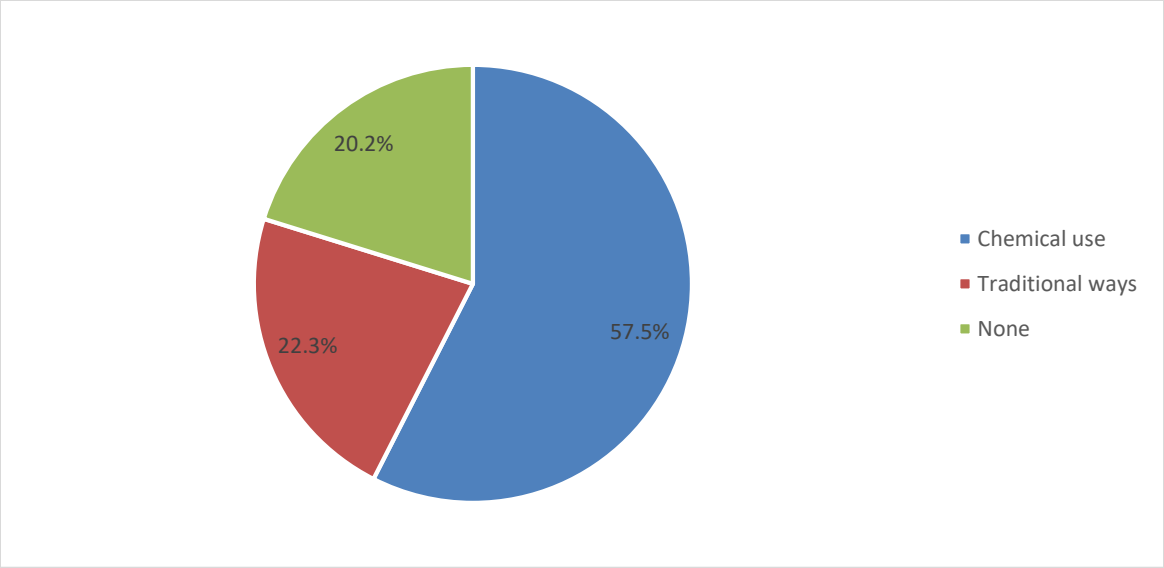


Figure 4.6: Methods used by respondents in controlling pests and diseases in the gardens

The impression on quality of kitchen garden was rated in ascending scale of 1 to 4 to represent poor, fair, good and very good. The aspects considered in rating were; the overall appearance of the garden, spacing, weeding and diversity of crops grown. Slightly over a fifth (22.3%) had a very good impression on quality whereas 45.1% was good, 16.6% was fair and lastly, poor impression on quality made up 15%.

4.2.8 Kitchen gardening challenges

The kitchen gardening challenges involved those experienced in starting up and in maintaining kitchen gardening. For the majority (50.2%) of the households, the main challenge when starting a kitchen garden was inadequate finance for purchase of inputs. A percentage of 35.8% of the households had a challenge in maintenance of kitchen gardening due to small animals, mainly chicken destroying the crops (Table 4.8). Weather challenges such as lack of rainfall during dry seasons and lack of market for abundant produce were mentioned by the respondents in the FGDs. “For kitchen garden maintenance, chicken are the main threat since they destroy crops at the kitchen garden except for a few traditional vegetables like spider plant and African vine spinach (“nderema”) which they do not feed on”. This was a statement made by a majority of the women in the FGD. They also pointed out that the government should make accessible cheap seeds and fertilizers, mainly offered at the Kenya Farmers Association centres.

Table 4. 8: Challenges of starting up and maintaining kitchen gardening

Challenges	Percent; N=193
Challenges in starting up a kitchen garden	
Inadequate finance, mainly for purchasing inputs	50.2
Inadequate time for gardening	14.5
Destruction by small animals	11.4
Inadequate land for gardening	9.3
Pests and diseases	3.1
None	11.4
Challenges in maintaining kitchen gardening	
Destruction by small animals	35.8
Inadequate time for gardening	27.5
Inadequate finance	19.1
None	17.6

4.3 Nutrition Knowledge

To determine nutrition knowledge, the study used ten questions divided into four areas. Two questions were dealing with kitchen gardening, three on dietary diversity, two on nutrient composition of various foods and three on micronutrient needs (Appendix 4). This was done in reference to FAO guidelines on nutrition related knowledge, attitude and practice.

4.3.1 Nutrition knowledge assessment

4.3.2 Nutrition knowledge level of the respondents

The knowledge assessment showed that more than half of the respondents (56%) responded correctly to half of the total questions asked. The lowest score obtained was 20% whereas the highest was 100%. The mean score for nutrition knowledge level was 50.1% with a standard deviation of 20.2.The distribution of respondents based on level of nutrition knowledge are illustrated in figure 4.7.

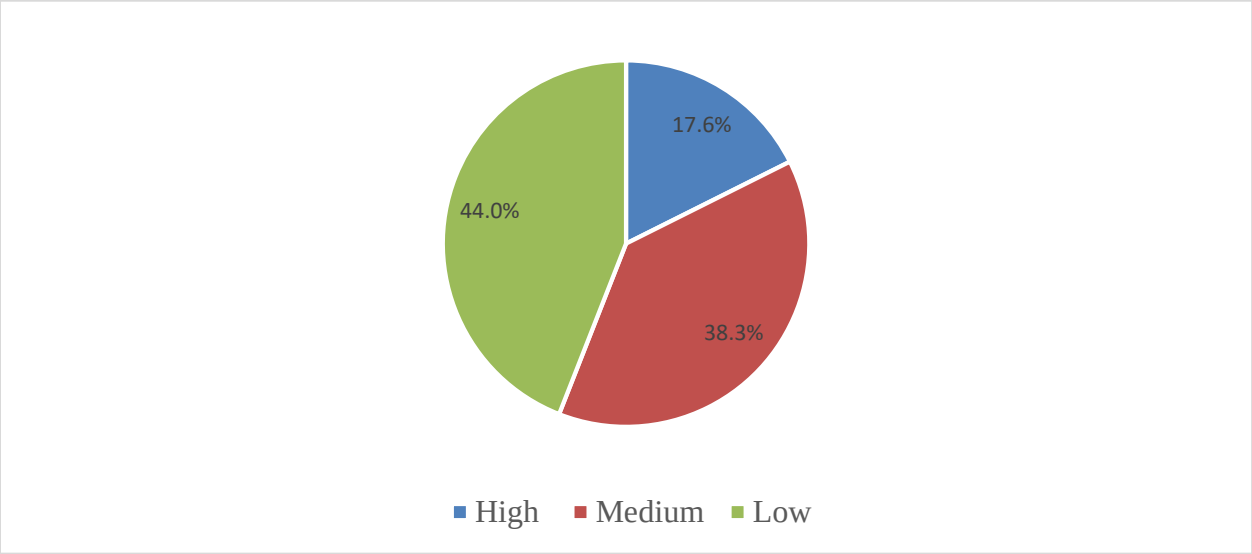


Figure 4.7: Percent distribution of respondents by nutrition knowledge levels

The level of nutrition knowledge scores were compared with the education levels of the respondents. All the respondents who had no education had low nutrition knowledge level while those who had attained primary school had the highest proportion (54.3%) having low nutrition knowledge scores with lowest proportion (12%) in that category having high nutrition knowledge scores. This trend was the same as those who had attained secondary education whereas the ones who had undergone vocational training had a similar trend in their levels of nutrition knowledge with those with college/university education levels (Figure 4.8).

There was a positive statistical significance between education level and nutrition knowledge as determined by one-way ANOVA ($F(4,192) = 6.087$, $p = 0.000$). Levene statistic ($p = 0.316$) revealed equal variances between education level groups. Least significant difference (LSD)

post-hoc test which assume equality of variances was used to clarify where the differences in nutrition knowledge exist among the various education levels. Those in college/university category proved to have significant

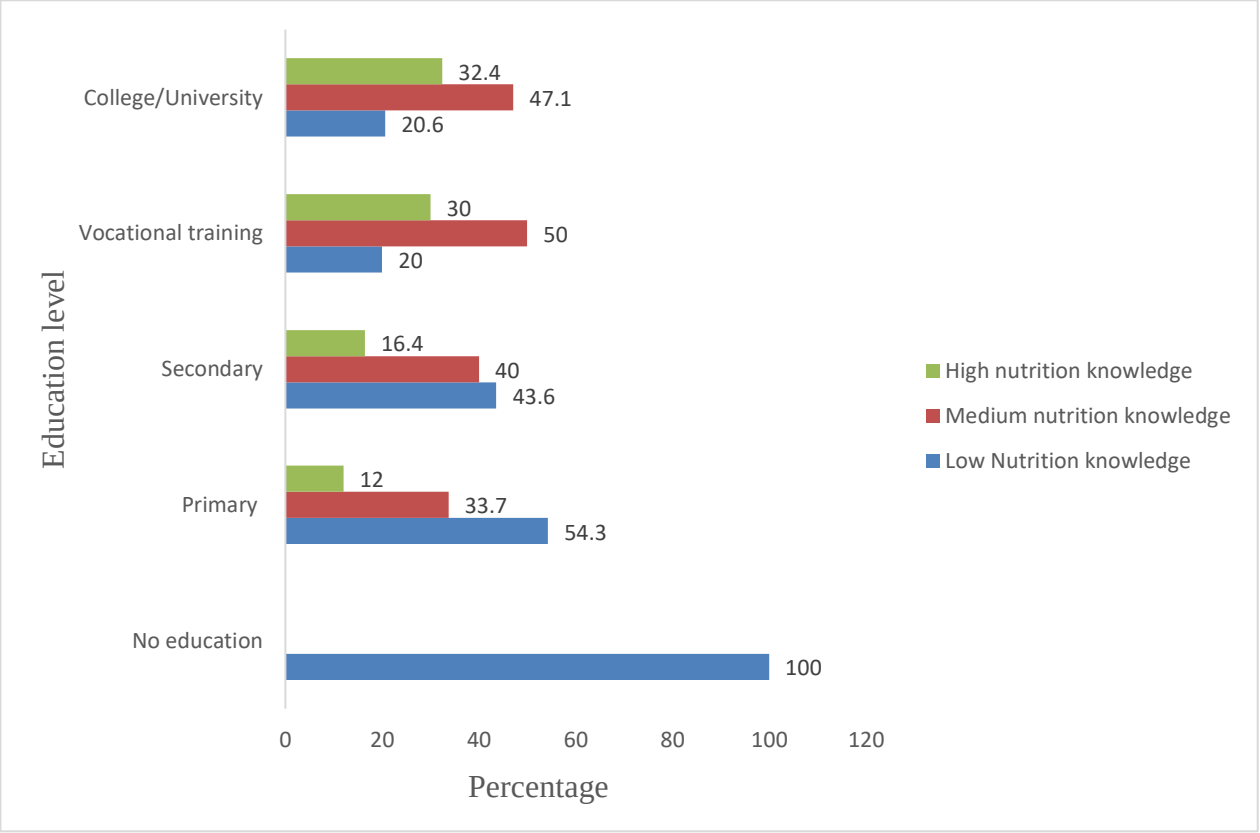


Figure 4.8: Distribution of respondents by education status and nutrition knowledge levels

4.4 Dietary practices of respondents

4.4.1 Dietary diversity of WRA in the study area

Minimum Dietary Diversity-Women (MDD-W) questionnaire determined the diet intake in terms of quality. The mean women dietary diversity score was 5.3±1.4, with a minimum score of 3 and a maximum score of 9 (Figure 4.10). According to FAO and FHI-360 (2016); the recommended MDD-W score is five and above food groups out of ten. For this study, 72% of women met the recommended score of 5 and above whereas 28% scored less than 5 (Figure 4.9). The distribution of respondents based on WDDS-10 is as shown in the figure 4.10.

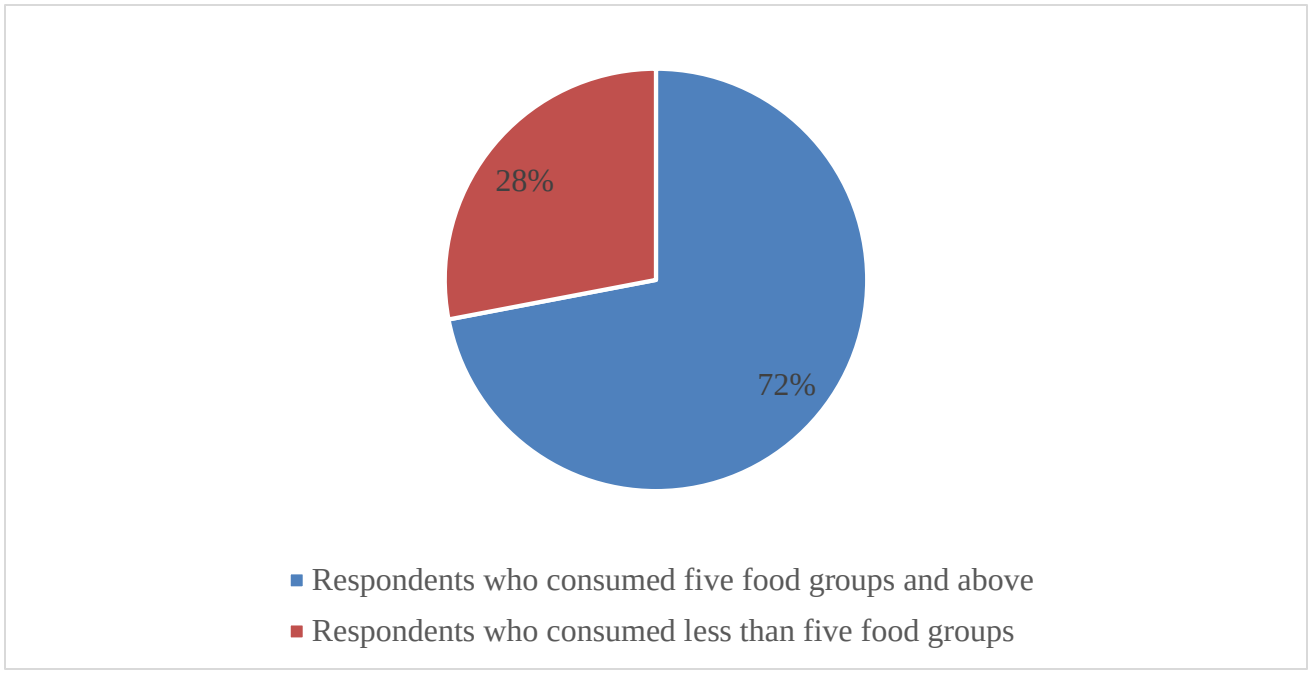


Figure 4. 9: Distribution of respondents by DDS adequacy

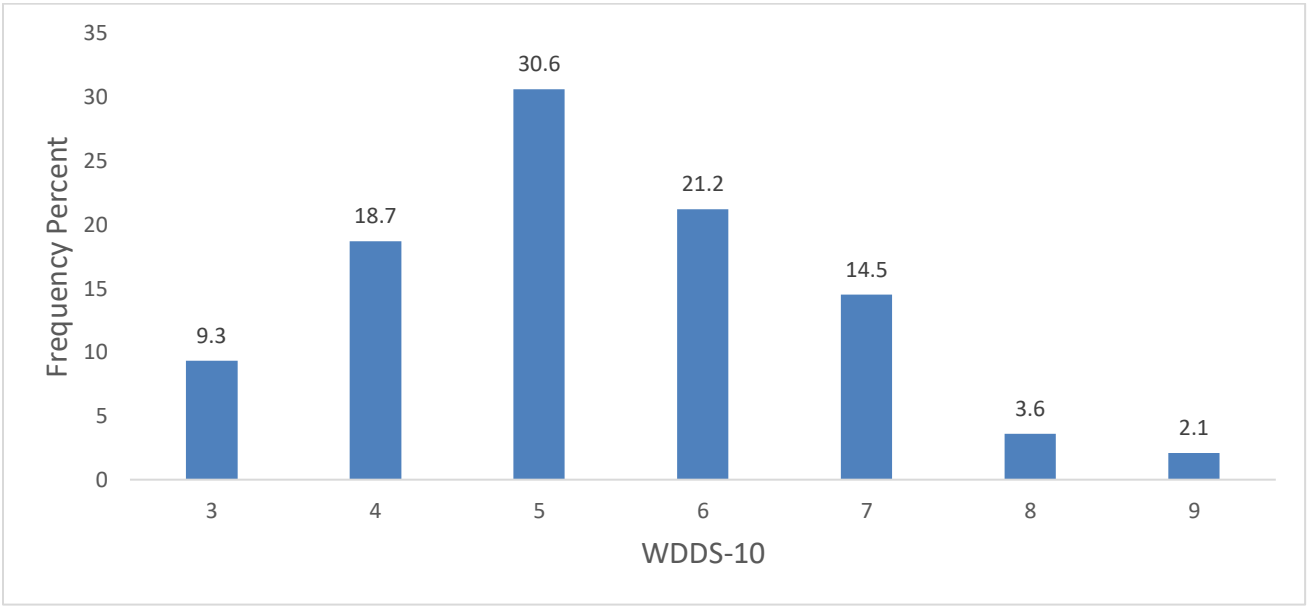


Figure 4.10: Distribution of respondents by WDDS-10

The main food group reported as having been consumed during the study period was starchy staples (100%) with the least consumed being nuts and seeds (6.7%) (Figure 4.11);

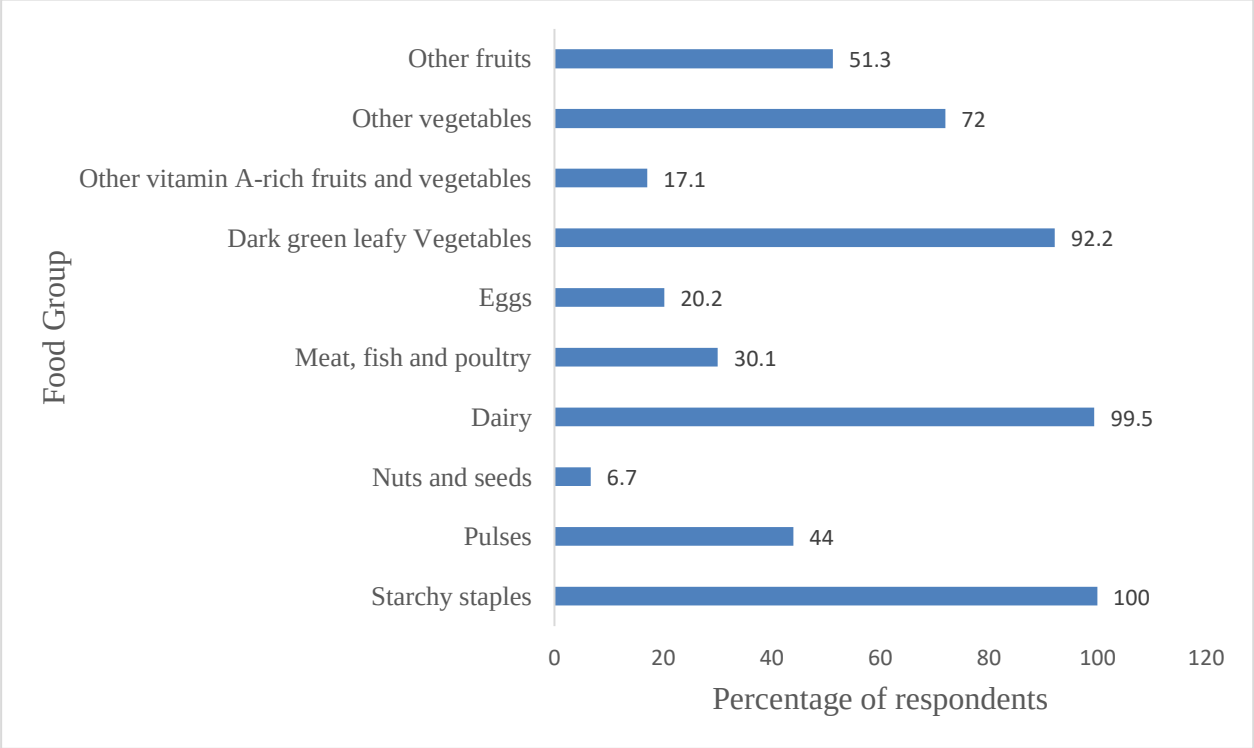


Figure 4.11: Distribution of respondents by consumption of various food groups

4.4.2 Different food consumption frequency pattern by women of reproductive age

A food frequency questionnaire was used to determine the frequency of consumption of foods by the respondents. Starchy staples were the most consumed food group, with all the respondents reporting regular consumption. Most of the respondents consumed maize as the main starchy staple with 46.1% consuming more than once a day and once a day equally, while the rest (7.8%) consumed 3-6 times per week.

Almost all respondents consumed dark green vegetables (98.5%) regularly. For meat, fish and poultry food group; red meat was regularly consumed by 37.8% of respondents. Fish was the least consumed with only 2.1% of the respondents reporting regular consumption. Other vitamin A fruits and vegetables had a majority of respondents reporting moderate consumption with mangoes and passion fruits being the most consumed with a moderate consumption of 78.2%

and 66.8% of respondents respectively. For other fruits, lemon was rarely consumed by 44.3% of the respondents. The detailed results are presented in table 4.9:

Table 4. 9: Distribution of respondents by food consumption frequency

	Regular consumption			**Moderate consumption**		**Rare consumption**	**Never consumed**
Food item N=193	**More than once per day**	**Once per day**	**3-6 times per week**	**Once or twice per week**	**Once per month**	**Once per year or less**	**Never**
Starchy staples							
Maize	46.1	46.1	7.8	0	0	0	0
Irish potatoes	0	0.5	11.4	39.8	46.1	2.1	0
Sweet potatoes	6.7	17.6	30.1	20.7	1.0	0	0
Wheat products							
i. Bread	0.5	14.0	33.7	30.1	20.7	1.0	0
ii. Chapatti	0.5	5.7	25.9	29.0	35.8	3.1	0
iii.Doughnuts	0	1.0	38.9	24.9	24.9	18.1	1.6
Rice	0	20.7	40.4	28.5	9.8	0.5	0

Table 4. 9: Distribution of respondents by food consumption frequency

	Regular consumption			**Moderate consumption**		**Rare consumption**	**Never consumed**
Green bananas	0	4.7	15.5	40.4	33.2	2.1	1.6
Millet	2.6	13.0	17.6	30.1	26.9	9.8	0
Meat, fish and poultry							
Poultry meat	0	1.6	3.6	10.4	38.3	46.1	0
Red meat	3.6	11.9	22.3	31.1	29.5	1.0	0.5
Fish	0	0	2.1	26.4	38.9	22.3	10.4
Liver	0	0	0.5	8.8	42.5	45.6	2.6
Eggs							
Eggs	0	7.3	15.5	40.4	33.2	2.1	1.6
Dairy							
Milk and milk products e.g. Milk tea	61.1	30.6	4.7	3.1	0.5	0	0
DGLVs	13.0	59.6	25.9	1.0	0.5	0	0
Other vegetables	23.8	37.8	32.1	3.6	2.1	0.5	0

Table 4. 9: Distribution of respondents by food consumption frequency

	Regular consumption			Moderate consumption		Rare consumption	Never consumed
Other Vitamin A fruits and vegetables							
Mangoes	0	1.0	6.7	17.6	60.6	13.5	0.5
Oranges	0.5	3.6	32.1	40.9	22.3	0.5	0
Passion fruits	0	0	3.6	15.5	51.3	29.0	0.5
Tree tomato	0	0.5	4.1	8.3	43.5	39.4	4.1
Other fruits							
Ripe bananas	0	2.1	26.9	40.9	29.0	1.0	0
Lemon	0	0.5	2.6	6.7	45.1	39.9	4.7
Pulses							
Beans and other dry legumes	3.6	10.4	28.5	40.4	17.1	0	0
Nuts and seeds	0	0	11.4	30.6	42.1	26.4	0

Through FGD, the participants specified that kitchen gardens helped them obtain a variety of vegetables; especially the DGLVs. Kitchen gardens also enable regular consumption of vegetables. They further asserted that, those who had chicken consumed eggs though not regularly since there was a lot of commercialization for poultry products to acquire money for other household needs. Cost was reported as the main hindrance to access meat and fish hence contributing to rare consumption. Some members pointed out the smell of raw fish as another hindrance to consumption of fish. They also specified that most of the vitamin A fruits were rarely consumed when they are out of season. Mangoes were bought specifically from the market

since they do not grow well in the area. “Lemon is mainly consumed for therapeutic purposes especially in treatment of colds”, one of the FGD members stated and was highly supported by other members, reflecting irregular consumption of lemons.

4.5 Micronutrient Adequacy

In the study, three micronutrients of interest -vitamin A, iron and zinc were taken into account. Micronutrient adequacy was calculated based on the individual foods consumed within the reference period of 24 hours. Nutrisurvey software was used in calculating all the nutrients contained in the foods recorded in the 24-hour recall. Kenya National Food composition table was used to obtain nutritional composition of food items listed in the 24-hour recall but were not found in the Nutrisurvey software (FAO & GoK, 2018).

4.5.1 Dietary Micronutrient Intake

The quantitative 24-hour recall was conducted on a representative sample of forty participants from the study sample. The respondents’ average intake of vitamin A, iron and zinc and corresponding recommended dietary allowances (RDAs) for micronutrients was as compared below (Table 4.10). The MAR for vitamin A, iron and zinc was 89.9%. Vitamin A had the least NAR of less than 50% (Table 4.10).

Table 4. 10: Mean micronutrient intake of the respondents against RDA

Micronutrient	**Dietary intake Mean ± SD**	**RDA**
Vitamin A	374.68 ±251.42	700µg/d
Iron	14.69±4.36	18mg/d
Zinc	8.87±2.32	8mg/d
NAR and MAR values	**Mean**	**SD**
NAR Vitamin A	46.35	31.89
NAR Iron	97.22	29.31
NAR Zinc	126.07	33.25
MAR (Vitamin A, iron and zinc)	89.88	17.04

4.6 Associations among sociodemographic characteristics, nutrition knowledge, dietary diversity and micronutrient adequacy of study participants

4.6.1 Sociodemographic and socioeconomic characteristics, and women's dietary diversity score categories

Spearman's correlation showed a positive significant association between WDDS-10 and education level of respondents (r=0.369, *p*=0.000). This was the same case for nutrition knowledge level and WDDS-10 (r=0.368, *p*=0.000).

One-way ANOVA tests showed a positive significant difference in the means of both education level of respondents with WDDS-10; ANOVA (F (4,188) =8.021, P=0.000) (Table 4.11) and estimated monthly income with WDDS-10; ANOVA (F (5,187) =8.616, P=0.000).There was no significant difference in means between various marital status categories with WDDS-10 (F (3,189) =750, *p*-value=0.524). There was also no significant difference between the means for various age categories of respondents and WDDS-10; ANOVA (F (6,185) =1.031, *p*=0.407).

Table 4. 11: Association between the level education and WDDS-10

Level of education	Mean	Standard deviation	95% CI for mean		ANOVA p-value
			Lower bound	Upper bound	
No education	4.5000	0.70711	-1.8531	10.8531	0.000
Primary	4.8587	1.22772	4.6044	5.1129	
Secondary	5.4909	1.27472	5.1463	5.8355	
Vocational training	5.6000	1.77639	4. 3292	6.8708	
College/university	6.2647	1.38459	5.7918	6.7376	

WDDS-10 was put in dichotomous categories of either having achieved MDD-W (≥5 food groups) or not (<5 food groups). The two categories were compared with various

sociodemographic and socioeconomic characteristics (Table 4.12). A positive statistical significance was found between education level of respondents and the MDD-W categories (χ^2 value=15.228, DF=4, p=0.004). There was also a positive statistical significance between estimated monthly income and MDD-W categories (χ^2=16.497, DF=5, p=0.006). However, there was no statistical significance between MDD-W categories and age, marital status and land size owned categories (p>0.05). In terms of age, there was high percentage of women who achieved the MDD-W in the age category of 35-39 years (79.3%), almost the same as those in 45-49 years (79.2%) whereas high percentage of those who didn't achieve MDD-W were in the age category of 20-24 years (46.7%). For marital status, those in the single/never married category had high percentage having achieved MDD-W (78.6%) while those who were widowed had the highest percentage having not achieved MDD-W (41.7%) (Table 4.12).

Table 4. 12: Distribution of respondents by achievement of MDD-W according to social demographic and socioeconomic characteristics

Variable	**Achieved MDD-W (≥5 food groups)**		**Not achieved MDD-W**		**Chi-square(χ^2) value, df**	***p*-value**
Age (years)	n	%	n	%	8.937, 6df	0.177
15-19	9	60	6	40		
20-24	16	53.3	14	46.7		
25-29	33	78.6	9	21.4		
30-34	26	76.5	8	23.5		
35-39	23	79.3	6	20.7		
40-44	13	72.2	5	27.8		
45-49	19	79.2	5	20.8		
Marital status					2.054, 3df	0.561
Married	94	71.2	38	28.8		
Separated	5	71.4	2	28.6		
Widowed	7	6.5	5	41.7		
Single/Never married	33	78.6	9	21.4		

Table 4. 12: Distribution of respondents by achievement of MDD-W according to social demographic and socioeconomic characteristics

Variable	Achieved MDD-W (≥5 food groups)		Not achieved MDD-W		Chi-square(χ^2) value, df	*p*-value
Education level			15.228, 4df	**0.04**		
No education	1	50	1	50		
Primary	56	60.9	36	39.1		
Secondary	42	76.4	13	23.6		
Vocational training	8	80	2	20		
College/University	32	94.1	2	5.9		
Estimated monthly income					16.497, 5df	**0.006**
<3000	7	50	7	50		
3000-5000	22	56.4	17	43.6		
5001-10000	34	73.9	12	26.1		
10001-20000	30	73.2	11	26.8		
20001-50000	27	79.4	7	20.6		
>50000	19	100	0	0		
Land size (ha) owned					5.294, 4df	0.258
<0.5	26	59.1	24	40.9		
0.6-1.0	12	57.1	11	42.9		
1.1-1.5	12	75	4	25		
1.6-2.0	28	80	7	20		
>2.1	34	80.1	8	19		

4.6.2 Micronutrient intake and dietary diversity score

There was a positive significant association between WDDS-10 and micronutrient intake of vitamin A (r= 0.473, p=0.002), iron (r=0.494, p=0.001) and zinc (r=0.551, p=0.000).

4.6.3 Dietary diversity score and NAR for Vitamin A, iron and zinc

There was a positive significant association between WDDS-10 and NAR for: Vitamin A (r=0.499), iron (r=0.528) and zinc (r=0.569) (Table 4.13).With every increase in WDDS-10, the NAR increased.

Table 4. 13: WDDS-10 and NAR for vitamin A, iron and zinc

NAR of micronutrients	**Correlation coefficient(r)**	**p-value**
NAR Vitamin A	0.499	0.001
NAR Iron	0.528	0.000
NAR Zinc	0.569	0.000

4.6.4 Associations between nutrition knowledge score and education level of the respondents.

One-Way ANOVA test showed that the mean nutrition knowledge scores among respondents in various education levels were significantly different {ANOVA (F (4,188) =6.087, p=0.000)}. The least significant difference (LSD) post-hoc test revealed a significant difference in means of nutrition knowledge scores between those in the college/university category and those who had no education (p=0.020) and those who were in primary (p=0.000) and secondary levels (p=0.000). The test, however, showed that there was no significant difference in the nutrition knowledge scores of those with no education, primary, secondary and vocational training levels (p>0.05). There was also no significant difference in the nutrition knowledge levels for the respondents in college/university level education with those in vocational training level (p>0.05).

4.6.5 Nutrition knowledge scores and WDDS-10

Bivariate Pearson correlation showed a weak but positive significant association between nutrition knowledge scores and WDDS-10 (r=0.224, p=0.02). Thus, the null hypothesis stating

no significant association between nutrition knowledge and dietary intake of the study population was rejected.

4.6.6 Size of kitchen gardens, number of crops grown and WDDS-10

A positive significant association was found between the size of kitchen gardens and the number of crops grown (r=0.392, *p*=0.000). On the other hand, the number of crops grown in the kitchen gardens had a positive significant association with WDDS-10 (r=0.305, *p*=0.000).

4.6.7 Associations between the dietary diversity scores, size of land owned, size of kitchen garden, number of crops grown and household size

A linear regression test was used to describe the associations between the dietary diversity scores and size of land owned, size of kitchen garden, number of crops grown in the kitchen garden and household size. Among the four independent variables, the total number of crops and size of kitchen gardens had a statistically significant contribution to the WDDS-10 (p-values of 0.08 and 0.06 respectively). Household size displayed a negative contributory factor to the dietary diversity score with standardized coefficient beta of -0.07. As the household size increase by one unit, the dietary diversity score decreases by 0.07units. However, this association was not significant (p-value=0.340 and beta close to 0). The size of the land owned showed a positive association to WDDS-10 but not statistically significant (p-value=0.295) (Table 4.14). These findings led to the rejection of null hypothesis stating that the number of crops grown in the kitchen gardens of households have no significant modifying factor on dietary diversity and micronutrient adequacy among WRA in Kericho County.

Table 4. 14: Relationship between dietary diversity scores and the size of land owned, size of kitchen gardens, number of crops grown and household size

Variables	Standardized coefficients Beta	Significance/p-value
Size of land owned in acres	0.078	0.295
Approximate size of kitchen garden in M^2	0.21	**0.006**
Total number of crops grown in kitchen garden	0.21	**0.008**
Household size	-0.07	0.340

4.7.8 Associations between micronutrient adequacy, sociodemographic and socioeconomic characteristics, nutrition knowledge scores and number of crops grown in kitchen garden of respondents

Binary logistic regression was done to detect the relationship between micronutrient adequacy and age of respondents, household size, TV ownership, nutrition knowledge scores and the number of crops grown in the kitchen gardens of respondents. TV ownership (used as a measure of wealth) and the number of crops in the kitchen garden showed a positive statistical significance with micronutrient adequacy. The odds ratio showed that TV ownership increased the odds of micronutrient adequacy by 6.5units and increase in one unit of the number of crops grown in the kitchen garden increases the chances of being micronutrient adequate by 1.2 times. The other variables considered; ages of the respondents, household sizes and nutrition knowledge scores had no statistical significance with micronutrient adequacy (p>0.05). However, nutrition knowledge scores had positive association with micronutrient adequacy (OR=1.2) even though the association was not statistically significant (p=0.067). The ages of respondents and household sizes had p>0.05, odds ratios <1 with Beta values close to 0 (Table

4.15). Hence, controlling for other factors in the model, there was no significant association between the ages and household sizes of respondents, and micronutrient adequacy.

The model was tested for goodness of fit using Homer and Lemeshow goodness of fit test. Pearson chi-square greater than 0.05 shows that the constructed model does not vary statistically from the observed sample population (Schupp, 2009). The constructed model predicting the probability of being micronutrient adequate in this study had a p-value of 0.39, thus proving to accurately fit the sample population (Table 4.16).

Table 4. 15: Relationship between dietary diversity score and the size of land owned, size of kitchen garden, number of crops grown in the kitchen garden and household size

Predictors N=193	B	Wald	Df	Sig	Exp(B)
Age	0.022	1.112	1	0.292	0.981
Household size	-0.035	0.126	1	0.722	0.966
TV ownership	1.865	13.226	1	0.000	6.458
Nutrition knowledge score	0.158	3.357	1	0.067	1.172
Number of crops in kitchen garden	0.180	4.661	1	0.031	1.197
Constant	-1.704	3.530	1	0.060	0.182

Significant at P≤0.05

B-Regression coefficient

Wald-Wald statistic

Df-degrees of freedom

Sig-Significance value

Exp(B)-Odds ratio

Table 4. 16: Logistic Regression Model for the Likelihood of micronutrient adequacy

Hosmer and Lemeshow Test

Chi-square	Degrees of freedom	Significance
8.468	8	0.389

CHAPTER 5: DISCUSSION

5.1 Introduction

The main objective of this study was to determine the influence of kitchen gardens' size and crop variety on dietary diversity and micronutrient adequacy among non-pregnant women of reproductive age in Kericho County. It involved characterizing the study population by socio-demographic and socioeconomic characteristics and sought to determine the size and crop variety in the kitchen gardens. The study also sought to assess nutrition knowledge and dietary practices of the study population. Dietary practices involved the assessment of dietary intake and diet diversity-used as a proxy for determining micronutrient adequacy. This chapter presents discussions of the findings reported in chapter 4 on the basis of study objectives and hypotheses.

5.2 Socio-demographic and socio-economic characteristics of the study population

All the respondents in the study were females as the study population involved women of reproductive age (15-49 years). The study population's households' data showed a slightly higher proportion of females than males with percentages of 51.1% and 48.9% respectively. This corresponds to the Kenya Demographic and Health Survey (KDHS) findings of 2014 which had the country's percentage of females being 51% and males being 49% (KNBS et al., 2015). The 2003 KDHS had similar figures of household population comprising 51% females and 49% males (KNBS, 2004). The study had the proportion of the young population outweighing the older population which corresponds to the country's findings (KNBS, 2004). This leads to high dependency ratio of the population which exerts a negative effect on the economy of households. The mean household size obtained (5.4) was higher than the country's mean of 3.9 members according to the Kenya Demographic Health Survey, 2014 (KNBS, 2014) and the KDHS 2003 which reported a mean household size of 4.4 similar to 1999 census (KNBS, 2004). This impacts negatively on the dietary diversity of individuals in the household due to the economic constraints involved in meeting the needs of large households (Kahanya, 2016).

The education level of respondents showed a high proportion having attained secondary school education with only one percent of women having no formal education. The findings differ with the national data showing women, between the ages of 15-49, having no formal education being 7% (KNBS, 2014).The findings also differ slightly to the findings of a study conducted in Laikipia which showed that 3.9% of the women had no formal education (Kahanya, 2016). The

women's level of education impacts on the type of occupation, income level, nutrition knowledge and dietary diversity (Gupta et al., 2019). Low education limits the women's nutrition knowledge and decision making with regards to dietary intake (Wangari, 2015). The prevailing education level among respondents reflects high proportion of respondents having moderate level of nutrition knowledge obtained which significantly correlated with dietary diversity scores. High nutrition knowledge level has a positive impact on nutrient adequacy of households since women are the main determinants of food consumption patterns in households (Kawai, 2003).

5.3 Kitchen garden practices

At the period of the study, several crops were growing in the kitchen gardens of the study households. A total of 32 crops, including fruit trees were recorded. This could be due to the season within which the study was carried out. It was a season of good climate with considerable rainfall and plenty of produce. Majority of the households had kales (Sukuma wiki) (89.6%) and bananas (63.2%) in their gardens. The mixed cropping system in the study area agrees with a study conducted at James Finlay, Kericho among workers who affirmed that kitchen gardening promoted their nutritional diversity (Njuguna, 2013). The crops grown were predominantly for household consumption with some farmers producing surplus for sale. The number of crops grown increased with increasing kitchen garden size. This holds true because the members who reported to have a small land acreage reported inadequacy of land for expanding their gardens and growing diverse crops.

5.4 Livestock keeping

The livestock kept include: cows, goats, sheep, chicken, rabbits and ducks. These are important sources of dietary bioavailable iron and Vitamin A. Most respondents, however, reported to be consuming cow milk and eggs at considerable quantities whereas the consumption of poultry was mainly occasional and limited to occasions like Christmas festival. The rabbits and ducks, however, were kept mainly for sale.

5.5 Nutrition Knowledge

Nutrition knowledge had a weak but positive statistical significance with dietary diversity scores. The scores correlated positively with all the nutrient adequacy ratios for the selected micronutrients in the study. This is similar to the findings of a study conducted in district 13 of

Tehran among children, adults and adolescents (Mirmiran, Azadbakht, Esmaillzadeh, Beheshti, and Sciences, 2004). A systematic review by Spronk, Kullen, Burdon, and O'Connor, (2014) on nutrition knowledge and dietary intake also found a weak positive significant correlation between nutrition knowledge and dietary intake. The positive association between the WDDS-10 and MAR agrees with a study conducted to determine dietary diversity, micronutrient intake and their variation in informal settlements of South Africa among black women (19-69 years) (Acham, Oldewage-Theron, and Egal, 2012).

5.6 Dietary Consumption Patterns

All women in the study population had consumed starchy staples during the study period. The highest consumption from kitchen garden produce comprised of dark green leafy vegetables (92.2%), and other vegetables at 72% while the least being other vitamin A rich fruits and vegetables (17%). The study findings correspond to the findings of a study done at Kapenguria in 2013 on pregnant women which found that cereals consumption was the highest (99%) (Kemunto, 2013). They also relate to the findings of a study done in Burkina Faso on WRA to determine their individual micronutrient intakes and food consumption behaviour in the year 2010 which found that the consumption of cereals was the highest (98.6%) followed by leafy vegetables (87.1%) (Martin-prevel, Becquey, and Martin-prevel, 2010).

Dairy consumption was the second highest (99.5%) in the study area. This is a reflection of the high proportion of study households (82.4%) who owned cows. The consumption of animal protein was followed by meat, fish and poultry at 30.1% and the least being eggs at 20.2%. There was a considerable number of households who owned chicken but the eggs were mainly for sale, same case to poultry, since poultry rearing was mainly done for commercial purposes. These resembles the findings of a study done in Sub-Saharan countries which recorded that animal source foods contributes a very low percentage (<5%) to the total dietary energy provided through animal source foods (Mutwiri, 2009).

Consumption of DGLVs has a positive impact on micronutrient intake, being rich sources of varied micronutrients such as iron, vitamin A, Vitamin C, Vitamin K, calcium, phosphorus, potassium and magnesium (Mumbi, 2004). The consumption of dairy boosts the level of bioavailable iron and fats essential in the absorption of fat-soluble vitamins. The high consumption of DGLVs by the sample population enhanced the micronutrient intake.

Fruits consumption was moderate with most of the respondents depending on the fruits in season. For instance, avocado and passion fruits were in season during the period of study hence, were heavily consumed. This indicates that seasonal variability affects fruit intake, hence, affecting the related micronutrients.

Less than ten percent of the study participants consumed nuts and seeds and the consumption was significantly related to nutrition knowledge. This implies that those who have high nutrition knowledge have better understanding on the importance of incorporating nuts and seeds in the diet. A study done in Burkina Faso established that consumption of nuts and seeds was significantly associated with lower risk of micronutrient deficiencies (Becquel, 2010).

5.7 Dietary Diversity

A more diversified diet increases the consumption of higher energy and micronutrient adequacy with a cut-off of at least five food groups, being used as a proxy to attain minimum micronutrient needs for women (Muthoni, 2017; Pal, Paul, and Dasgupta, 2018; Ruel et al., 2010).

The WDDS-10 obtained from the study; being a proxy for attainment of minimum micronutrient intake among WRA, indicates that slightly less than three-quarters (72%) of the women were micronutrient adequate. This is similar to a study done by Shashikantha et al in India which found out that 76.6% of WRA had a DDS of 5 and above. However, the study had used IDDS with a scale of 9 unlike this study in which WDDS with a scale of 10 was used as recommended by FAO and FHI 360 (2016).

The dietary diversity questionnaire used had various strengths. For instance, the method relied on memory for the foods and drinks taken for only a period of prior 24-hours. The respondent was free to list them in any order from the first to the last meal taken. It was also a non-invasive method of obtaining data on diet.

5.7.1 Determinants of Dietary Diversity

Socio-demographic and socioeconomic factors such as education and income level of the respondents showed a positive significant association with dietary diversity. These findings agree with other studies such as, the findings of a study conducted among pregnant women in Kapenguria which found that education level of women had an impact on their dietary intake (Kemunto, 2013). A study done in Japan also found that education level had an impact on dietary

intake patterns of Japanese women even though the study found no correlation between the socioeconomic factors and dietary intake (Goodarzi-Khoigani et al., 2017). A Ghanaian study on women's participation on decision making and higher dietary diversity also obtained a positive significant association between education and other sociodemographic characteristics with dietary diversity (Amugsi et al., 2016). Moreover, a study done in Fatehabad Haryana, India among adolescents recorded a positive association between dietary diversity and socioeconomic characteristics (Rani and Rani, 2017). Amugsi et al (2016) also found a positive association between women's dietary diversity and socioeconomic status (Amugsi et al., 2016).

The number of crops grown in the kitchen gardens had a positive significant association with the size of kitchen gardens (r=0.392, p=0.000) and positively influenced WDDS-10. Both kitchen gardens' size and number of crops grown contributed significantly to dietary diversity. A study conducted in rural Kenya among children and their mothers/caregivers found that agricultural biodiversity had a significant positive contribution to dietary diversity (Kaibi et al., 2016).

5.8 Micronutrient Adequacy

The mean adequacy ratio for Vitamin A, iron and zinc implied that more than three-quarters of the sample population met their micronutrient needs. However, MAR is known to mask the deficiencies of specific nutrients due to overconsumption of other nutrients (Ty and Krawinkel, 2016). For instance, this study found out the NAR for vitamin A to be below fifty percent while the NAR for zinc was above 100%. The interpretation of MAR does not show vitamin A deficiency if interpreted alone without confirming NAR values. This corresponds to a study done among Vietnamese women whereby, they did not meet vitamin A requirements as reported by Nguyen et al. (2013). The NAR for Zinc (above 100%) could imply that majority of the respondents met or even exceeded the requirements for zinc intake in their diets. The NAR for all the micronutrients increased with increase in WDDS-10. The relationship between WDDS-10 and NAR for vitamin A, iron and zinc showed a medium level of correlation (r=0.528 and r=0.569 respectively). "Correlation coefficients in the order of 1.0 is perfect, 0.5 to 0.7 are medium, 0.3 to 0.49 are low and less than 0.3 are little if at all any correlation"(Ty and Krawinkel, 2016).

Micronutrient deficiencies were likely to be lower during study period due to wide variety of fruits and vegetables available. The mean WDDS-10 of 5.3 obtained indicates that majority of women met the minimum requirement of micronutrients in their diets with a greater contribution from kitchen gardens. However, vitamin A deficiency could still be prevalent with vitamin A NAR being below 50%. Therefore, there is need to encourage households to diversify crops within kitchen gardens to involve more vitamin A rich fruits and vegetables. There is also need to encourage adequate intake of diversified diet to prevent any of the micronutrient deficiencies.

The prevailing micronutrient situation could be different during drought season from January-March since most farmers depend on rain-fed agriculture (MoALF, 2017). From the FGDs, it was noted that such times was a season of shortage, mainly vegetables shortage, which has greater impact in reducing micronutrient adequacy. A study done in Machakos district among pregnant and lactating mothers found out that serum Vitamin A levels had seasonal variability. The levels significantly rose during the period from April-June when traditional vegetables were available (Mutwiri, 2009).

5.9 Study Limitations

Generalization with regard to findings is limited to the study area since the selection of the area was majorly purposive to take care of households with kitchen gardens. Secondly, the findings may not be a true representation of the usual diet for all the days because the study did not take care of inter and intra variability by doing several nonconsecutive 24-hour dietary recalls. The FFQ has inherent limitation as a food consumption method as the respondents relies on memory which in some cases fails them since they have to recall over long past periods. However, in this study most diets were habitual, hence, the above limitation was not a major concern. Thirdly, the influence of size and crop variety of kitchen gardens on dietary diversity and micronutrient adequacy can be obtained using longitudinal comparative study to cover all seasons of a year.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

Conclusion

Both the kitchen gardens' size and number of crops grown have a positive influence on the dietary diversity of women and hence, their micronutrient adequacy.

Micronutrient adequacy is dependent on the socioeconomic factors. It varies across different education and income levels, favouring those with high education and income levels.

Nutrition knowledge level affects the dietary intake of women, especially with regards to nuts and seeds consumption.

Majority of the women in Kericho County are micronutrient adequate in iron and zinc with an exception of vitamin A adequacy.

There is high consumption of starchy staples, dairy products and dark green leafy vegetables but the consumption of other food groups which include: "other vitamin A rich fruits and vegetables", "eggs", and "nuts and seeds" is low.

Recommendations

There is need to enlighten the population to practice kitchen gardening on larger portions of land with diverse crops to target intake optimal food groups.

There should be more emphasis on incorporation of other vitamin A fruits and vegetables in the kitchen gardens and in the diet. Consumption of eggs, nuts and seeds should also be encouraged.

A similar longitudinal study which takes seasonal variations into consideration is highly recommended to cover all seasons of a year.

A similar study conducted in different parts of the country is recommended to understand the status quo in different parts of the country.

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APPENDICES

Appendix 1: Informed Consent Form

My name is Mercy Chepkirui, pursuing MSc. Applied Human Nutrition at the University of Nairobi. I am conducting a research on the influence of size and crop variety of kitchen gardens on dietary diversity and micronutrient adequacy among women reproductive age in Kericho County, Kenya. You are requested to give consent to participate in this study by going through this consent information and thereafter signing it to prove your agreement of participation.

Purpose of the research

The purpose of this research is to provide information on influence of size and crop variety of kitchen gardens on dietary diversity and micronutrient adequacy among women reproductive age in Kericho County, Kenya.

Your part in the research

You are requested to co-operate in this study by answering the questions in the questionnaire and providing any other information that pertains to the study.

Possible benefits

The benefits from this study may not be directly anticipated but the results may be useful to the relevant stakeholders such as the government, non-governmental organizations and other researchers in formulating policies on kitchen gardening, dietary diversity, micronutrient adequacy and other appropriate interventions targeting the women of reproductive age (15-49 years).

Possible Risks

There are no foreseeable risks associated with this study.

Compensation

Your participation is voluntary and therefore, you will not receive any form of compensation.

Ethical issues and Confidentiality

Whatever information you shall provide shall be kept strictly confidential and shall not be shown to any other persons. Participation in the study is voluntary and you can choose not to answer any individual question(s) or to opt out of the research at any time.

In case of any questions or concerns regarding this study, please consult the enumerators or the principal investigator.

Principal investigator Name**: Mercy Chepkirui,** Contacts: **0716575833**

Volunteer Agreement

I have read and understood the consent form describing benefits, risks and procedures for this study on "Influence of size and crop variety of kitchen gardens on dietary diversity and micronutrient adequacy among women reproductive age in Kericho County, Kenya" and I voluntarily agree to participate.

Name_____Signature _____ Date_____

For official use only

I certify that the nature and purpose, the potential benefits and possible risks associated with participating in this study have been well explained to the above participant.

Date_____ Signature_____

Appendix 2: Questionnaire

Questionnaire Number_____Date_____

Household number: _____

County Name_____Ward_____

Location_____Sublocation_____

Name of the interviewer_____

SECTION A:SOCIODEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

Household Profile

S/No	**Name**	**Age(Years)**	**Number of HH members**	**Number of children**	**Marital status**	**Relationship to HH head**	**Religion**	**Education Level**	**Main Occupation**

Marital status	RHHH	Religion	Education level	Main occupation
1=Married 2=Separated 3=Widowed 4=Single/Never married 5=Divorced	1=HHH 2=Spouse 3=Daughter 4=Grand daughter 5=Relative 6=Parent 7=Employee	1=Christian 2=Muslim 3=Hindu 4= Pagan 5=Others(specify)	1=No education 2=Primary 3=Secondary 4=Vocational training 5=University 6=Adult education	1=Farmer 2=Self-employed 3=Business 4=Housewife 5=Civil servant 6=Student 7=Unemployed 8=Others (Specify)

Socioeconomic characteristics

1. What is your monthly income category? 1. <3000, 2. 3001-5000, 3. 5001-10000, 4. 10001-20000. 5. Above 20,000
2. Source of incom**e**: 1. Formal employment 2. Business 3. Casual labour 4. Sale of food crops 5. Sale of cash crops 6. No income 7. Any other_____
3. Where do you live? 1. Own house 2. Rented house 3. Any other; Specify_____
4. What material the house is the wall of made of? 1 .Mud and wooden poles 2. Bricks 3. Cement or stone blocks 4. Iron sheets 5. Timber 6. Other (specify)_____
5. What kind of Roof is your house you made of? 1. Grass 2. Iron sheets 3. Tiles 4. Other (specify_)_____
6. What material is the floor of your house made of? 1. Cement 2.Timber 3.Earthen
7. What do you use as the Source of Lighting**?** 1**.** Fire 2. Kerosene burner 3. Kerosene lamp 4. Gas lamp 5. Electricity 6. Solar 7. Candle 8 .Other (specify)_____
8. What do you use as the source of cooking fuel? 1. Firewood 2. Kerosene 3. Charcoal 4. Gas 5. Electricity 6. Other----------
9. Assets ownership____

Assets owned	Quantity/Number	Assets owned	Quantity/Number
Land		Sofa set	
Cows		Motor cycle	
Goats		Car	
Sheep		Refrigerator	
Poultry		Rental houses	
Radio			
TV			

SECTION B: Kitchen gardening

1. Do you own a kitchen garden? 1. Yes 2. No

If Yes;

Which crops do you grow?

2. How far is the kitchen garden from the homestead?

a. Within the homestead(<100Metres away) b. >200Metres from the homestead c. away from the homestead

3. How is the impression on quality of the available kitchen gardens? 1. High 2. Moderate 3. Low

4. Diversity of crops in the kitchen garden

a. How many varieties of crops are in your kitchen garden?

b. Do you practice intercropping?

5. What is the approximate size of the kitchen garden in M^2

6. Is the produce sufficient for all the household members?

7. What are the various ways of utilization of foodstuffs from the kitchen garden?

a) Main mode of utilization1. Consumption 2. Sale 3. Other; Specify_____

b) Other utilization modes 1. Consumption 2. Sale 3. Gifts/ Offerings 4. Animal feeds 5. Others, Specify_____

8. Soil care

a. What do you apply to the soil in the kitchen garden to keep it fertile?

1. Green Manure 2. Chemical fertilizers 3. Compost manure 4. Animal manure 5. Food remains 6. Others; specify_____

b. How do you prevent/remove weeds from the garden?

1. Weeding 2. Spraying with chemicals 3. Burning 4. Use animals 5. Others; specify_____

c. What ways do you use to control for pests and diseases in the garden?

1. Use of chemicals 2. Use of traditional ways 3. Others; specify_____

d. How is the spacing of the available crops in the kitchen garden?

1. Good 2. Fair 3. Bad

SECTION C-Challenges to the adoption of kitchen gardens by households in Kericho County.

What challenges do you encounter in? a) Starting up a kitchen garden?

b) Maintaining the kitchen garden?

Appendix 3: Observation Checklist

Component	Remarks
What is the size of the kitchen garden?	
What cropping system is practiced in the kitchen garden? Single cropping or mixed/intercropping?	
How many types of crops are in the kitchen garden?	
What is the impression on quality of the available gardens? Check for: i) Size of the crops, ii) Colour, iii) Spacing and iv) Cleanliness in the garden	

Appendix 4: Nutrition knowledge score card questionnaire

Serial number	**Questions for assessing women's level of nutrition knowledge (Tick yes if the answer given is right)**	**Yes**	**No**
1	What do you understand by kitchen gardening		
2	What are the nutritional advantages of kitchen gardening		
3	Name any three food groups which you know		
4	What are the advantages of dietary diversity?		
5	Name any of the consequences of poor dietary diversity		
6	Which benefits of fruits and vegetables do you know?		
7	Mention the foods rich in vitamin A		
8	Mention the functions of Vitamin A to the body		
9	Name any nutrition deficiency which you know		
10	What are the signs and symptoms of the deficiency mentioned above?		
Total score out of 10			

Appendix 5: Minimum Dietary Diversity-Women questionnaire

10 food groups in the MDD-W	**Description of foods in the group**	**Consumed** **Yes=1** **No=2**
Grains, white roots and tubers, and plantains	Maize, millet, sorghum, wheat products, rice, white potatoes, white yams, green banana and other foods made from white-fleshed roots or tubers	
Pulses	Mature beans, peas and lentils, soya beans	
Nuts and seeds	Any tree nut, groundnut/peanut, or nut/seed "butters" or pastes	
Dairy	Fresh milk, mala, cheese, yoghurt or other milk products	
Meat, poultry and fish	Beef, pork, lamb, goat, rabbit, wild game meat, chicken, duck, other birds Fresh or dried fish, shellfish or seafood	
Eggs	Eggs from poultry or any other bird	
Dark green leafy vegetables	Amaranth, spinach, kales, pumpkin/bean leaves, dhania greens, Spider plant ("Sageek"), African spinach("Nderemiat"), black nightshade ("Isooik")	
Other Vitamin A-rich fruits and vegetables	Pumpkin, carrots, squash, sweet potatoes that are yellow inside, passion fruit, papaya, tree tomato	
Other vegetables	Cabbage, green beans, cauliflower, cucumber, eggplant, green pepper, mushroom, onion, tomato, green maize	
Other fruits	Avocado, banana, orange, pineapple, plum, apple, guava, watermelon, lemon, grapes, dates	

Appendix 6: Food frequency questionnaire

Food Item	More than once a day	Once per day	3-6 times per week	**Once per month or less**	**Never**
Ugali					
Irish potatoes					
Sweet potatoes					
Bread					
Chapati					
Doughnuts					
Potato chips/fries					
Pumpkin					
Rice					
Green bananas					
Eggs					
Fish					
Chicken/Poultry					

Beef					
Milk and milk products					
GLVs					
Other vegetables					
Ripe papaya					
Mangoes					
Oranges					
Tree tomato					
Passion fruits					
Ripe bananas					
Lemon					

Appendix 7: 24-hour-Dietary recall questionnaire

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 up to the last meal of the day before going to sleep.

Period	Dish Name/Volume	Name of ingredients	Amount of ingredients used in household measures	Amounts in standard units(grams)	Amount consumed in grams
Breakfast					
Mid-morning					
Lunch					
Afternoon					
Dinner					
After dinner					

Appendix 8: Focus Group Discussion Guide

My name is Mercy Chepkirui. I am a student at the University of Nairobi, Department of Food Science, Nutrition and Technology. I am pursuing a research on the influence of kitchen gardening on the dietary diversity and micronutrient adequacy of WRA in Kericho County. I would like to use the next 30 to 45 minutes for this exercise. Please cooperate and give your honest opinions which will be treated with confidentiality.

Guidelines

1. Ice breaker/introduction
2. What does a kitchen garden mean to you?
3. What inputs do you need for a kitchen garden?
4. Which plants are grown in the kitchen garden?
5. What nutrients are contained in the crops you have mentioned above?
6. Which foods do you mostly consume?
7. What do you understand by dietary diversity?
8. Have the kitchen gardens improved nutritional diversity? If yes how?
9. How do you take care of your kitchen garden?
10. What time do you dedicate for nurturing your kitchen garden: a) Daily? b) Weekly? C) Monthly?
11. What challenges do you face in starting up and maintaining a kitchen garden?
12. What are your suggestions on how these challenges can be overcome?