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## Assessment of dietary diversity among smallholder farmers in contribution to household food, nutrition and income security at Misungwi district in Mwanza region, Lake Zone of Tanzania

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### Abstract

The study was conducted in Misungwi district in Mwanza Region, Lake Zone, Tanzania, to assess dietary diversity in the contribution of household food, nutrition, and income security among smallholder farmers. Focus group discussions in ten farmers' groups of 39 farmers were conducted whereby a total of 390 smallholder farmers from three Agricultural Marketing Co-operatives (AMCOS) in Nguge, Igongwa, and Igege were involved in the focus group discussions. 100% of smallholder farmers used firewood for the preparation of breakfast, lunch, and dinner. 100% used one bowl for washing hands before eating. 97% prepared thin porridge with or without sugar as breakfast, and the rest of the household (3%) consumed plain rice or boiled sweet potato slices (*michembe or matobolwa*) with black tea or drinking water. 92% of farmers prepared boiled sweet potatoes (*michembe or matobolwa*) with commercial juices or drinking water, 8% prepared a blend of rice and pulses (*mseto*) or deshelled maize and pulses (*kande*) as lunch, and 94% prepared stiff porridge saved with pulses, sardines, or vegetables, while 6% prepared rice or stiff porridge saved with beef or chicken as dinner. 97% of farmers had little knowledge of a balanced diet, while% had no idea about a balanced diet. 90% of the household used cotton as a cash crop as a source of income, and the rest 10% sold food crops, livestock, and other products to generate income in the household. An alternative source of cooking to rescue the environment and minimize global warming's consequences is required. Food processing and preservation techniques are important to improve varieties, longevity, and accessibility in line with good WASH practices to assure health, nutrition, and income for smallholder farmers in Misungwi.

**Keywords:** Smallholder farmers, food, income, nutrition, livestock and dietary diversity

### Introduction

Food is an integral part of life that, when consumed in the right proportion and in a diversified manner, keeps the human body healthy. It provides important nutrient components, including carbohydrates, proteins, fats, minerals, vitamins, water, fibre, and phytochemicals, which are very important for body growth, development, and protection against diseases. The requirement of food for the body depends upon various aspects such as gender, age group, and physical activities throughout a lifetime (Chuwa, 2022) <sup>[1]</sup>. Eating healthy foods with varieties of nutrients such as proteins, fats, carbohydrates, vitamins, and minerals will boost our immune system and prevent us from chronic diseases including cancer, osteoporosis, overweight and obesity, cardiovascular disease, strokes, Alzheimer's, etc (Chuwa *et al.*, 2021) <sup>[2]</sup>. There is no specific food group that provides all the essential nutrients except breast milk during the first six months of life. Therefore, a person needs to consume a healthy diet from all food groups (Labadarios *et al.*, 2011) <sup>[3]</sup>.

A recent study shows that dietary diversity is an alternative measure of nutritional adequacy and food security in the household (Leonard *et al.*, 2020) [4]. Nutritional security refers to the adequate consumption of different food groups to maintain a balanced diet and meet daily nutrient needs (Habte and Krawinkel, 2016) <sup>[5]</sup>. (FAO, 2001) <sup>[6]</sup> states that food security exists when all people at all times are able to access sufficient, safe, and nutritious food to meet their dietary needs and food preferences, thus ensuring an active and healthy life. (USAID, 2012) <sup>[7]</sup> proclaims that food security exists when every person has stable and continuous access to different foods of good quality that are safe, affordable, and available in sufficient amounts. A non-diversified diet, on the other hand, can harm a person's health and development by impairing physical capacity, lowering immunity, and raising their susceptibility to illness.

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It may also affect social development, reproductive health, and cognitive development (Savy *et al.*, 2005)<sup>[8]</sup>.

The COVID-19 pandemic had a negative impact on household food, nutrition, and income security around the world (ReliefWeb, 2020)<sup>[9]</sup>. The frequent lockdown to control the spread of COVID-19 had restricted people from participating in agricultural as well as social and economic activities worldwide. Thus, people did not produce food during the lockdown period; however, business was also affected, and many people lost their jobs. Therefore, this situation leads to food, nutrition, and income insecurity. There is evidence that COVID-19 has a harmful impact on people's general eating patterns throughout Africa, India, and the Middle East (Matsungu and Chopera, 2020; Pakravan-Charvadeh *et al.*, 2021)<sup>[10-11]</sup> and that human health and well-being have been seriously affected.

Eliminating hunger, achieving food security, and enhancing nutrition is the Sustainable Development Goals (SDGs) priorities by 2030 (UN, 2019)<sup>[12]</sup>. Tanzania is among the Sub-Saharan countries facing a triple burden of malnutrition (undernutrition, micronutrient deficiency, and obesity) due to low intake of dietary variety and poor water sanitation and hygiene (WASH) practices (Arimond and Ruel, 2004)<sup>[13]</sup>. The most affected setting is rural areas, where the majority depends on cyclical food harvests and have inadequate post-harvest handling techniques, including poor storage facilities, poor food processing, low knowledge of cooking, and mixing varieties of food groups. This resulted in a disproportionately heavy burden of malnutrition, particularly for vulnerable groups. Tanzania has a high prevalence of stunting above 40 percent in the regions of Njombe (54%) and Rukwa (48%) and Iringa (47%) and Songwe (43%) and Kigoma (42% and

41%, respectively) (MoHCDGEC, MoH, TFNC, NBS, OCGS, UNICEF, 2018)<sup>[14]</sup>. The majority of household diets consist mostly of starchy carbohydrates with little to no fruit or vegetable consumption, as well as animal-source foods (URT, 2019)<sup>[15]</sup>. The present study was conducted on smallholder farmers to assess their dietary diversity intake habits and knowledge of food preparation and consumption in line with WASH practices at Misungwi district in Mwanza Region, situated at Lake Zone in Tanzania.

## Methods

**Study area:** The study was carried out in three Agricultural Marketing Co-operatives (AMCOS): Nguge, Igongwa, and Igenge, which are located in Mwaniko, Sumbugu, and Mbarika wards, respectively (Figure 1a). Each AMCOS is conducting its activities at the Nguge, Igongwa, and Igenge primary school farms. Tanzania Agricultural Research Institute (TARI), in collaboration with the Ministry of Agriculture, Tanzania Cotton Body (TCB), WFP Brazil, the University of Campina Grande, and Brazilian Cooperative Agency (ABC), is implementing the Beyond Cotton Project (BCP) at Misungwi District in the production of cotton as a cash crop but also bio-fortified food crops such as yellow maize, *Jesca* beans, and orange-fleshed sweet potatoes (OFSP) to ensure food, nutrition, and income security for smallholder farmers. These crops provide nutrients beyond and above basic nutrition as they are bio-fortified with important nutrients like  $\beta$ -carotene from OFSP and yellow maize and zinc and iron from *Jesca* beans. Apart from these nutrients, they have other nutrients, including crude protein, fat, fibre, ash, vitamins, minerals, and bioactive compounds. The study area shown in this investigation is in Fig 1.



**Fig 1:** Misungwi District showing study area (highlighted wards blue)

## Sampling and data collection

The data in this investigation is part of the Beyond Cotton Project, in which focus group discussions were conducted to assess the intake of dietary diversity, knowledge of food preservation, skills in food preparation, and consumption among smallholder farmers. The assessment was conducted at Nguge primary school, where we met with smallholder farmers from selected wards. A total of 390 smallholder farmers were interviewed, as follows: Nguge AMCOS 203 (103 F and 100 M), Igongwa AMCOS 93 (26 F and 67 M), and Mbarika AMCOS 94 (18 F and 76 M). The age group of participants ranged from 18 to 35 years old. The participants were divided into 10 groups of 39 farmers each. Each group stayed separate during the discussion, and answers were recorded on a flip chart. The focus group discussions were conducted for each group to assess the knowledge on intake of dietary diversity, frequency, food preparation and preservation techniques, as well as WASH practices.

## Results

### 1. Food and livestock availability

All 39 groups (100%) mentioned food crop availability in most of the households, including white maize (local varieties), rice, cassava, sweet potatoes (local varieties), green gram, ground nuts, chickpeas, yellow beans, bambara nuts, sorghum, millets, cowpea, and sesame. Also, the reported availability of fruits such as oranges, mangoes, watermelon, cucumber, jamun, tamarind, *Vertex mombasa*, and passion fruit, as well as vegetables like tomatoes, onions, cabbage, Chinese cabbage, bitter tomatoes, okra, bell pepper, brinjal, and pumpkin, was mentioned to all groups. Similarly, some households keep livestock such as indigenous cattle, goats, sheep, poultry, pigs, rabbits, fish, and sardines.

### 2. Food preparation

All 39 groups (100%) prepared food using firewood as a source of energy in three stone cookers for breakfast, dinner, and lunch. This delays cooking time due to the fact that most of the firewood is wet and other households do not have a source to access firewood. Smoke pollution has some health effects, such as asthma, cough, acute respiratory infections, pneumonia, tuberculosis, chronic obstructive pulmonary disease, and red eyes. Apart from this, wood smoke increases air and environmental pollution, which causes global warming. Too much cooking of vegetables and the use of soda ash in some vegetables (*mlenda*), which kills most of the micronutrients, were also mentioned in all groups.

### 3. Food processing and preservation

39 groups (100%) were processed using indigenous techniques such as dry and heap fermentation of cassava roots, which are associated with mould growth. Other foods, like fruits and vegetables, are eaten raw during the season, and most are wasted due to a lack of processing facilities like solar or cabinet dryers, which will extend the shelf life of these products throughout the year. Other foods, such as sweet potatoes, are consumed as boiled roots or sundried slices (*michembe*) or cooked and sundried slices (*matobolwa*). Furthermore, they had no processing knowledge (value addition) or product diversification to improve food, nutrition, or income security. Other simple food preparation methods like washing, peeling, slicing, soaking, boiling, deep and shallow frying, and roasting are among the common practices

in all households.

### 4. WASH practices

Before eating, all 39 groups (100%) reported washing hands in one bowl, starting with elders or parents and children coming last. This could be the root cause of infectious diseases such as diarrhea and worms, which negatively affect the nutritional status of the household, especially children and the elderly due to their low immune systems.

### 5. Food consumption

#### Breakfast

Thirty-eight groups out of thirty-nine (97%) consumed thin porridge with or without sugar as breakfast, while one group (3%) mentioned plain rice with black tea or boiled cassava roots with black tea or boiled sweet potato slices (*matobolwa* or *michembe*) with drinking water or black tea or stiff porridge made from a blend of cassava and maize, sorghum, or millet flour, with sardines or vegetables.

#### Lunch

Thirty-six groups (92%) prepared boiled *matobolwa* or *michembe* saved with drinking water or commercial juice, and the rest of the groups prepared a blend of rice and green gram (*mseto*) or a blend of deshelled maize and pulses (*kande*) with no animal source. Fruits and vegetables were consumed before or along with lunch.

#### Dinner

Thirty-seven groups (94%) saved rice or stiff porridge with either sardines, pulses, or vegetables, while the remaining groups saved rice or stiff porridge with beef/chicken/fish/eaten only when the households had guests. Therefore, the animal source is normally taken in an occasional manner.

### 6. Diversified diet

Thirty-eight groups (97%) had little knowledge of how to prepare a balanced meal by using a combination of all five food groups (cereals, animal source legumes, vegetables, fruits, and fat, oil, or sugar) during the preparation of breakfast, lunch, and dinner, whereas one group (3%) had no idea about a diversified diet with five food groups at all.

### 7. Source of income

Thirty-five farmer's groups (90%) sell cotton, which is a cash crop, as a source of income, and the rest of the groups (10%) sell fruits, vegetables, livestock, and its products to generate household income.

## Discussion

### 1. Food and livestock availability

Food crops such as rice, maize, cowpea, melon, groundnut, cassava, sweet potatoes, millet, sorghum, etc. are crops that contribute to the food and nutrition security of the majority of the household as well as being the source of livestock feeds. Its production is therefore important to meet the food needs of poor rural households. The food crops produced by smallholder farmers in Misungwi District can be used to meet household dietary needs and as by-products for animal feeds. Food and nutrition security is influenced not only by the quantity of available food but also by its accessibility and diversity. As a result, access to healthy, diverse, and

affordable food is central to household food security (Ruel *et al.*, 2017) <sup>[16]</sup>. Furthermore, most smallholders assessed sold their livestock and its products, including fruits and vegetables, to the local markets as a source of income and did not eat as a source of good health and nutritional status. Subsequently, identifying and understanding the interactions between agriculture and nutrition is far more complicated than may be assumed. Smallholder farmers need more than increasing agricultural productivity to ensure sustained accessibility of diverse foods, food preparation techniques, and improved WASH practices to safeguard their food and nutrition security as well as their health and well-being.

## 2. Food preparation

In Misungwi District, cooking energy is derived from firewood. Most rural residents in developing nations, particularly those in Sub-Saharan Africa, including Tanzania, struggle with the lack of access to contemporary, sustainable, and clean sources of energy for domestic uses like cooking. They rely on traditional sources of energy in the form of biomass, including firewood and charcoal, as well as animal and plant sources of energy, for cooking because they lack access to modern and clean sources of energy (Francis *et al.*, 2014) <sup>[17]</sup>. The challenge of relying on conventional energy sources is a global issue, but it is particularly severe in Tanzania's rural areas. According to studies by (Mwakapugi, 2010; Swai, 2014) <sup>[18-19]</sup>, more than 85% of Tanzanians living in rural regions use traditional energy sources for cooking, despite the country's abundance of energy resources, including biomass, hydroelectric power, and solar power. According to (Kusekwa, 2011) [20], the primary sources of energy used for cooking in Tanzanian rural families and the traditional sector of the economy are firewood and charcoal. In a similar vein, the 2012 Household Budget Survey study found that the majority of Tanzanians living in rural areas outside of Dar es Salaam do not have access to contemporary energy sources for cooking (Swai, 2014) <sup>[19]</sup>. The households using firewood for cooking have to encounter not only disease burdens such as the high prevalence of respiratory diseases such as asthma, cough, acute respiratory infections, pneumonia, tuberculosis, and chronic obstructive pulmonary disease; low birth weight; cataracts; and cardiovascular diseases, but also financial burdens due to increased health costs owing to this disease-induced healthcare utilization (Van Gemert *et al.*, 2013) <sup>[21]</sup>; Besides health risks, wood smoke is a complex mixture of gases, liquids, and solid particles (aerosol) produced by incomplete combustion or pyrolysis of wood and other wood products such as charcoal, wood pellets, sawdust, and so on, at elevated temperatures and reduced oxygen (Toledo, 2008) <sup>[22]</sup>. The regular cutting down of trees has increased the consequences of global warming, including little or no rain, which seriously affect agriculture and food security. To rescue the situation, smallholder farmers in Misungwi need a clean source of energy for cooking to secure their health and environment.

## 3. Food processing and preservation

As evidenced during group discussions, smallholder farmers from Misungwi had little to no knowledge of food processing and preservation techniques to improve food security and shelf life. Food processing and preservation are the activities and operations required for converting raw agricultural produce into safe and nutritious food products. Food

processing and preservation are necessary to ensure access to safe, wholesome, and palatable foods at reasonable costs. It enhances the shelf life of food in various ways, such as through microorganism control, low-temperature storage, dehydration, and the removal of oxygen. It also modifies the texture, flavour, and nutritional value of food products to make them more appealing to consumers. But also due to its prolonged shelf life, it assures sustainable food and nutrition security at all times of the year.

## 4. WASH practice

Smallholder farmers from Misungwi use one bowl for washing their hands before eating. According to the WHO, "lack of water, sanitation, and hygiene promotion increases the risk of diarrhea, which kills approximately 2.2 million people every year, as well as trachoma (an eye infection that can lead to blindness) and other related illnesses." The increased morbidity and mortality in the community affect negatively agricultural production in line with other social and economic activities, which creates a vicious cycle of poverty from one generation to the next.

## 5. Food consumption

Based on focus group discussions with smallholder farmers in Misungwi District, they prepare and consume one type of meal mainly consisting of carbohydrates, despite the fact that they have a variety of food crops and livestock. The dietary diversity necessary to ensure a mixed food group intake will be highly advocated to avoid a mono diet, which weakens health and hence productivity.

### Breakfast

The mono-diet breakfast is the most common among smallholder farmers in Misungwi District. Since we need a proper and healthy breakfast to start the day with a healthy brain and body, it becomes difficult to perform their daily activities with a poor breakfast to attain high performance. The word breakfast means to break the fast since the intake of dinner at night. While sleeping, our bodies do not need as much energy as they do during the day to function properly. This is because during sleep there is little energy needed for the brain and body compared to the daytime, when a lot of energy is needed to attain brain functions and physical activities including agricultural productivity, exercising, and playing. Therefore, high energy is needed during the morning compared to the rest of the day to achieve our daily work and related missions; hence, a diversified and sufficient breakfast is of paramount importance.

### Lunch

The focus group discussion revealed that most households prepared mainly starchy carbohydrates with little or no fruits, vegetables, or animal sources for lunch. Lunch is a midday meal and is generally smaller than dinner. The origin of the words lunch and luncheon refer to a small meal originally eaten at any time of the day or night, but during the 20<sup>th</sup> century, the focus gradually shifted toward a small meal eaten at midday. Despite the fact that lunch should be a small portion, it should contain all five groups of nutrients for good health and well-being.

### Dinner

It has been noted that one type of nutrient (starchy



carbohydrate) is commonly consumed during dinner by the majority of smallholder farmers in Misungwi District. Dinner should be taken as a balanced diet in the evening time before bedtime, and it is recommended to be taken early, at least three hours before sleeping, to make the stomach empty and reduce food metabolism to assure bed rest [23].

## 6. Diversified diet

As a result of a balanced diet, most smallholder farmers in Misungwi District had little knowledge of a diversified diet that included all nutrients. Some people don't know how to mix food groups to make a balanced meal from breakfast, lunch, and dinner, although they have varieties of fruits and vegetables. A balanced meal is essential to maintaining the physical, psychological, and mental health of children of all ages (Chuwa, 2022) [1]. A balanced meal is made up of foods from the five food groups: starchy carbohydrates, fruits and vegetables, protein, dairy, and healthy fats. Each provides the range of nutrients our bodies need to function efficiently. It's unlikely that every meal will include all five, but the aim is to achieve a balance across the day or across the week. Starchy carbohydrates are the body's primary source of energy; they should account for roughly one-third of our diet. This food group includes potatoes and grains such as wheat, barley, and rice. When choosing starchy carbohydrates, opt for whole grains where possible to maintain digestive health and get more fibre, vitamins, and minerals. Research has shown that eating whole grains (rather than refined grains) reduces the risk of stroke, type-2 diabetes, and heart disease (Chuwa *et al.*, 2021) [2]. The Recommended Dietary Allowance (RDA) for carbohydrates is 130 grams per day for everyone over the age of one year. This is the amount of glucose needed for optimal brain and nervous system function. Since the carbohydrates (starch and sugar) in our food provide 4 calories of energy per gram, this is equivalent to a minimum of 520 calories from carbohydrates each day. It is recommended that we consume 45%–65% of our total energy intake (in calories) from carbohydrates [24]. Because carbohydrate provides 4 calories per gram, we can figure out how many grams of carbohydrate we need. For example, if our daily energy need is 2000 calories, it would be recommended that we consume 225 to 325 grams of carbohydrates per day.

2000 calories x 45% = 900 calories; 900 calories divided by 4 calories per gram = 225 g.

2000 calories x 65% = 1300 calories; 1300 calories divided by 4 calories per gram = 325 g.

Excessive carbohydrate intake may lead to weight gain, while low intake leads to weight loss, but both can be unhealthy and risky for some individuals with certain health conditions (ADA, 2019) [25].

Fruit and vegetables are also vital parts of a healthy, balanced diet. This is because they're high in fibre and packed full of vitamins and minerals. Different colours indicate different nutrients, which each play a part in keeping our bodies healthy with a strong immune system. This is why it's important to eat the rainbow and embrace a variety every day. Fruits and vegetables (F&V) are included in dietary recommendations due to their high concentrations of dietary fibre, vitamins, minerals, particularly electrolytes, and, more

recently, phytochemicals, particularly antioxidants" (Slavin and Lloyd) [26]. Despite an increasing focus on the health benefits of fruits and vegetables, their consumption is below the recommended intake among adults (Schneider *et al.*, 2007) [27]. Therefore, considering how nutritional-related health problems have risen drastically globally, it seems critical that formal nutrition education aiming to increase knowledge of fruit and vegetable intake be given priority in health education and promotion programs. This review provides insight into the importance of fruits and vegetables as well as the benefits and progress of nutrition education in improving intake. Therefore, to maintain body health and well-being, WHO recommended at least 400 g (i.e., five portions) of fruit and vegetables per day, excluding potatoes, sweet potatoes, cassava, and other starchy roots.

Protein provides us with key amino acids, which are the building blocks of the body. Our bodies are continually building and renewing cells, and we need amino acids to be able to do this. The protein intake should be enough but should not be too high. The amount of protein intake is only about one-eighth of our balanced diet. Different types of protein provide us with the variety of vitamins and minerals that we need to stay healthy and strong. Therefore, it is very important to vary our protein sources.

Fat is an essential nutrient, but we only need a small amount to protect our organs, absorb certain vitamins, and help us grow. However, we do need to be careful about the type and amount of food we eat because it's high in energy. The reference intake of fat is a maximum of 70 grams per day for adults, of which no more than 20 grams of saturated fat should be consumed. Saturated fats are found in foods such as beef, pork, chicken skin, butter, cheese, and coconut oil.

## 7. Source of income

Smallholder farmers from Misungwi sell livestock and its products, as well as fruits and vegetables, to the local market to earn an income. These could be a good source of nutrition to improve health and well-being. Income from cash crop production provides cash so that food becomes economically accessible to those households not directly producing their own food (Devereux, 2001) [28]. However, the income pathway to food security may not be linear, as the income may be used for other household non-food expenditures (Devereux, 2001) [28]. Some studies have found cash crop productivity negatively associated with food crop productivity, as the competes with the latter in smallholder production where land is a limiting resource (Mazunda *et al.*, 2015; Tankari, 2017) [29-30].

## Conclusions

From this investigation, smallholder farmers produce a variety of food crops and keep lots of livestock, but they prepare only one type of food for breakfast, lunch, and dinner. This will cause people in Misungwi District to get malnutrition, especially undernutrition, which will cause stunting and wasting in the long run. Based on food preparation and consumption (breakfast, lunch, and dinner), most farmers didn't meet the Recommended Dietary Allowance (RDA) because they ate one type of food from breakfast to dinner. In order to meet the RDA, varieties of food are required from each group of carbohydrates, protein, fat, vitamins, and minerals to provide essential nutrients for body growth and well-being. According to the study, Misungwi District has

food security but nutrition insecurity due to low nutrition awareness.

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### Authors' contributions

PS and CC design the project, CC and MN conducted focus group discussions, CC analyzed and interpret data and manuscript writing, PS and MN final draft proofreading of the manuscript

### Declaration

#### Ethical issues

No ethical issue is to be declared in this study

### Conflict of interest

The authors state that they have no interest in conflict.

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