

**THE INFLUENCE OF THE MARKET OF SOLAR DRIED VEGETABLES  
ON IMPROVING LIVELIHOODS OF SMALLHOLDER FARMERS  
IN ARUMERU DISTRICT, TANZANIA**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE  
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**2023**

**CERTIFICATION**

The undersigned certifies that he has read and hereby recommends for acceptance by the Open University of Tanzania a dissertation titled; **“The Influence of The Market of Solar Dried Vegetables on Improving Livelihoods of Smallholder Farmers in Arumeru District, Tanzania”**, in partial fulfillment of the requirements for the degree of Master of Arts in Monitoring and Evaluation of the Open University of Tanzania.

.....

Dr. Noel Matemba

(Supervisor)

.....

Date

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**DECLARATION**

I, **Tamilwai Kingazi**, do hereby declare that this research report is my original work and that it has not been submitted and was not submitted for a similar or other degree award.



.....

Signature

.....

Date

**DEDICATION**

This work is dedicated to my family and friends who supported me during the entire period of my study. Special thanks to my beloved wife Neema, you have been an inspiration to me through your hard work, your commitment, and your love for me. Your prayers and wisdom are highly appreciated. My wife without you, I would not pursue my studies and be what I am.

Thank you.

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I wish to express my sincere gratitude to the Almighty God for bringing me this far. I am very grateful to all persons who offered invaluable contributions and suggestions as to how this dissertation might be organized and made useful

In the cause of reading and writing this dissertation, I have traveled widely in the Arumeru District meeting with different people who were interested in assisting my research. It is for this reason that I feel indebted to express my gratitude for their hospitality, kindness, perspective criticism, and encouragement. In particular, I forward my heartfelt thanks to my parents Mr. and Mrs. William Kingazi

My intellectual debt to both OUT students and Lecturers whose fertile concepts and comments appear herein will be obvious to my readers familiar with the University. I endeavored to acknowledge the scholarly materials and resources relied upon in the references from Open University Tanzania.

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## **ABSTRACT**

This study examined influence of the market of solar dried vegetables on improving smallholder farmers' livelihood status in Arumeru District, Arusha Region. Specifically, the study sought to: examine the contribution of the solar dried vegetables market towards smallholder farmers' incomes; find out the contribution of the solar dried vegetables market towards food security among smallholder farmers; and; identify the contribution of the solar dried vegetable market toward smallholder farmers' well-being. Cross-sectional research design was adopted based on a mixed research approach incorporating qualitative and quantitative research approaches. Simple random sampling and purposive sampling techniques were used to select 73 respondents and 10 key informants respectively. Primary data were collected using interviews and questionnaires while secondary data were collected using a documentary review. Quantitative data were analyzed using SPSS version 25 to compute descriptive statistics such as percentages and frequencies while the qualitative data were analyzed using content analysis method. Findings showed that improvement of income among smallholder farmers, capital formulation for establishing other income generating activities, food availability, accessibility, and nourishment among smallholder farmers, and improvement of education and health services among small household farmers were associated with the presence of a market for solar dried vegetables. The study concludes that, promoting the consumption of vegetables is important to address malnutrition and presence of solar dried vegetables has contributed to the improvement of income among smallholder farmers; solar-dried vegetables have great contribution to food availability, food accessibility, and nourishment among smallholder farmers; and well-being of smallholder farmers has been also influenced by the presence of markets for solar dried vegetables. The study recommends that there should be strong support between processors, distributors, and regulatory agencies, provision of awareness education on the importance of solar dried vegetables, training to local carpenters on how to construct solar dryers using local materials, and increasing value chain for solar dried vegetables.

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**LIST OF ABBREVIATIONS**

BCC	Behavioral Change Communication
F & BKP	Food & Business Knowledge Platform
FAO	Food and Agriculture Organization
FNS	Food & Nutrition Security
IFRCI	International Federation of Red Cross
IGA	Income Generating Activities
MAFC	Ministry of Agriculture, Food Security and Cooperatives
SME	Small and Medium Enterprises
SPSS	Statistical Package for Social Science
TBS	Tanzania Bureau of Statistics
TDHS-MIS	Tanzania and Demographic Health Survey- Management Information System
TFDA	Tanzania Food and Drugs Authority
TNNS	Tanzania National Nutrition Survey
UNDP	United Nations Development Programme
UNV	United Nations Volunteers
URT	United Republic of Tanzania
WASH	Water Sanitation and Hygiene

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Chapter Overview**

This chapter highlights the background to the research problem, statement of the research problem, research objectives, research questions, scope of the study, significance of the study, and organization of the research report.

#### **1.2 Background of the Research Problem**

Globally, it is accepted that vegetables are of greater nutritional importance since they make a significant contribution in supplying a wealth of essential vitamins, minerals, antioxidants, fiber, and carbohydrates that improve the quality of the diet (Barrett, 2007). However, in Tanzania, fresh vegetables are not always available throughout the year, particularly in those regions affected by drought (Ragedunda et al., 2018). In these regions vegetable production is seasonal and drying could be an important option to ensure families have vegetables for consumption at all times. Dried vegetables contribute to nutrition level because of their maintained nutrient compounds especially when novel drying technologies like solar dryer is used (Sablani, 2007; Çağlarırnak & Hepçimen, 2013). This can be done by encouraging farmers and other value chain actors to venture into value addition through the adoption of improved solar drying methods and tap higher value markets.

Drying vegetables has been proven as one of the methods to prolong the shelf life of this perishable food. Drying is a widely used food preservation process in which water removal minimizes many of the moisture-driven deterioration reactions impacting the bioproduct quality. There are several ways of drying vegetables, and open sun drying is one of them (Ahmed, 2010). Open sun drying results in poor



quality in terms of hygiene, nutrient composition, and color. Also, this method is often impeded by haze, high humidity (rain), windblown debris, weather uncertainties, insects, rodents, and bird infestation (Ringeisen 2014).

Protected solar drying is one of the most promising methods that can be adopted by consumers especially in developing countries due to its advantages over open sun drying. Other advantages include reduced drying time, less or no spoilage, less construction, and operational skills, hygienic, healthier, and relatively more expensive. Solar dryers have been recommended as the affordable method that result in to supply of vegetable even if when is off-season (Kumar et al. 2014; Esper and Mühlbauer 1998). There are several types of dryers developed to serve the various purposes of drying food products as per local needs and available technology.

### **1.3 Statement of the Research Problem**

Vegetables are major sources of vitamins, minerals, fiber, and other plant-bioactive compounds like antioxidants important for human health and well-being (Orsat et al. 2006, Slavin, 2012). Vegetables are highly perishable due to high moisture content (some up to 95%) and therefore require appropriate preservation methods. High moisture supports enzyme activity and microbial growth causing crop deterioration or spoilage hence post-harvest losses. Post-harvest losses of vegetables are estimated to range from 30–50% in sub-Saharan Africa depending on crop, markets, and region (Ofor, 2011). Tanzania produces a large variety of fruits and vegetables. However, postharvest losses are enormous (30-40%) (Kimambo, 2007). The food processing industry in the country has not grown enough and less than 10% of the produced fruit and vegetables are being processed, resulting in large

waste every year (MAFC, 2009). Various studies have shown that solar drying is a simple and inexpensive form of food processing that has greater potential to reduce post-harvest losses and ensure the availability of fruit and vegetables year-round (Habou et al., 2003; Mujumdar, 2004).

Despite several actors being involved in training, processing, and marketing of solar-dried fruit and vegetables in the country, the information on the performance of different dryers under different weather conditions, nutrient retention, sensory quality, shelf-life qualities, and local standards of these products is limited, which makes dried fruit and vegetables in Tanzania to be of varied qualities (Ringo, 2008). Consequently, product development and market opportunities of the dried fruit and vegetable sub-sector in the country are adversely affected. Considering the importance of fruits and vegetables for human health, the food industry, and the national economy against the stated high postharvest losses; it indicates a need for appropriate technology of fruit and vegetable processing and preservation to reduce the losses quantitatively and qualitatively (Kabasa et al., 2004). Solar drying technology retains nutrients, improves quality and safety is critical in gaining access to markets as well as prolonging the shelf-life of fresh and processed fruits and vegetables (Temu et al., 2008). The current study documents producers' perceptions about the consumption of dried vegetables and the challenges of building the dried vegetables value chain and recommends actions necessary for upgrading the drying and consumption of dried vegetables to address nutrition challenges in peri-urban and rural areas.

## **1.4 Research Objectives**

### **1.4.1 General objective**

The general objective of this study was to assess the influence of the market of solar dried vegetables on improving smallholder farmer's livelihood status in the Arumeru District Arusha Region.

### **1.4.2 Specific objectives**

- i. To examine the contribution of the solar dried vegetables market towards smallholder farmers' incomes.
- ii. To find out the contribution of the solar dried vegetables market towards food security among smallholder farmers.
- iii. To identify the contribution of the solar dried vegetable market toward smallholder farmers' well-being.

## **1.5 Research Questions**

### **1.5.1 General Question**

What is the influence of the market of solar dried vegetables on improving smallholder farmer's livelihood status?

### **1.5.2 Specific questions**

- i. What are the contributions of the solar dried vegetables market toward smallholder farmers' income?
- ii. What are the contributions of the solar dried vegetables market towards food security among smallholder farmers?
- iii. What are the contributions of the solar dried vegetable market toward smallholder farmers' well-being?

### **1.6 Significance of the study**

The findings of this study will provide insight to policymakers to formulate policy on food security and food preservation to address the issue of malnutrition and hunger. The study is potentially aligns with the second Sustainable Development Goal that is committed to zero hunger and specifically seeking to establish sustainable food production. The study further aligns with the SADC Food and Nutrition Security Strategy 2015-2025 that basically seeks to reduce food and nutrition insecurity by 2025. In particular, the strategy aims to improve utilization of nutritious, healthy, diverse and safe food for consumption under adequate biological and social environment with proper health care (SADC, 2014).

The study findings will also help to promote the consumption of vegetables during summer season to address the challenge of malnutrition in the country, the study will help to improve smallholder farmer's livelihood status but also contribute to the existing body of knowledge to the other researchers. Findings of the study will also be useful for researchers conducting research in the related field and the academia in particular.

### **1.7 Scope of the study**

This study was limited to its objectives and sought to find out the influence of the market of solar dried vegetables on improving farmers' livelihood status in the Arumeru district in three selected wards that are Mbuguni, Karangai, and Ndatu. The selection of study sites was basically on a previous project that trained farmers in the use of solar drying to promote the consumption of vegetables year-round. Furthermore, sampling methods and the processes of data collection, processing, and analysis were limited to research objectives as highlighted in this report.

### **1.8 Organization of the report**

The arrangement of this dissertation is logical to reflect a proper research process. It contains an introductory chapter that highlights the background of the problem, followed by a problem statement then objectives of the study and research questions. The second chapter of this report is concerned with a literature review by which a researcher tries to link various literatures with the proposed study including empirical theories and the gap. The third chapter presents the methodology segment describes procedures, methods, and tools for data collection and analysis. The fourth chapter presents data analysis, presentation, and discussion of the findings. The fifth chapter presents a conclusion and recommendations based on the presented research findings.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Overview**

This chapter presents the related literature that appears relevant to the present study. It consists of definitions of key terms, theoretical and empirical literature review, research gap, and conceptual framework.

#### **2.2 Conceptual Definitions**

##### **2.2.1 Market**

Is a means by which the exchange of goods and services takes place as the result of buyers and sellers being in contact with one another, either directly or through mediating agencies or institutions (Violet, 2017)

##### **2.2.2 Solar dried vegetables**

Solar drying vegetables are vegetables that have removed moisture through simultaneous heat and mass transfer and are a classical method of food preservation that provides longer shelf life and reduced weight and volume (Yaldiz, 2004).

##### **2.2.3 Livelihood**

These are the capabilities, assets, and activities required for people to earn money and secure means of living (IFRC, 2022).

#### **2.3 Theoretical Literature Review**

In Tanzania, fresh vegetables are not always available throughout the year, particularly in those regions affected by drought (Ragedunda et al., 2018). In these regions vegetable production is seasonal and drying could be an important option to ensure families always have vegetables for consumption. Dried vegetables

contributes to nutrition level because of their maintained nutrient compounds especially when novel drying technologies like solar dryer is used (Sablani, 2007; Çağlarırnak & Hepçimen, 2013). This can be done by encouraging farmers and other value chain actors to venture into value addition through the adoption of improved solar drying methods and tap higher value markets.

### **2.3.1 Smallholder Farmers Livelihoods and Empowerment Theory of Change**

Based on the theory of change developed by Weiss, (1995) who argued that, for smallholder farmers to have sufficient incomes and resources to sustain productive and fulfilling lives, they must first be “ready for economic opportunity” and “ready to contribute to the wider good and care for others.” However, readiness is not sufficient. The theory of change identifies five additional preconditions that make it possible for ready smallholder farmers to attain the sustainable livelihood objective. Not all of these preconditions must be met simultaneously, so they are not in the strictest sense necessary conditions. In addition, they may not cover all that is needed, however, these are pathways through which a “ready” youth may attain a sustainable livelihood, and the more of them that exist, the greater the opportunity for success.

The fifth pre-conditions are:

- Smallholder farmers have engaged in drying vegetables.
- Smallholder farmers experience fair and inclusive dried vegetable markets.
- There is household demand for solar dried vegetables and items are available at the market.
- Markets for solar dried vegetables are available and accessed to everyone in the community.

- Demand and supply of solar dried vegetables are rational at the market.

Smallholder farmers' livelihood must be market-driven in ways that the rise of the market could enhance farmers through the selling of dried vegetables that make them earn income for the family expenditure. The framework suggests that income accumulation in turn increases the household purchasing power which is a necessary condition for the improvement of smallholder farmers' lives.

The presence of a market for solar dried vegetables is essential to increase food security as illustrated in the livelihood framework. Dried foods are tasty, nutritious, lightweight, easy to prepare, and easy to store and use. The energy input is less than what is needed to freeze or can, and the storage space is minimal compared with that needed for canning jars and freezer containers. Hence this can increase food availability at a time when production is not taking place (dry seasons) (Weiss, 1995).

### **2.3.2 A livelihood portfolio theory of households**

It is the theoretical framework that allows households to choose many “points of welfare production within the 5- 5-dimensional welfare space” all leading to the satisfaction of their needs. The welfare pentagon represents the five core institutions that households use to satisfy current and future needs in a given society: family, markets, social networks, membership institutions, and public authorities. Even though historical and geographical appearances differ, these institutions are found in all societies across time and locations. The relevance of each institution and the exchanges between households and these institutions though may differ by society



and over time. It is assumed that households make decisions on their income generation and consumption.

A livelihood comprises the capabilities, well-being, food security, assets (stores, resources, claims, and access), and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the long and short term.

When it becomes clear that income does (will) not suffice, households can seek alternative funding for the expenditures. When these measures are effective, households can maintain a particular welfare level, even when income falls short. The market for dried food vegetables can play a great role in ensuring producers maximize their income earnings after sales while also the available solar dried vegetables can be stored in households for future use during the dry seasons.

### **2.3.3 DFID's Sustainable Livelihood Framework**

The DFID's sustainable livelihoods framework presents one of the popular and most widely used frameworks in development practice. According to the framework, a livelihood comprises the capabilities, assets and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (DFID, 2000). Core to the framework is the vulnerability context which in the present study may refer to the poverty context under which the low income small holder farmers of Arumeru

operate. The livelihood assets described in the framework may also refer to the human, physical and social capital assets that the small holder farmers possess that allow them to effectively participate in the production of the solar dried vegetables. The livelihood outcome, in the context of this study is therefore the attainment of food security.

## **2.4 Empirical Literature Review**

### **2.4.1 Solar Vegetable Market and Smallholder Farmer's Incomes**

Studies on vegetable production and horticultural in general have been conducted in various corners in different countries. The focus was to find out how dried vegetable markets have an influence on household income generation among smallholder farmers. Since the beginning of the economic transformation from a centralized economy to a market economy, vegetable production has increased rapidly in the Hanoi district.

In 2018, with support from UNDP, solar dryers were bought to enhance the vegetable drying process at Mubvumbi and create a more refined and valuable final product. The dryers have also helped the Mubvumbi community to reduce post-harvest losses. Through training provided by UNDP and its partners, the community is now running a profitable fruit and vegetable drying enterprise. In addition to business and financial management training, the group has also been trained in solar dryer operations, food handling, and safety and hygiene (UNDP, 2019).

The dried vegetables have a larger market base, with vegetables being sold in Gokwe, neighboring towns, a local retail chain store in Kwekwe, and in the capital city, Harare. A marketing committee has been established by the community, responsible for ensuring continued market development.

*“Ever since I began drying vegetables, I have been able to earn a higher income from sales. A 200g packet of dried vegetables is selling for \$7.50. We no longer worry about the vegetables going bad if they are not sold immediately, as the dried vegetables have a longer shelf life”. Alec, community member.*

Aside from providing the community members with an enhanced source of income, community members have established a barter system where 50kg of dried vegetables is exchanged for 35kg of dried fish in Binga.

The production and sale of fresh vegetables are one of the main sources of income in the community of Mubvumbi. Commonly grown vegetables such as kale would be sold at the local market for 20 – 50 cents depending on demand. Several challenges were faced by the community in selling their produce:

*“It was difficult selling fresh vegetables at the market as there was a lot of competition, which would push the price down. You would incur a loss selling the vegetables at a lower cost, and would only earn enough money for transport to go back home” - Alec.*

To preserve the shelf life of her vegetables, Mrs Kazembe would attempt to dry her leafy greens at home using improvised and unhygienic drying methods.

*“I would try and dry the vegetables using makeshift drying platforms such as pieces of metal sheeting. The vegetables would sometimes go off during the drying process as there wasn't enough sunlight” (UNDP, 2019).*

#### **2.4.2 Solar dried vegetables market and food security among smallholder farmers**

Preserving foods expands the utility and productivity of farm produce, which may be surplus during peak seasons but scarce during off-seasons, and helps smooth availability and access. For example, in developing countries, fruit trees tend to be

produced in flushes and fresh fruits are highly perishable. This is especially true of mangoes, pineapples, peaches, and bananas (Miricho, 2005).

An important aspect of food processing is that it permits greater dietary diversity, giving households access to a wider range of vitamins and minerals than they would otherwise consume. When included in household diets, dried vegetables can contribute significantly to household nutrition. Dried fruits have a higher concentration of sugar than their fresh counterparts as most water is removed in drying (Miricho, 2005). Therefore, there are more calories in dried foods than in fresh foods on a weight-for-weight basis. Dried vegetables are rich in riboflavin and iron. Dried vegetables are a good source of minerals, B vitamins, riboflavin, and niacin. Both dried fruits and vegetables provide useful amounts of digestive fiber (Miricho, 2005).

FAO, (2016) issued a report on the Anti-hunger program through a sustainable agriculture and rural development and wider access to food in the world when relating food access showed that, food insecurity in the world has been increasing each year although the world produces more food than is required to provide everyone with an adequate diet. Yet, 800 million people almost one person in every seven do not have enough to eat. Most of these people live in South Asia and sub Saharan Africa. The report pointed out that, low agricultural production of food crops are responsible for current food insecurity in the world. However, despite that, the world produces enough food to feed the nearly 6 billion people in the world and even more, still this food is not readily available to many millions of people

The Dutch Food & Business Knowledge Platform (F&BKP) commissioned an explorative study regarding the existing knowledge base from development practice

and research about the potential of the dried Fruit and Vegetables sector to contribute to Food & Nutrition Security (FNS) in the context of (a) sustainable development (i.e. economic, social, ecological and gender equity) and (b) the Dutch international cooperation agenda (i.e. combining aid, trade, and investments).

The outcome of this explorative study reflected during the dry season when vegetation is almost apparent, the dried vegetable can be a measure to increase food availability. Production has increased over the past 10-15 years, also in food-insecure countries such as Ethiopia, Rwanda, Ghana, Uganda, Kenya, Indonesia and Vietnam. Different donor-funded projects have been implemented to increase the production of dried vegetables. Some of these projects show a positive impact in terms of increased food availability. However many other donor-funded projects do not measure results in terms of FNS at outcome or impact level, resulting in limited empirical evidence on the impact of these projects (FAO, 2016).

#### **2.4.3 Solar dried vegetables market and smallholder farmers' wellbeing**

Under nutrition is a public health problem that affects the entire population in Tanzania but women and children are especially vulnerable (URT, 2010). Vegetables are perceived to have the potential to reduce extreme diet deficiency among households in Tanzania (Ochieng et al., 2017). Traditional African vegetables are excellent sources of dietary fiber, vitamins, and minerals, however, they are not readily available all year round due to persistent drought conditions. However, in developing countries, losses of food crops are a major problem in the postharvest chain leading to losses between 30 to 40% (FAO, 2011). Some of the causes of postharvest losses include inadequate post-harvest handling skills, lack of appropriate processing technology and storage facilities, poor infrastructure as well

and poor marketing systems. The factors that shorten the shelf life of fresh vegetables are enzymatic browning, microbial spoilage, dehydration, rapid wilting, and senescence caused by respiration and ethylene production. Drying vegetables is one of the oldest procedures for food preservation known to man (James and Matemu, 2016). It is a process that involves the removal of biologically active water to a safe level that reduces deteriorative chemical reactions, provides microbiological stability, and extends the shelf life of dried products (Mongi, 2013). Furthermore, it substantially reduces weight and volume; and minimizes packaging, storage, and transportation costs (Guiamba, 2016).

Promoting the consumption of vegetables will continue to be important as a way to address the problem of malnutrition challenges in Tanzania. This study has highlighted critical information drawing a picture of vegetable drying in the Central regions of Dodoma and Singida in Tanzania. All the households in the present study were aware of open sun-dried vegetables while 36% were aware of solar dried vegetables. Literature reports the shortcomings of the open sun drying method as the traditional way of conserving food yet it is commonly used by most processors. Open sun drying methods result in vegetables of poor quality in terms of less nutritional value, poor hygiene; bad appearance, color, and taste (Ochieng et al., 2018).

On the other hand, solar dried vegetables are of better quality in terms of nutritional content, better hygiene, good appearance, color, and taste than open sun-dried ones. However, the solar dried vegetables are still not known to many households and related knowledge is relatively low compared to open sun drying. Households often consider hygiene, nutritional value, taste, timely availability, drying methods, and easiness of cooking in their purchase decisions. This is equally influenced by the

gender of the household head, years of consuming dried vegetables, awareness of solar dried vegetables, and level of income (Ochieng et al., 2018).

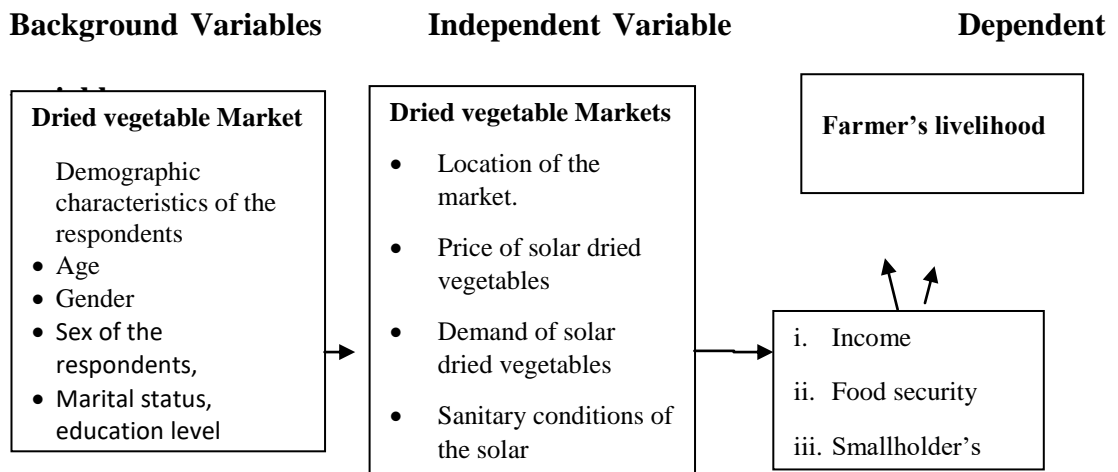
## **2.5 Research Gap**

Diverse types of vegetables made using different drying methods are becoming increasingly commercially important for the food processing industry worldwide because they are also recognized as healthy for human consumption. Several studies and research has already been conducted to examine the perceptions of dried vegetable towards consumer needs, some research conducted were concerned with dried vegetable and fruits towards food security variable. The researcher identified the gap in this context as per the problem statement that, still there was a need for current studies to examine the market of dried vegetables towards the livelihood of smallholder farmers with a comprehensive review of the recent progress in income, smallholder farmers welfare, and the food security.

## **2.6 Conceptual and Theoretical Framework**

The sustainable livelihoods framework is a way of thinking about the objectives, scope, and priorities for development activities. It is based on evolving thinking about the way the smallholder farmers and vulnerable live their lives and the importance of the dried vegetable market (DFID, 2000). The conceptual framework shown in Figure 1.1 helps to organize the factors that constrain or enhance livelihood opportunities and shows how they relate to one another. A central notion is that different households have different access to livelihood assets. The livelihood of people must include a strategy in which the poor must often make trade-offs and choices, drained vegetable markets are among the platforms for smallholder farmers

that can influence their livelihoods in the sphere of household income, household welfare, and household food security.



**Figure 2.1: Conceptual Framework**



## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Study Area**

The study was conducted in the Arumeru District Council located in the southeast of Arusha region. The district has an area of 2996 km<sup>2</sup> and a human population reaching 781,127 according to the 2023 census (URT 2003). The justification for selection of the study area was influenced by a previous project that trained farmers in the use of solar drying to promote the consumption of vegetables year-round.

#### **3.2 Population of the Study**

A target population is defined as a group of individuals or participants with specific attributes of interest and relevance (Creswell, 2009). The target population of the study was smallholder farmers who practice solar dried vegetables in Arumeru District Council and dealers in local Markets for domestic items including vegetables.

#### **3.3 Research Approach**

This study used both qualitative and quantitative research approaches. It employed a qualitative approach to capture the feelings, perceptions, understandings, and opinions of buyers and farmers towards dried vegetables, while a quantitative approach was employed to measure numerical data. The mixed research approach provides strengths that offset the weaknesses of both quantitative and qualitative research thus, by using both types of research, the strengths of each approach can make up for the weaknesses of the other.

### 3.4 Research Design

The study used a cross-sectional research design, the selection of this design was basically because, the cross-sectional design allows the researcher to study different groups of respondents at one point at a time, it is simple to use and easy to collect various information from respondents based on a particular study that a researcher conduct with great degree of accuracy and quick results. Therefore, the researcher adapted to this design by reviewing different literature from research reports, journals, and books that contain both qualitative data and quantitative data.

### 3.5 Sample Size and Sample Techniques

#### 3.5.1 Sample Size

A sample size is simply a subset of the population. The sample must be representative of the population from which it has to be drawn and it must have a good size to warrant statistical analysis. The sampling frame engaged the list of all people and households who have to be involved in this study. However, the sample size was estimated using sample size lookup tables where the general rule states that a statistical sample should contain 50 to 100 cases for each sample or sub-group to be analyzed (Haque, A.K.M.A 2012). In this study, the sample size was 73 as obtained from the following formula that is used for unknown population (Lidhiana, H. 2021)

$$n = \frac{t^2 \times p(1-p)}{m^2}$$

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

$$n = \frac{3.8416 \times 0.05(0.95)}{0.0025}$$

$$n = 72.9904$$

$$n=73$$

where 'n' is the required sample size; 't' is the confidence level at 95% (standard value of 1.96); 'p' is the estimated percentage of the population in the study area, expressed as decimal, and 'm' is margin of error at 5% (standard value of 0.05).

### **3.5.2 Sampling Techniques**

The study employed both probability and non-probability sampling techniques to obtain respondents from the population. Simple random sampling was used to select 73 respondents from smallholder farmers and buyers of solar dried vegetables. A researcher adopted this technique to simplify the task of getting respondents. Under the non-probability sampling method, a researcher employed purposive sampling to select 13 key informants from Nutritional Officers, Community Development Officers, and Local Government Authorities from the Arumeru District Council. Purposive sampling was applied to the respondents who met specific criteria specified by the researcher based on the research topic.

## **3.6 Variables and Measurement Procedures**

### **3.6.1 Independent Variables**

- Demographic characteristics of participants such as age of the respondents, sex of the respondents, marital status, education level, occupation, household size
- Price of solar dried vegetables
- Demand of solar dried vegetables
- Sanitary conditions of the solar dried vegetables
- Advertisement
- Quality of the solar dried vegetables

- Government policy
- Location of the market.

### **3.6.2 Dependent Variable**

The dependent variable is the Farmers livelihood

## **3.7 Types and Sources of Data**

### **3.7.1 Primary Data**

The primary data are those that are collected fresh from the field and for the first time and thus happen to be original (Kothari, 2014). Both qualitative and quantitative data were collected using questionnaires and interviews. Questionnaires were used for the key respondents and interviews were used with the key informants.

### **3.7.2 Secondary Data**

These are data collected by someone other than the researcher through consultation with different readings or publications. The study collected secondary data from different books, journals, and magazines, from published and unpublished papers, through online materials/internet and public libraries. The review enabled the researcher to obtain the information necessary to provide sufficient evidence for the study.

## **3.8 Data Collection Methods**

To achieve the objectives of the study, the researcher collected both primary and secondary data. Primary data were collected through questionnaires and interviews while secondary data were collected through documentary reviews.

### **3.8.1 Interview**

The interview is defined as a way of collecting data from individuals through conversations (Anol, 2012). This method was used to select 13 key informants who

were believed to be knowledgeable of the study topic (Nutritional Officers, Community Development officers, and Local government Authorities from the Arumeru District Council). In this study, both structured and semi-structured interviews were also applied to key informants. As they responded to the listed items more questions emerged and they were asked besides the prepared ones

### **3.8.2 Questionnaires**

The questionnaire is regarded as a series of questions, each one providing several alternative answers from which the respondent can choose (Kothari 2004). Both open and closed-ended questions were employed in this study from which questions were asked and the respondents (farmers) were required to give their answers. The reason for using questionnaires was that they covered a large sample at a low cost, and gave respondents adequate time to give well-thought-out answers.

### **3.8.3 Documentary Review**

Documentary review is the use of outside sources, and documents to support the viewpoint or argument of an academic work (Rajasekar *et al.*, 2013). In this study, the researcher reviewed various documents such as books, journals, report dissertations, magazines, and articles. This was because some of the information that was needed by the researcher had been already collected and stored in a library or obtained from online source.

## **3.9 Data Analysis**

### **3.9.1 Quantitative Data**

The collected data were coded, recorded, cleaned, processed; and finally, analyzed using a statistical tool that is Statistical Package for Social Science (SPSS) version 25

to compute descriptive statistics such as percentages and frequencies. Quantitative findings were presented in tables.

### **3.9.2 Qualitative Data**

Qualitative data were analyzed using the content analysis technique whereby data were organized and summarized into different themes based on conceptual descriptions of ideas, and views which expressed by the respondents' interview guide. These themes were related to the study objectives to give detailed information. Finally, the results of the analyzed data were presented in the form of word text narration.

## **3.10 Validity and Reliability of Research Instruments**

### **3.10.1 Validity of research instruments**

To ensure the validity of the proposed research, the researcher used different data collection tools to get information, these tools were questionnaires and key-informant interviews.

### **3.10.2 Reliability of the research instruments**

To control the reliability of the study pre-testing of questionnaires, a key informant interview guide was considered to check their comprehensiveness in collecting data required for this study.

### **3.10.3 Ethical considerations**

The data collection process demands the team to observe ethical guidelines. Observing ethical guidelines ensures security to the participants and that their participation does not lead to any harm in any case. This research study was bound to research ethics. The researcher observed participants' rights and consent were considered. Before conducting the study the researcher sought permission from all

institutions to be involved in the study and communicate to the respondents the purpose of the study and a method to be used to create awareness among participants on what exactly was needed from them. All collected information from respondents was confidential and was used for this study.

## **CHAPTER FOUR**

### **RESULTS AND DISCUSSIONS**

#### **4.1 Chapter Overview**

This chapter presents results from the analysis of collected data. The first section is founded on demographic characteristics of the participants. The second part focuses the contribution of solar dried vegetables market towards smallholder farmer's income in Arumeru District Arusha Region. The third section focuses on the contributions of solar dried vegetables market towards food security among smallholder farmers in Arumeru District Arusha Region. The fourth section focuses contributions of solar dried vegetables market toward smallholder farmers' well-being in Arumeru District Arusha Region and the last part focuses on the conclusion and recommendations of the study.

#### **4.2 Socio- demographic Information of the Respondents**

This section describes the general characteristics of the respondents such as age, sex, marital status, educational level, occupation, and household size.

##### **4.2.1 Age of the Respondents**

The findings in Table 4.1 show that most of the respondents (52%) were in the age group between 41 and 45, indicating that vegetable drying is mostly undertaken by aged people, about (19%) of the respondents were in the age group of 31 and 35, it was further revealed that (17%) of the respondents were in the age between 26-30 and 12% of the respondents were in the age between 36 and 40. The study revealed that the respondents of this study were in different age groups which can provide a clear picture of the influence of the market of solar dried vegetables on improving smallholder farmers livelihood status. The results imply those who are engaged in the



production, selling, and buying of solar dried vegetables are aged people ranging from 41 and 45 years, this indicates that most young people do not prefer to engage in solar dried vegetables than aged people.

**Table 4.1 Socio- demographic Information of the Respondents**

<b>Age of the respondents</b>	<b>Frequency</b>	<b>Percent</b>
26-30 years	12	17
31-35 years	14	19
36-40 years	9	12
41-45 years	38	52
<b>Sex of the respondents</b>		
Male	19	26
Female	54	74
<b>Marital Status</b>		
Single	12	17
Married	25	34
Divorced	16	22
Widow	20	27
<b>Education level</b>		
Primary	42	58
Secondary	14	19
College	17	23
<b>Occupation of the Respondents</b>		
Employed	16	22
Farmer	44	60
Entrepreneurs	13	18
<b>Household size</b>		
1	7	9
2	10	14
3	20	27
4	10	14
5	10	14
6	10	14
7	6	8

Source: Survey Data (2022)

#### **4.2.2 Sex of the Respondents**

The findings in Table 4.1 show that most of the respondents (74%) were female and it was further revealed that (26%) of the respondents were female. The results imply that vegetable drying is mostly undertaken by women which links well with their household role of ensuring food and nutritional security for their families. The finding is supported by Ochieng. *et al.*, (2015) who found that most of the respondents who engaged in vegetable drying are women than men, the reason given was because women are the ones who have the role of ensuring food and nutritional security among their family members.

#### **4.2.3 Marital status of the respondents**

The findings in Table 4.1 show that the majority of the respondents (34%) who engaged in vegetable drying were married, about (27%) of the respondents were widows, it was further revealed that (22%) of the respondents were divorced and 17% of the respondents who engaged with vegetables drying were single. This implies that the majority of the respondents who are engaging in vegetable drying are married and widows followed by divorced, the reason behind this was that unmarried ones were not interested in engaging in vegetable drying on the perception that the work of vegetables drying is not the work of their status and leaving the work to the rest. In the other hand the married and widows engaged in drying vegetables because they needed to generate income for their families, they were responsible for their children's wellbeing. Female household head of the household head was found to be significantly ( $p < 0.05$ ) influencing the purchasing decision. This is because women are responsible for feeding their families and food preparation within the household

and therefore have a greater chance of making choices on what to be consumed by their families (Ochieng *et al*, 2017).

#### **4.2.4 Respondent's level of education**

The findings revealed that more than half of the participants 58% have a primary level of education, 23% have college education, and about 19% have a secondary education. The results imply that failure to pursue further education was one of the factors that influenced most of the primary education leavers to engage in vegetable drying, if they could obtain higher level of education most likely they could not opt for such activity, they could prefer another job alternative. Attainment of the higher education is one of the factors that most of educated would not involve in precipitate vegetable drying as the source of income, due to facts that most of them are likely to think vegetable drying is not work of their status. Wilbon, (2021) observed that majority of the respondents had a basic education with a mean of 6.3 years of schooling with some without any form of education and those with highest years of schooling being 12 that is secondary level. However, technology transfer is associated with the level of education thus considering the low level of education implies little know-how on solar drying technology

#### **4.2.5 Occupation of the respondents**

The findings in **Table 4.1** shows that most of the respondents 60% were farmers, about 22% were employed and it was further revealed that 18% of the respondents were entrepreneurs. This implies that most of the respondents who are engaging in vegetable drying are farmers as they represent 60% of the total respondents, those who are employed, and entrepreneurs are not very much interested in engaging with

the vegetable. As such, Wilbon, (2021) suggests that even if farmers produce other crops can sell those crops and purchase solar dried vegetables.

#### **4.2.6 Household size**

The findings in **Table 4.1** show that 27% of the respondents had three household sizes, about 4% of the respondents had two, four, five, and six, household size respectively and 9% of the respondents had one household. This means that the majority of the smallholder farmers in vegetables drying had vegetable of household size.

#### **4.3 Contribution of solar dried vegetable market towards smallholder farmer's income in Arumeru District Arusha Region.**

The researcher was interested in knowing the contribution of solar dried vegetables market towards the improvement of smallholder farmers' income. Respondents were asked to give their views on the contribution of solar dried vegetable markets to improving the income of smallholder farmers.

##### **4.3.1 Time engaged in selling, buying, or producing solar dried vegetables**

The researcher was interested to know how long the smallholder farmers have been engaged in vegetable drying since they started. The findings in Table 4.2 show that the majority of the respondents (42%) asserted that they have been drying vegetables for five years, about 25% of the respondents said that they have been in the work for almost four years, 15% of the respondents said that they have been engaged in vegetables drying for three years, it was further revealed that 10% of the respondents acknowledged that they have been in solar dried vegetables for two years and 8% of the respondents asserted that they have been engaged in vegetables drying for one year. The results imply that solar dried vegetables it's not something new to them since they have been engaging in the production, selling, and buying of solar dried

vegetables for more than five years as indicated in Table 4.7. The findings are similar to those of Wilbon, (2021) who found that some respondents have consumed dried vegetables for the last 84 years implying the technique of drying vegetables is not new with a minimum of consumption length being one year and a mean of 34.1 years.

**Table 4.2 Time engaged in selling, buying, or producing solar dried vegetables**

<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
For one year	6	8
For two years	7	10
For three years	11	15
For four years	18	25
For more than five years	31	42
<b>Total</b>	<b>73</b>	<b>100</b>

**Source: Survey Data (2022)**

#### **4.3.2 Challenges facing smallholder farmers in the production, selling, and buying of solar vegetable products**

The study finding reveals that most of the respondents 23 equivalent to 32% suggested weather dependence as a key challenge facing smallholder farmers in the production of dried vegetables compared to the rest challenges identified. Also, the Data presented in Table 4.8 reflect that low capital and storage problems were minor challenges to smallholder farmers in either production, selling, or buying of dried vegetables as only respondents 3 equivalent to 4% proposed such challenges respectively separately. This feedback means that vegetable drying businesses in the areas lack a guarantee of stable weather conditions that could assure producers and vegetable processors due to extremely dependent on weather conditions affected by

climatic changes. As such, dried vegetables can be stored for long thus this explains their consumption during dry period or its consumption based on climate change (Vriens and van Diesen, 2007).

Secondary data tells other challenges facing smallholder farmers in production, selling, and buying of solar dried vegetable products. Such findings did not appear in challenges suggested by respondents of this study; however, they had a very great influence on smallholder farmers in solar dried vegetables. For example, the study findings from the research conducted by World Vegetable Centre (2018) revealed that, the majority of the respondents did not know if these vegetables can be dried and still retain the nutrients and quality while also there were few solar dryers in the village and are located far away from the farmer's group.

**Table 4.3 Challenges facing smallholder farmers in production, selling, and buying of solar vegetables products**

<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Market challenge	21	29
Weather dependent	23	32
Low capital	3	4
Negative attitude towards solar dried vegetables	12	16
Inadequate tools(dryers) for vegetable drying	7	10
Inadequate knowledge of solar dried vegetables	4	5
Storage problem	3	4
<b>Total</b>	<b>73</b>	<b>100</b>

**Source: Field Data (2022)**

#### **4.3.3 Contribution of Solar dried vegetables towards the improvement of households' livelihood**

A researcher was interested to know whether the presence of solar dried vegetables has contributed to overall improved household livelihood or not. Finding as

presented in Table 4.4 show that most of the respondents (50) 69% accepted the view that solar dried vegetables have positive impacts towards their livelihoods while few of them 23 accounting to 31% rejected that solar dried vegetables did not contribute to the improvement of smallholder farmers livelihood. This was clearly emphasized by the Key informant who narrated as follows;

*“Ever since farmers began drying vegetables, they have been able to earn a higher income from sales. A 200g packet of dried vegetables is sold for 1000 Tanzania shillings. We no longer worry about the vegetables going bad if they are not sold immediately as the dried vegetables have a longer shelf life”*(KI, 16 July, 2023).

This implies that there are significance contributions brought by the presence of solar dried vegetable markets among smallholder farmers. These findings are consistency with the study conducted by Matavel, *et al.* (2022) who found that increasing solar dried agricultural production is a necessary effort to address challenges of inadequate post-harvest treatment leads to storage losses and quality degradation, with repercussions for food security. The use of solar drying were promoted as a solution to provide efficient and reliable access to food preservation that improves the food security situation in rural communities

**Table 4.4 Contribution of Solar dried vegetables towards improvement of household livelihood**

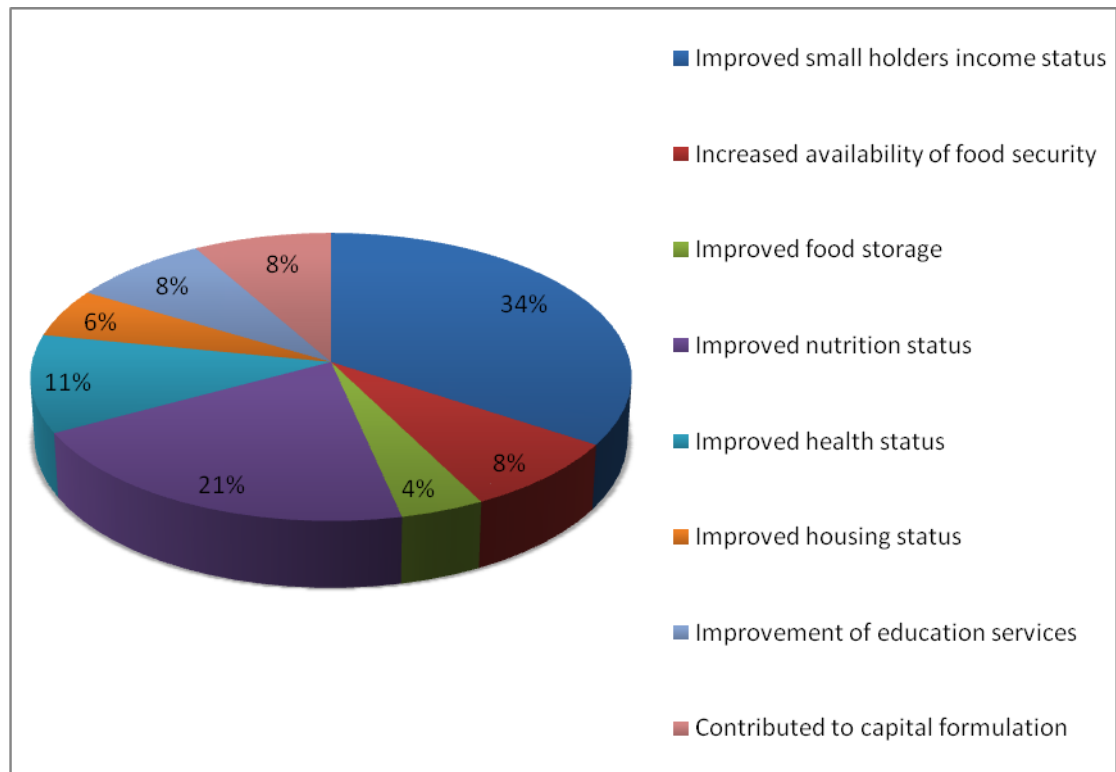
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Yes	50	69
No	23	31
<b>Total</b>	<b>73</b>	<b>100</b>

**Source: Survey Data (2022)**



#### **4.3.4 Significant changes contributed by the presence of solar dried vegetables to smallholder farmers**

The presence of solar dried vegetable markets to smallholder farmers had have significance contributions to participants as data presented in figure 4.1 data indicates that many respondents (25) 34% said they have earned income and improved income status, 21% said that they have improved households nutrition status and the rest few respondents selected other significances. Based on the same question other data from literature review indicated that there were significant changes in people's livelihood especially for those who either engaged in selling vegetables or those producing them (smallholder farmers). One of the study conducted in Zimbabwe Northern Province by UNDP 2019 indicated that the dried vegetables have a larger market base with vegetables being sold in Gokwe, neighboring towns, a local retail chain store in Kwekwe (Spar) and in the capital city Harare. These findings implies that those participants engaging in solar dried vegetables had satisfying living standards as some of them have improved income and have increased access to food availability, access to social services, improved housing.



**Figure 4.1: Significant changes contributed by the presence of solar dried vegetables to smallholder farmers**

#### **4.3.5 Target market of solar dried vegetables**

This section presents the research data finding as shown in Table 4.10 respectively, during the household survey/ data collection the respondents were asked about their target marketers in order to examine whether their markets for solar dried vegetables were assured and guaranteed with markets. In response to this question, most of the respondents (50) 69% indicated that people around their residence areas as most target marketers compared to less respondents (23) account for 31% who indicated that people from outside their areas are most target marketers. This means that the presence of people consuming dried vegetables around producers (smallholder's farmer) residences had have contributed to increase of demand development of solar dried vegetables. This in turn has contributed to survival of producers in terms of

income accumulation, access to social services. The report from World Vegetable Centre (2018) showed that respondents were willing to purchase solar dried vegetables either in the market or from neighboring households. The most common dried vegetables that majority were willing to pay include amaranth, African nightshade, Ethiopian mustard, and tomatoes. The respondents were willing to pay an average of Tshs 4038 per kilogram for dried tomatoes, especially those residing in Moshi, Babati and Lushoto districts. Hence such demands are essential for production and supply of solar dried vegetables.

**Table 4.5 Target market of solar dried vegetables**

<b>Target marketers</b>	<b>Frequency</b>	<b>Percent</b>
People around compound/ residences	50	69
People from outside the area	23	31
<b>Total</b>	<b>73</b>	<b>100</b>

**Source: Survey Data (2022)**

#### **4.3.6 Contribution brought by the presence of the market of solar dried vegetables towards livelihoods**

Markets for dried solar vegetables are often an important factor in production, sells, consumption and purchase decisions and 70% of the respondents accepted the view that reliable markets had have much contribution towards business development and for their livelihood improvement. However, few respondents account to 30% who said no; meaning that either they didn't realize the significances of markets towards improvement of livelihood, or they didn't know any potential impact of markets for solar vegetables as presented in table 4.11 respectively. This was also raised by the Key informant who had this to say;

*Available markets are good platform for producers... Yes it has contributed to development of business and those who engage in have improved livelihood compared to those who didn't engage in any Income Generating Activities* -(Key informant 2, July, 2023).

These results in particular suggest a view that without reliable markets for dried solar vegetables, there could be little or no improvement in smallholder farmer's livelihood. Hence the presence of such markets have had contributed to more production, more sells, more consumption and purchase of dried solar vegetables for those interested in. Studies Wilbo, (2021) market quality attributes, that is, price, drying method, colour, freshness, nutritional value, packaging and hygiene were more likely to influence consumption frequency of open sun dried TAVs.

**Table 4.6 Contribution brought by the presence of the market of solar dried vegetables towards livelihoods**

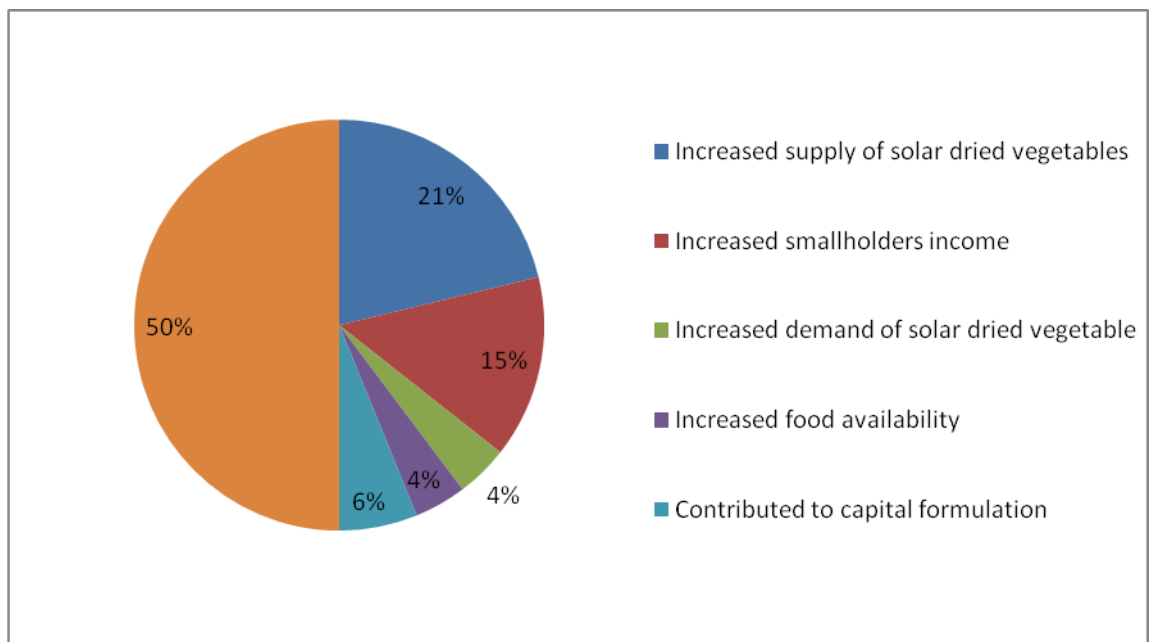
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Yes	51	70
No	22	30
<b>Total</b>	<b>73</b>	<b>100</b>

**Source: Field Data (2022)**

#### **4.3.7 Contribution of the market of solar dried vegetables**

A researcher was interested to know the contribution brought by the presence of a market of solar dried vegetables among the smallholder farmers who were engaging in vegetable drying. The findings in Figure 4.2 show that the majority of the respondents (43%) asserted that the presence of the market of solar-dried vegetables has led to the increased of supply of solar dried vegetables to smallholder farmers as most of them were able to produce more because of the assurance of the market of their products, about (29%) of the respondents said that the presence of the market of

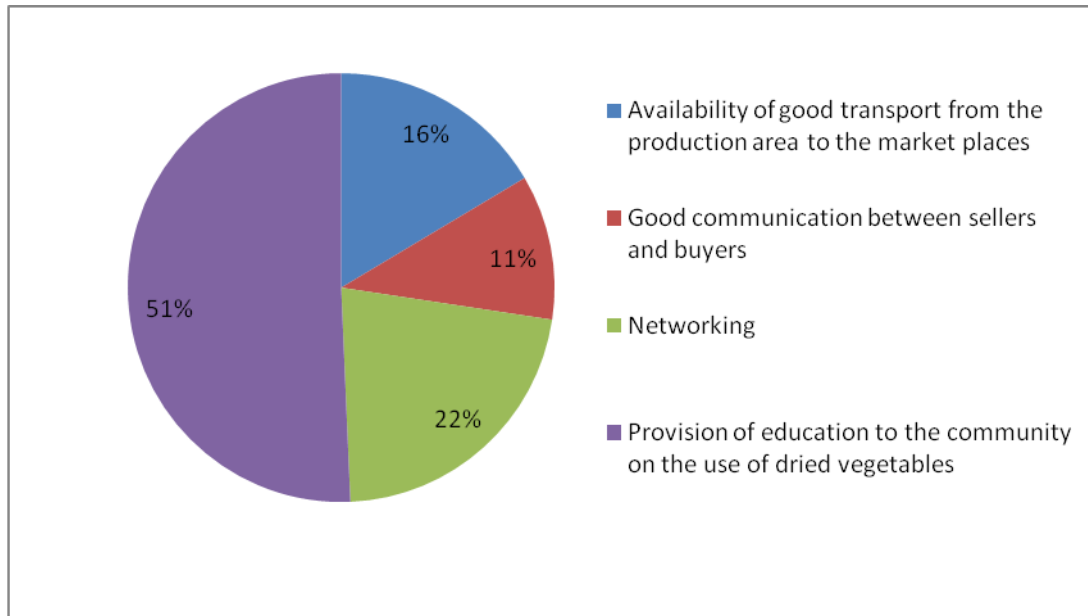
solar dried vegetables has helped them to increase their income from those products sold by them, it was further revealed that the presence of the solar dried vegetables helped them in the capital formulation and 8% of the respondents acknowledged that the presence of solar dried vegetables has helped in the availability of food among the smallholder farmers and other people which led to an increase in demand of solar dried vegetables. The results imply that the presence of solar dried vegetables among smallholder farmers has a great impact on their activities since has helped them to get market of their product and also helped them to increase income. The findings are in line with those of FAO (2011) that disclosed that dried, green leafy vegetables and fruits can be sold directly to neighbours, local markets, hotels, restaurants, shops, supermarkets, schools, hospitals and local famine relief agencies, especially during the dry season.



**Figure 4.2: Contribution of the market of solar dried vegetables****4.3.8 Market opportunities for dried vegetables**

A researcher was interested to know the market opportunities for solar dried vegetables of smallholder farmers. The findings in Figure 4.3 show that most of the respondents (51%) asserted that the provision of education to the community on the use of solar dried vegetables could be one of the marketing opportunities for solar dried vegetables of smallholder farmers, about (22%) of the respondents said that having good networking is one of the market opportunities for solar dried vegetables, it was further revealed that (16%) of the respondents acknowledged that availability of good transport of their products from the production area to where they are needed for consumption could be one among the market opportunities for solar dried vegetables and about (11%) of the respondents asserted that presence of good communication between buyers and sellers is one among the marketing opportunities to solar dried vegetables. The results imply that to ensure there are market opportunities for the solar dried vegetables there must be strategic planning to make sure that market opportunities are observed as per respondent's response especially in the provision of education to the consumers on the use of solar dried vegetables and having good networking with consumers. Yegon, (2021) found that 63.5% of respondents were not aware of availability of solar dried vegetable while only 36.5% were aware. Solar drying technology is a new practice thus this explains why 63.5% were not aware. Malik *et al*, (2013) point out that creating consumer awareness plays a critical role in stimulating buyers' interests in a product. Solar dried vegetables is still a new technology for majority of households in the region hence the low

frequencies of consumption of solar dried vegetables is due to limited awareness and availability (Ochieng *et al*, 2017)

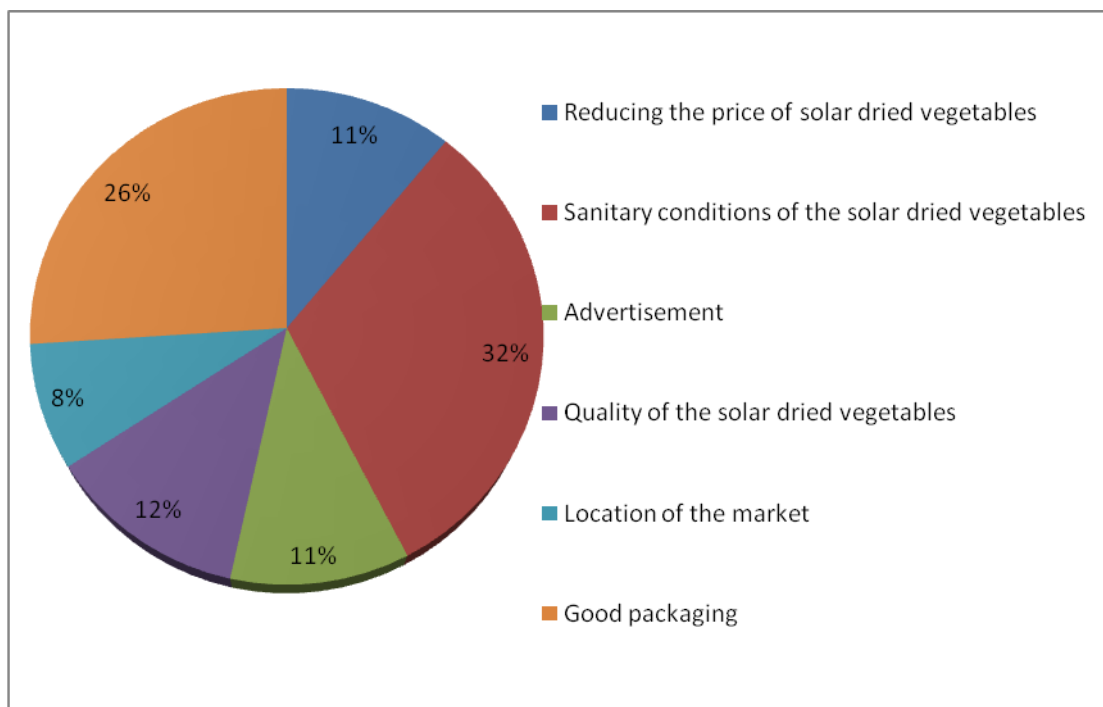


**Figure 4.3: Market opportunities for dried vegetables**

#### **4.3.9 Ways of increasing market opportunities for solar dried vegetables**

A researcher was interested to know the ways to be observed to increase market opportunities for solar dried vegetables among smallholder farmers. The findings in Figure 4.4 show that the majority of the respondents (32%) asserted that sanitary conditions of the solar-dried vegetables are one among the way that can be used to increase market opportunities for the solar-dried vegetables of smallholder farmers, about (26%) of the respondents said that good packaging of the solar dried vegetables is one among the ways to increase market opportunities of solar dried vegetables, it was further revealed that (11%) of the respondents acknowledged that reducing the price of solar dried vegetables and advertisement of the solar dried vegetables could be one of the ways to increase market opportunities of solar dried vegetables and 8% of the respondents declared that market location is also one

among the ways to increase market opportunities of the solar dried vegetables among smallholder farmers. The results imply that to ensure market opportunities for the solar dried vegetables there must be several ways that should be taken to increase market opportunities especially improving sanitary conditions of the solar dried vegetables and having good packaging of the products. FAO, (2011) emphasizes on clean procedures towards drying vegetables from harvesting to packing, it suggests that, a farmer should carefully harvest vegetables and fruits and wash them with clean water to remove any dirt, sand, stones, or other impurities, then after all the procedures the farm ought to pack dried vegetables and fruits in airtight moisture-proof black plastic bags; seal the bags using a burning candle and label fruit and vegetable bags with date produced and expiry date.



**Figure 4.4: Ways of increasing market opportunities for solar dried vegetables**



#### **4.3.10 Contribution of Solar dried Vegetables on improvement of Smallholder's income**

A researcher was interested to know the contribution of solar dried vegetables to improvement of smallholder farmer's income. The findings in Table 4.6 show that out of 73 respondents, 47 of them which is equivalent to (64%) agreed that solar-dried vegetables have helped them in improving the income of smallholder farmers, about 15 respondents which is equivalent to (21) were not sure if solar dried vegetables have any contribution to the improvement of income of smallholder farmers and it was further revealed that 11 respondents equivalent to (15%) disagree with the statement that solar dried vegetables have improved income of the smallholder farmers. From the findings above, it implies that solar dried vegetables have contributed to the improvement of smallholder farmer's income as most of the respondents (64%) agreed that solar dried vegetables have great impacts on the improvement of smallholder farmers through selling dry vegetables products.

#### **4.3.11 Contribution of Solar dried vegetables in capital generation for the establishment of other IGA**

A researcher was interested to know the contribution of solar dried vegetables in capital generation for establishing other IGAs. The findings in Table 4.13 show that out of 73 respondents, 37 of them which is equivalent to (51%) affirmed that solar dries vegetables have contributed to capital formation which is further being used for establishing other Income Generating Activities among smallholder farmers, about 17 respondents which are (23%) were not sure if solar dried vegetables have contributed to the capital formation and it was further revealed that (26%) of respondents disagreed that solar dried vegetables have no any contribution to the

formation of capital. The results imply that solar dried vegetables have great contribution to the capital formation which on the other hands is going to be used in establishing other Income Generating Activities, this is because most of them (51%) agreed that solar dried vegetables have contributed to the formation of capital through selling dry vegetable products.

#### **4.4 Contributions of solar dried vegetables market toward food security among smallholder farmers**

From this objective, the researcher was interested in knowing the contribution of solar dried vegetables market towards food security, food availability, and accessibility among smallholder farmers. Respondents were asked to give their views on the contribution of solar dried vegetable markets in ensuring food security among smallholder farmers.

##### **4.4.1 Contribution of Solar dried vegetables towards availability of food at household level during summer seasons**

A researcher was interested in knowing the contribution of solar dried vegetables towards the availability of food security. The findings in Table 4.14 show that out of 73 respondents, 41 of them which is equivalent to (56%) affirmed that solar dried vegetables have contributed to the availability of food among smallholder farmers and other people, 22 respondents equivalent to (30%) were not sure if solar dried vegetables contributed to the availability of food among the smallholder farmers and 10 respondents which is equivalent to (14%) disagreed that solar dried vegetables have no contribution to the availability of food security among smallholder farmers. The results imply that solar dried vegetables have great contribution to the availability of food security as most of the respondents (56%) agreed that solar dried

vegetables have contributed to the availability of food security among smallholder farmers as most of the dried vegetables were consumed during a shortage.

The findings further reveal that solar vegetable has a great contribution to food availability, food accessibility, and nourishment among smallholder farmers. During the summer season when fresh vegetables are not be available in markets, solar dried vegetables remain available and accessible to local communities that are smallholder farmers.

#### **4.5 Contributions of solar dried vegetable market toward smallholder farmer's wellbeing**

From this objective, the researcher was interested in knowing the contribution of solar dried vegetables market toward smallholder farmer's well-being. Respondents were asked to give their views on the contribution of solar dried vegetables market in improving smallholder farmers' wellbeing.

##### **4.5.1 Contribution of Solar dried vegetables towards the improvement of nutrition status among smallholder farmers.**

A researcher was interested in knowing the contribution of solar dried vegetables towards the improvement of nutrition status among smallholder farmers. The findings in Table 4.15 show that out of 73 respondents, 40 of them which is equivalent to (67%) affirmed that solar dried vegetables have contributed to the improvement of nutrition status among smallholder farmers, 18 respondents equivalent to (25%) were not sure if solar dried vegetables contributed to the improvement of nutrition status among the smallholder farmers and 6 respondents which is equivalent to (8%) disagreed that solar dried vegetables have no contribution to the improvement of nutrition status among smallholder farmers. The

results imply that solar-dried vegetables have contributed to the improvement of nutrition status among the smallholder farmers as most of the respondents (67%) agreed that solar dried vegetables have contributed to the improvement of nutrition status among smallholder farmers as dried vegetables have got many nutrients. Similar findings were revealed by Ochieng *et al.*, (2017) who found that dried vegetables have nutritional values which are important in strengthening of body immunity.

#### **4.5.2 Contribution of Solar dried vegetables towards the improvement of the health status of the smallholder farmers**

Nutrition and nourishment are essential components for assessing the livelihood of smallholder farmers and participants of solar dried vegetables. Taking importance to this, a researcher was interested to know whether there the presence of solar dried vegetables has contributed to the improvement of their health status or not. Significantly, most of the respondent i.e. 51 equivalent to 50% agreed that they had improved health status, 14 respondents equivalent to 19% neither agreed nor disagreed and the rest of few respondents i.e. 8 equivalent to 11% disagreed with the question statement. Using secondary data from other literature, data indicate that solar dried vegetables had some contribution to the improvement of health among potential consumers and producers who engaged in. since vegetables are major sources of vitamins, minerals, fiber and other plant bioactive compounds like antioxidants important for human health and well-being it is necessary to consume them (Orsat *et al.* 2006, Slavin, 2012). Other findings from other studies were opposite to data obtained in the field on the significance of solar dried vegetables towards health status of the consumers or producers. Ofor, (2011) indicated that

dried vegetables are highly perishable due to high moisture content (some up to 95%) and therefore require appropriate preservation methods. High moisture supports enzyme activity and microbial growth causing crop deterioration or spoilage hence post-harvest losses. Post-harvest losses of vegetables are estimated to range from 30–50% in sub-Saharan Africa depending on crop, markets, and region. All these may result in dangerous and might be harmful to its users unless otherwise well produced, processed, and preserved.

#### **4.5.3 Contribution of Solar dried Vegetables towards the improvement of housing status of the smallholder farmers**

A researcher was particularly interested in examining whether there was a significant improvement in housing for smallholder farmers producing dried solar vegetables or not. Data presented in Table 4.17 reveal that the majority of the respondents i.e. 41 equivalent to 56% agreed that they had improvement in their housing contributed by the business as they were able to accumulate income after sales. Furthermore, other respondents accounting for 19 equivalent to 26%, and 13 respondents equivalent to 18% had nothing side to propose from the question statement while others significantly opposed meaning that they didn't find any contributions of solar dried vegetables towards their housing improvements.

Data presented under this discussion suggests the view that there could much more contributions from solar-dried vegetables as many respondents justified through their agreement with the statement. Such findings are consistency with the research report finding from the study by Habou, D., Asere, A. A. and Alhassan, A. M. (2003) in the study aimed at examining Water, Health, and Hygiene Through the direct support of UNV, a solar borehole was installed at the Mubvumbi gardens and has already

improved the water, sanitation and hygiene (WASH) outcomes of the residents involved in dried solar vegetables project. The borehole provides the community with water needed to maintain their crops as well as providing a clean source of drinking water for the local community. more emphasis were given by the key informant who narrated that.

*“Since the installation of the borehole, we have seen the construction of standard toilets at the homesteads of the individuals active in the drying project”* (Key informant, July, 2023).

#### **4.5.4 Contribution of Solar dried vegetables towards the improvement of education services among smallholder farmers**

A researcher was interested in studying the contribution of solar dried vegetables towards an improvement of education services among the smallholder farmers. The findings in Table 4.18 indicated that 37 respondents which are equivalent to 50% affirmed that solar dried vegetables has helped them in improving the education services to their children, as through selling their products they were able to send their children to school and managing to pay some other education expenses, it was further revealed that 18 respondents which are 25% were not sure whether solar dried vegetable has brought any improvement in education services among smallholder famers and about 18 respondents which is equal to 25% disagreed that solar dried vegetables have no contribution in improving education services among the smallholder farmers. Data presented in this discussion suggests the view that there could much more contributions from solar dried vegetables to improving education services among the smallholder farmers as many respondents justified through their agreement to the statement.

This evidenced during an interview with the key respondents from the Arumeru district, one among them said:

*“Since I have engaged in solar dried vegetables, I was able to get money and pay school fees and other education expenses to my children, helped in owning and running a small business, helped in saving opportunities, but also I was able to pay for medical expenses”*

**Table 4:7 Contributions of solar dried vegetable market toward smallholder farmer’s wellbeing**

Statements	Agree	Neutral	Disagree
Contribution of Solar dried Vegetables on improvement of Smallholder’s income	47 (64%)	15 (21%)	11 (15%)
Contribution of Solar dried vegetables in capital generation for establishment of other IGA	37 (51%)	17 (23%)	19 (26%)
Contribution of Solar dried vegetables towards availability of food at the household level during summer seasons	41(56%)	22 (30%)	10 (14%)
Contribution of Solar dried vegetables towards the improvement of nutrition status among smallholder famers	49 (67%)	18 (25%)	6 (8%)
Contribution of Solar dried Vegetables towards the improvement of the health status of the smallholder farmers	51 (70%)	14 (19%)	8 (11%)
Contribution of Solar dried vegetables towards the improvement of housing status of the smallholder farmers	41 (56%)	13 (18%)	19 (26%)
Contribution of Solar dried vegetables towards the improvement of education services among smallholder farmers	37 (50%)	18 (25%)	18 (25%)

## **CHAPTER FIVE**

### **CONCLUSION AND RECOMMENDATIONS**

#### **5.1 Chapter Overview**

This chapter presents the conclusion and recommendations of the study. The conclusion has been drawn from findings and recommendations about solar dried vegetables. The conclusion summarizes what has been discussed above; while the recommendations part of this chapter presents the suggestions proposed based on the gaps identified in terms of loopholes and enforcement of the laws and policies on solar dried vegetables.

#### **5.2 Conclusion**

Promoting the consumption of vegetables is important to address malnutrition in Tanzania. This study has highlighted critical information drawing a picture of vegetable drying in Arumeru District Tanzania. From the findings, it can be concluded that;

The presence of solar dried vegetables has contributed to the improvement of income among smallholder farmers. Though income obtained from selling solar dried vegetable smallholder farmers were able to accumulate fund that has also enabled them to establish other Income income-generating activities.

The findings further reveal that solar-dried vegetable has a great contribution to food availability, food accessibility, and nourishment among smallholder farmers. During the summer season when fresh vegetables are not available in markets, solar dried



vegetables remain available and accessible to local communities that are smallholder farmers.

The well-being of smallholder farmers has been also influenced by the presence of markets for solar dried vegetables. Since participants have been able to access social services such as education and health services due to income obtained from the business. Findings reveal that smallholder farmers have been able to pay school fees and other education expenses to their children, able to afford medical expenses, and able to make quality housing in their residence areas.

### **5.3 Recommendations**

Based on the findings of this study, the following recommendations are proposed:

Solar dried vegetables are a business opportunity that many people can benefit from but communities are unaware of. This can be tapped by individuals who are willing to invest their money. However, efforts to encourage the establishment of SMEs should be combined with consumer demand creation through behavioral change communication (BCC) approaches. There is a low level of knowledge and awareness of solar dried vegetables and promotion programs should not only target farmers but also consumers and the general public to inform them of the health and nutrition benefits of solar dried products compared to open sun dried products. These efforts will effectively help to build the value chain.

There should be strong cooperation between processors, distributors, and regulatory agencies like the Tanzania Food and Drugs Authority (TFDA) and Tanzania Bureau

of Standards (TBS) to increase access to and consumption of dried products. Targeting processors will enhance the uptake of solar drying technologies for drying for business and the availability of attractive and safe products will encourage consumers to purchase the dried products that can potentially be available throughout the year. Regulation and oversight are necessary and prudent to provide testing of the dried products and certify them before selling them in the market.

Based on challenges identified i.e. drying facilities it is also recommended that local carpenters should be trained on how to construct solar dryers using locally available materials instead of delivering already built ones to the farmers. This way the solar dryers will be available at a cheaper price that many farmers can afford.

To expand the market for solar dried vegetables, there should be an increase in the value chain for dried vegetables by strengthening the relationship between actors along the value chain; supporting organizations and stakeholders should coordinate various links in the dried vegetable value chain.

#### **5.4 Recommendation for further study**

The study only covered the Arumeru district, therefore, it is suggested that future studies should cover other areas with different geographical conditions to compare results and see if solar dried vegetables can contribute to improving smallholder farmer's livelihood status.

Also, more studies are needed to be carried out to investigate the nutritional standards of the solar dried vegetables to potential consumers.

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## **APPENDICES**

### **Appendices I**

#### **Questionnaires for Participants**

I am, a student at the Open University of Tanzania pursuing a Master of Arts in Monitoring and Evaluation I am conducting a study on “*The Influence of The Market of Solar Dried Vegetables on Improving Small Holder Farmers Livelihood Status. A Case of Small Holder Farmers on Arumeru District.*”. I humbly request your cooperation in answering this interview to enable me to get information for the study. All information given will be treated with high levels of confidentiality and



be used for academic purposes only. Thank you for taking the time to share with me in this study.

**Section A: Demographic characteristics of the participant**

1) Sex of participant      a. Male b. Female

2) Age group in years

a) 20-25 years    b) 26-30 years c) 31-35 years

a) 36-40 years    e) 41- 45 years d) 46 -above

3) Marital status

a) Single            b) Married            c) Divorced

d) Widower        e) Widow            d) Separated

4) Level of education

a. Primary    b) Secondary      c) College/ University

d. Others specify \_\_\_\_\_

5) For how long have you engaged in selling, buying, or producing solar dried vegetables in recent years?

a) For one year

b) For two years

c) For three years

d) For four years

e) For more than five years

5. What are the challenges facing you during the process of producing, selling, and/or buying of solar dried vegetable products in your area?

6. Have solar dried vegetables changed your household livelihood?

a) Yes

b) No

7. If the answer is **Yes** to question number three above what are the significant changes are

8. What are your target marketers?

a) People around your compound

b) People from outside the area

9. Do you think the presence of the market of solar dried vegetables has any contributions towards your livelihoods?

a) Yes

b) No

10. If the answer is **Yes** in question number 4 above mention those contributions

i. \_\_\_\_\_

ii. \_\_\_\_\_

iii. \_\_\_\_\_

iv. \_\_\_\_\_

v. \_\_\_\_\_

11. What do you think are market opportunities for dried Vegetables?

- a) Availability of good transport from the production area to the marketplaces
- b) Good communication between sellers and buyers
- c) Networking
- d) Provision of education to the community on the use of dried vegetables

12. What are the best ways of increasing market opportunity for dried vegetables in your area?

- a) Reducing the price of solar dried vegetables
- b) Sanitary conditions of the solar dried vegetables
- c) Advertisement
- d) Quality of the solar dried vegetables
- e) Location of the market.
- f) Good packaging

### **SECTION B: Variables per Objectives**

**Tick inside the box that represents your stand.**

<b>S/N</b>	<b>VARIABLES</b>	<b>SD</b>	<b>D</b>	<b>A</b>	<b>DA</b>	<b>SA</b>
1.	<b>Household Income</b>					
i.	Solar dried vegetables have improved smallholders' income status through selling dried vegetables.					

<b>2.</b>	<b>Food security</b>	<b>SA</b>	<b>A</b>	<b>SD</b>	<b>DA</b>	<b>D</b>
i.	Solar dried vegetables have increased the availability of food at the household level during summer seasons					
<b>3.</b>	<b>Household wellbeing</b>	<b>SA</b>	<b>A</b>	<b>SD</b>	<b>DA</b>	<b>D</b>
i.	Solar dried vegetables have improved the nutrition status of smallholder farmers					
ii.	Solar dried vegetables have improved health status of smallholder farmers					
iii.	Solar dried vegetables have improved the housing status of smallholder farmers					

**THANK YOU VERY MUCH FOR YOUR COOPERATION**

**Appendix 2: Guidance for self-introduction and the purpose of the interview:**

Guideline for Key Informant Interviews (13 key informants that are Nutritional Officers, Community Development Officers, and Local Government Authorities from Arumeru District Council.

**Introduction**

I am, a student at the Open University of Tanzania pursuing a Master of Arts in Monitoring and Evaluation I am conducting a study on “*The Influence of The Market of Solar Dried Vegetables on Improving Small Holder Farmers Livelihood Status. A Case of Small Holder Farmers in Arumeru District.*”. I humbly request your cooperation in answering this interview to enable me to get information for the

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- 3) Marital status
  - a) Single              b) Married              c) Divorced
  - d) Widower          e) Widow              d) Separated
- 4) Level of education
  - a. Primary      b) Secondary      c) College/ University
  - d. Others specify\_\_\_\_\_

**Section B: Level of awareness on solar dried vegetable market and smallholder farmers in your area.**

1. What is your understanding of the solar dried vegetable market?
2. Is there any market for solar dried vegetables in your area?
3. What is the trend of these markets in your area?
4. Did you find any significance of dried solar vegetable markets towards smallholder farmer's livelihood?

5. If the answer is Yes to question number four above how the significance in the following is
  - i. Income
  - ii. Food security
  - iii. Smallholder farmer's wellbeing
6. Is small holder farmer's livelihood influenced by the presence of solar dried market?
7. If the answer is **Yes** providing your facts