FISH CONSUMPTION PATTERNS AND CONTRIBUTION OF FISH TO DIETS IN RURAL HOUSEHOLDS OF LUWINGU DISTRICT IN NORTHERN PROVINCE, ZAMBIA

BY

GEOFREY MAILA

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LUSAKA

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DECLARATION

I, Geofrey Maila do hereby declare that this thesis is my original work and has not been submitted for a degree at this or any other university.

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APPROVAL

This thesis of Geofrey Maila has been approved as fulfilling the requirements for the award of Master of Science in Human Nutrition by the University of Zambia.

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DEDICATION

I dedicate this thesis to my wife, Namoonga N. Mulilwa and my son, Luyando Maila for their support and encouragements during this research work.

ABSTRACT

Fish provide high-quality proteins and micronutrients, when taken adequately it can help in reducing undernutrition and micronutrient deficiencies in Zambia. Little is known with regard to fish consumption patterns and contribution of fish to rural household diets. Therefore, this study aimed at assessing the fish consumption patterns and contribution of fish to rural household diets in Luwingu district of Northern Province.

A descriptive cross-sectional study design was used. A sample of 132 households with women of reproductive age (15-49 years), children (6-59 months), and men (18-64 years) in Luwingu district were enrolled in the study. Using a semi-structured questionnaire, socio-economic and demographic data was collected. A food frequency questionnaire (with a 7-day recall period) and a 24-hour recall questionnaire were used to collect household and individual dietary data, respectively. Data was analyzed using Statistical Package for Social Sciences (SPSS) version 22.0 and Microsoft excel 2013 version, while Nutrisurvey 2007 was used to analyze nutrient content of foods. Nutrient contribution ratio was used to determine the contribution of fish to diets.

Overall, fish was the most consumed animal-source food in the study site. About 75.8% of the households consumed fish 24 hours prior to the interview. Other animal-source foods consumed were eggs (3.8%), meat (1.5%), and poultry (0.8%). On average, children aged 6-12 months consumed 60.4 ± 35.2 g of fish per day while those aged 13-36 months had 73.8 ± 51.0 g and 37-59 months consumed 87.9 ± 45.7 g of fish per day. Women and men had a mean intake of 162.1 ± 86.0 g and 173.3 ± 70.0 g of fish per day, respectively.

In 7 days prior to the interview, the study showed that all households (100%) consumed fish at least once in the past 7 days among other animal-source foods. Small pelagic fish were the most consumed, as these were consumed once or more times per day. Other animal source foods consumed by households included eggs (31%), meat (13.6%), and poultry (18%) while the least consumed animal-source foods were milk (0.8%) and wild birds (3.2%).

The determined intake of micronutrients from fish among children showed no significant difference in intake of vitamin A ($p = 0.22$), calcium ($p = 0.544$) and iron ($p = 0.479$) while the difference in intake was observed in proteins ($p = 0.042$). In adults, differences in intake were observed in proteins (p = 0.028) and iron (p = 0.008) while in calcium (p = 0.919) and vitamin A (p = 0.161) there was no difference. Fish contributed more in terms of proteins and calcium while lower contribution was observed in iron and vitamin A across all categories of study participants' diets and the contribution of diets to recommended nutrient intake (RNI) was fairly low for most of the nutrients.

Among the barriers to fish consumption, price of fish was the most common barrier in households. The results from the current study show that fish plays a critical role in the household's diets of Luwingu district and can be incorporated in policies and programs aimed at improving food and nutrition security and ultimately contribute to the reduction of undernutrition in Zambia.

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ACRONYMS

AUC	African Union Commission
ASF	Animal-Source Food
CSO	Central Statistics Office
DHA	Docosahexaenoic Acid
EPA	Eicosapentaenoic Acid
FAO	Food and Agriculture Organization of the United Nations
IFAD	International Fund for Agricultural Development
LIFDC	Low-Income Food Deficient Countries
MUFA	Monounsaturated Fatty Acid
NCR	Nutrition Contribution Ratio
NEPAD	New Partnership for Africa's Development
NFNC	National Food and Nutrition Commission
NFSD	Nordenfjeldske Development Services
NNSS	National Nutrition Surveillance Survey
PUFA	Polyunsaturated Fatty Acid
RDA	Recommended Daily Allowance
RE	Retinol Equivalent
RNI	Recommended Nutrient Intake
SFA	Saturated Fatty Acids
TDRC	Tropical Diseases Research Center
WHO	World Health Organization of the United Nations

CHAPTER 1: INTRODUCTION

1.1 Background

Fish consumption provides important nutrients to a large number of people in the world and makes a very significant contribution to nutrition (Pawar and Sonawane, 2013). About 3.2 billion people derive almost 20% of their average per capita intake of animal protein from fish which accounts for about 17% of animal protein consumed by the global population (FAO, 2018a).

In Africa, fish contributes essential proteins to over 400 million people (World Fish Center, 2009) and provides 22% of the protein intake in Sub-Saharan Africa (Béné and Heck, 2005). It has been further projected that the demand for fish in Africa will increase by 2.6 million tonnes a year by 2030 (WorldFish Center, 2009).

In low-income populations like Zambia, which depend on a narrow range of calorie-dense staple foods, fish presents the much-needed means of dietary diversification that is relatively cheap and locally available (FAO, 2018a). In Zambia, fish contributes over 20% to dietary animal protein and it is the most consumed animal-source food (ASF) (NFDS Africa, 2016; NFNC, 2009), while in the Northern Province of Zambia, fish contributes 26% protein to women's diets and 16% to the diets of children aged 6-59 months (Alaofe et al., 2014).

Fish is an excellent source of high-quality animal protein, essential fatty acids especially long-chain polyunsaturated fatty acids such as omega-3 fatty acids (Beveridge et al., 2013) and micronutrients, such as zinc, iron, calcium, and vitamins A and B_{12} (Kawarazuka and Béné, 2010) and is thus considered to be a highly nutritious food (Sam et al., 2015).

Given its nutritional value and dominance in diets, fish has an important place in food-based approaches to food security and nutrition (Kawarazuka and Béné, 2010). Increased fish consumption among the poor can contribute to reducing the high prevalence of undernutrition (Benson, 2008), micronutrients deficiencies, and disease burden, particularly in Sub-Saharan Africa where approximately 28% of all deaths are attributed to malnutrition which is also a problem in Zambia (Genschick et al., 2017; WorldFish Center, 2011). Additionally, adequate intake of fish reduces cholesterol levels and incidences of heart diseases as well as preterm birth (Beveridge et al., 2013; Sam et al., 2015).

1.2 Problem statement

Fish is an important animal-source food rich in high-quality protein and micronutrients, therefore, adequate intake of fish may help to improve the micronutrient content of a person's diet (Gibson et al., 2020; Kawarazuka and Béné, 2010) and reduce micronutrient deficiencies (WorldFish Center, 2011).

Micronutrient deficiency is a form of undernutrition that may lead to damage in cognitive development and lower disease resistance in children (Wieser et al., 2013; Gibson et al., 2020). According to World Health Organization (WHO), one in every two pre-school aged children suffer from micronutrient deficiencies (McLean et al., 2009) and it is the major contributor to child morbidity and mortality (Central Statistical Office (CSO) et al., 2019). More than 3.5 million mothers and children under-five years of age die each year in poor countries due to micronutrient deficiencies (Salam et al., 2014).

Zambia is among the developing countries with a population estimated to be deficient in essential vitamins and minerals particularly in vitamin A and iron (Fe) (Micronutrient Initiative, 2009). These deficiencies affect health and development during important stages of life such as pregnancy, breastfeeding, and childhood (Kawarazuka and Béné, 2010). The country's statistics show that 35% of under-five children are stunted, 12% underweight and 4% wasted (CSO et al., 2019). Vitamin A deficiency is highly prevalent in Zambia, affecting at least 50% of children under-five years (MOST et al., 2003). About 31% of women of childbearing age are anemic and 58% children aged 6-59 months are also anemic which may be attributed to micronutrient deficiencies (CSO et al., 2019).

Northern Province has the highest percentage of stunted children (46%) in Zambia, with 35.3% and 35% of children aged 6-59 months deficient in vitamin A and iron, respectively and 30.6% women of childbearing age are anemic (CSO et al., 2019; Alaofe et al., 2014). Regardless of the province having some of the major lakes such as Bangweulu, Tanganyika, Chila, Mweru-wantipa and corresponding swamps and wetlands, as well as contributing the highest quantity of fish (2,118.5 metric tonnes in 2017) at household level (Ministry of Fisheries and Livestock and Central Statistics Office, 2019). The diets of the households in the province are inadequate in vitamin A, iron and calcium which can be obtained from fish (Alaofe et al., 2014). Gibson et al.

(2010) also emphasizes that complementary foods for children aged 6-24 months are deficient in micronutrients such as iron, zinc, and calcium.

The nutrient content of fish and eating patterns determine the importance of fish to macro and micronutrient intake (Roos et al., 2002), and hence, dependency on fish remains a substitute where other forms of animal-source foods are not accessible to the poor (Gomna and Rana, 2007).

Data on fish consumption patterns are scarce and poorly reflected in national statistics in developing countries (Kawarazuka and Béné, 2010). Therefore, the role and significance of fish in food and nutrition security, mostly in developing countries has frequently been overlooked (Kolding et al., 2016) and its contribution in terms of nutrients to diets receives little attention (Roos et al., 2003).

In Zambia, studies to establish the fish consumption patterns were conducted in the urban areas by Marinda et al. (2018), Genschick et al. (2018), and Hichaambwa (2012) but there is still limited data on the fish consumption patterns and its contribution to diets in the rural households. Nsonga, (2015) further revealed that there is limited information reported on fish consumption in Luwingu district. Therefore, this study was conducted in Luwingu to address this gap in knowledge.

1.3 Main objective

To assess the fish consumption patterns and contribution of fish to household diets in Luwingu district of Northern Province, Zambia.

1.3.1 Specific objectives

- To establish the consumption patterns of fish and other animal-source foods among rural households of Luwingu district.
- To determine the intake level and nutritional contribution of fish to diets of rural households in Luwingu district.
- To establish barriers to fish consumption among households of Luwingu district.

1.4 Research questions

- What are the fish and other animal-source foods consumption patterns in the selected rural households of Luwingu district?

- What are the intake levels and nutritional contribution of fish to diets of rural households of Luwingu?
- What are the barriers to fish consumption among selected rural households of Luwingu district?

1.6 Justification

Fish is consumed as relish. Its importance as a rich source of animal protein is well established and this is frequently used to justify fish as valuable food. However, very little attention has been given to the role of fish in supplying vitamins and minerals in the diet (Roos et al., 2007). Therefore, the focus should not only be on fish as a source of proteins but also on the composition of fish in terms of other nutrients and the contribution of these nutrients especially vitamin A and minerals to diets (Béné et al., 2016), which have not received much attention (Kawarazuka and Béné, 2010) especially in Zambia.

Due to its importance in diets, fish can be used as a key component in the strategies aimed at reducing essential fatty acid and micronutrient deficiencies in developing countries (WorldFish Center, 2011). Owing to limited data that is available at rural household level which reveal the consumption patterns of fish among the poor (Kawarazuka and Béné, 2010), limited attention has been given so far to fish as a key element in food and nutrition security strategies at the national level and development interventions (Béné et al., 2015).

In spite of its significance in diets, little is known about the contribution of fish to the Zambian diet (Genschick et al., 2017). Therefore, this study was conducted to generate evidence on the consumption patterns and determine the contribution of fish to diets in terms of proteins, vitamin A and minerals (iron and calcium) at household level.

The findings of this study will contribute to the knowledge base on fish consumption and its contribution to diets in rural households in Zambia. The evidence from this study can be used to guide programs, policies, and development of interventions aimed at improving food and nutrition security and ultimately reducing undernutrition in Zambia.

CHAPTER 2: LITERATURE REVIEW

2.1 Global fish consumption

Globally, fish accounts for about 17% of animal protein consumed by people. About 3.2 million people get almost 20% of their average per capita of animal protein from fish (FAO, 2018). Between 1961 and 2016, the average annual increase in global fish consumption (3.2%) outpaced population growth (1.6%) as shown in Figure 1 and exceeded that of meat from all terrestrial animals combined (2.8%) (FAO, 2018).

Fish does not only contribute to quality nutrients but also contributes substantially to the income and food security of more than 10% of the world population. Its nutritional properties make it also essential to the health benefits of billions of consumers both in developed and developing countries (Béné et al., 2015).

In per capita terms, fish consumption grew globally from 9.0 kg in 1961 to 20.2 kg in 2015, at an average rate of about 1.5 percent per year. Preliminary estimates for 2016 and 2017 pointed to further growth to about 20.3 and 20.5kg, respectively (FAO, 2018).

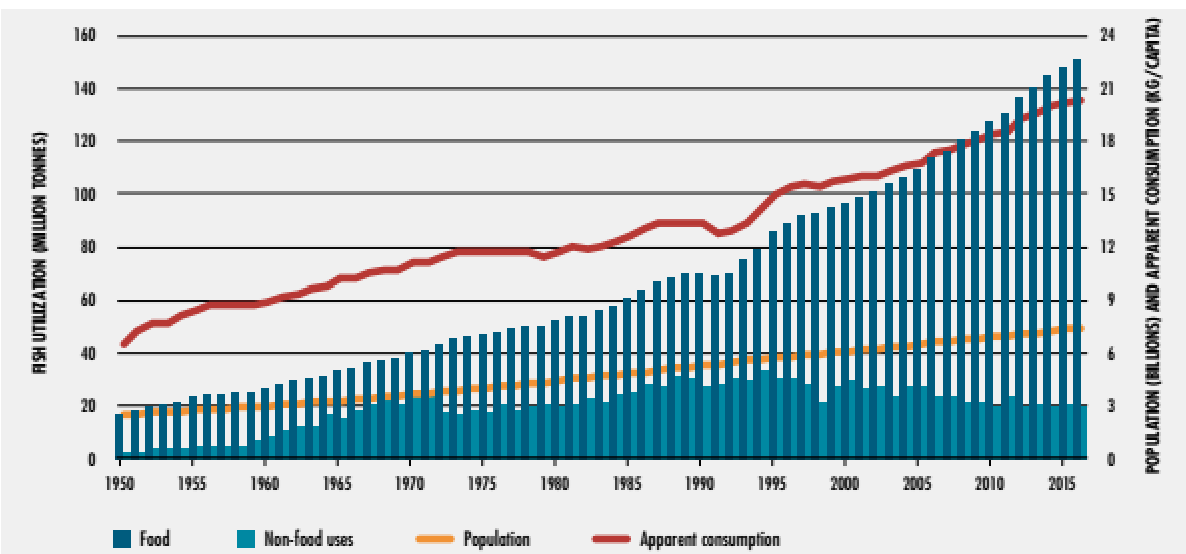

Figure 1. World fish utilization and apparent consumption. Source: FAO, 2018.

Fish is mostly consumed as fresh or processed. Fresh fish is often the most preferred and highly-priced form of fish and represents the largest share of fish for direct human consumption with 45% in 2016, followed by frozen (31%), prepared and preserved (12%), and cured (dried, salted, in brine, fermented and smoked) (12%) (FAO, 2018). Freezing represents the main method of processing fish for human consumption and it accounted for 56% of the total processed fish for human consumption and 27% of total fish production in 2016 (FAO, 2018).

The availability of fish is not evenly distributed, with supply constraints faced by some undernourished populations in developing countries with high dependence on fish, particularly in Sub-Saharan Africa, the least developed countries of South and South-East Asia, and small island states in the Pacific Ocean (WorldFish Center, 2011). The significant growth in fisheries and aquaculture has enhanced the capacity to consume diverse and nutritious food (FAO, 2018).

2.2 Fish consumption in Africa

Africa as a whole is well endowed with fishery resources from the sea and inland waters (rivers, floodplains, lakes, and reservoirs). It is a continent in which aquaculture is expanding rapidly and where the potential for increased fish production is considerable (Kolding et al., 2016). Over 2.5 million people are involved in fishing activities and three times this number is involved in trading and processing (Béné et al., 2016).

The per capita fish consumption for Africa in 2010 was 9.1kg which was less than half of the global average 20.2 kg (AUC-NEPAD, 2014; FAO, 2018). The continent was projected to need an additional million tonnes of fish a year by 2015 to maintain the consumption at that time (WorldFish Center, 2009).

Although there is an increase in continental fish consumption, the per capita consumption in Sub-Saharan Africa is the lowest compared to other regions and it is the only part of the world where consumption is declining (WorldFish Center, 2009; Béné and Heck, 2005). The main reason for this decline is the reduction in capture fish production and the growing population (Béné and Heck, 2005; AUC-NEPAD, 2014).

The value of fish in the diet of people across the continent is well known from specific country studies (Kolding et al., 2016). More than 200 million Africans eat fish regularly as it is a critical source of dietary protein and micronutrients for many communities in rural areas (Béné and Heck, 2005).

People in developing countries have a higher share of fish in their diets than those in developed countries (FAO, 2018a) and in many parts of Sub-Saharan Africa, fishing for subsistence plays a central role in sustaining human wellbeing as it provides proteins in the Sub-Saharan Africa especially for those who cannot afford to buy meat (Béné and Heck, 2005). Furthermore, evidence suggests that locally available fish have considerable potential as cost-effective food-based strategies to enhance micronutrient intakes or as a complementary food for undernourished children (Kawarazuka and Béné, 2010).

2.3 Fish consumption in Zambia

About 107,000 tonnes/year of fish is produced in Zambia and 81% comes from capture fisheries (NFDS Africa, 2016). The per capita fish consumption is 7 kg per person which constitutes 4% of the total protein intake (NFDS Africa, 2016).

According to the 2017/18 Livestock and Aquaculture Census Report, Zambia had a total of 9.615 households involved in fish farming as of January 2018, the highest proportion (33.9%) of these were from Northern Province, which also had the highest proportions (19.8%) of establishments involved in fish farming. Northern Province contributed the highest quantity of 2,118.5 metric tonnes of fish in 2017 at household level, representing 38% of the total household production (Table 1) (Ministry of Fisheries and Livestock and Central Statistics Office, 2019). Overall, the fish supply per capita in Zambia is on the rise (Genschick et al., 2017).

Table 1 Fish production in Zambia by province in 2017

Province	**Households**		**Establishments**		**Total**	
	MT	**(%)**	**MT**	**(%)**	**MT**	**(%)**
Central	237.4	4.3	0.9	0	238.3	1.1
Copperbelt	411.7	7.4	881.1	5.5	1292.7	6
Eastern	30.6	0.5	0.4	0	31	0.1
Luapula	843	15.1	0.8	0	843.8	3.9
Lusaka	641.9	11.5	1341.9	8.4	1983.8	9.2
Muchinga	571	10.3	403.3	2.5	974.3	4.5
Northern	2118.5	38	1173.5	7.3	3291.9	15.3
North Western	493.6	8.9	28	0.2	521.7	2.4
Southern	171.3	3.1	12167.3	76.1	12,338.6	57.2
Western	51	0.9	-	-	51	0.2
Zambia	**5570.00**	**100**	**15997.00**	**100**	**21,576.1**	**100**

Source: Ministry of Fisheries and Livestock and Central Statistics Office, 2019

Fish consumption is high in rural areas and in low-income groups than in urban areas and higher-income groups (Genschick et al., 2017; Hichaambwa, 2012). The consumption is higher in Northern, Western, and Luapula provinces (Genschick et al., 2017), possibly because these regions have the largest water bodies such as Lake Mweru, Lake Bangweulu, and Zambezi River. The low-income groups spend proportionally more on fish than on any other animal-source food, in comparison to higher-income groups, though this differs when disaggregated by fish species (Longley et al., 2014).

2.4 Nutritional value and Health benefits of fish

A balanced, diverse, and appropriate selection of foods eaten over a period of time is important because it ensures that the needs for macronutrients and micronutrients are met and it makes up a healthy diet (FAO, 2019). The nutrient content of the fish species and local processing methods and eating patterns determine the relevance of fish to macro and micronutrient intake (Roos et al., 2002).

In low-income countries, fish as a food group is important because it provides vitamins and minerals required to address some of the severe and widespread nutritional deficiencies (FAO, 2018) and contributes significantly to food and nutrition security (Béné et al., 2016). Therefore, fish can be used to tackle undernutrition in maternal and child health interventions (WorldFish Center, 2011).

The consumption of fish is beneficial for individual growth and development, while consumption of a certain amount of fish is associated with reduced risk of coronary heart disease and stroke (Beveridge et al., 2013). Polyunsaturated fatty acids from fish and fish oil, are thought to lower blood pressure and reduce the risk of heart disease (WorldFish Center, 2011).

The emerging evidence shows that fish consumption may reduce the risk of multiple adverse health effects such as ischemic stroke, non-fatal coronary heart disease events, congestion heart failure, arterial fibrillation, cognitive decline, depression, anxiety, and inflammatory diseases (FAO/WHO, 2011). There is little doubt that long-chain polyunsaturated fatty acids, including eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), in fish are key nutrients responsible for at least some of these benefits (FAO/WHO, 2011).

2.5 Nutrient composition of fish

About 50-60% of the fish weight is constituted by muscle, with proteins being the main constituents (16-21%), followed by lipids (0.5-2.3%), ash (also known as mineral content; 1.2-1.5%), and water (52-82%); carbohydrates content is low, around 0.5% (Petricorena, 2014).

Some fish species in particular the small fish have higher micronutrient nutrient content including vitamin A, iron, zinc, and calcium (WorldFish Center, 2011), iodine, vitamin B which are often lacking in vegetable-based diets (FAO, 2018). Fish is an integral component of a balanced diet, providing a healthy source of dietary protein and long-chain polyunsaturated fatty acids (FAO/WHO, 2011).

Fish also provides energy and its proteins are superior to other animal-source foods in terms of total protein and essential amino acid content and digestibility, and micronutrients for millions in Africa (Kawarazuka and Béné, 2010; Béné and Heck, 2005).

2.5.1 Proteins

Fish is the most important source of animal protein and has been accepted as a good source of protein and other elements for the maintenance of a healthy body (Cahu et al., 2004). The consumption of fish and fish products is recommended as a way of preventing cardiovascular diseases and has greatly increased over recent decades in many countries (Cahu et al., 2004).

Next to meat, fish is the only protein source that contains all the essential amino acids in the right proportions, hence called ‘complete protein’ (Pawar and Sonawane, 2013). Besides, fish is a good source of antimicrobial peptides that helps in defending against dreadful human pathogens (Ravichandran et al., 2011).

There are three main groups of proteins in fish, myofibrillar, sarcoplasmic, and stroma proteins which constitute 70-80%, 20-30%, and 3% of total muscle proteins, respectively. Myofibrillar proteins, high-salt-soluble proteins, corresponding to 65-75% (w/w) of the total protein in fish muscle and consists mainly of myosin (which accounts for 65-78%) and actin. The level of each protein can vary significantly among the species, for example, mollusks have no hemoglobin (Petricorena, 2014).

In general, muscle protein contains approximately 3% stroma proteins which consist mainly of collagen and elastin. In some fish, such as shark stroma proteins can account for 10% (w/w) of total muscle proteins (Ravichandran et al., 2011).

The protein found in fish is of good quality due to its high digestibility and the specific amounts of the relative proportion of essential amino acids (Alasalvar et al., 2010). Almost all species are well balanced with respect to their essential amino acids. The predominant amino acids are lysine and leucine and within the non-essential, aspartic, and glutamic acids are the most abundant (Cahu et al., 2004).

2.5.2 Lipids

Fish lipids consist mainly of saturated fatty acids (SFA), with palmitic acid (16:0) as the most relevant, monounsaturated fatty acids (MUFAs) with oleic (18:1 n-9) as the most predominant, and polyunsaturated fatty acids (PUFAs) which are represented by EPA (22:5 n-3) and DHA (22:6 n3) which are omega-3 fatty acids in the linolenic series and their content varies from one species to another (Nunes et al., 2011).

Generally, fatty fish contain more long-chain omega-3 PUFAs than leaner species and SFAs content is usually constant in every aquatic fish. However, PUFAs are the predominant group of fatty acids in most fish with the exception of fish like black scabbard fish, with MUFA content higher than the PUFA (Petricorena, 2014).

Besides the species, fish lipid content depends on the season, geographic locations (variables such as water temperature, depth, and salinity), age, gender, typical maturity, and nutrition as well as whether the specie is being cultured or living in the wild (Nunes et al., 2011).

Considering dependence on the season, for example, the lipid content can vary from 4% to more than 30 percent in mackerel and from 25 to 25 percent in herring, and also species living in temperate water have more lipid content in their fresh than leaner tropical fish (Petricorena, 2014)

In general, fish have less fat than red meats, ranging from 0.2 to almost 30%, and contrary to terrestrial animals which deposit their lipid in the adipose tissue. Fish have their lipids in the liver, muscle, and per-visceral and subcutaneous tissues. Distribution of lipids in fish decrease from head to tail; distribution of lipids in dark muscle is several times higher than in white muscles. (Petricorena, 2014).

2.5.3 Vitamins

Fish is a good source of vitamins A (Kawarazuka and Béné, 2010), D, and E as well as vitamin B. Lipid soluble vitamins particularly A, D and E are essentially found in the flesh of fatty fish and in the liver of lean species (Roos et al., 2007). The vitamin content in fish varies with the species, age, season, sexual maturation, and geographic area (Petricorena, 2014). The current study concentrated more on vitamin A because it was reported to below in diets of households in Northern Province (Alaofe et al., 2014).

2.5.3.1 Vitamin A

Vitamin A is essential to maintain the health of the outer cover of the eye. The deficiency of this vitamin is a serious problem globally since it affects several vital functions of the human body and can be prevented with adequate intake of vitamin A (Roos et al., 2007).

Dark-green vegetables, and yellow vegetables which contain pro-vitamin A carotenoids, have long been considered a major source of vitamin A and are often used in food-based interventions in order to increase vitamin A intake. However, fish is also very rich in vitamin A (Kawarazuka and Béné, 2010).

Vitamin A as retinol is found in oily fishes such as small sardines, herring, and mackerel. 100g of the flesh of these species provide 10-15% of the recommended daily allowance (RDA) for retinol and the content per 100g raw edible parts of fish ranges from 100mg retinol equivalent (RE) in most species to 2680mg (Roos et al., 2002). The total vitamin A content has been estimated that the dehydroretinol isomers have 40% of the biological activity of all-trans-retinol (Roos et al., 2003).

Vitamin A is concentrated in the liver, visceral, and eyes of fish although also present in less amount in their flesh (Roos et al., 2007). Therefore, fish liver oil is an excellent source of vitamin A. The content in fish varies, depending on the age and size of the fish, sex, stage of sexual maturation, anatomical structure, the temperature of water, and availability of nutrients (Cahu et al., 2004; Roos et al., 2007).

The distribution of vitamin A makes the cleaning practices extremely important for its retention. Cleaning practices depend on fish species, size of fish, and the person cleaning the fish. The waste can include the gill cover, jaw, head, tail, and viscera which concentrates vitamin (Roos et al., 2002).

2.5.4 Minerals

Fish is a rich source of minerals since they acquire minerals for their normal life processes. Fish absorb minerals not only from their diet but also from the surrounding water through the gills and skin. Calcium, magnesium, sodium, and potassium are important for human nutrition and therefore, consumption of fish provides these minerals. The current study has concentrated on calcium and iron because these were reported to be low in diets of households in Northern Province (Alaofe et al., 2014)

2.5.4.1 Iron

Some fish (especially small species) are rich in iron (Fe), however, this nutrient is concentrated in the head and visceral (Kawarazuka and Béné, 2010).

The composition of iron in fish is different from what is found in plant-source foods because fish contains large amount of heme iron which is characterized by high bioavailability as opposed to non-heme iron found in plant source foods (Kawarazuka and Béné, 2010).

According to Roos et al. (2007), a serving of sour soup made of fish eaten boiled has shown to supply on average 45% of the daily requirement of Fe in women of childbearing age and 42% of that in children.

2.5.4.2 Calcium

Calcium is necessary to maintain optimal bone development; hence fish is a good source of this mineral. Calcium content is much higher in species in which bones are commonly consumed and included in edible parts (Bogard et al., 2015) such as the small fish are an excellent source of calcium (Roos et al., 2002).

In developed countries, dairy products tend to be the primary source of dietary calcium (Belton and Thilsted, 2014) which may not be the case for Zambia. Therefore, dietary calcium is obtained from fish for those living near fishing areas.

2.6 Fish processing / preservation

The common methods of preserving fish are salting, smoking, solar drying, and open sun drying.

2.6.1 Drying

Drying is one of the oldest and most widely used fish preservation methods, used to prolong the shelf life of fish (Ojutiku et al., 2009; Bharda and Desai, 2017). It is the process of removing water from a food product thereby reducing the water activity of that food and preventing the growth of microorganisms in that food (Akinyemi et al., 2011).

2.6.2 Smoking

Fish smoking is the process of treating fish by exposing it to smoke from smoldering wood or plant materials. The process is usually characterized by a combination of salting, drying, heating, and smoking steps (FAO, 2017).

Smoking preserves fish by drying, cooking, and depositing natural wood-smoke chemicals like tars, phenols, and aldehydes all of which have powerful bactericidal action and prevent the growth of other microorganisms on the flesh of the fish (Obodai et al., 2009).

2.6.3 Salting

Salting is an ancient method for preservation of food products. Salted fish products have been one of the most important food items over the years (Ojutiku et al., 2009). The goal of drying salted fish is both to reduce the moisture content of fish and therefore increase the shelf life and to decrease transportation cost. The drying also gives special taste and texture which is desirable in some markets where the product is a popular commodity (Canadian International and Development Agency, 1997).

2.6.4 Open sun-drying

Open sun-drying is presumably the oldest method of preserving fish. It employs heat from the sun and atmosphere. It has been observed as the most convenient and cheapest form of preservation (Farid et al., 2014)

2.6.5 Solar drying

Solar drying is a technique that employs the use of solar energy to dry fish (Ojutiku et al., 2009). It differs from open sun drying in that a structure, often very simple in construction is used to enhance the effects of the insulation due to the fact that a solar tent dryer is an enclosed structure that traps the heat inside the tent and makes effective use of the heat which is stored inside the tent both in the day and night by the help of some rocky stones which are painted black to absorb heat In order to minimize the limitations of open sun drying, solar dryers have been developed. It has been observed as the most convenient and cheapest form of preservation (Ojutiku et al., 2009).

2.7 Barriers to fish consumption

Although fish is considered to be an important part of a healthy and balanced diet many do not consume the recommended amounts due to various barriers to consumption (Christenson et al., 2017) which include price and availability as the major barriers (Longley et al., 2014; Yilma et al., 2020). Some of the barriers are discussed below.

2.7.1 Availability

As it is the case with other food products, fish consumption depends on whether the product is available or not. Fish availability is a subjective factor to a larger extent, as it was established in Norway, people who grew up in the coastal areas where fresh fish was more available, but later moved inland, perceived the availability of fish to be limited (Trondsen et al., 2003). From the consumer point of view, all fish is divided into several segments depending on when the fish is consumed. Some fish products are seen as suitable for everyday consumption while other (mostly of high value) are considered an option for the weekend meal (Trondsen et al., 2003).

2.7.2 Price

Many studies that focus on barriers to fish consumption list price as a major barrier the prevents people to consume more fish (Longley et al., 2014; Yilma et al., 2020; Christenson et al., 2017). The price of fish varies depending on the type of fish and method of processing. For example, according to the study conducted by Birch et al. (2012) in Australia which showed that price has a different effect as a barrier for fresh and frozen fish. The participants of their study reported price of fish to be the main barrier for fresh fish that have a shorter shelf life and more expense (Birch et al., 2012).

2.7.3 Self-efficacy

Self-efficacy refers to the individual’s level of competence in preparing fish. It is usually related to fresh fish, that is believed to need a higher competence in consumers at all stages, from assessing the quality of the fish upon purchase to preparing the meal (Birch and Lawley, 2012). Self-efficacy builds upon consumer’s knowledge, experience, expertise, and self-confidence and it is considered that lower efficacy in preparing fish functions as barrier and leads to lower consumption (Carlucci et al., 2015; Christenson et al., 2017; Skuland, 2015).

2.7.4 Convenience

Convenience can be defined as the ability of a consumer to save time and effort while preparing food. Regardless of fish generally seen as an inconvenient meal option (Olsen et al., 2007) that requires a lot of time and effort in preparation, some fish products, such as processed fish, is perceived as an easy and quick food option (Carlucci et al., 2015). Perceived inconvenience of fish affects fish consumption negatively (Carlucci et al., 2015) it has been proven that those consumers that see fish as difficult to prepare, eat little fish (Birch and Lawley, 2012).

2.7.5 Age

Several studies concluded that younger consumers express less positive attitude towards fish consumption (Birch and Lawley, 2012). While among the young children, the major barrier to fish consumption is the fear of fish bones to hurt them and therefore, fish is not incorporated in their diets (Thorne-Lyman et al., 2017).

2.7.6 Sensory perception

Sensory characteristics of fish, such as taste, texture and smell are important determinants of fish consumption. Consumers usually these characteristics to evaluate the freshness and consequently the quality of fish (Carlucci et al., 2015). Attitude was used in the number of studies as a proxy means of sensory perception. Sensory aspects and taste are among the main criteria that define a person’s attitude towards food products as positive or negative (Olsen et al., 2007).

CHAPTER 3: METHODOLOGY

This chapter presents an overview of the methodological approach which was used to establish the fish consumption patterns and contribution of fish to household diets.

3.1 Study design

A cross-sectional study design was used to carry out the household survey which established the dietary intake of animal source-foods in Luwingu district, with a special focus on fish consumption patterns and nutritional contribution of fish to diets consumed by household members.

3.2 Study area

The survey was conducted in Ibale ward of Luwingu district, Northern Province which was the operational area for the project *'Strengthening Capacity of Local Actors in Nutrition-Sensitive Agrifood Value Chains in Zambia and Malawi Project.'* Luwingu District is one of the nine districts in Northern Province, covering a land area of 8,892 square kilometers with a population of 122, 136 (Central Statistics Office, 2012).

Luwingu has abundant streams, wetlands, and 500 square meters of Lake Bangweulu situated within its boundaries. The district has adequate rainfall and the climate is ideal for crop production, livestock, and fisheries (Nsonga, 2015).

Over 70% of the farming land is used for cultivating cassava, beans, groundnuts, maize, and finger millet. About 86% of households in the district are engaged in farming as their main economic activity (Ngoleka, 2013).

3.3 Study population

The study was conducted among households with women of reproductive age (15-49 years), children aged 6-59 months, men (18-64 years) outside elderly bracket (Central Statistics Office, 2012).

Inclusion criteria

- All households with women of reproductive age (15-49 years), children (6-59 months), men (18-64 years).
- All households with only women (15-49 years) and children (6-59 months).

Exclusion criteria

- All households with elderly people only (65 years and above)

3.4 Sample size and sampling procedures

3.4.1 Sample size determination

The sample size was calculated based on the Cochran's formula (Cochran, 1963) for calculating the sample size as shown below:

$$n = \frac{Z^2 pq}{e^2}$$

$$n = \frac{(1.96)^2\ 0.09\ (1 - 0.09)}{0.05^2}$$

$$= \frac{3.8416 \times 0.09 \times 0.91}{0.0025}$$

$$= \frac{0.3146}{0.0025}$$

$$\text{Sample size} = 126 \text{ households}$$

Where:

n= is the sample size

Z = is the critical value of desired confidence level of 95% (corresponding z-score value is 1.96)

p = the proportion of an attribute that is present in the population; and in this study *p* = 9% (contribution of fish to morning meals in Northern Province (Alaofe et al., 2014).

q = 1 – *p* and *e* = desired level of precision of 5% (0.05)

The calculated sample size of 126 was adjusted for attrition and non-response bias at 5% to arrive at the sample size of 132 households. A total of 132 households were surveyed in the study comprised of 132 women of childbearing age, 132 children (6-59 months), and 46 men (18-64 years).

3.4.2 Sampling procedure

Multi-stage sampling was used in this study. Ibale ward was purposively selected as the operational area for the project. A list of villages was generated from Ibale ward with the help of Fisheries Officers and simple random sampling was used to select three villages (Lundu, Chanika, Munsambwa) out of the 33 villages in Ibale ward. With the help of the village headmen from the selected villages, lists of households with women of reproductive age (15-49 years), children (6-59 months), and men (18-64 years) were generated.

From the generated lists of households, using a determined sampling interval, systematic random sampling was used to select 44 households from each of the three villages that met the inclusion criteria. The first household that met the inclusion criteria was randomly selected and using the sampling interval the next households were selected, this procedure was followed until the required number of 132 households was obtained.

Separate lists of replacement households were prepared and eligible households that refused to participate in the study and those who were not available during the day of interviews were replaced by households from the replacement lists which comprised of 10 households from each village.

3.5 Data collection tool and procedures

A semi-structured questionnaire was used to collect data. The questionnaire comprised of sections on demographics and socio-economic information, 24-hour dietary recall, frequency of animal-source foods consumption, household members' preference for fish with regard to size and the method of processing and barriers to fish consumption.

A 24-hour dietary recall was used to capture information on food consumption 24 hours preceding the data collection exercise. A non-consecutive repeat 24-hour dietary recall was conducted among the participants to estimate the usual dietary intake of the participants. During data collection participants were asked about the type, cooking method, and quantity of foods they consumed in the 24 hours prior to the interview. The quantities of foods consumed were estimated using estimated food intakes in the previous 24 hours done by measuring of foods using common household measures such as the kitchen scales, graduated measuring cups, and spoons. Furthermore, pictures with estimated quantities from carbs and calorie counter book

(Cheyette and Balolia, 2016) were used to estimate the quantity of some common foods. The quantities of the weighed foods were recorded in grams.

After administering the 24-hour dietary recall, the food frequency questionnaire (FFQ) with a 7-day recall period adapted from FAO (2018b) with modification, was used to capture data on frequency of consumption of any type of fish or other animal-source foods consumed 7 days prior to the interview at household level. Further, information about the size of fish and methods of processing for the fish consumed (whether it was fresh fish, sun-dried, smoked or salted) was also collected. The purpose of FFQ in this study was to establish the frequency of consumption of fish and other animal-source foods at household level.

The data collection tool was translated to *Bemba*, a local language that is spoken in Northern Province. The questionnaire was administered by the investigator with assistance from five enumerators who were trained before data collection.

The data collection exercise was from 23rd May to 31st May 2019. The main respondents were mothers/caregivers of reproductive age, responsible for meal preparation within the households. They provided information on their individual food consumption and that of children (6-59 months) as well as at household level consumption. Men provided information about their individual food consumption.

3.6 Pretesting

The data collection tool was pretested among non-participating households in Ibale ward of Luwingu district with similar characteristics. The findings helped to refine the data collection tool before the actual data collection process.

3.7 Data analysis

Data were analyzed using IBM statistical package for social sciences (SPSS) for Windows, version 22.0 (IBM Corporation, Armonk, NY, USA) and Microsoft Excel 2013 while nutrient analysis was done using Nutrisurvey 2007 software.

Descriptive statistics such as means and frequencies were used to summarize and describe various sample socio-economic and demographic characteristics such as income, occupation, and education level. Descriptive statistics were further used to summarize data on consumption patterns such as most consumed animal-source foods, the proportion of participants who consumed fish, frequency of consumption of fish and other animal source foods as well as the barriers to fish consumption.

The nutrient contents of fish and other foods consumed were determined using Nutrisurvey 2007 software. Prior to data entry in the software, the local fish species and other foods that were not in the Nutrisurvey food database were added manually using the Zambian food composition tables and West African food composition tables (Nyirenda et al., 2009; Stadlmayr et al., 2012). The following information was added; names of foods (including preparation/cooking methods), nutrients found in those foods, and their quantities.

During the data entry stage in Nutrisurvey, the age category for the individual study participant was selected and names of the foods consumed entered with appropriate preparation/cooking method. The next step was to input the quantities consumed.

With the data entered in the Nutrisurvey software, analysis of food records for all the 132 women, 132 children aged 6-59 months, and 46 men were done. A Microsoft Excel sheet was generated having quantities of nutrients for all foods consumed and nutrients per food item entered in the software for each individual participant.

In order to ensure accurate calculations of the contribution of fish to diets of household members, those who did not consume fish were eliminated from list prior to calculating the mean intakes of fish and other foods. Thereafter, mean intakes, standard deviations, were calculated using the generated Microsoft Excel sheet for participants who consumed only fish and other foods.

The contribution of fish to diets and contribution of diets to Recommended Nutrient Intake (RNI) was determined using the Nutrient Contribution Ratio (NCR) as explained by Roos et al. (2003) with modification. The NCR expresses the intake of a nutrient of interest from fish estimated to be consumed by the study population in a day as a percentage of intake of that nutrient from the diet (NCR = mean nutrient consumed from fish / mean nutrient from diets X 100).

Analysis of variance (ANOVA) was used to establish the differences in nutrient intake and quantities of fish consumed among the age groups of children. While, an independent *t*–test was used to establish the differences in nutrient intake and quantity of fish consumed between women and men. The normality test for continuous variables was conducted using Kolmogorov-Smirnov

(K-S) (with Lilliefors correction) for participants less than 50 (Elliott and Woodward, 2007). All statistical tests were performed at a critical value $p < 0.05$.

3.8 Ethical considerations

Ethical approval was sought and approved by the Tropical Diseases Research Centre (TDRC) Ethics Committee (00003729) (Appendix 5.0). The permission to collect data in the area was obtained from the District Administrative Officer, District Agriculture Officer, and Village Headmen. Informed consent was obtained from participants by signing the consent forms or thumbprints for those who could not sign. Participants were informed of their freedom to choose either to participate in the study or not. They were also assured that the information provided was going to be treated as confidential.

CHAPTER 4: RESULTS

This chapter presents the findings of this study. It is organized under the following sub-headings: demographic and socio-economic characteristics of the households, fish and other animal-source foods consumption patterns, nutrition contribution of fish to diets and barriers to fish consumption.

4.1. Demographic and socio-economic characteristics of participants.

4.1.1 Age and size of the households

The study enrolled 132 households, with 132 women of the reproductive age, 132 children aged 6-59 months, and 46 men who were present on the day of interviews. The mean age for respondents (mothers/caregivers) was 28.9 ± 7.6 years and those of children aged 6-12 months, 13-36 months and 37-59 months were 10 ± 1.8 months, 23.6 ± 8.0 months, and 47 ± 6.5 months, respectively. While the mean age for men was 35 ± 11.9 years. The household size ranged from two (2) to thirteen (13) household members and the mean was 6.0 ± 2.1 members.

4.1.2 Marital status

About 88.6% (n=117) of the respondents (mothers/caregivers) were married, while 6.8% (n=9) were single. A small percentage (1.5%, n=2) of the respondents were on separation with their spouses and 3% (n=4) were divorced (Table 2).

4.1.3 Level of education

Generally, the education levels of the respondents (mothers/caregivers) were low. More than half (78%, n=103) of the respondents had attained primary school level of education, while 13.6% (n=18) reported to have attained the secondary school level and none had attained tertiary education. Few study respondents (8.3%, n=11) reported to have had no formal schooling (Table 2).

Table 2 Demographic and socio-economic characteristics of respondents[1] in Ibale Ward, Luwingu District, Zambia

Characteristic	Number of respondents (n)	Percent[2] of respondents (%)
Education level of the respondents		
No formal education	11	8.3
Primary	103	78.0
Secondary	18	13.6
Occupation		
Formal	2	1.5
Informal	105	79.5
Unpaid family member	25	18.9
Marital status of respondents		
Married	117	88.6
Single	9	6.8
Separated	2	1.5
Divorced	4	3.0
Household Monthly Income (ZMK[3])		
Less than 250	93	70.5
250 to 500	37	28
Above 500	2	1.5
Proportion of income spent on food (ZMK)		
Less than 200	124	93
200 to 500	8	6.1
Proportion of income spent on fish in a month (ZMK)		
Less than 50	92	69.7
51 to 100	10	7.6
101 to 200	3	2.3.
Above 200	1	0.8
Caught by self / did not buy	26	19.7

[1]132 women, (132 children) and 46 men
[2]Percentage calculated as n/N x 100 and presented as %; N – Total number of households interviewed (N=132 households)
[3]ZMK – Zambian currency (Kwacha); Exchange rate 1USD = ZMK14.074

4.1.4 Occupation

The study categorized occupation as formal, informal, and unpaid family member. Only 1.5% (n=2) of the respondents reported to have been in formal employment, while 79.5% (n=105) reported to have been in informal employment, and 18.9% (n=25) reported to be unpaid family members (Table 2). Further investigation on the type of informal employment revealed that 46.7% (n=50) of respondents reported that they were doing regular small businesses, 12% (n=13) were fishmongers and 0.9% (1) was a shopkeeper. Additionally, 40.2% (n=40) reported to have been doing seasonal businesses such as sale of agricultural products e.g. maize and cassava when they are available from own production.

4.1.5 Monthly income and expenditure on food

Majority of the households (70.5%, n=93) earned less than K250 as their monthly income, 28% (n=37) earned between K250 and K500, while only 1.5% (n=2) earned more than k500.

Further investigation on the proportion of income spent on food revealed that 93% (n=124) of the households spent less than K200 on food per month while 6.1% (n=8) spent above K200 of their income on food. The proportion of income spent on food that was allocated to fish for home consumption showed that 69.7% (n=92) of the households spent less than K50 on fish per month, 7.6% (n=10) spent between K51 and K100 while 2.3% (n=3) spent above K100. Furthermore, 19.7% (n=26) households reported that they never spent any money on fish as they were able to catch fish by themselves for home consumption (Table 2).

4.2 Consumption patterns of fish and other animal-source foods

Fish and other animal-source foods consumption data were captured using a 24-hour dietary recall method while the frequency of consumption of fish and other animal-source foods were captured using the food frequency questionnaire with 7 days recall period.

4.2.1. Fish consumption during the last 24-hours

It was established that 75.8% (n=100) of the households consumed fish while 24.2% (n=32) did not consume fish 24 hours prior to the interview (Figure 2).

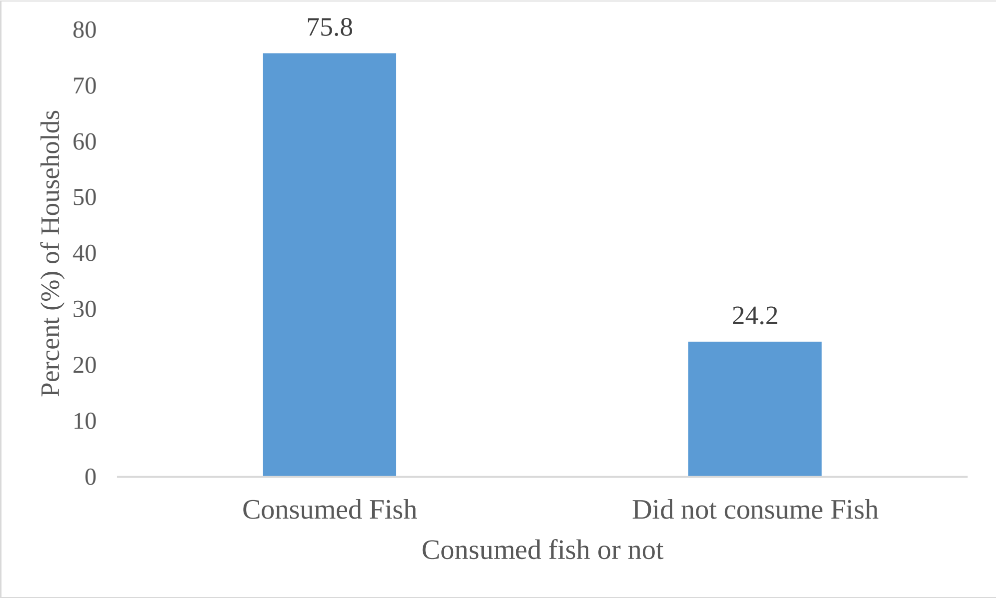

Figure 2. Households' fish consumption obtained through 24-hour dietary recall

Among the household members, 67.4% (n=89) children aged 6-59 months consumed fish. A small proportion (13.5%, n=12) of children aged 6-12 months consumed fish compared to those who consumed fish in ages 13-36 months (51.7%, n=46) and 37-59 months (34.8%, n=31). In adults, 62.9% (n=83) of the women of childbearing age consumed fish while 80% (n=36) men consumed fish as shown in Figure 3.

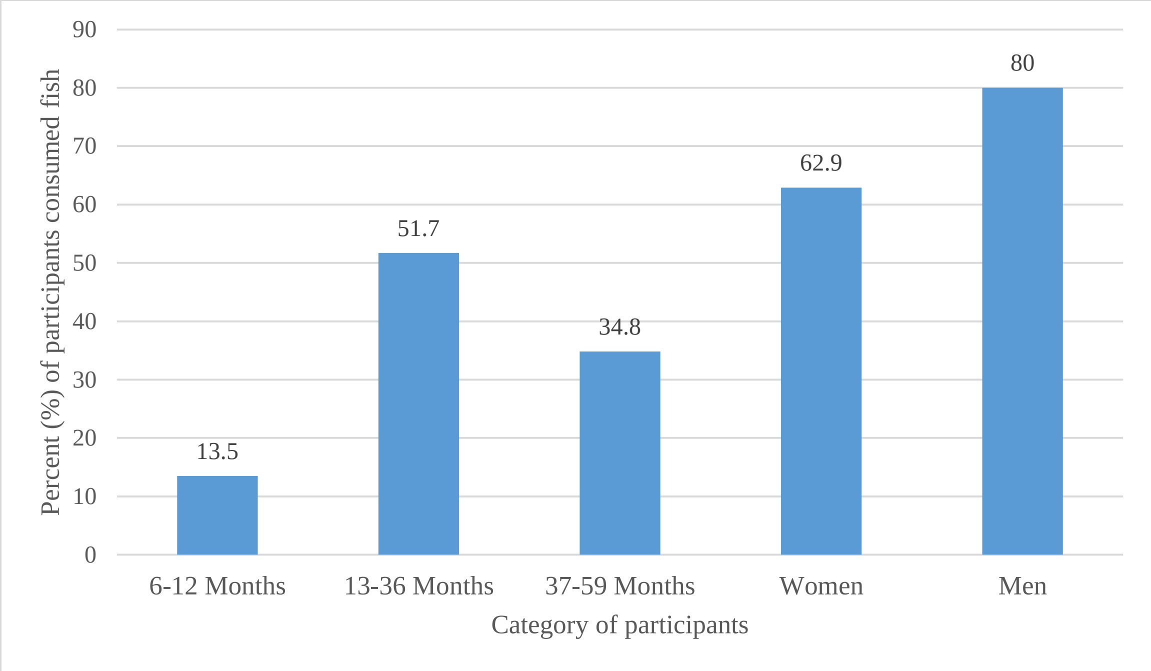

Figure 3. The proportion of participants who consumed fish 24 hours prior to the interview

4.2.3 Quantity of fish consumed by household members 24-hours prior to the interview.

The average quantities of fish consumed by different categories of participants were established as presented in Table 3. On average, older children of ages 37-59 months consumed more fish (87.9 ± 45.7 g/day) compared to young children of ages 6-12 months (60.4 ± 35.2 g/day). Children of ages 13-36 months had a mean consumption of 73.8 ± 51.0 g/day. There was a significant difference in the quantities of fish consumed by children (p = 0.001). In adults, women consumed 162.1 ± 86.0 g/day, while men consumed 173.3 ± 70.0 g of fish per day and no statistical difference was observed in intake between men and women (p = 0.278).

Table 3 Daily fish consumption among different age categories of participants

Category	**Mean intake of fish (g/day)**	**n**
6-12 months	60.4 ± 35.2 (15-110)	12
13-36 months	73.8 ± 51.0 (15-275)	46
37-59 moths	87.9 ± 45.7 (20-210)	31
Women (15-49 years)	162.1 ± 86.0 (20-400)	83
Men (18-64 years)	173.3 ± 70.0 (50-350)	36

n-Number of participants who consumed fish, Values are means ± SD (range)

4.2.4 Consumption of animal-source foods by participants 24-hours prior to the interview

This study established that, the most consumed animal-source food by study participants was fish. Majority of men (80%) consumed fish, followed by children (67.4%) and women (62.9%). Eggs were mostly consumed by children (3.8%) and women (3.8%). Other animal-source foods consumed by children were meat (1.5%) and poultry (0.8%), while 2.3% of women consumed meat and 1.5% consumed poultry. In men, 1.1% consumed meat and 1.1% poultry (Figure 4).

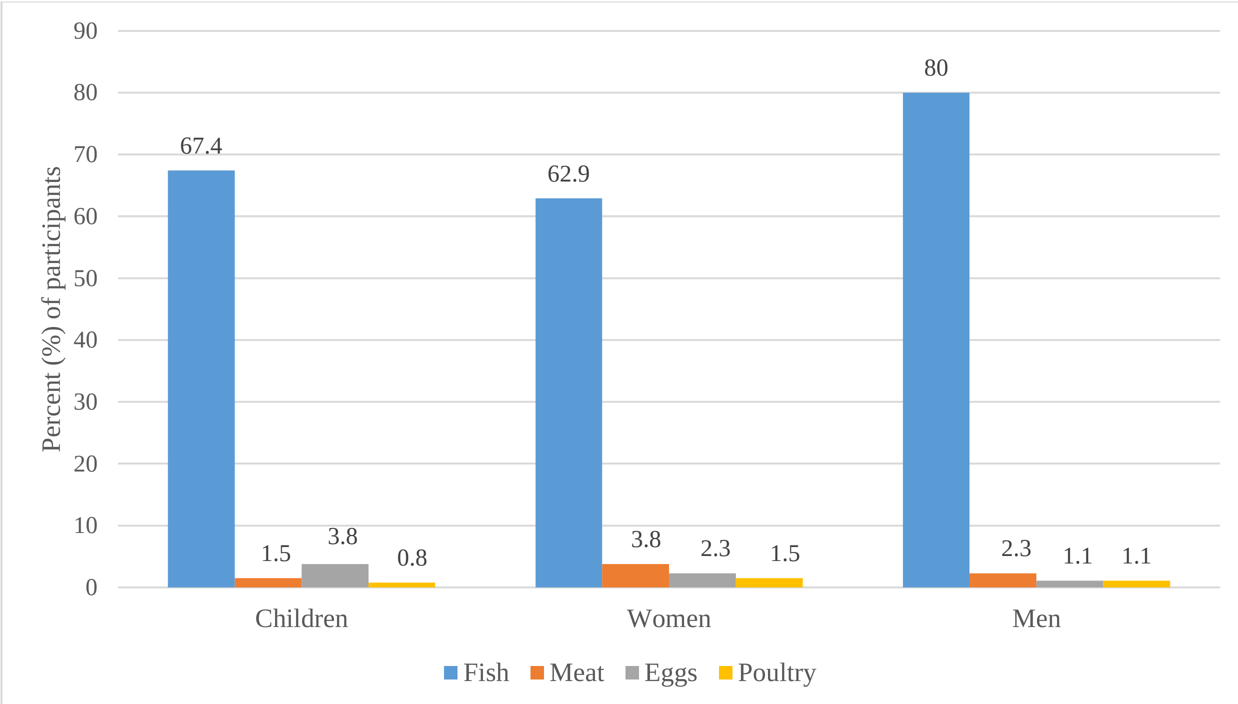

Figure 4. Consumption of animal-source foods 24 hours prior to the interview by children, women, and men

4.3. Household fish consumption 7 days prior to the interview

The frequency of fish consumption was obtained using a food frequency questionnaire considering fish consumption in 7 days prior to the interview at household level.

4.3.1 Household fish consumption in relation to other animal-source foods 7 days prior to the interview

The current study compared the proportion of fish consumed to other animal-source foods within 7 days prior to the interview. It was established that in a 7-day period, fish was the most consumed animal-source food. All households (100%, n=132) surveyed consumed fish, eggs were consumed by 31% (n= 41) of the households. Other animal-source foods consumed by households were meat (13.6%, n=18), poultry (18%, n=24), wild birds (3.8%, n=5) and milk (0.8%, n=1) (Figure 5).

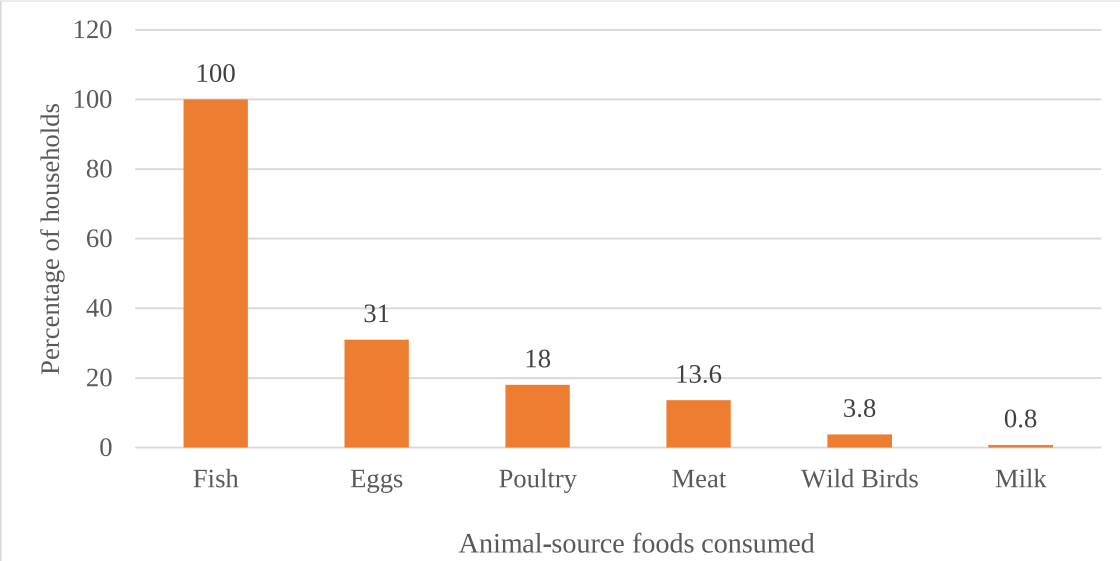

Figure 5. Household fish consumption in relation to other animal-sources food 7 days prior to the interview

4.3.2 Frequency of fish consumption 7 days prior to the interview, at household level

The frequency of fish consumption 7 days prior to data collection was established at household level. The fish consumed was categorized into size and method of processing, the following were the findings.

Few households (2.3%) consumed small-sized fish every day, more than once which was the highest frequency. In medium-sized fish the highest frequency was three to four days, reported by 8.3% households, while in large-sized fish the highest frequency was three to four days reported by 0.8% households. Most of the households consumed fish one or two days in 7 days prior to the interview (Table 4).

In all categories of fish, small fish had the highest frequency of consumption and the largest proportion of households consuming it while the lowest frequency and proportion of households was among those who consumed large-sized fish.

Table 4 Household Frequency of fish consumption 7 days prior to the interviews

Fish	Everyday more than once	Everyday once a day	Three to four days	One to two days	Total
	% (n)	% (n)	% (n)	% (n)	% (n)
Fresh					
Small fish	2.3 (3)	2.3 (3)	17.4 (23)	42.4 (56)	64.4 (85)
Medium	0.8 (1)	0 (0)	8.3 (11)	28.0 (37)	62.0 (83)
Large	0 (0)	0 (0)	0 (0)	3.8 (5)	3.8 (5)
Sun-dried					
Small fish	0.8 (1)	0 (0)	2.3 (3)	35.6 (47)	38.6 (51)
Medium	0 (0)	0 (0)	3.0 (4)	10.6 (14)	13.6 (18)
Large	0 (0)	0 (0)	0.8 (1)	1.5 (2)	2.3 (3)
Smoked					
Small	2.3 (3)	3.0 (4)	9.8 (13)	12.1 (16)	27.3 (36)
Medium	0 (0)	0 (0)	1.5 (2)	0 (0)	1.5 (2)

n-Number of households that consumed fish

4.3.3 Most consumed form of fish 7 days prior to the interview

In this study, 66.1% (n=87) of the households consumed fresh fish while 33.9% (n=45) households consumed processed/preserved fish (Figure 6).

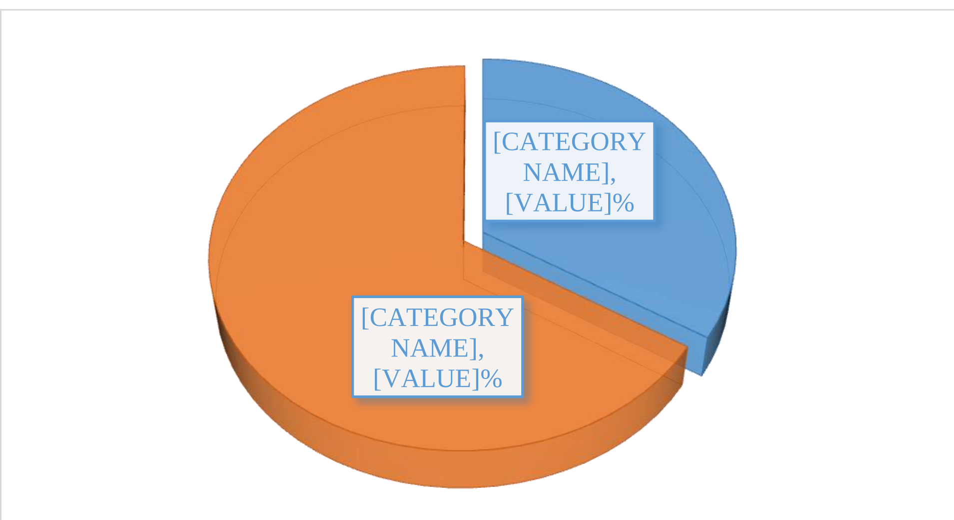

Figure 6. Proportion of households consumed preserved and fresh fish

4.3.4 Fish consumption in relation to the method of processing and size (small, medium, and large)

Small-sized fresh fish were the most consumed as they were consumed by 64.4% (n=85) of the households, followed by small-sized sun-dried fish (38.6%, n=51), while the least consumed were the small-sized smoked fish 27.3% (n=36) as indicated in Figure 8. The small fish included *Chalukuwa*, *Chisense (Stolothrissa miodon), Kapenta (Limnothrissa miodan)* (lower right corner), *Kapupu* (Lower right corner), *Kasepa* (top right corner), *Katopwe* (top left corner) *and Ubushimba*, Figure 7 shows different small sized fish consumed.

Figure 7. Small-sized fish consumed by households in Luwingu district. *Photo from Kamumango market Luwingu.* [Photo by the author]

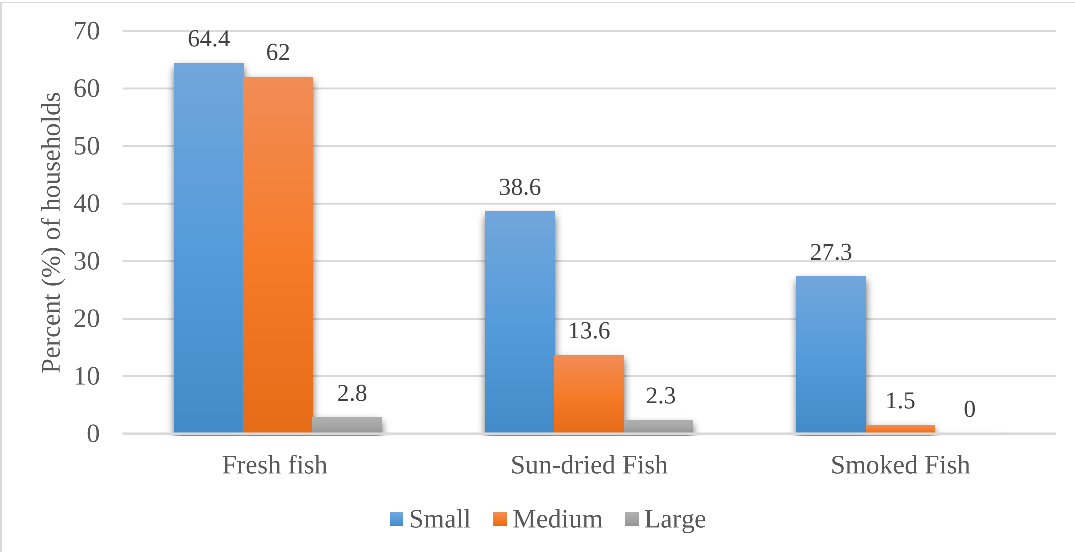

Figure 8. Household fish consumption in relation to method of processing and size

Medium-sized fresh fish were consumed by 62.0% (n=83), followed by medium-sized smoked fish (1.5%, n=2), while the least consumed were the medium-sized sun-dried fish (13.6%, n=18) as indicated in Figure 8 and displayed in Figure 9. Fish in this category included *Amatuku (Tilapia sparmanii), Bomba (Clarias stampersii boulenger)* (right)., *Buka buka fish (Lates angustifrons)* (left) *Milonge (Clarias theodorae), Mintesa (Marcusenius macrolepidotus), Impende (Sargochromis giardii)* and *Polwe (Serranochromis Angusticeps).*

Figure 9. Medium-sized fish consumed in Luwingu district. *Photo from Kamumango market Luwingu.* [Photo by the author]

In the category of large-sized fish, fresh fish were the most consumed (2.8%, n=5), while sun-dried fish were consumed by 2.3% (n=3) (Figure 8). *Bomba (Clarias stampersii boulenger), Milonge (Clarias theodorae)* (left), *Impende (Sargochromis giardii)* (right) and *Polwe (Serranochromis Angusticeps)* were the large fish types reported. Large fish are shown in Figure 10.

Figure 10. Large-sized fish consumed in Luwingu district. [Photo by the author]

4.3.5 Frequency of consumption of animal-source foods 7 days prior to the interview, at household level

The current study revealed that other animal-source foods were mostly consumed one or two days in the 7 days prior to the interview and more households reported to have consumed eggs and poultry (Figure 11). Very few households consumed meat and chicken for three to four days in 7 days. The findings agree with the 24-hour recall data which revealed eggs as the second most consumed animal-source food.

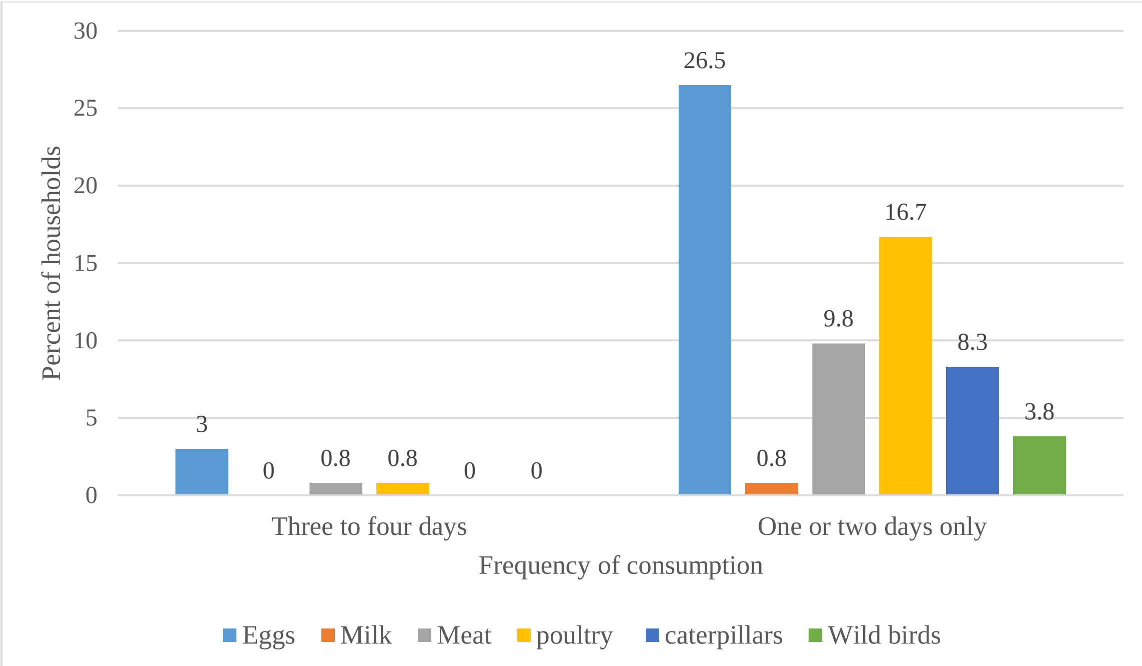

Figure 11. Households' frequency of consumption of other animal-source foods 7 days prior to the interview by households

4.4 Contribution of fish to diets of household members 24-hours prior to the interview.

4.4. 1 Description of the diet

In 24 hours prior to the interview, the diets of the households were predominantly plant based and fish. The consumed food groups were roots and tubers which included the following foods; cassava tubers (81%, n=106) and sweet potatoes (25.3%, n=33), vegetables (cassava leaves (*katapa) (*60%, n=79), bean leaves (*chimpapila*) (20%, n=26), sweet potatoes leaves (*kalembula*) (24.5%, n=32), and pumpkin leaves (*chibwabwa*) (37.5%, n=50), rape (17.5%, n=23), Chinese cabbage (30%, n=40) and okra (13%, n=17). While in the group of pulses/legumes/nuts consumed foods consumed were beans (35.1%, n=46), groundnuts (38.5%, n=51) and cowpeas (10.4%, n= 14), *pumpkins (15.0%, n=20)*. Other groups consumed were: cereals (nshima from maize (43%, n=57)), fish 75.8% (n=100), Eggs (3.8%, n=5), meat and poultry (meat (2.3%, n=3), and chicken (1.5%, n=2))

The foods described were used to calculate the mean intake of nutrients from diets of children, women, and men (Table 5).

4.4.2 Contribution of fish to diets of household members

The contribution of fish to diets consumed by children, women, and men was analyzed for proteins and selected key micronutrients such as vitamin A, calcium, and iron which were reported to be inadequate in diets of households in Northern Province (Alaofe et al., 2014).

Due to differences in nutrient requirements, children aged 6-59 months were categorized into various age groups according to WHO (WHO and FAO, 2004) and the contribution was calculated for each age group. The contribution of fish to diets consumed in terms of the selected nutrients are presented in Table 6 and 7 for children and adults, respectively.

Table 5 Mean intake of nutrients from fish and other foods among the study participants

Nutrients	**Children**			**Women**	**Men**
	6-12 months	**13-36 months**	**37-59 months**		
Nutrients in fish consumed (based on 24-hour recall)					
Protein (g/day)	10.4 ± 5.9 (2.4-17.6)	11.6 ± 5.8 (3.2-24.0)	13.2 ± 5.9 (4.0-24.0)	30.9 ± 16.5 (4.3-67.0)	41.3 ± 25.9 (10.7-134.0)
Iron (mg/day)	1.0 ± 0.7 (0.1-2.2)	1.1 ± 0.9 (0.1-3.0)	1.2 ± 0.8 (0.1-3.0)	2.3 ± 1.6 (0.1-6.0)	2.8 ± 2.8 (0.3-12.0)
Calcium (mg/day)	24.8 ± 18.1 (2.5-55.0)	28.0 ± 21.2 (2.5-75.0)	31.7 ± 18.8 (3.4-75.0)	56.1 ± 40.3 (3.4-150)	55.6 ± 38.1 (8.5-150.0)
Vitamin A (µg/day)	4.6 ± 2.6 (1.0-7.7)	5.5 ± 3.3 (1.4-16.0)	7.0 ± 3.7 (1.8-17.7)	12.2 ± 6.9 (1.8-22.5)	14.4 ± 6.0 (4.5-27.5)
Nutrients in the entire diet (based on 24-hour recall)					
Proteins g/day	25.7 ± 21.1 (4.6-88.5)	25.5 ± 10.4 (1.6-55.5)	32.0 ± 21.0 (6.9-109.1)	64.7 ± 25.2 (25.7-170.1)	80.0 ± 34.3 (27.1-207.4)
Iron mg/day	6.8 ± 7.6 (1.7-32.4)	6.7 ± 2.5 (0.8-12.6)	7.5 ± 3.7 (2.6-17.6)	18.1 ± 5.9 (8.6-39.0)	19.7 ± 5.6 (10.7-35.9)
Calcium mg/day	91.4 ± 45.5 (30.8-206.5)	93.4 ± 57.0 (7.45-258.0)	99.7 ± 50.0 (40.3-214.3)	293.7 ± 230.9 (75.2-146.2)	234.9 ± 122.5 (64.9-673.9)
Vitamin A µg/day	63.2 ± 56.0 (5.1-163.9)	64.2 ± 60.0 (3.9-199.6)	63.7 ± 69.0 (4.1-254.2)	170.2 ± 212.1 (2.4-1580.8)	139.5 ± 163 (10.7-677.8)

Results presented as means ± SD (Range)

4.4.3 Protein

Protein intake from fish was determined for all the groups of participants and it was established that, among children, the mean protein intake from fish was 10.4 ± 5.9 g/day, 11.6 ± 5.8 g/day, and 13.2 ± 5.9 g/day for children aged 6-12 months, 13-36 months and 37-59 months, respectively. In adults, the average consumption was 30.9 ± 16.5 g/day (women) and 41.3 ± 25.9 g/day (men) (Table 5). Protein intake from fish was observed to increase with age among children and a statistically significant difference in intake was observed among children ($p = 0.042$) and among adults ($p = 0.028$).

The protein contribution of fish to diet was also determined and it was observed that, in children aged 6-12 months, fish contributed 40.9% to diet, while in 13-36 months and 37-59 months it contributed 45.5% and 40.3%, respectively (Table 6). In diets for adults, fish contributed 47.8% of the protein in women and 51.6% in men (Table 7). These results showed that fish contributed fairly close to half of the proteins to diets of most of the study participants with the exception of men in which fish contributed more than half of the proteins to the diet.

Table 6 Contribution of fish to diets of children aged 6-59 months in terms of proteins, iron, calcium, and vitamin A

Nutrients	**6-12 months**			**13-36 months**			**37-59 months**		
	Diet	**Fish**	**% contr**	**Diet**	**Fish**	**% contr**	**Diet**	**Fish**	**% contr**
Proteins g/day	25.7	10.4	**40.9**	25.5	11.6	**45.5**	32.7	13.2	**40.3**
Iron mg/day	6.8	1.0	**14.7**	6.7	1.1	**16.4**	7.5	1.2	**16.0**
Calcium mg/day	91.4	24.8	**27.1**	93.4	28.0	**30.0**	99.7	31.7	**31.2**
Vitamin A µg/day	63.2	4.6	**7.3**	64.2	5.5	**8.7**	63.7	7.0	**11.0**

Contr- contribution; % Contribution = mean nutrient consumed from fish/ mean nutrient from diets X 100

4.4.3 Vitamin A

The intakes of vitamin A from fish for children were as follows; 4.6 ± 2.6 µg/day, 5.5 ± 3.3 µg/day, and 7.0 ± 3.7 µg/day for children aged 6-12 months, 13-36 months, and 37-36 months, respectively. In adults, the mean intake was 12.2 ± 6.9 µg/day for women and 14.4 ± 6.0 µg/day for men (Table 5). Although it was observed that the daily intake of vitamin A increased with age in children, statistically, there was no significant difference observed in intake of vitamin A in the age categories of children ($p = 0.22$) and among adults ($p = 0.161$).

With regards to contribution of fish in terms of vitamin A to diets, in children aged 6-12 months fish contributed 7.3% while in children aged 13-36 months and 37-59 months fish contributed 8.7% and 11.0%, respectively (Table 6). In adults, fish contributed about 7.1% vitamin A to diet in women and 10.3% in men (Table 7).

It was observed that the contribution of fish in different age groups for children increased with age. In older children fish contributed more vitamin A than in younger ones. These results are related to what was established in section 4.2.3, that the quantity of fish consumed by children increased with age.

4.4.4 Calcium

The study revealed that in the category of children, average intake per day was; 24.8 ± 18.1 mg/day, 28.0 ± 21.2 mg/day, and 31.7 ± 18.8 mg/day for children 6-12 months, 13-36 months, and 37-36 months, respectively, while in adults it was 56.1 ± 40.3 mg/day for women and 55.6 ± 38.1 mg/day for men (Table 5). Regardless of the variations in intake observed, the intake of calcium was not significantly different amongst the children ($p = 0.544$) and among men and women ($p = 0.919$).

Further analysis on the contribution of fish in terms of calcium to diets in children, women, and men showed that in children aged 6-12 months fish contributed 27.1% of calcium to diets while in those aged 13-36 months and 37-59 months fish contributed 30.0% and 31.2%, respectively (Table 6). In adults, fish contributed 19.1% (women) and 23.7% (men) of calcium to diets (Table 7).

Table 7 Contribution of fish to diets of women and men in terms of proteins, iron, calcium, and vitamin A

Nutrients	**Women**			**Men**		
	Diet	**Fish**	**% contr***	**Diet**	**Fish**	**% contr**
Proteins g/day	64.7	30.9	**47.8**	80.0	41.3	**51.6**
Iron mg/day	18.1	2.3	**12.7**	19.7	2.8	**14.2**
Calcium mg/day	293.7	56.1	**19.1**	234.9	55.6	**23.7**
Vitamin A µg/day	170.2	12.2	**7.1**	139.5	14.4	**10.3**

Contr*- contribution; % Contribution = mean nutrient consumed from fish/mean nutrient from diets X 100

4.4.5 Iron

The average iron intake in children was 1.0 ± 0.7 mg/day, 1.0 ± 0.9 mg/day, and 1.2 ± 0.8 mg/day for children aged 6-12 months, 13-36 months, and 37-36 months, respectively. In adults, the average intake was 2.3 ± 1.6 mg/day in women and 2.8 ± 2.8/day mg in men (Table 5). There was no difference in iron intake among children ($p = 0.479$), while in adults a significant difference in intake was observed between men and women ($p = 0.008$).

The contribution of fish in terms of iron to diets showed that fish contributed 14.7% of iron in children aged 6-12 months and 16.4% in children aged 13-36 months, while in children aged 37-59 months, it contributed 16.0% (Table 6). In adults, fish contributed 12.7% iron to diets consumed by women and 14.2% by men (Table 7). From the results, it was observed that the contribution of fish in terms of iron was increasing with age as revealed in other nutrients in the children category and that men had the highest contribution from fish compared to other categories of the study participants.

4.5 Micronutrients contribution of diets to Recommended Nutrient Intake (RNI)

The study further looked at how diets consumed by participants contributed to RNI in terms of micronutrients (vitamin A, calcium, and iron).

4.5.1 Nutrient contribution of diets to RNI in children

The contribution of diets to RNI in children was low for vitamin A and calcium while for iron, the dietary intake exceeded the RNI for all age groups of children (Table 8).

Table 8 Mean intakes of micronutrients and their contribution to RNI

Nutrients	6-12 months			13-36 months			37-59 months		
	Diet	RNI[1]	% Contr[2]	Diet	RNI	% contr	Diet	RNI	% Contr
Vitamin A µg/day	63.2	190	**33.3**	64.2	200	**32.1**	63.7	200	**31.8**
Calcium mg/day	91.4	400	**22.9**	93.4	500	**18.7**	99.7	600	**16.6**
Iron mg/day	6.8	6.2	**109.7**	6.7	3.9	**171.8**	7.5	4.2	**178.5**

RNI[1]=Recommended Nutrient Intake, Contr[2] = Contribution to RNI, NCR = the intake of a nutrient from diet/FAO-WHO recommended intake X 100

4.5.2 Nutrient contribution of diets to RNI in adults

Among the adults, the nutrient contribution of diets to RNI was fairly low in terms of calcium and vitamin A though variations were observed in vitamin A which was more than 50% in women and close to 50% among men. The dietary contribution of iron was close to meeting the recommended intake in women, while in men it exceeded the RNI (Table 9).

Table 9 Mean intakes of micronutrients and their contribution to RNI

Nutrients	**Women**			**Men**		
	Diet	**RNI**	**% Contr**	**Diet**	**RNI**	**% Contr**
Vitamin A µg/day	170.2	270	**63.0**	139.5	300	**46.5**
Calcium mg/day	293.7	1000	**29.4**	234.9	1000	**23.5**
Iron mg/day	18.1	19.6	**92.3**	19.7	9.1	**216**

RNI[1]=Recommended Nutrient Intake, Contr[2] = Contribution to RNI, NCR = the intake of a nutrient from diet/FAO-WHO recommended intake X 100

4.6 Barriers to fish consumption

More than half (54.5%, n=72) of the households reported facing several challenges associated with fish consumption. A large number of households (76.4%, n=55) reported that they were unable to consume as much fish as they desired because it was expensive, 29.2% (n=21) reported that fish was not readily available in the markets while 6.9% (n=5) reported that the fish found in the area is of poor quality. Furthermore, 20.8% (n=15) of the households reported that fish takes a lot of time to prepare and because of that, they were unable to consume as much fish as they desired (Figure 12).

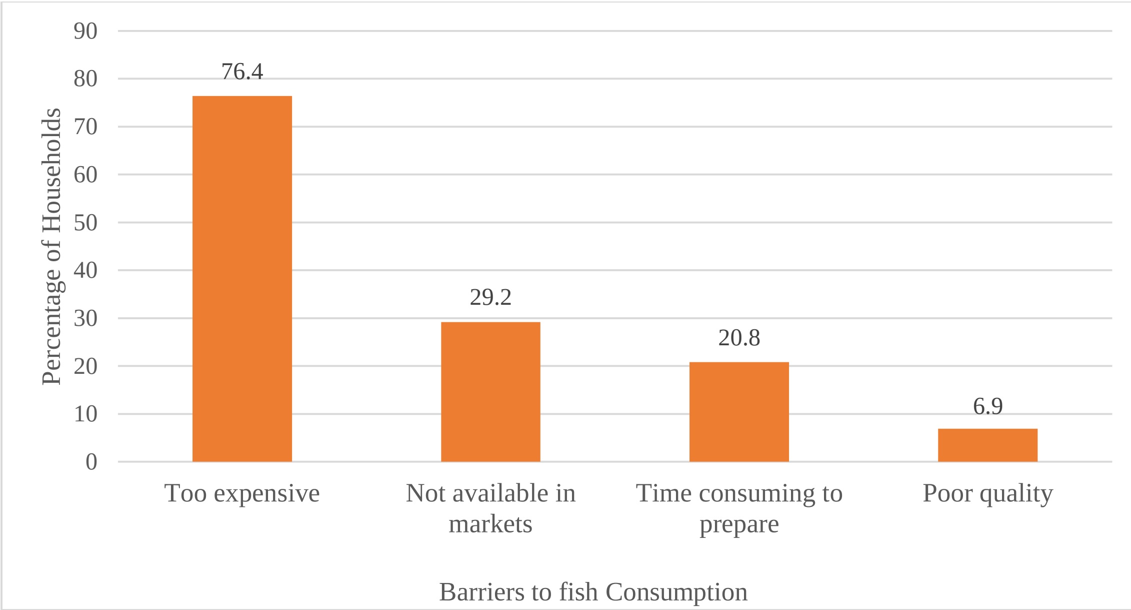

Figure 12. Barriers to fish consumption among consumers interviewed in Ibale

CHAPTER 5: DISCUSSIONS

The aim of the study was to assess the fish consumption patterns and the contribution of fish to household diets in Luwingu district. The findings of the study showed that fish plays a critical role in the diets of rural households in the district as evidenced by the 24-hour dietary recall and 7-day dietary recall data which indicated that fish was regularly consumed, as 75.8% household consumed fish in 24 hours prior to the interview, while all (100%) households surveyed consumed fish 7 days prior to the day of the interview. Studies by Marinda et al. (2018), Bandoh and Kenu (2017), and Mlauzi and Mzengereza (2017) carried out in urban Lusaka, Zambia, Ghana, and Malawi, respectively, showed that 81%, 78%, and more than 50% of the households consumed fish 24 hours prior to data collection.

The quantity estimates of fish consumption by household members showed that in the children category the quantities increased with age with the significance difference in quantities consumed. The lowest being children in the age group 6-12 months which may be attributed to the fact that this category does not often eat fish for fear of being choked by fish bones compared to other age groups and this was a barrier to consumption (Marinda et al., 2018). Additionally, children aged 6-12 months usually consume small quantities of food (Gibson et al., 2010), therefore, low consumption even in this study. A related study conducted in Bangladesh confirms this trend of consumption among children (Thorne-Lyman et al., 2017).

The current study also revealed that men consumed more fish as compared to other participants. The findings where men consuming more fish are in line with the study conducted by Marinda et al. (2018), which revealed that men consumed more fish (110.3 g/day) than women (91.4 g/day). Children aged 24-59 months consumed more (49.0 g/day) than those aged 6-24 months (36.9 g/day), although the study by Marinda et al. (2018) showed lower quantities consumed by participants compared to the present study, which confirms that rural households consumed more fish than urban poor households (Hichaambwa, 2012).

Intra-household fish distribution observed in this study where men consume more fish compared to women and children was also observed in the study conducted by Gomna and Rana (2007) in Nigeria, which revealed that male household heads consumed larger quantities of fish compared to their wives and children. Gomna and Rana (2007) further explained that when a single fish was shared, there was a tendency to distribute the body to the men, the tail to his wife, and the head to children. This intra-household distribution of fish which is skewed towards men compared to other categories of household members may be due to households social structure common in African rural areas where men are given large quantities of food on account that they are heads of the households and engage in manual labor which requires more energy at an expense of children and women of reproductive age who are more vulnerable to nutrient deficiencies due to physiological changes and increased nutrient requirements.

In the current study, fish consumption was compared with other animal-source foods consumed 24 hours prior to the interview and it was revealed that fish was the most consumed animal-source food among the household members. These findings are in line with the National Nutrition Surveillance survey conducted by the National Food and Nutrition Commission (NFNC) (2009) which established that fish was the most (41%) consumed animal-source food in 24 hours prior to the interview. Another related study conducted in Indonesia by Gibson et al. (2020) revealed that fish was the most consumed animal-source food with about 90% of women consuming fish 24 hours prior to the interview.

Fresh fish was the most consumed form of fish by households than processed/preserved fish during the period of data collection. With regards to the size of fish consumed, small-sized fish were the most consumed by households, followed by medium-sized fish and the least consumed were large-sized fish. In a related study, Genschick et al. (2018) found that small fish were the most consumed in Zambian urban areas.

Among the small-sized fish, the current study also revealed that small fresh fish were the most consumed which differs from the study conducted by Genschick et al. (2018) which established that sun-dried small fish were the most consumed in urban Lusaka. The differences may be because small fresh fish were more accessible by households in the study area which is near the water bodies where fish is caught from. To extend the shelf life of small fish, it is usually processed by sun-drying, smoking or other means before it is transported to urban centers that are far from the water bodies.

Small fish play a critical role in micronutrient intake because they are consumed whole since micronutrients are concentrated in bones and visceral (Kawarazuka and Béné, 2011; Nölle et al., 2020). They also offer nutritional advantages as they can be processed and stored for longer periods compared to medium to large-sized fish. They are also affordable and can be evenly divided among household members (Kawarazuka and Béné, 2011).

This study further established the proportion of households consuming fish in relation to other animal-source foods 7 days prior to the interviews and the findings revealed that fish was the most frequently consumed ASF by households, followed by eggs and the least were meat and poultry. Other consumed foods were wild birds, and milk. These findings agree with the 24-hour recall in this study. The 7-day frequency of consumption findings are in line with the 24-hour recall data findings, where fish was the most consumed ASF followed by eggs and the least consumed were meat and poultry. Roos et al. (2003) and Mlauzi and Mzengereza (2017) established that fish had the highest frequency of consumption compared to other animal-source foods in related studies in Bangladesh and Malawi where a five-day recall period and 7-day recall periods were utilized, respectively. Another study conducted in Indonesia also agrees with the current study's findings that fish is the most frequently consumed animal-source food (Gibson et al., 2020).

The present study further determined the intake and contribution of fish to diets in terms of selected micronutrients (vitamin A, calcium, and iron) and proteins. Variations in intake were observed and intake increased with age among the children in most of the nutrients. Regardless of the variations in intake, there were no statistically significant differences in intake of all selected micronutrients among children based on their age categories, whereas the difference in intake was observed in protein.

In adults, the variations were observed between men and women. A significant statistical difference in intake was observed in proteins and iron while no significant difference was observed in vitamin A and calcium between men and women. Therefore, large quantities of fish consumed among the men translated into higher nutrient intakes in terms of proteins and iron.

Apart from the consumption of ASFs especially fish, the current study also found that more households were consuming dark green leafy vegetables which are good sources of pro-vitamin A carotenoids such as β-carotene. Cassava tubers were mostly consumed and therefore, provided a significant amount of calcium and iron as these are high in cassava (Bayata, 2019). Other foods that contributed to proteins and micronutrients were soya beans, beans, and sweet potatoes.

Considering the contribution of fish to diets, this study further revealed that fish contributed more to diets in terms of proteins and calcium while the lowest contribution was observed in iron and vitamin A across all study participants. There were variations in the percent contribution of nutrients among the groups of participants. In the studies conducted by Bogard et al. (2015) and Roos et al. (2003) which revealed that calcium, vitamin A and iron were much higher in fish and they serve as an important source of vitamin A and calcium. Kawarazuka and Béné (2011) also established that fish was the major source of micronutrients and therefore, it is able to contribute significantly to diets.

Furthermore, this study established a low contribution of diets to RNI in terms of the selected micronutrients (vitamin A and calcium) except for iron which exceeded the RNI in most of the participants. Though iron intake exceeded the RNI, the district has higher levels of anemia which may be attributed to the largest contribution of iron from plant sources (non-heme iron) which is less bioavailable to the body compared to hem iron found in animal-source foods which is well absorbed (Kawarazuka and Béné, 2010). The other reason could be that anemia is also caused by infectious diseases such malaria (Ncogo et al., 2017).

The diets of the participants did not meet vitamin A and calcium recommended intake and this is related to the study conducted in northern province by Alaofe et al. (2014) which revealed that households diets in Northern province are deficient in vitamin A and calcium, which increases the risk of children and women developing nutrient deficiencies and low height for age (stunting) which has positive relationship with fish consumption among children aged 6-23 months (Marinda et al, 2018). On the contrary, infants may have met their recommended nutrient intake through breast milk which was not captured in the current study, though the iron content in breast milk is low at the complementary food stage (Gibson et al., 2010).

Regardless of high fish consumption observed among households, households were faced with several barriers to fish consumption. The most common barriers were the cost fish as some households could not afford to buy fish due to limited income as established in this study that household have limited income and therefore could not afford to buy fish. The other common barrier was availability of fish in the markets among those households living far from the water bodies as they depended on the fish in the markets. In similar studies conducted by Yilma et al.

(2020), Christenson et al. (2017), and Grieger et al. (2012), cost and availability of fish were frequently reported as barriers to fish consumption.

This study, however had a limitation which was inadequate information on the nutrient composition of locally available foods in the Zambian food composition tables led to the use of the West African food composition tables which may have some disparities in the nutrient composition of some foods used to calculate the nutrient contribution ratio.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study established that fish is an important part of the diets of most households of rural communities of Luwingu district and that it was the most consumed animal-source food when compared to other animal-source foods. Small species were the most consumed type of fish.

Fish contributed fairly to the much-needed micronutrients and proteins from animal-source foods particularly for children aged 6-59 months and women of reproductive age. Though dietary contribution to RNI was low in vitamin and calcium. Regardless of high consumption fish reported, the cost of fish and availability were reported as the most common barriers to its consumption among the fish consuming households.

The high proportion of household consuming fish and its contribution to diets is an indication that fish plays a key role in the household diets of rural communities. Therefore, fish consumption should be fully promoted not only as a good of source proteins but also as a good source of vitamins and minerals. This will enhance food security amongst the fish consuming households and ultimately reduce micronutrient deficiencies.

6.2 Recommendation

1. Fish should be fully incorporated in the strategies and programs aimed at reducing micronutrient deficiencies because it is consumed by many households.

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APPENDICES

1.0 Information sheet

My name is Geofrey Maila, a student at the University of Zambia studying Master of Science (MSc) in Human Nutrition. I am conducting a study focusing on assessing the fish consumption patterns and contribution of fish to household diets of Luwingu district in Northern Province, Zambia. The study is for academic purposes only.

It will provide information on the fish consumption patterns and its contribution to the diets. This will help interested stakeholders to incorporate fish in the programs and strategies aimed at reducing the undernutrition.

Participation in this study is entirely voluntary, therefore you are free to either participate or decline. If you decide to participate in this study, you will be required to provide information on different kinds of foods you eat and details on fish. Therefore, your honest answers to these questions will be of great benefit to the study. You are free to ask questions where you are not clear. The information collected will be taken as confidential and this interview will take about 35 minutes.

Investigator's contact details

Geofrey Maila

The University of Zambia

School of agricultural sciences

Department of Food Science and Nutrition

P.O. Box 32379,

Lusaka, Zambia.

Mobile +260 968693203

2.0 Consent

The investigator/enumerator has explained to me clearly about the proposed research study. I agree
that I understand the above description of this research and that I want to take part in the study.

Participant

_______________________ ___________________________ ________________

Name of Participant Signature Date

Witness

_______________________ ___________________________ ________________

Name of witness Signature Date

Investigator:

_______________________ ___________________________ ________________

Name of Researcher Signature Date

Investigator's contact details

Geofrey Maila

The University of Zambia

School of agricultural sciences

Department of Food Science and Nutrition

P.O. Box 32379,

Lusaka, Zambia.

Mobile +260 968693203

3.0 Questionnaires

3.1 English Questionnaire

FOOD CONSUMPTION SURVEY QUESTIONNAIRE

GENERAL INFORMATION

Questionnaire number	
Constituency Name	
Ward Name	
Name of enumerator	
Date of interview	**……………/…………. / 2019**

SECTION A: DEMOGRAPHIC AND SOCIO-ECONOMIC INFORMATION

A1	Name of the respondent		
A2	Age of the respondent	[ ][ ] Years	
A3	Sex	1. Male 2. Female	[ ]
A4	What is the highest level of education you have attained	1. None 2. Primary 3. Secondary 3. Tertiary	[ ]
A5	What is your marital status?	1. Single 2. Married 3. Separated 4. Divorced 5. Widowed	[ ]
A6	Are you in formal or informal employment	1. Formal 2. Informal 3. Unpaid family member –*skip to A8*	[ ]
A7	Specify the types of employment a bit more if formal or informal ……	1. Tailor 2. Shopkeeper 3. Fish monger 4. Teacher 5. Business 6. Other (please specify!	[ ]

		……………………………………………	
A8	What is your monthly income in Kwacha	1. Less than 250 2. 251 to 1000 3. 1001 to 2000 4. Above 2000	[ ]
A9	How much money do you spend on Food per month	1. Less than 200 2. 201 to 500 3.500 100 4. Above 1000	[ ]
A10	How much money do you spend on fish for consumption per month	1. Less than 50 2. 51 to 100 3.101 200 4.Above 200 5.I catch by myself /Nil	[ ]
A11	How many people live in your household?	1. Specify ____________	[ ]

SECTION B: FOOD CONSUMPTION (24 HOUR RECALL)

Before beginning the 24-hour recall: Enumerator asks the respondent if the previous 24 hour period was "Usual" or "Normal" for his/her household. If there was a special occasion, such as funeral or feast, another day should be selected for the interview. If this is not possible, please select another household instead of asking the respondent about an earlier day in the week.

B1: CHILD FOOD CONSUMPTION QUESTIONNAIRE (6-59 MONTHS)

Do you have a child aged 6-59months	**Yes =1 0=No *skip to section C***
Name of the child	
Age in months	**[ ] [ ] Months**

Complete the table below by entering appropriate responses in the spaces provided.

In the previous 24 hours (1 day), what foods did your child eat as part of the meals or as snacks?

Time of day *1= morning*	**Name of food consumed**	**Method of preparation**	Quantity of food consumed	Processing level of each ingredients	Source of food	**Place eaten**

2- mid morning 3 = Mid-day 4= Afternoon 5= Evening 6= Night		*1=Boiled 2=fried 3= Roasted 4= Raw 5=Other specify*	*Estimate using household measures*	*1= raw, fresh 2= dried 3=flour or powder 4=other (specify)*	*1=Own production 2=Purchased 3=Gift 4=other specify-*	*1=Home 2=out of home*

B2: WOMEN FOOD CONSUMPTION QUESTIONNAIRE

Complete the table below by entering appropriate responses in the spaces provided.

In the previous 24 hours what foods did you eat as part of the meals or as snacks.

Name of female HH member

Age in years [ ] [ ] Years

Time of day	**Name of food consumed**	**Method of preparation**	Quantity of food consumed	Processing level of each ingredients	Source of food	**Place eaten**
1= morning *2- mid morning* *3 = Mid-day* *4= Afternoon* *5= Evening* *6= Night*		*1=Boiled* *2=fried* *3= Roasted* *4= Raw* *5=Other specify*	*Estimate using household measures*	*1= raw, fresh* *2= dried* *3=flour or powder* *4=other (specify)*	*1=Own production* *2=Purchased* *3=Gift* *4=other specify-*	*1=Home* *2=out of home*

B2: MALE HOUSEHOLD MEMBER FOOD CONSUMPTION QUESTIONNAIRE

Complete the table below by entering appropriate responses in the spaces provided.

In the previous 24 hours (1 day), what foods did you eat as part of the meals or as snacks?

Name of male HH member

Age in years [ ] [ ] Years

Complete the table below by indicating the appropriate responses in the spaces provided

In the previous 24 hours (1 day), what foods did you eat as part of the meals or as snacks?

Time of day *1= morning* *2- mid morning* *3 = Mid-day* *4= Afternoon* *5= Evening* *6= Night*	**Name of food consumed**	**Method of preparation**	**Quantity of food consumed**	**Processing level of each ingredients**	**Source of food**	**Place eaten**
		1=Boiled *2=fried* *3= Roasted* *4= Raw* *5=Other specify*	*Estimate using household measures*	*1= raw, fresh* *2= dried* *3=flour or powder* *4=other (specify)*	*1=Own production* *2=Purchased* *3=Gift* *4=other specify-*	*1=Home* *2=out of home*

SECTION C: HOUSEHOLD LEVEL FREQUENCY OF FISH CONSUMPTION AND OTHER ANIMAL PRODUCTS

The following questions are on Household fish consumption other animal products

NO	QUESTIONS	RESPONSE		CODE
C1	Do you or your household consume fish or other fish products? *If not mentioned in part B*	0 = No - *Skip to section D* 1=Yes		[ ]
C2	If yes, why do you consume fish	1. It is nutritious 2. It is cheap 3. We love to eat it 4. It is easily accessible 5. Other specify		[ ]
C3	Do you face any barriers in consuming fish as often as you like?	0= No *go to Q. D5* 1=Yes		[ ]
C4	If yes, What are the main barriers you face in consuming fish? *(Multiple Responses allowed)*	**Barriers**	**0=No**	**1=Yes**
		Too expensive		
		Fish is not available in the market		
		Fish is of poor quality/ unsafe		
		Time consuming to prepare		
		Other specify …………………………………....		
C5	Which form of fish do you normally consume	1. Processed/preserved fish 2. Fresh fish		[ ]
	FREQUENCY OF FISH CONSUMPTION AND OTHER ANIMAL PRODUCTS			

C6	*How many times were the following types of foods consumed by members of your household either as part of the meals or as a snack*				
	(Enumerator to Choose the period of consideration below)		0=No	1=Yes	
	C6.1	During past 7 days			

Animal products	1.Yes If yes, proceed to C2-6 0.No -Next food type/group	C2. Specific name of food consumed	C3. Every day, more than once a day	C4. Every day, once a day	C5. Three to four days	C6. One or two days only
Fish						
Fresh Fish (small)						
Fresh fish (Medium)						
Fresh fish (Large)						
Dried Small fish						
Dried fish (medium)						
Dried fish (large)						
Smoked fish (small)						

Animal products	1.Yes If yes, proceed to C2-6 0.No -Next food type/group	C2. Specific name of food consumed	C3. Every day, more than once a day	C4. Every day, once a day	C5. Three to four days	C6. One or two days only
Smoked fish (medium /large)						
Salted Fish						
Eggs						
Milk and milk products						
Fresh milk						
Yoghurt						
Sour milk (Mabisi)						
Cheese						
Butter						
Meat (beef, goat, pork						
Meat						
Liver/organ meat						
Poultry						
Chicken, duck, pigeons, guinea fowl						
Birds						

3.2 Bemba Questionnaire

IMEPUSHO PAMILILE YAFYAKULYA MU LUWINGU

Questionnaire number	
Constituency Name	
Ward Name	
Name of enumerator	
Date of interview	**……………/…………. / 2019**

SECTION A: IMIKALILE NA IMIBOMBELE YA BANTU

A1	Ishina lyabeyasuka		
A2	imyaka yabaleyasuka	[ ] [ ] imyaka	
A3	Umubela	1.Mwaume 2. Mwanakashi	[ ]
A4	Mwafikile pesa nesukulu	1. Nshapita musukulu 2. Usukulu lyakubwaice 3. Imasambililo yapakati 3. Amasambililo yapamuulu	[ ]
A5	Bushe mwaliba muchupo?	1. Nshaupwa 2. Naliba muchupo 3. Twalilekana 4. Fyalipwa ifyupo 5. Mukamfwilwa	[ ]
A6	Bushe Mulabomba?	4. Ukubomba mubuteko nakumbi 5. Ndaibombela 6. Nshifola mbomba fye pang'anda *–tolokeleni pa A8*	[ ]
A7	Ninchito nshi Mubomba?	1. Ukubila ifyakkufwala 2. Kashitisha wa mwituuka 3. Kashitisha we sabi 4. Kafundish	[ ]

		5. Kashitisha wama kwebo 6. fimbi (ladeni)……..……	
A8	Mukwata shinga indalama pa mweshi?	1. Taifika 250 2. 251 to 1000 3. 1001 to 2000 4. Ukucila 2000	[ ]
A9	Nishinga indalama mubomfya mukushita ifyakula pa mweshi?	1. Taikwana 200 2. 201 to 500 3.501 to 1000 4. Ukuchila 1000	[ ]
A10	Nishinga indalama mubomfya, mukushita Isabi pa mweshi?	1. Taikwana 50 2. 51 to 100 3.102 To 200 4.Ukuchila 200 5.Ndaikatila isabi nemwine	[ ]
A11	Mwikala banga pang'anda?	2. Lembeni ___________	[ ]

SECTION B: IMILILE YA FYAKELYA MULI 24 HOURS (24 HOUR RECALL)

Elyo tamulatampa ukwipusha pali '24hour diet recall,' mufwile ukwipusha bakaasuka ngacakweba ati ubushiku bwamailo bulelanga ifyo balya iligiline pang'anda yabo. Ngacakweba ati tefyo ninsh muusale ubushiku bumbi.

B1: AMEPUSHO PAMILILE YABAANA PAKATI KAMYESHI 6-59

Bushe namukwata umwana uli pakati ka myeshi 6-59	Emukwai =1 0=Awe *lekeni ukwipusha*
Ishina lyamwana	
imyeshi yamwana	[ ] [ ] imyeshi

Muli 24 hours (ubushiku bumo), fyakulyanshi umwana alile?Lembeni pesamba

Inshita *1-Uluchelo*	**ishina lyacakulya**	**Umusango baipikilemo**	**ubwingi bwafykulya alile**	**Ifyo calemoneka**	**Ukocafumine**	**Ukuwalillile**

2- Uluchelo pakati *3 = Pakati* *4= Mukasuba* *5= Icungulo* *6=Ubushiku*		*1= ukwipika namenshi* *2=Ukusalula* *3=Ukocha* *4= icishaipikwa* *5=fimbi*	*ukupima ifyakulya*	*1= icishaipikwa* *2=icauma* *3=icabunga* *4=fimbi fye*	*1=ndailimina* *2=nashitafye* *3=Bupe* *4=fimbi*	*1=Kung'anda* *2=kunse ya ng'anda*

B2: AMEPUSHO PAMILILE YAKWA NAMAAYO

Muli 24 hours (ubushiku bumo), fyakulyanshi namaayo alile?

Ishina lyakwa namaayo………

Imyaka [ ] [ ] imyaka

Inshita *1-Uluchelo*	**ishina lyacakulya**	**Umusango wakwilamo**	**ubwingi bwafykulya alile**	**Ifyo calemoneka**	**Ukocafumine**	**Ukuwalillile**

2- Uluchelo pakati *3 = Pakati* *4= Mukasuba* *5= Icungulo* *6=Ubushiku*		*1=Boiled* *2=Ukusalula* *3=Ukocha* *4= icishaipikwa* *5=fimbi*	*ukupima ifyakulya*	*1= icishaipikwa* *2=icauma* *3=icabunga* *4=fimbi fye*	*1=ndailimina* *2=nashitafye* *3=Bupe* *4=fimbi*	*1=Kung'anda* *2=kunse ya ng'anda*

B2: AMEPUSHO PAMILILE YAKWA SHITAATA

Ishina lyakwa shitaata ………

Imyaka [ ] [ ] imyaka

Muli 24 hours (ubushiku bumo), fyakulyanshi namaayo alile? Lembeni pesamba

Inshita *1-Uluchelo*	**ishina lyacakulya**	**Umusango wakwilamo**	**ubwingi bwafykulya alile**	**Ifyo calemoneka**	**Ukocafumine**	**Ukuwalillile**

2- Uluchelo pakati 3 = Pakati 4= Mukasuba 5= Icungulo 6=Ubushiku		*1=Boiled 2=Ukusalula 3=Ukocha 4= icishaipikwa 5=fimbi*	*ukupima ifyakulya*	*1= icishaipikwa 2=icauma 3=icabunga 4=fimbi fye*	*1=ndailimina 2=nashitafye 3=Bupe 4=fimbi*	*1=Kung'anda 2=kunse ya ng'anda*

SECTION C: IMILILE YESABI NA IFYAKULYA FIMBI IFIFUMA KUNAMA PAMAYANDA

Imepusho yakonkapo yali pamilile ya isabi na ifyakulya fimbi ififuma kunama pamayanda

No.	AMEPUSHO	UBWASUKO	CODE
C1	Bushe mulalya isabi pano pang'anda? *(ngatabalandile pano section B)*	0 = Awe – *tolokeleni ku section D* 1= Tulalya	[ ]

C2	Ngamwasumina, cinshi mulila isabi?	1. Lyalikwata ubukumu 2. Tatuposa indalama ishingi 3. Twalilitemwa 4. Talishupa ukusanga 5. Fimbi……			[ ]
C3	Bushe mulakwatako ubwafya mumililile ya isabi?	0= Awe *kabiyeni ku Q. D5* 1= emukwai			[ ]
C4	Ngamwasumina, maafyanshi mukwata? *(amaasuko ayengi nayasumishiwa)*	**Ifikaanya**	**0=awe**		**1= Emukwai**
		Lyalidula			
		Talisangwa sangwa			
		Kuti lyaleta amalwele			
		Lilaposa inshita			
		Fimbi …………………………………....			
C5	Lisabi lyamusango shani ilyo mulya ilingiline?	3. Ilyakanikwa 4. Ilyafuma fye mumenshi			[ ]
	IMILILE YA ISABI NA IFYAKULYA FIMBI IFIFUMA KUNAMA PAMAYANDA				
C6	*Miku inga mwalile ifi ifyakulya na bamung'anda bonse nangu bamobamo mung'anda*				
	(bakepusha saleni inshita)		0=awe	1=Emukwai	
	C6.1	Panshiku cinelubali (7) ishapita			

Inama nafimbi ififumako	1.Emukwai, *ngabasumina, kabiyeni ku* C2-C6 0. Awe - *kabiyeni pamubela wachakulya*	C2. Lembeni ishina lyachaculya	C3. Cilabushiku, ukuchila umuku umo	C4. Chilabushiku umuku umo	C5. Inshiku shitatu nangu shine	C6. Ubushiku bumo nangu shibili
Fish						

Inama nafimbi ifufumako	1.Emukwai, *ngabasumina, kabiyeni ku* C2-C6 0. Awe - *kabiyeni pamubela wachakulya*	C2. Lembeni ishina lyachaculya	C3. Cilabushiku, ukuchila umuku umo	C4. Chilabushiku umuku umo	C5. Inshiku shitatu nangu shine	C6. Ubushiku bumo nangu shibili
Ilyafuma mumenshi (ilinoono)						
Ilyafuma mumenshi (pakati)						
Ilyafuma mumenshi (Likulu)						
Ilyauma kukasuba (ilinoono)						
Ilyauma kukasuba (pakati)						
Ilyauma kukasuba (Ilikulu)						
Ilyakucushi (Linoono)						
Ilyakucushi (ilya pakati na ilikulu)						
Ilya uma kukasuba na umucele						
Amani						
Umukaka na ififuma kumukaka						

Inama nafimbi ifyfumako	1.Emukwai, *ngabasumina, kabiyeni ku* C2-C6 0. Awe - *kabiyeni pamubela wachakulya*	C2. Lembeni ishina lyachaculya	C3. Cilabushiku, ukuchila umuku umo	C4. Chilabushiku umuku umo	C5. Inshiku shitatu nangu shine	C6. Ubushiku bumo nangu shibili
Inama (ing'ombe, imbushi, inkumba)						
Inama yamumala						
Ifyuni						
Inkoko, ifibata, amakanga						
Utuuni twampanga						

4.0 Ethical clearance letter

TROPICAL DISEASES RESEARCH CENTRE
Tel/Fax +260212 615444
P O Box 71769
tdrc.ethics@gmail,com
NDOLA, ZAMBIA

TDRC ETHICS REVIEW COMMITTEE
IRB REGISTRATION NUMBER : 00002911
FWA NUMBER : 00003729

TRC/C4/10/2019
21st October, 2019
Mr. Geofrey Maila
Department of Food Science and Nutrition,
School of Agricultural Sciences,
UNZA, P.O. Box 32379
Lusaka

Dear Mr. Maila,

RE: ETHICAL APPROVAL OF STUDY PROTOCOL

Reference is made to the protocol entitled "**Assessing the Nutrition Contribution of Fish to Household Diets and Dietary Exposure to Aflatoxins through Fish Consumption in Luwingu District Northern Province".**

On behalf of the Chairperson of the TDRC Ethics Review Committee (ERC), I wish to inform you that the Committee during its meeting held on 21st October 2019 in the TDRC Boardroom, reviewed your protocol and ethical approval was granted based on the following conditions.

You are required to submit progress reports to the ERC twice a year. The Committee shall not provide renewal of ethical clearance for on-going projects in absence of progress reports.

You are now required to submit your protocol to the National Health Research Authority for final approval following the link: **https://www.nhra.org.zm** and submit a final report to the ERC Secretariat at the end of the study.

Should there be any protocol modifications or amendments, you are required to notify the ERC and submit protocol amendments for approval.

This approval is valid for the period 21st October 2019 to 21st October 2020

The Committee wishes you success in the execution of the study.
.Yours faithfully,
TROPICAL DISEASES RESEARCH CENTRE

Edna Mwale. Simbayi
SECRETARY – TDRC Ethics Review Committee
cc: Chairperson – TDRC Ethics Review Committee