ASSESSMENT OF POTENTIALS OF FRUIT TREES ON FOOD SECURITY OF RURAL FARMERS IN NIGER STATE, NIGERIA

BY

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MTech/SAAT/2018/8270

DEPARTMENT OF AGRICULTURAL EXTENSION AND RURAL DEVELOPMENT

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

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A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF TECHNOLOGY IN AGRICULTURAL EXTENSION AND RURAL DEVELOPMENT.

JANUARY, 2023

DECLARATION

I hereby declare that this thesis titled **"Assessment of Potentials of Fruit Trees on Food Security of Rural Farmers in Niger State, Nigeria"** is a collection of my original research work and it has not been presented for any other qualification anywhere. Information from other sources (published or unpublished) has been duly acknowledged.

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CERTIFICATION

This thesis titled **"Assessment of Potentials of Fruit Trees on Food Security of Rural Farmers in Niger State, Nigeria"** by GARBA, Mohammed Habib (M.Tech/SAAT/2018/8270) meets the regulations governing the award of the degree of (M.Tech) of the Federal University of Technology, Minna and it is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

I dedicate this work to my father Mallam Garba Hassan (Late) and my mother Mallama Khadijah Garba who stood by me during the period of this study.

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ABSTRACT

The study assessed potential of fruit trees for food security among rural farmers in Niger State, Nigeria. A sample size of 219 fruit trees farmers were selected in the state using multi-stage sampling technique. Structured questionnaire complimented with interview scheduled were used for data collection. Data collected were analyzed using both descriptive and inferential statistics. The findings revealed that majority (82.2%) of the respondents were male, while 46.1% were in their active age and only 42.9% of the respondents had secondary school education. A larger proportion (87.7%) of farmers were food secured. Maintenance, restoration of soil fertility and generation of employment and income from sales of fruits had the highest perception of potentials in the study area. The coefficient of farming experience (0.2350635) and that of extension service (0.4646172) were positive and significant; indicating that increase in farming experience and extension service will increase farmers' willingness to plant fruit trees. The major constraints associated with fruit trees farming in the study area were long gestation period of fruit trees ($\bar{X}$ =2.83) and problem of security ($\bar{X}$ =2.83) both ranked 1st and lack of credit facilities on fruit trees production ($\bar{X}$ =2.73) ranked 3rd. Based on the finding, it was recommended that fruit farmers should embark on planting of improved varieties with short gestation period. Charcoal and firewood making should be complimented with planting of new trees by individuals and forestry officers in order to protect the fruit trees from going into extinction. Also, credit and other incentives should be provided for fruit farmers in order to enhance their food security status in the study area.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Fruit trees form weighty biological resources in many agroecological systems and forest ecosystems all over the world. These tree species in nature, have long time economic and ecological impacts. Fruits are full of nature's rich essential nutrients, antioxidants and health benefits for ready use by humans and other animals without alternation in most cases, unlike vegetables and other edible agricultural/horticultural produce that may require necessary pre-treatments, such as heating in most cases before consumption (Lapena *et al*., 2014). The tropics, more than other region of the world, is endowed with great diversity of fruit tree species that have provided humans with basic food and nourishment for ages since the domestication of beneficial wild plants (Aju, 2014a).

In Africa, as in many other parts of the world, trees on farms are often overlooked in research and policy making. In agriculture and livelihood studies, the focus is typically on annual crops and their effects on household income. When perennial trees such as Shea, parkia, cashew, mango trees are considered, it is mostly from a value chain perspective. As a result, contribution of trees on farms are often left out of forest-related, agricultural and sustainable socio-economic livelihood statistics and little remains known about their prevalence and economic contribution, particularly at the national scale.

Yet, trees on farms are often vital component of agriculture-forest landscapes. They perform important ecological functions, which include the provision of soil nutrients, habitat for animals, and greater structural connectivity as well as serve as key basis for biodiversity conservation and climate change adaptation/ mitigation strategies (Mbow *et al*., 2014). Furthermore, sub-national case studies suggest that farm trees often play an

important role in rural livelihoods, either directly as a source of income (from timber or non-timber products such as fruits) or indirectly for the ecological services such as as nitrogen fixing, prevention of soil erosion, and provision of shade (Place and Garrity, 2015). Roughly one third of the agricultural land in Sub-Saharan Africa is estimated to be covered with trees at about 10 percent between 2008-2010 (Zomer *et al*., 2014). Trees and agricultural activities therefore often co-exist not only in larger landscape contexts but also in individual landowners.

Tropical continents of the world possess rich variety of fruit trees with about 1000 species identified in Americas, 500 species in Asia and 1200 species in Africa (Sthapit *et al*., 2012). Although only relatively few fractions of these diversities are marketed worldwide, the diversities are nature's inestimable assets for the livelihoods of local people throughout the tropical regions. Nigerian rural households suffer from food insecurity. Economic crisis and raising global food prices are affecting rural livelihood adversely. A decline in crop productivity of traditional farming systems coupled with growing rural populations implies a necessity to find alternative or complementary sources of livelihood to deal with the growing needs in rural areas (Owoeye, 2010). Majority of fruit juice in Nigeria markets are imported despite the abundant fruit trees in the rural areas. In Niger State, rural farmers who are naturally endowed with these fruit trees fail to harness the potentials of the crops in addressing their food security and income generation problems. Some of these tree crops are even destroyed through various human activities leading to annual deforestation of 3.5% which has resulted to severe local and global environmental damage (World Bank, 2013).

According to Food and Agricultural Organization, FAO (2010), there is a great potential for growth of fruits produce in the international markets due to the increasingly health

consciousness and much intensive nutritional awareness about the consumption of more fresh fruits as well as vegetables in people's diets. Fruit trees are a particularly important source of incomes, providing regular and fairly low-risk returns (Schreckenberg *et al*., 2002). In the context of off-farm economy in Nigeria, the rural people especially the poor are dependent on forest and fruit tree products for most of their livelihood. Fruit trees are derived from natural forest, artificially established forest and trees outside forest.

However, Food security is one of the targets of the Millennium Development Goals (MDGs) and is widely considered as important measure for evaluating the progress of a country in terms of wellbeing (Vasco, 2007). Regardless of various concern by governments all over the world on ensuring that every household can at least provide three square meals for their family, food insecurity continues to be a significant development problem across the globe, impairing people's health, productivity, and often their very survival (Aworh, 2014). Global hunger is severe, as closely 30 per cent of the world's population is currently suffering from one or more forms of malnutrition, including inadequate caloric consumption, protein deficiency, poor dietary quality, and insufficient concentrations of protein and micronutrients (FAO, 2015). Worldwide, approximately 840 million people are undernourished or chronically food insecure, and as many as 2.8 million children and 300,000 women die accidentally every year because of malnutrition in developing countries Nigeria inclusive (WHO, 2018).

Food security for rural households in developing countries encompasses all factors affecting a household's access to an adequate year-round supply of food. Thus, it is likely to involve not just the household's production of food crops, but availability of income with which to purchase other seasonal variations in food supply and income, the nutritional quality of the food available, shifts from subsistence to the cash economy and

the incidence of other cash needs such as school fees and health care. In terms of household food security, forest and fruit tree resources serve to supplement existing food resources and income, fill in seasonal shortfalls of food and income as well as provide seasonally crucial agricultural inputs such as fertilizers, agro-chemicals and help reduce risk and lessen the impact of droughts and other emergencies. In addition, forests and farm trees appear to be especially important for the rural poor as they mostly rely on off-farm employment opportunities and available forest resources to help meet their household needs.

1.2 Statement of the Research Problem

Evidence suggests that Nigerians food production is increasing at less than 2.0% while population growth rate is estimated to be 2.5% per annum, (NPC, 2012; Aku, 2012). Thus, the increasing evidence of change in population and available food production has generated contention and empirical questions. The suggested theoretical disparity indicates that low rate of food production and high rate of population growth will generate high rate of food demand, thereby causing food demand-supply gap which can give rise to food insecurity (Aku, 2012). Nigeria spends over 13 trillion Naira annually on the importation of basic food items including; wheat, rice, sugar and fish. More so, Malnutrition is widespread in the entire country and rural areas are especially vulnerable to chronic food shortages, unbalanced nutrition, erratic food supply, poor quality foods, high food costs, and even total lack of food (Aworh, 2014).

Irrespective of the growing evidence of the importance of fruit trees in the livelihood of rural people, there is inadequate information on the role of fruit trees on the food security status of rural farmers in Niger State in terms of fruit availability, accessibility, affordability and nutritional provision. Also, the willingness of farmers to plant fruit trees

in their farms is yet to be well documented in the area. This research tends to reveal some of the capabilities of these fruit trees not only their high nutritive value but also the development of their industrial uses which will stimulate its large scale production for availability, accessibility and affordability of food by the rural farmers in order to improve their level and standard of living and reduce the rate of rural-urban migration. Fruits production in Nigeria is a business that can provide means of livelihood and enhance food security of rural dwellers of Niger State in particular and Nigeria at large. It is against this background that this study seeks to provide answers to the following research questions:

i. What are the socio-economic characteristics of the rural farmers in the study area?
ii. What are the potentials of fruit trees for food security of the rural farmers in the study area?
iii. What is the food security status of farmers in the study area?
iv. What is the effect of fruit trees on food security status of the rural farmers in the study area?
v. What is the willingness of rural farmers to plant fruit trees in the study area?
vi. What are the constraints associated with fruit trees farming in the study area?

1.3 Aim and Objectives of the Study

The aim of the study was to assess the potentials of fruit trees for food security of the rural farmers. The specific objectives are to:

i. describe the socio-economic characteristics of the farmers in the study area;
ii. determine the potential of fruit trees for food security of the rural farmers;
iii. examine the food security status of rural farmers in the study area;

iv. determine the effect of fruit trees on food security of the rural farmers in the study area; (farmers involved in fruit trees farming are food secured)

v examine the willingness of rural farmers to plant fruit trees in the study area;

vi examine the constraints associated with fruit trees farming in the study area.

1.4 Hypotheses of the Study

HO_1: There is no significant relationship between selected socio-economic characteristics (age, education, income, farm size) and food security

HO_2: Fruit trees have no significant effect on food security of the rural farmers

1.5 Justification of the Study

Theoretically and methodologically, this study is significant in the current parlance of development economic, especially in extending similar studies, such as; Babatunde *et al*. (2007) and Ayantoye *et al*. (2011) among others. Most of these studies have not attempted to use the production and adequate utilization of fruit trees for food security in the rural areas. Hence, there is need to remedy some of their methodological shortcomings. This opens spaces for research to attempt to provide an analytical tool for food security situation in Nigeria most especially the rural populace. Therefore, the foregoing is practical gap that will contribute to knowledge and practice. Moreover, studies into food security have become increasingly important due to world development focus on it as a panacea for reducing poverty, hunger, diseases, improving education, and reducing environmental problems. In consonance with that, ensuring the future food security in developing economies has been an area of interest in food insecurity literature.

The overwhelming significance of planning development in less developed countries is compelling as food crises in Nigeria demonstrated the difficulties the region is facing to

ensure food security through own production. In addition, Governments, NGOs (especially those dealing with poverty reduction), community development associations (CDAs), international organizations, academics, students, economic planners, programme planners and policy makers are intended to benefit from the findings of this research. Academics and students particularly those in the field of development economics, agricultural extension, agricultural economics and health sectors will also benefit from this research. Again, because of the multi-lateral pattern of food insecurity, that call for interdisciplinary studies, historians, politicians, environmentalists, forestry personnel and others interested in development economics are expected to see this work as containing contemporary knowledge on potential of fruit trees and poverty. Literature in this aspect of development economics is vital in West Africa, Nigeria and Niger State.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Socio-Economic Characteristics of the Rural Farmers

The demographic characteristics of farmers are personal background of the farmers including gender, age, household size and education, which reflects human capital (David,1997).

2.1.1 Sex

It is a yardstick for differentiating people into males and females, which in turn explain the activity of each in the society. FAO (2007) reported that in the northern Nigeria males participate fully in farming activities whereas females engage mostly in processing and selling of farm produce.

2.1.2 Age of the farmers

This is an important factor affecting crop production, consumption and household food security in Nigeria. Farmers are mostly located in the rural areas, and because of inadequate infrastructural facilities in the rural areas, most rural youth migrate to the urban areas in search of white collar jobs leaving the aged farmers in the villages (FAO, 2007).

2.1.3 Marital status

Expansion of the family occurs through marriage, as such, marital status has a significant role to play on the household labour availability. The common cultural practice of early marriage and labour demand among farming households in the rural areas might explain this scenario.

2.1.4 Household size

The household is the main source of labour for production activities in the forest areas. Among family members, individual provide labour under reciprocal arrangements during land preparation and harvesting. Labour is also provided to other non-family members for a fee and is a good source of income for the households. Often most rural household depend on hired labour for nursery bed preparation and sustainable management of forest seedling (David,1997). The potential in this kind of labour arrangement is that it brings people together and could enhance the sharing of knowledge and collective action to adopt improved sustainable forest practices as was noted by Nyangena (2008) in his study of Western Kenya on the adoption of soil conservation practices. According to Krishna (2001), such social network can foster cooperative behaviour that could promote adoption.

2.1.5 Level of education

Education is a precondition for improving agricultural and consequently the living standard of the rural dwellers, education has promoted development and means for harnessing the potentials of fruit crops, hence, leading to sustainability of food security by rural farmers (FAO, 2014). Education assist in the use of various classes of food by the farmers. Lower educational level jeopardises access to food, job opportunities in the labour market and hampers more profitable entrepreneurship (FAO, 2012).

2.1.6 Access to credit

Access to credit which is the ability of household to obtain credit both in cash and kind for either consumption or to support production increases household income in the short run and could increase the consumption basket of household (Babatunde *et al.,* 2007). Production credit when obtained on time could increase chances of household to acquire

productive resources (seeds, seedlings, fertilizers, pesticides and others) which will boost and improve sustainable fruit trees production.

2.1.7 Farming experience

According to Ogunmefun and Achike (2015), the higher the age of the respondents, the higher their experience in farming and this translates to more encounter with risks among older farmers than in younger farmers. Farming experience is expected to help farmers in boosting crop production through the knowledge acquired from years of farming.

2.1.8 Membership of cooperative society

A cooperative has been defined as an association of persons who have voluntarily joined together to achieve a common end through equitable contributions to the required capital and accepting a fair share of the risks and benefits of the undertaking in which the member actively participates (Ihimodu, 1989).

2.1.9 Contact with extension agents

Agricultural extension is an education process directed to bringing about improvement in people in a systematic way, through careful planned and organized programmes. High level of extension contact has the tendency of positively affecting the farmers' level of productivity. The reverse will be the case in terms of absence or low level of extension contact. Continuous, regular and timely extension contact is needed to explain new technology to farmers and teach them how to increase their production and income. (Abubakar *et al*., 2009).

2.1.10 Access to land

Nwajiuba (2013) noted that access to land is key strategy to reduce rural poverty and ensure fruit trees management practices. Available evidence showed that fruit trees

production is mostly not visible for a landless rural farmer. Farming experience refers to the number of years a household have been engaged in farming. All things being equal, an experienced household is expected to have more insight and ability to diversify their production to minimize risk of fruit trees production. An experienced farmer is also expected to have adequate knowledge of proper agronomic management practices as well as good knowledge of climatic conditions especially how they affect fruit tree products (Ijoma *et al*., 2016).

Trees outside forest include isolated trees in landscape, windbreaks, shelterbelts, trees along roads and rivers, trees in agricultural system and trees in urban environment (FAO, 2013). The wider body of literature lists several factors that may drive farmers' decisions to retain and plant trees of different species (Aju, 2014b). According to Ibeawuchi (2015), these factors can broadly be categorized into two; internal and external to the household. For the internal (such as farm size, land tenure, access to labour, capital, education and ethnic background of household decision makers) and external (such as prevailing land-use system, relative availability of on-farm resources, market access and the policy/ legislative context).

2.2 Potentials of Fruit Trees

Fruit trees contributes in myriad of ways to sustainable agricultural production and food security. The greatest contribution is through its protective environmental functions such as the maintenance and restoration of soil fertility and its improvement, erosion control and maintenance of biodiversity. Fruit trees also contributes in many other ways such as through the direct production of food, provision of rural employment and income. A detailed discussion of these contributions is made below.

2.2.1 Maintenance and restoration of soil fertility and its improvement

When soil becomes poor in plant nutrients, food production is impaired. In other words, continued agricultural production is dependent on the fertility of the land. But continued crop production on a piece of land leads to the depletion of soil nutrients which translate into poor yield. However, maintenance of fruit trees cover on the land helps in restoring soil fertility hence resulting to increased yield of agricultural crops. Fruit trees improve soils by many processes; the most important of which are organic matter maintenance, nitrogen fixation, nutrient recycling and augmentation of nutrient uptake. The inclusion of trees in land use systems can augment the supply of plant material to the soil, as above ground litter and pruning deposits and more importantly by the shedding of fine roots. Many tropical species of trees belong to the family of leguminosae whose roots harbor bacteria that enable nitrogen to be fixed from the atmosphere. As many as 600 different tree species (not only leguminous ones) are known to be able to fix atmospheric nitrogen. (Corina *et al*., 2018).

The greatest potential contribution of fertility maintenance lies in the capacity of root system from trees to recycle plant nutrients that would otherwise be lost in leaching. Due to their sheer size, fruit trees have a major role to play in the cycle by which nutrients pass from the soil through plants and back to the soil. The slow removal of nutrients through leaching by rainwater is compensated by the steady release of minerals through the weathering of the underlying rock. Fruit tree roots reach far down, bringing up water and nutrients from depths that non-woody plants cannot reach. Also, their leaf fall can be used as a natural mulch to increase soil moisture as well as fertility (Dirceu and Jose 2018).

These beneficial effects of trees have a potential for farming systems with both low and high inputs. In the absence of fertilizers, soil organic matter (SOM) maintenance supplies a reserve of balanced nutrients, progressively released by mineralization while recycling delays the necessity for fallowing.

2.2.2 Erosion control

Soil erosion is a serious threat to continued agricultural productivity. Erosion whether by wind or water leads to the loss of top soil where plant nutrients are concentrated thus leading to the disruption of agricultural production and degradation of the soil. This situation can however be halted by the provision of vegetation cover. Fruit trees conserve the soil by protecting it from rain and wind, reducing soil erosion to the bearest minimum. The canopy of fruit trees shelters the ground from the impact of heavy downpours. The leaves drip water on the earth, giving it time to seep underground, bringing nourishment to animal and plants living beneath the tree (Obiefuna *et al*., 2016).

Planting fruit trees as windbreaks and shelterbelts can reduce the velocity of the wind to a speed that is insufficient to move soil particles. This can keep seeds and newly germinated seedlings from being blown away or dislodged, and can prevent ‘’sand blast’’ damage to growing crops. The reduction in wind speed leads to lower evaporation from both open water and soil surfaces, making more water available for plant growth. The cumulative effect is that, after allowing for the loss of cropping area planted to fruit trees and the reduction in crop growth immediately next to the shelterbelt due to shading and competition for moisture and nutrients, crop production usually increases in the area protected by the shelterbelt. Research in China for instance has confirmed that shelterbelt eight to nine years old can reduce wind velocity and evaporation by about 30 and 18%

respectively, and increase soil moisture and atmospheric humidity by around 20 and 9%, respectively (World Bank, 2013).

2.2.3 Maintenance of biodiversity

According Edmundo *et al*. (2018), biodiversity represents the wealth of live forms found on earth including millions of different plants, animals and micro-organisms and the genes they contain. Maintenance of this diversity is an insurance and investment necessary to sustain and improve agriculture. This is because it is the sources of all our food. Moreover, cross breeding of domestic crops with wild varieties can improve yields and produce new strains better adapted to growing conditions or more resistant to diseases and pests.

The major store house of this genetic diversity is the forest. The forest systems of the world – particularly tropical forests which contain a lot of fruit trees, house a great portion of the planets plant and animal species. No doubt, forest ecosystems are very important for both the maintenance and expansion of food production (Bronwen *et al*., 2015).

2.2.4 Direct production of food

Globally, it is estimated that 50 percent of all fruit consumed by humans originate from trees, most of which come from cultivated sources (Powell *et al*., 2015). Most of these planted fruit trees still have "wild" or "semi-wild" stands in "native" forest that are also harvested and which form important genetic resources for the improvement of planted stock (Dawson *et al*., 2014b).

The variety and importance of food that people especially in the rural areas obtain either directly from the forest, or produce in an environment sustained and protected by trees are enormous. In the whole of West Africa for instance, forests and fruit trees provide

food sources in a variety of forms which include edible leaves, fruits, seeds, nuts, sap which are good sources of some essential vitamins needed by the body such as vitamin C, and B as well as roots, tubers, bark, mushroom, honey, game, snails and insects. Fruit trees are often the only reliable source of food for the family when crops fail or during the lean periods between harvests (Adama, 2016). Food from the forests are often used to help meet dietary shortfalls during particular seasons of the year, bridging "hunger periods" when stored food supplies are dwindling and the next harvest is not yet available. They are also valued during the peak agricultural labour periods when less time is available for cooking and people consume more snack foods. In addition, these products feature prominently during emergency periods such as floods, droughts, famine, wars, economic and social disasters and also when fuel for cooking/heating, timber for the reconstruction of homes and animal shelters become critical. (Aju and Uwalaka, 2010).

2.2.5 Provision of traditional medicine

Fruits are commonly consumed for their nutrients, and some fruits are used as medicine. The medicinal properties of fruits are closely related to their available phytochemicals, as well as antioxidants. Many of the indigenous fruits have been traditionally used as folk medicine. These fruits contain phytochemical antioxidants that can prevent, treat, and cure various types of diseases. Many phytochemicals such as carotenoids, tannic acids, triterpenes, and some flavonoids are free radical scavengers that can contribute to the suppression of oxidative stress and anti-inflammatory effect in the human body (Thilakarathna *et al*., 2012).

2.2.6 Provision of farm inputs

A vast variety and amounts of forest and fruit tree products also support the major productive activities of farming including livestock production, fishing and hunting. A shortage of these products constraints the efficiency of crop production. Non- timber

forest products (NTFPs) provide materials for supporting crops (e.g. yam and pumpkin stakes), as well as materials for making farm tools. In the North Central of Nigeria for example hoe, axe, machete and digger handles, are made of materials taken from Shea trees and Lucost bean trees (Achille *et al*., 2019).

2.2.7 Fuel wood supply

Fruit trees also provides fuel wood needed for the processing of farm produce. In West Africa for instance, fuel wood is the principal fuel used in the preservation and processing of food in many rural areas and this contributes to the stability of food supplies all year round because it extends food resources into a non-productive period. Although, the exact effects of fuel wood scarcity on diet is yet to be adequately researched, it is well known that cooking releases the nutrients in grains and fibrous foods, making them edible and appealing. Some classes of food, for example certain varieties of cassava and beans, can be poisonous if not properly cooked. In this regard, wood for energy is essential if adequate food supplies are to be converted into adequate diets (Aju and Uwalaka, 2010).

Fuel wood is also needed in agricultural based industries like fish-smoking, tea and tobacco curing, bakeries, brick making and pottery. Thus, fuel wood shortages directly affect these industries and the level of employment and income generated by them. With increased scarcity of fuel wood, families may be compelled to eat less nutritious quick-cooking foods or even uncooked meals. This may seriously impair their health which would automatically translate into low agricultural production (Sabeena *et al*., 2017).

2.2.8 Fruit trees as a source of fodder

Fruit trees provide animal fodder, enabling communities to keep livestock that provide them with nutritionally important milk and meat. They also provide green manure that replenishes soil fertility and supports annual crop production (Place and Binam, 2013).

In the case of fodder production, for example, a recent initiative in East Africa involved more than 200,000 smallholder dairy farmers growing mostly introduced fodder shrubs as supplementary feed for their animals (Franzel *et al*., 2014).

The typical increase in milk yield achieved enabled smallholders to raise extra revenue from milk sales of more than USD 100 per cow per year and allowed them to provide more milk more efficiently to urban consumers (Place and Binam, 2013). Such fruit trees and shrub-based practices for animal fodder production increase farmers' resilience to climate change (Dawson *et al*., 2014a). Many fruit trees and other forest products are also used in ethnoveterinary treatments that support animal health and hence human food production. Fruit trees contribute immensely to the overall food security of households (Dharani *et al*., 2014).

2.2.9 Employment and income generation

Fruit trees also contributes indirectly to household food security, through the generation of employment and income from the sale and exchange of gathered and processed products. According to Aju and Uwalaka (2010), a wide range of fruit tree products which rural people gather, produce and trade to derive income. These products include fuel wood, dyes, rattan, fibres, fruits, nuts, leaves, mushrooms, bamboo, medicines, gums, and forest game. In many countries, forestry – based activities are a major source of off-farm employment in rural areas. According to Owoeye (2010), small fruit trees based gathering and processing enterprises provide one of the largest source of non-agricultural employment and income to rural people at a time when rural households have to look to non-farm employment and income for a growing share of their total livelihood. For example, in Sierra Leone and Jamaica, fruit – based, small – scale enterprises account for

more than one - fifth and one – third of off-farm respectively, of total employment in the small-scale enterprise sector (FAO, 2013).

According to Kaimowitz (2007), between 15 – 30% of non - farm rural enterprises involve wood – based activities. Forest – based activities also accounts for a significant proportion of household income in many rural areas in Nigeria. A survey carried out in Imo state for instance revealed that forest and fruit tree products accounted for 20-60 percent of household income among its farming communities (Muhammad *et al.,* 2017). This income helps to supplement income from agricultural production as well as provide a relief source in times of seasonal and emergency food and cash shortages.

2.3 Food Security Status of the Rural Farmers

Food security is a complex phenomenon and may be an integration of three core dimensions i.e. food availability, accessibility, utilization and safety (FAO, 2009). The problem of food insecurity is not only caused by insufficient supply of food, but also due to the lack of purchasing power and access at national and household levels. Therefore, despite gains in global food production and food security over the last three decades (1986-2016), still more than 800 million people are undernourished and almost all of them belong to the developing countries (Abid *et al*., 2016). Furthermore, growing population coupled with increased intensity of environmental extreme events i.e. floods, droughts, extreme variability in temperature and rainfall has increased the pressure on current food production systems and has threatened the current food security in most of the developing countries. Due to higher food demands and reduced crop productivity, the higher food prices may further negatively affect the food access and availability for low income and already poor households (Government of Pakistan, 2014).

Despite the growing world abundance of food, food-related crises continue to occur. Disparity in food security statuses within countries are common, even if the country has sufficient food in aggregate during normal periods. There have been increased observations of lack of equality in the sufficiency of food intake by certain groups despite total adequacy of supply. However, since the World Food Conference of 1974, the focus on the topic "Food security" has moved from a global and national perspective to that of households and individuals (Lofgren *et al*., 2003). Food security as a complex and multidimensional phenomenon alongside poverty is nowadays defined as "a situation when all people at all times have physical and economic access to safe, efficient and nutritious food needed to maintain a healthy and active life" (FAO, 2008). Nord and Hopwood also defined food security as an access by all people at all times to enough food for an active life (Nord and Hopwood, 2007).

The international community has long been concerned about eradication of hunger and undernourishment especially of vulnerable groups. This led to its inclusion as one of the two targets of the first Millennium Development Goal (MDG). The target is a reduction by half, the amount of people who suffer from acute starvation and who earned less than $1 per day by the year 2015 (FAO, 2006). Despite the global resolution to curb the food insecurity menace, the recent report on world food insecurity highlighted that the number of people suffering from hunger has increased every year since 1996. Also, about 925 million people worldwide still suffer from chronic hunger, in which 235 million hunger sufferers are from Sub Sahara Africa (FAO, 2010). This brings to the fore, the fact that the right to food is still one of the most often violated right in the world today (Clover, 2003).

Consequently, global food insecurity, coupled with the sharp increases in world food prices, the financial crisis and the economic depression, is a concept that can no longer

be ignored. Thus, it was again a topic of discussion at the World Food Summit (FAO, 2010). Hunger on a global scale however, remains serious. For instance, among the world's regions, South Asia and Sub-Saharan Africa continue to have the highest levels of hunger. In Nigeria, a Global Hunger Index (GHI) rank of 40 among 79 countries in 2012, together with rising food prices, malnutrition, deaths because of wide-spread poverty coupled with recent devastating effect of covid-19 is an indication of the prevalence of food insecurity in the country. Also, food insecurity is a sign of extreme suffering for millions of poor people (Global Hunger Index Report, 2012). Although, successive governments have made efforts to achieve food security in the country through the setting up of a number of agricultural development institutions, and special programmes and projects which include: The National Agricultural Development Fund, NADF (2002); National Special Programme on Food Security, NSPFS (2002); National Food Crisis Response programme (NFCRP), Food Security Thematic Group (FSTG) in 2009 among others, an overwhelmingly large proportion of Nigerians are still food insecure. The country now faces the challenge of meeting the basic food needs of its population. For instance, between 1990 and 2001, there was an increase in the share of food imports in Nigeria's budget from 9 percent to 19 percent. It reached its peak in 1995 at 55 percent. Although some drastic measures were put in place by the Government of Nigeria, to boost agricultural production, the country is seriously suffering from high level of food insecurity that resulted from high inflation prices of food, insecurity effect of covid-19 pandemic.

Similarly, relative to total imports, the share of food imports increased from about 8 percent to 22 percent over the same period (Okullo *et al*., 2010). Recently, food imports were estimated at US$3.99 billion a year, which amounts to about 8 per cent of total foreign exchange disbursement (CBN, 2009). In addition, Nigeria was listed among the

42 countries tagged “low-income food deficit countries” (Okunmadewa, 2003). Available evidence indicates that on almost every indicator such as deficit in per calories intake, export earnings, per capita income and food imports, Nigeria exhibits high levels of food insecurity (Akpan, 2009).

With majority of Nigerians residing in rural areas and about two-thirds engaged in crop and livestock production for their own use and market sales, food and nutrition security is closely tied to agricultural productivity. This is because higher production on one’s own farm or from one’s livestock improves the food security status of the household and vice versa. However, malnutrition is pervasive in the entire country especially across people of similar age and other categories of individuals in the rural areas. This situation persists despite various approaches addressing the challenge (Isaac, 2009). From the foregoing, it is evident that Nigeria may not be able to achieve the Millennium Development Goals especially those related to hunger and poverty, if the food insecurity situation especially among rural households is not adequately addressed. The problem of food insecurity especially during the hunger period among rural households in Nigeria is long standing. This is because after harvesting most rural households are food secure as they have enough food from their own production (Obamiro *et al*., 2003).

However, owing to inadequate processing and storage facilities and the fact that these households have other important needs, they usually end up selling their excess produce at low prices during the harvesting period. Most times, they rely on market purchases since they do not have enough to survive on, the year round. This leads to inconsistent food availability thus contributing to food insecurity during the period. There is an agreement that in matters pertaining to food insecurity, food insecure households should be properly identified and the reasons for their insecurity investigated. In addition,

changes in food security status of households over time should be closely monitored with explanations given for the changes. Thus, since more than half of Nigeria's population are currently employed in the agricultural sector and with the clear majority of these individuals living in rural areas, an examination of the factors associated with food insecurity status during the post planting season and contribution of fruit trees in Nigeria economy is pertinent if progress is to be made towards achieving the first Millennium Development Goal (MDG) (Manyong *et al*., 2005).

2.4 Effects of Fruit Trees

2.4.1 Eradicate extreme hunger and poverty

Fruits and vegetables generate more jobs per hectare, on-farm and off-farm, than staple based agricultural enterprises (FAO, 2013). This benefits farmers and landless laborers in both rural and urban areas. Value addition to fruits and vegetables generates further employment in the associated agri-businesses and further down the commodity chain from the producer to the consumer. The value of fruits and vegetables per unit area is significantly higher than the value of the cereal crops. Although the costs of inputs such as labour can be higher, the profits are higher and the income thus generated can be used for many different purposes in terms of eradication of hunger and affording access to education and health care. Over two billion people suffer from micronutrient deficiencies through poor diets. Fruits and vegetables are the most appealing and affordable sources of these micronutrients. Diet improvement increases a person's productivity, reduces health care related costs and therefore raises the productivity and incomes of the poor (WHO, 2018).

2.4.2 Achieve universal primary education

Micronutrient deficiencies impair cognitive and psychomotor skills, particularly in young children. These deficiencies can be alleviated through eating a balanced diet, rich in vegetables and fruits. With these improved, micronutrient-rich diets, children's cognitive and psychomotor skills are enhanced. Children who learn more and do well in school are more likely to want to stay in school and their parents are more likely to see the financial benefits of supporting their children's education (Haddad *et al*., 2002). Increased education also enhances the ability of the new generation of farmers to adopt more advanced technologies and fruit trees management techniques.

2.4.3 Promote gender equality and empower women

Fruits trees production provides women with economic opportunities. Women are the major key players in fruit trees exploitation in developing countries and are predominantly involved in the value-addition activities from production to marketing. Targeting women in agricultural technology dissemination can have a greater impact on poverty than targeting men. The enhanced social and economic status of women, for example achieved through fruit trees production activities, leads to greater household food and nutrition security. In addition to the financial benefits of fruit trees production, increasing women's access to fruits for themselves and their families, will improve their health and work performance, thereby contributing to higher incomes. The sale of garden surplus is often a major source of income for rural women, and largely used for crucial family needs (FAO, 2017).

2.4.4 Reduce child mortality

Malnutrition is one of the major causes of, or is a significant contributing factor to, child mortality in developing countries. The link between fruit trees and child mortality is

indirect, but important. The absence of essential micronutrients exacerbates poor children's vulnerability to disease. Improving access to fruits in their diets reduces mortality and morbidity of infants and children under five years old, particularly in rural areas. Improving diets of women of child-bearing age and specifically pregnant women, reduces infant mortality and may reduce maternal transmission of HIV/AIDS to infants (WHO, 2018).

2.4.5 Improve maternal health

Maternal health depends on having achieved food security during girlhood as well as a diet rich in micronutrients during conception, pregnancy and the first few months after childbirth (UN, 2018). The health of women before conception directly impacts their health during pregnancy and child birth. Most pregnant women in developing countries suffer from anemia and other micronutrient deficiencies. This affects both their productivity during pregnancy and can lead to complications for the fetus during and after childbirth. Fruit trees consumption can benefit maternal health directly by improving the quality of women's diets. Fruits and vegetables are the most appropriate sources of micronutrients in the diets of these women, and are critical in regions where vegetarian diets predominate (WHO, 2018).

2.4.6 Higher incomes and stronger rural economies

Fruit trees production provide new and profitable sources of income for farmers. The production of fruit trees can be especially important for small-scale farmers since these crops are well suited to smallholdings and family enterprises and are often adaptable to rural areas and small plot gardens (Smith *et al*., 2004). Fruit trees have a comparative advantage over cereal crops when land is scarce, and labour is abundant, which is often the case in developing countries. Studies from the developing countries of Asia and Africa

consistently show that farmers engaged in the production of fruits and vegetables earn higher net farm incomes than farmers engaged in cereal production alone (Benard, 2019).

2.5 Willingness of Farmers to Plant Fruit Trees

After several unsuccessful large-scale tree plantation efforts, it was generally accepted that the involvement of local communities is essential to improve the chances of plantations being successful (Nawir 2007). Thus, tree planting and other forms of fruit trees plantation management by rural farmers has been increasingly encouraged through many forest management arrangements with multiple objectives referred as the "farm forest". Much of the tree planting programmes in Nigeria have been funded by the government's Forest Rehabilitation Fund. However, these programmes had poor outcomes in terms of plantation areas established and plantation performance in terms of growth and quality which affected some of the farmers' willingness to plant more fruit trees in their farms to augment the assisting ones in form of domestication (Barr *et al*., 2010).

Despite the socio-economic potentials of the shea tree and its ability to grow well in the study area, the economic tree is yet to be domesticated and cultivated in form of organize farms by farmers, as majority of the rural farmers go to the wild to pick shea nuts which grow naturally untended. This background necessitates information on willingness of farmers towards domestication of shea tree (Sheshi, 2018). Direct integration of people's perceptions, attitudes and preferences in the decision making process is an important aspect of sustainable fruit trees production, because it can increase the social acceptance of the decisions and reduce differences among stakeholders. The willingness of farmers to plant fruit trees assure its promotion and development while farmers unwillingness creates fruit trees production failure (Dagar, 2012).

2.6 Constraints Associated with Fruit Trees Farming

2.6.1 Lack of development

Lack of development in general is a problem when it comes to agriculture in Nigeria. The lack of development includes: social development (development relating to people and the country), economic development (development relating to finance and wealth of the country), and environmental development (development relating to quality of the air, water, soil etc), and political development (development relating to political system). Identifying and tackling development constraints in the Nigeria agricultural system will help create a climate to improve performance and will help promote and accelerate the growth of fruit trees production in particular and the agricultural sector at large (Oni, 2013).

2.6.2 Lack of planting materials

According to Kwesiga *et al*. (2003) lack of planting materials (seed and seedlings) is another factor considered to constrain farmers to key into the production of fruit trees. High yield varieties of fruit trees and improved agronomic practice to optimize their yield potentials are inadequately available and wide scale dissemination is restricted by inadequate funding of the relevant research institutes that are saddled with the responsibility of producing improved seedlings. In addition, farmers are poorly linked to these research institutes to enable them asses the limited planting materials that are available to enable them to increase their productivity.

2.6.3 Pest and diseases

Fruit tree diseases are the impairment of health or a condition of abnormal functioning of the tree. Diseases cause nothing but a significant yield and quality constraint for farmers. These include fungal, bacterial, viral or nematodes and can damage fruit trees above or

below the ground. Products. Fruit tree diseases and their adverse effects on production in Nigeria have become thorns on the flesh of most farmers who depend so much on fruit trees production. These have totally reduced the quality of fruits which the farmers produce and have discouraged many farmers because of the losses they encounter during such diseases outbreak (Ugese *et al*., 2012).

2.6.4 Marketing problem

Marketing involves the conveying of agricultural product from farmers to consumers. Some of the problems of marketing affecting fruit trees production include poor transportation means, poor packaging and poor quality. If farmers have poor packaging system (making product look good and attractive to customers) and your competitor have a better packaging system the farmers, then customers are more likely to buy from your competitor even if the qualities are the same. Good road is needed in order to effectively and efficiently transport products from one place to another. Unfortunately, the overall marketing system of the country is primitive. Departments that have been assigned to build road and railways for transportation takes many years and sometimes up to a decade to get a network constructed because of corruption. Even the little road and rail constructed normally crumbles due to poor maintenance (Oni, 2013).

2.6.5 Storage and processing

Inadequate storage and processing facilities affect both national food security and household food security. Even when there is a lot of harvest and the production of farm product seems enough, because of poor storage, it will still lead to food scarcity as the food will not be available or be in a good condition when it is time for consumption. Good storage and processing are required to ensure that food is available in good condition whenever it is required. Simple and effective method for storing perishable food like fruits

and vegetables are not really developed and well known in Nigeria when compare to that of grains (Adama, 2016).

Storage is a problem for Nigeria as a large number of food produce perishes, because of the lack storage and processing facilities. The traditional methods of storage used contain flaws, like having low base which therefore becomes easily accessible to rodent and having wooden floor which is an easy target for termite and some of the storage are non-moisture proof surface which could get damage by water. Due to the inadequate storage and processing system, farmers loss heavily and especially when it's time for profuse harvesting. Safe places to store product from farms are not efficient and are inadequate. Improved storage system and technique have been developed by experts from different institute, but these systems have not been adopted and sometimes not even known to farmers (Kelvin, 2017).

2.6.6 Lack of good Infrastructure

Infrastructure include physical structure, such as health and educational facilities, social services (stable electricity and safe water) and effective communication system. Fruit tree production in Nigeria suffers greatly due to lack of developed infrastructure. For example, in the rural area where most of the farmers operate without good infrastructure in place. This problem is mostly caused by the government, as the government favours urban development over rural development by a great margin. The lack of infrastructure continues because of bad political leadership, poor governance, poor maintenance culture, poor funding, epileptic power supply. Safe water and health facilities is also inadequate for those living in the rural area. Some places in the villages have only one tap for water which does not always work because of lack of electricity, so water used in the farm and houses are gotten from the rivers, and this could take hours to fetch as the river could be far from the houses and the farms (Kelvin, 2017).

2.6.7 Unstable prices

One of the problems affecting external and internal investment in Nigeria is the escalating cost of important farm tools and machines. The average cost of tools, machine, and planting materials such as cutlass, hoe, tractors and seed/seedlings have been increasing for many years. These unstable prices are caused by the unstable macro-economic policy which then lead to inflationary pressures and high interest rate and then lead to a volatile exchange rate. All these have the tendency to cause rising prices in fuel, transportation, farm inputs and therefore increase cost of fruit trees production (Oni, 2013).

2.6.8 Agricultural labour

The traditional system used in Nigeria seriously affects the use of farmland because of the availability of labour. In Nigeria, agricultural activities are mainly done without machines and thus human labour becomes important in the production system, accounting for about 90% of the farm operations. While under a semi-mechanized system, human labour is still up to 70% of the farm operations (NISER, 2001). So labour could be and is affected by the continuous migration of able bodied young men to the urban area which in turn causes labour shortages and in time when labour is required for fruit trees production. The main cause of this migration is the perception by young men that farm labour cannot effectively and efficiently support them and their families (Kelvin, 2017).

2.7 Challenges of Food Security

Poverty is the main problem of food accessibility, availability and utilization. Poverty leads to insufficient income needed to meet household basic need. There are also other political and socioeconomic problems leading to food insecurity and these are discussed below:

A. Government Policy: Nigeria depended so much on agricultural productivity for its revenue until the exploration of oil in 1970s. The oil boom led to the negligence of the non-oil sectors especially the agricultural sector which used to be the major source of revenue for the country. The attention given to agriculture reduced drastically, farming reduced drastically, farmers' needs were not attended to and the worst of all was that research and development in the sector slowed down causing a stagnation in food production. Government policies regarding agricultural production were rapid with plans hurriedly put together and little or no participation from people who are engaged in agricultural productivity. Moreover, policy change that advocate increased incentive for rural farmers for improved local food productions were despaired (Ojo *et al.,* 2012).

B. Agricultural Practices: The farming system widespread in Nigeria is the subsistent farming. This system is characterized by use of simple farm tools, small farm holdings, restricted access to credit facilities inadequate storage facilities, low agricultural inputs, insecure markets for post-harvest products and exploitation of farmers by the middlemen. In terms of technology, Nigeria is still lagging when compared to other nations in Europe and Asia. Due to poverty and illiteracy, farmers do not have access to modern communication system with which they can access information regarding new technologies. Also, there are few extension officers to transfer new idea to the farmers. Funding for agricultural research is still low in Nigeria and heavy importation of food crops hampers productivity of rural farmers because of the small farmers' inability to compete with the imported products.

C. Population Increase: The demand for food surpass the supply of food because the rate of population growth is higher than the growth in agricultural productivity. Also, the large number of the rural populace continues to migrate to the urban areas in search of

white collar jobs which do not exist. This youth rural-urban drift makes it difficult for Nigeria to be food secured.

D. Environmental Issues: Flood, drought, desertification are environmental issues affecting availability of food in Nigeria. Climate change affects food supply through loss of farmland, fluctuation in food prices, increases in food borne illnesses and other food utilization issues (Global Food Security Index, 2015). The recent environmental degradation through deforestation and flooding has wide negative implication for food production. For instance, in 2012 the country witnessed an unprecedented rainfall because of extreme weather. The rainfall resulted in severe flooding causing loss of agricultural crops, live stocks and human lives.

According to Metu *et al.* (2015), the estimated loss of the country's GDP was worth N2.6 trillion. In the same period, share of agriculture value added to total GDP declined from 23.89% in 2010 to 22.05% in 2012. Other environmental factors that may affect food security includes soil degradation, soil pollution and deforestation. Also air and water pollution from industrialization pose threat to both human and natural resources to an extent that food securities capabilities are devastated.

E. Corruption: Corruption in Nigeria has been on the increase leading to money budgeted for public utilities being siphoned for private use. This leads to decay in infrastructure especially rural infrastructure where majority of the farmers live and operate from. The menace of corruption is seriously affecting the food security status of the rural farmers in particular and the whole country at large (Ojo *et al.,* 2012).

2.8 Common Existing Fruit Trees

A. SheaTree

Nigeria is blessed with abundant natural resources including many cash crops which include cassava, cashew, shea, cotton, cocoa, oil palm and rubber. (Onwualu, 2012). It has been shown that when the value chains for these crops are developed, it can lead to employment generation and wealth creation. Of all these crops, the shea tree although has many industrial utilization, its production, processing and storage are still not developed (Olife, *et al*., 2013).

Niger State ranked top among the shea nut producing States in Nigeria (German International Cooperation, 2010). Shea nut is obtained from shea trees that grow wild in the forest in large commercial quantity across the State. Based on recent events, the interest on the shea nut oil produced from shea nut for industrial application in food, cosmetics, pharmaceutical and traditional needs at national and international levels has increased. Women constitute the majority in collecting shea nut from the bush between April and September during the wet season. They travel between 2 to 15 km into the forest to pick the nuts and return home with only 20-30kg load of nuts carried on the head (GIZ, 2010).

Shea tree (Vitellaria), with sub species *paradoxa* and *nilotica* is indigenous to the Sub-Saharan Africa, Guinea and Sudan Savanna zone from Senegal to Sudan, to Western Ethiopia and Uganda in a belt 500–700 km wide. Shea is found in the interior, separated from the Gulf of Guinea by forest. It is only in Ghana and Nigeria that it occurs within 50km from the coast (Nikiema and Umali, 2007). It is a perennial and deciduous tree which grows naturally throughout Guinea Savannah region.

Shea tree is an important economic crop because of the heavy demand for its butter in the international market mainly as a substitute for cocoa butter in the production of chocolate. There is also increasing demand for shea butter in pharmaceutical and cosmetics industries. shea butter is a useful cocoa butter substitute because it has a similar melting point (32–45°C) and high amounts of distearin (30%) and some stearopalmitine (6.5%) which makes it blend with cocoa butter without altering flow properties. The high proportion of unsaponifiable matter, consisting of 60–70% triterpene alcohols, gives shea butter creams good penetrative properties that are particularly useful in cosmetics (Nikiema and Umali, 2007).

Chemically, shea butter is naturally rich in Vitamins A, E, and F (Okullo *et al.*, 2010). According to Alander, (2004) shea butter is widely utilized for domestic purposes such as cooking oil, skin moisturizer, dressing hair, protecting skin from extreme weather and sun, relieving rheumatic and joint pains, healing wounds/swelling/bruising, as massager and the fruit when very ripe can be eaten raw. Meanwhile industrially, it is used as an ingredient in cosmetic, pharmaceutical and edible products such as chocolates. Shea butter is also a high–value export product to Europe and the United States, where it is considered a luxury (Lovett, 2004).

B. *Parkia biglobosa* (African locust bean tree)

Parkia biglobosa tree have been known to be a native of Africa and is an important multipurpose tree of West African Savannah land which is primarily grown for its pods that contain both a sweet pulp and valuable seeds. Various part of the African locust bean tree is used for medicinal purposes and have high value commercially (Olorunmaiye *et al*., 2011).

Farmers manage and protect this tree for their nuts and fruits. The tree has been used both locally and internationally in drug manufacturing and cosmetics production. Despite its important uses, the population of this tree is reducing, and it remain semi- or undomesticated (Teklehaimanot, 2004).

African locust bean tree was named *Parkia biglobosa* by Robert Brown, a Scottish botanist in 1826 after Mongo Park, a Scottish surgeon who explored West Africa in 1790's. Mongo Park gave this tree a local name 'nitta' (Uaboi-Egbenni *et al*., 2009). In 1995, research indicated that there were about 77 more species. African locust been tree was described by Robert Brown, as a genus of flowering plants in the legume family, Fabaceae, which belongs to the sub-family Mimosoideae and Leguminosae with the genus Parkia and botanical name *Parkia biglobosa* (Abdoulaye, 2012). *Parkia bicolor*, *Parkia filicoidea*, *Parkia clappertoiana* and *Parkia biglobosa* are other species of the genus *of Parkia biglobosa* which can also be fermented to produce food condiments for flavouring which also for adding good aroma to food. It was reported that fermented African locust bean seeds is a leguminous plant with an outstanding protein quality. The protein and amino acid composition have been reported by several researchers (Cook *et al*., 2000).

Parkia biglobosa seed is known as *Kalwa* in Hausa language while the fermented seed as *Daddawa* is one of the major sources of plant protein in African diet which is known as fermented vegetable protein (Ademola *et al*., 2011). *Daddawa* is consumed in many African countries, especially Nigeria and Ghana (Azokpota *et al*., 2005).

C. Cashew (*Anacardium occidentale* L.)

Cashew is a tropical fruit native from Brazil, principally grown in the North and Northeast regions. The pseudo-fruit, known as the cashew apple, is the part of the tree that connects it to the cashew nut, the real fruit, a well-known product worldwide (Zepka and Mercadante, 2009). The cashew nuts represent only 10% of the total fruit weight, and large amounts of cashew apples are left in the field after the removal of the nut (Honorato *et al*., 2007). The cashew tree grows even on poor soils with low rainfall and is cultivated in 32 countries around the world, with Brazil, India, Vietnam and Nigeria as the main producers (Rabelo *et al*., 2009).

Cashew apple is the peduncle of the cashew fruit, which is rich in reducing sugars (fructose and glucose), vitamins, minerals, and some amino acids, carotenoids, phenolics, organic acids and antioxidants, and considered as a source of energy (Honorato *et al*., 2007). It can be processed to obtain juice, ice cream, and other food stuffs (Dèdéhou *et al*., 2015). Astringency of cashew apple undertakes consumption, due to polyphenols, tannins (0.35%), and unknown oily substances (3%) present in the waxy layer of the skin (Adeigbe *et al*., 2015). Many factors, such as the seasonal nature of the cashew trees produce, the extreme perishable character of apples hindering it full utilization (Bidaisee and Badrie, 2001). Thermal processing has a negative effect on the sensory and nutritional characteristics of the juice as the compounds responsible for aroma and flavor are volatile and some vitamins are thermosensitive. The effects of processing methods, such as clarification by membrane and enzymatic methods or the use of clarifying agents on the nutritional quality of cashew apple juice have also been investigated (Adou *et al*., 2012).

Furthermore, the effect of thermal treatment and high hydrostatic pressure on cashew apple juice have been reported by various researchers (Talasila *et al*., 2011). Other studies

on the storage stability of cashew apple juice by using artificial preservative or microfiltration and the effect of storage conditions on cashew apple juice stability were reported (Talasila *et al.*, 2012). On the other hand, cashew apple can be used in fortification of the nutritional quality of some tropical foods by mixing the apple juice or powder with other tropical food to increase it vitamins and minerals level (Emmanuelle *et al*., 2016).

D. Mango (*Mangifera indica* L.)

Mango is one of the superior fruits in the world (Josh *et al*., 2013). It belongs to the family of Anacardiaceae, one of the most important species of the family and one of the most preferential fruit crops of the tropical and subtropical regions of the world for human consumption (Vasugi *et al*., 2012). Due to its popularity and importance, *Mangifera indica* is often named "King of fruits" for its luscious flavour and taste. Its social and economic impact are most relevant. *Mangifera indica* has been an important component of the indigenous medical systems for over 4000 years (Josh *et al*., 2013).

However, various parts of the plant are used as a dentrifrice, antiseptic, astringent, diaphoretic, stomachic, vermifuge, tonic, laxative and diuretic. According to Gálvez-López *et al*, (2010), all parts of the tree can be used to treat abscesses, broken horn, rabis dog bite and jackal bite, tumour, snake bite, stings, acute poisoning due to ingestion of Datura spp., heat stroke, miscarriage, anthrax, blisters, mouth wounds, diarrhoea, glossitis, indigestion, bacillosis, bloody dysentery, liver disorders, excessive urination, tetanus and asthma. Fruits of *Mangifera indica* may be used to produce juice, mango nectar, or flavouring as well as major ingredient in ice cream and sorbets production (Encyclopedia of Life, 2015). Bark from mango trees possesses 16% to 20% tannin and has been employed for tanning hides. Wood from mango tree is extensively used for low-

cost furniture, ceiling boards, window frames, heavy packing cases, match splints, brush backs and agricultural implements (Aguoru *et al*., 2017).

Mangifera indica occupies a unique position among edible fruit plants in Nigeria as it grows in all ecological zones of the country (Aguoru *et al*., 2016). According to the FAO report of 2004, Nigeria is the largest mango producing country in Africa and seventh in the world, but on the contrary not listed among the 10 leading mango fruit exporters (Ugese *et al*., 2012).

2.9 Theoretical Framework of the Study

Three families of theories have been prominent in literatures that explain the causes/pattern of food insecurity in the underdeveloped countries; Population-Driven Theory, Surplus-Extraction Theory and the "Lewis Model"-The Theory of Economic Growth.

2.9.1 Population-driven theory

This model is based on the Malthusian work. According to this approach, the cause of food insecurity was a tendency for population to outstrip resources particularly land over a long period of time. Population pressure pushed production into more labour intensive techniques and eroded the surplus that would be needed to fund innovation and growth. Malthus maintained that economic arrangements, particularly the level of the real wage and the number of positions within the economy, dictate the level of population at a given time. This causal connection is supposed to work through positive and negative checks: positive checks include sources of increased mortality resulting from overpopulation (war, civil strife, famine), while negative checks include culturally specific checks on fertility, delayed nuptiality, birth control, and the like. Thus, population change is a

dependent variable, conditioned by the economic environment: as a regional economy becomes more productive, population can rise.

Malthus posited a mathematical model of population growth. The model, though simple, has become a basis for most future modeling of biological populations. Malthus's model is an example of a model with one variable and one parameter.

Malthus also realized that his model implied that real wages determined by the market would always be pinned down to the subsistence level. If real wages were above this level, population would begin to grow, inducing a decline in nominal wages because of firms having a larger supply of labour available. Moreover, the larger population would result in an increase in the demand for goods, which would force prices to go up and real wages to decrease to their subsistence level. This concept was known as the Iron Law of Wages, and, although first conceptually formalized by Ricardo in 1817, it was constantly present in Malthus's work. Thus, the rise in population lowers the man-land or the man-resources ratios. This implies that a static,

backward economy without any technological progress, like Nigeria could only experience greater poverty and hunger with growing population pressure on available resources. While the eco-Malthusian vision has not yet been convincing for the world at large, in recent decades it has emerged as a popular way to understand the plight of sub-Saharan Africa. In this region, efforts to expand arable land area to boost food production, to keep pace with population growth, have led to serious environmental damage in the form of forest loss and habitat destruction. Damage to cropland productivity has been severe as well because population pressures on the land have led to reduced fallow times, hence a more rapid depletion of soil nutrients. This in turn has constrained production. In some African countries, average crop yields per hectare have declined, and for Sub-

Saharan Africa over the past several decades, total food production per person has declined. Hunger simultaneously has increased. The number of Africans who are "food insecure", those consuming less than the nutritional target of 2,400 calories per day increased from 300 million in 1992 to roughly 450 million by 2006 (Robert, 2010).

Thus, Africa's problems are tragic and severe; sometimes take the form of a classic Malthusian trap, where population growth outstrips food production potential. This is because food production in Africa today is far less than the known potential for the region. African farmers today use almost no fertilizer (only one-tenth as much as farmers in Europe use), only about 4 percent of their cropland has been irrigated, and most of the cropped area in Africa is not planted with seeds improved through scientific plant breeding. Therefore, average cereal crop yields per hectare in Africa are only about one-fifth as high as in the developed world. Africa is failing to keep up with population growth not because it has exhausted its potential but instead because too little has been invested in developing that potential.

2.9.2 Surplus-extraction theory

This model attempts to explain economic underdevelopment and technical innovation in terms of local class relations and the particulars of the system of surplus extraction that is in place. The surplus-extraction model holds that the key to understanding the process of economic under development in each economy is the system of social relations of production, the property relations and the distribution of political power through which productive economic activity proceeds. This model postulates that an economy typically embodies a class system dividing the immediate producers (farmers, workers, artisans) from an elite class that confiscates part of the surplus products/resources for its own uses. The direction that economic development takes depends very much on the incentives,

opportunities, and powers conferred on the various class parties by the property system; thus, the class relations impose logic of development on the system.

An extensive application of this framework to the traditional Nigerian rural economy will be justified. The rural societies are substantially stratified, containing a small elite class and a large class of poor peasants and workers, and the elite managed to appropriate the surplus land resources for their own purposes. And the cultural and economic values that governed the consumption behaviour of the elite were such as to discourage them from investing the surplus in economically productive ways, infrastructure, capital improvements, irrigation, new technologies, etc. If these assumptions are substantiated, then a pattern of economic stagnation follows fairly directly. Producers (small scale farmers) lack the funds necessary to invest in more efficient technologies; while the elite group lacks the incentive to do so. As a result, the spectrum of innovations that would lead to economic development is blocked.

2.9.3 The Lewis model - the theory of economic growth

One of the best-known early theoretical models of development that focused on the structural transformation of a primarily subsistence economy was that formulated by Nobel laureate Lewis in the mid-1950s and later modified, formalized, and extended by John and Gustav. The Lewis two-sector model became the general theory of the development process in surplus-labour. Third World nations during most of the 1960s and early 1970s. It still has many adherents today.

In the Lewis model, the underdeveloped economy consists of two sectors: a traditional, overpopulated rural subsistence sector characterized by zero marginal labour productivity-a situation that permits Lewis to classify this as surplus labour in the sense that it can be withdrawn from the traditional agricultural sector without any loss of output

and a high productivity modern urban industrial sector into which labour from the subsistence sector is gradually transferred. The primary focus of the model is on both the process of labour transfer and the growth of output and employment in the modern sector. Both labour transfer and modern-sector employment growth are brought about by output expansion in that sector. The speed with which this expansion occurs is determined by the rate of industrial investment and capital accumulation in the modern sector. Such investment is made possible by the excess of modern sector profits over wages on the assumption that capitalists reinvest all their profits. Finally, Lewis assumed that the level of wages in the urban industrial sector was constant, determined as a given premium over a fixed average subsistence level of wages in the traditional agricultural sector. At the constant urban wage, the supply curve of rural labour to the modern sector is considered to be perfectly elastic.

2.10 Conceptual Framework

The dependent variable (Food security) it is expected that fruit trees production will go a long way in making food available, accessible, affordable and safe for consumption for both the present and future generations. This will have a positive impact on the welfare and sustainable livelihood of the rural farmers.

The conceptual frame work shows the relationship between dependent, independent and intervening variables. The dependent variable of the study is food security, while the independents variables are socio-economic characteristics, potential of fruit trees, willingness of farmers to plant fruit trees and constraints associated with fruit trees production. The intervening variable includes government policy, institutional factors, norms and beliefs.

Age can have both negative and positive influence on the production of fruit trees, farmers within the active age are more likely to adopt new technology. While framers that are advanced in age are likely not to adopt new technology because of their traditional belief and socio-cultural norms.

The more educated and exposed a farmer is, the more likely he/she is to show willingness to plant fruit trees that will enhance his/her livelihood status. This is because an enlightened individual will have a better understanding on the desirability and consequently the benefits derivable from planting fruit trees.

Farmers with higher income will be in better position to go into fruit trees production than the lower income farmers because of their higher financial status.

The more the fruit trees in the farmer's farm land, the more the food security because he would have a lot of harvest during the season to consume and also sale to earn exra money for other needs.

If fruit trees have potentials, there will be food security. Farmers will have direct food supply, fodder for their animals, the menace of erosion would be checked, soil fertility will improve and annual income of the farmer will increase.

Farmers that are willing to plant fruit trees in their farms are likely to be food secured than those that are not willing to plant.

When farmers are faced with a lot of predicaments in fruit trees production, the availability, accessibility, affordability of food will be low. Intervening variables such as government policy, availability of credit facilities, prevailing culture and norms can also

influence fruit trees production, they can either accelerate or slow down the rate of production.

Conceptual Model

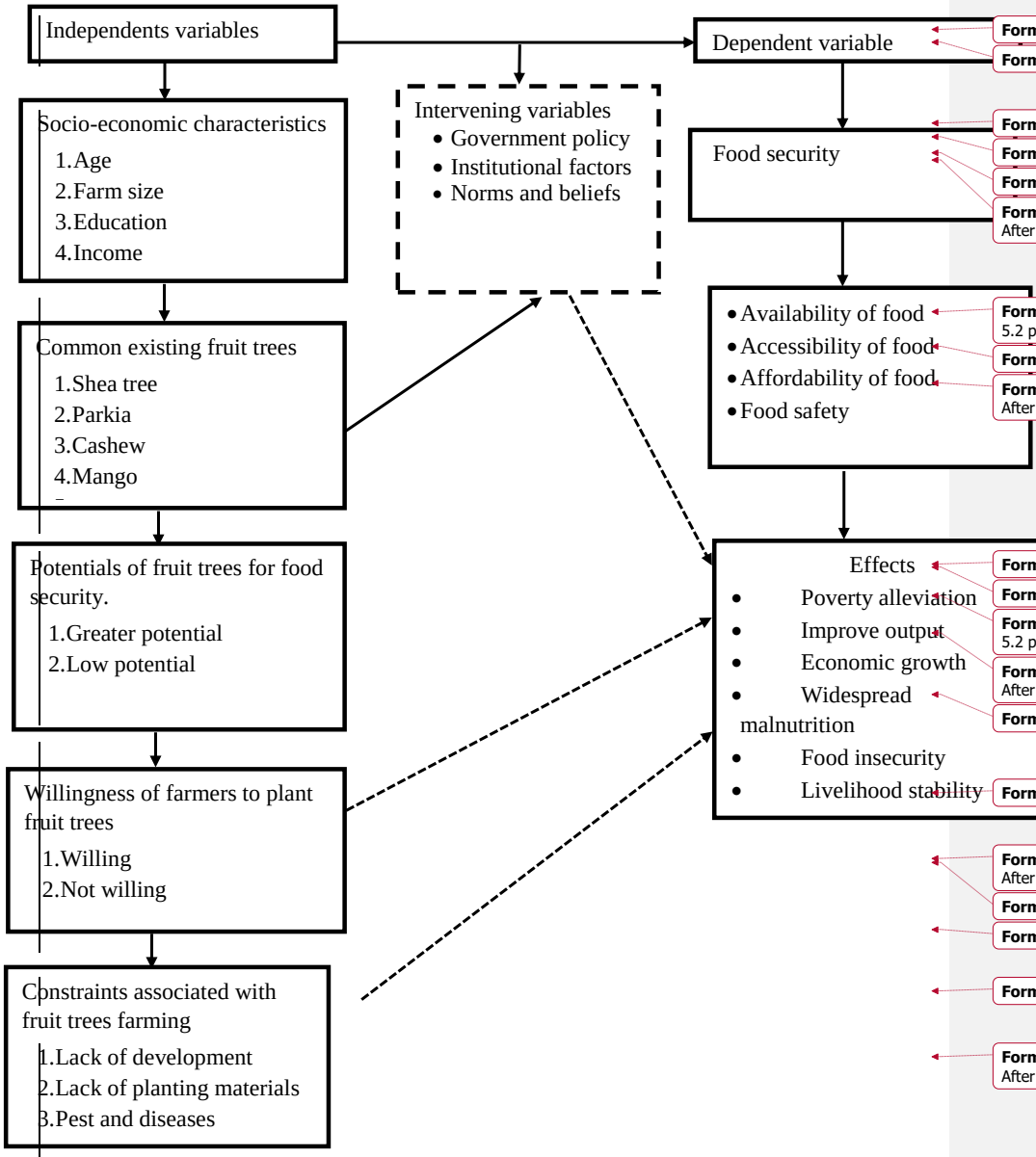

Figure 2.1: conceptual framework for the penitential of fruit trees for food security

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Study Area

The study was conducted in Niger State. The State is located in the Guinea Savannah ecological zone of Nigeria. In terms of land mass, it is the largest State in Nigeria. It covers an estimated total land area of 74,224km² thus accounting for about eight percent of Nigeria's land area. About 85% of its land area is good for arable crop production (NSGIS, 2007). The State lies between Latitude 8º 20' and 11º 30'N and Longitude 38º 30'and 8º 20'E of the equator with a population of about 3,950,249 (NPC, 2006). And with a growth rate of 2.5%, the State was estimated to have a population of 6,722,378 in 2020. 85% of the populace are farmers. The State is bordered to the North by Zamfara State, West by Kebbi State, South by Kogi State, South West by Kwara State, North-East by Kaduna State and South East by Federal Capital Territory. The State also has an International Boundary with the Republic of Benin along Agwara and Borgu LGAs to the North West (NSGIS, 2007).

Niger State consist of twenty five (25) Local Government Areas (LGAs) that are grouped into three agricultural zones viz.: i. ii and iii with the zones having eight, eight and nine LGAs, respectively. Nupe, Gwari and Hausa are the major ethnic groups in the State (Adebayo *et al*., 2010). There are other minor ethnic groups such as Koro, Kakanda, Kadara, Baraba, Ganagana, Dibo, Kambari, Kamuku, Pangu, Gwada, Ingwai and other tribes also settle in the State. The most predominant soil type is the ferruginous tropical soils. The soils are fertile, it's hydrology permit the cultivation of most of Nigeria staple crops and still allows sufficient opportunities for grazing, fresh water fishing and forestry development. The State is blessed with abundant mineral resources such as gold, clay,

silica, kyanite, marble, copper, iron, feldspars, lead, columbite, kaolin and tantalite (Mustafa and Ezeamaka 2020).

Niger State experiences distinct dry and wet seasons with annual rain fall varying from 1,100mm in the Northern part to 1,600mm in the Southern parts. The average annual rain fall is about 1,400mm. the duration of the rainy season is approximately 180days. The wet season usually begins in April/May to October, while the dry season starts from November to March. Its maximum temperature is usually not more than 35ºC, while the minimum temperature is around 23ºC. Dry season commence in October, most of the communities in the State are predominantly agrarian. Some of the crops grown in the area are yam, cotton, maize, sorghum millet, cowpea, soybean, beans, rice and groundnut. Some of the fruit crops are shea, mango, citrus, coconut, cashew, banana, pawpaw. The inhabitant of the State also rears some livestock like goat, sheep, cattle and chicken among others. The other non-agricultural activities engage in by men includes blacksmithing. Leatherwork, mat and basket making, trading while women also engage in technical handicraft and trading (NSGIS, 2007).

3.2 Sampling Technique and Sample Size

Multistage sampling technique was adopted for the selection of the respondents for this study. The first stage involves random selection of one Local Government Area from each Agricultural zone namely: Gbako from zone I, Paikoro from zone II, and Borgu from zone III respectively due to the presence of the trees in abundance and involvement of the farmers in processing activities of some of the trees in these Local Government Areas. The second stage involved random selection of four villages in each of the three selected Local Government; This gives a total of twelve villages. At the third stage, based on farmers 2016 census by Niger State ministry of agriculture, proportionate selection of

10% of farmers from the selected twelve villages was used for this study. A total of 219 respondents were selected for the study from the sampling frame of 2160 farmers.

Table 3.1: Sampling design for the study

Agricultural Zones	LGA	Village	*Sampling Frame	Sample Size (10%)
I	Gbako	Gbadafu	217	22
		Etsu Audu	89	9
		Batagi	119	12
		Kucitagi	201	20
II	Paikoro	Adunu	159	16
		Kaikuta	207	21
		Sesita	97	10
		Abolo	186	19
III	Borgu	Wawa	316	32
		Baburasa	217	22
		Tamanai	149	15
		Dogongari	203	21
Total			2160	219

Key= ***** Source: Niger State Ministry of Agriculture (Farmers census, 2016)

3.3 Method of Data Collection

The data for this study was collected using questionnaire complimented by interview schedule. The questionnaire was administered by trained enumerators supervised by the researcher. The instrument for data collection covered socio-economic characteristics of respondents, potential of the fruit trees, food security status of farmers, willingness of farmers to plant fruit trees, and major constraints to fruit trees production in the study area. The period of data collection lasted for Three months.

3.3.1 Validity of instrument for data collection

To improve on the content validity of the data collection instrument, the instrument designed by the researcher was scrutinized by the supervisors and other experts in the field of agricultural extension.

3.3.2 Reliability of instrument for data collection

To ensure reliability of the data collection instrument for this study, test and re-test method which is the process of administering the same test twice over a period to a group of individuals was used for this study. The two set of scores were correlated using rank correlation analysis to estimate internal consistency of the instrument vis-à-vis objectives of the study. A reliable coefficient value of 0.82 was obtained for this study

3.4 Measurement of Variables

The dependent variable of this study is food security in terms of food availability, accessibility, affordability, utilization and safety. These were determined by asking the respondents to indicate the consumption frequencies of food items from food groups of cereals and tubers, pulses, vegetables, fruits, meat and fish, milk, oil, sugar and condiments.

While independent variables of the study are socioeconomic characteristics of the respondents, common existing fruit trees, potentials of fruit trees on food security, willingness of farmers to plant fruit trees and the constraints associated with fruit trees production. These variables were measured as follows:

i. Age was measured in years
ii. Education level of the respondent was measured based on the number of years spent in school.
iii. Income of the respondents was measured in naira (N)

iv. Farm size of the respondents was measured in hectares (ha).

v. Household size was measured as the total number of people living within the family at the time of the study.

vi. Farming experience of the respondents was measured in years

vii. Co-operative membership was measured as dummy variable (membership =1, non-membership =0

viii. Extension contact was measured based on the number of extension contact with Extension Agents in a year.

ix. Sex was measured as dummy variable (male =1, female =0).

x. The potential of fruit trees on food security was determined using four points Likert type rating scale of high potential = 4, moderate potential = 3, low potential = 2 and No potential = 1. To determine the potential of fruit trees, values of the scale were added together (4+3+2+1) to obtain 10, the sum (10) was divided by the number of the values of the scale to obtain 2.5. Any scores that is less than 1.5 was regarded as No potential, between 1.6-2.5 was regarded as low potential, score that is between 2.6-3.0 as moderate potential, and above 3.0 was regarded as high potential towards the food security.

xi. Willingness to plant fruit trees was measured as a dummy variable. That is, willing to plant fruit trees =1, otherwise = 0.

xii. The constraints to the production of fruit trees was achieved by asking the respondents to indicate the challenges they face in the production of fruit trees in the study area. This was achieved by using 3 points Likert type rating scale of very severe =3, severe =2 and not severe =1, the sum of the values was divided by the number to get 2.0 which is the mean point, any scores that is less than 2.0

is regarded as not severe while any score that is 2.0 was regarded as severe and above 2.0 as very severe.

3.5 Method of Data Analysis

Both descriptive and inferential statistics were used to analyze the data that were collected.

3.6 Model Specification

3.6.1 Descriptive statistics

Descriptive statistical tools such as frequency counts, percentages and mean were used to achieve objectives i (describe the socio-economic characteristics of the farmers in the study area), ii (determine the potential of fruit trees for food security of the rural farmers) and vi (examine the constraints associated with fruit trees farming in the study area). Objective iii was measured using FAO format as indicated in Table 3 which was adopte d by Elliot Vhurumuku, (2014).

Table 3.2: Food Groups and Weights in FCS and HDDS

Food Group	Food items belonging to group	Food groups weight for FCS
1. Cereals and grain:	Rice, pasta, bread/cake and/ or donuts, sorghum, millet, maize.	1. Cereals and Tubers 2
2. Roots and tubers:	Potato, yam, cassava, sweet potato, taro and/or other tubers.	
3. Legumes/nut:	Beans, cowpeas, peanuts, lentils, nut, soy, pigeon pea and/or other nuts.	2. Pulses 3
4. Orange vegetables (vegetables rich in Vitam in A):	Carrot, red pepper, pumpkin, orange sweet potatoes.	3. Vegetables 1
5. Green leaf vegetables:	Spinach, broccoli, amaranth and/or other dark green leaves, cassava leaves.	
6. Other vegetables:	Onion, tomatoes, cucumber, radishes, green beans, peas, lettuce, etc.	
7. Orange fruits (fruits rich in Vitamin A):	Mango, papaya, apricot, peach.	4. Fruit 1
8. Other Fruits:	Banana, apple, lemon, tangerine	
9. Meat:	Goat, beef, chicken, pork (meat in large quantities and not as a condiment)	5. Meat and Fish 4
10. Liver, kidney, heart and /or other organ meats		
11. Fish / Shellfish:	Fish, including canned tuna, escargot, and/or other seafood (fish in large quantities and not as a condiment).	
12. Eggs		
13. Milk and other dairy products:	Fresh milk/sour, yogurt, cheese, other dairy products (Exclude margarine/butter or small amounts of milk for tea/coffee)	6. Milk 4
14. Oil/fat/butter:	Vegetable oil, palm oil, shea butter, margarine, other fats/oil	7. Oil 0.5
15. Sugar, or sweet:	Sugar, honey, jam, cakes, candy, cookies, pastries, cakes and other sweet (sugary drinks).	8. Sugar 0.5
16. Condiments / Spices:	Tea, coffee/cocoa, salt, garlic, spices, yeast/baking powder, lanwin, tomato/sauce, meat or fish as a condiment.	Condiments 0

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After data collection, the Food Consumption Score (FCS) was calculated using the following steps:

Calculation steps for FCS

- Using standard 7-day food frequency data, group all the food items into specific food groups.
- Sum all the consumption frequencies of food items of the same group, and recode the value of each group above 7 as 7.
- Multiply the value obtained for each food group by its weight and create new weighted food group scores.
- Sum the weighed food group scores, thus creating the food consumption score (FCS).
- Using the appropriate thresholds, recode the variable food consumption score, from a continues variable to a categorical variable.

Thereafter, the food security status of the respondents was determine using the below FAO Food Consumption Score threshold

Table 3.3: FCS Thresholds

FCS	FCS (High Oil/Sugar Diet)	Profiles
0 – 21	< 28	Poor
21.5 – 35	28.5 – 42	Borderline
> 35	> 42	Acceptable

Source: Elliot Vhurumuku, (2014).

The independent variables are as follows:

X_1 = Cereals and Tubers consumption (Number of days in a week)

X_2 = Pulses consumption (Number of days in a week)

X_3 = Vegetable consumption (Number of days in a week)

X_4 = Fruits consumption (Number of days in a week)

X_5 = Meat and Fish consumption (Number of days in a week)

X_6 = Milk consumption (Number of days in a week)

X_7 = Oil consumption (Number of days in a week)

X_8 = Sugar consumption (Number of days in a week)

3.6.2 Ordered probit regression model

Objective iv was achieved using the Ordered Probit regression model. The explicit form is express as follows:

$$y^*=x'\beta + \varepsilon \quad (7)$$

Where y* is unobserved.

What is observable is:

The μ ′s are unknown threshold parameters to be estimated with β. Thresholds parameters determine the estimations for different observed value of y. These threshold parameters can be interpreted as intercepts in equation (7).

The effect of fruit trees on food security categorization is coded as 0, 1 and 2 with respect to order of categorization.

The implicit form is express as follows:

X_1 = Age of household head (Years)

X_2 = Sex (Male = 1, Female = 0)

X_3 = Marital status (Married = 1, single = 0),

X_4 = Education level (number of years spent in school),

X_5 = Household size (Number of persons in the household),

X_6 = Farm size (ha)

X_7 = Farming experience (years)

X_8 = Income (N)

X_9 = Cooperative membership (Yes = 1; No = 0)

X_{10} = Extension contact (Number of visits)

X_7 = Land ownership (owner=1, otherwise= 0)

X_8 = Number of fruit trees owned (NO.)

X_9 = Types of fruit trees owned (NO.)

X_{10} = Estimated annual income from fruit trees (N)

X_{11} = Yield obtained from fruit trees (kg)

X_{12} = Farm size for fruit trees production (ha)

X_{13} = Availability of fruits throughout the year (yes=1, No=0)

X_{14} = Accessibility of fruits throughout the year (yes=1, No=0)

X_{15} = Affordability of fruits throughout the year (yes=1, No=0)

X_{16} = Safety of fruits consumption throughout the year (yes=1, No=0)

e = Error term

3.6.3 Logit regression model

Objective v was achieved using the logit regression model. A dummy variable as a proxy for the dependent variable having a value of 1 for willing and a value of 0 for not willing.

Logit regression analysis as used by (Adepoju and Obayelu, 2013) was adopted. The model is implicitly expressed as:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6 \ldots\ldots\ldots X_{16})$

The explicit form of the Logit regression model is expressed as:

$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \ldots\ldots\ldots + \beta_{16} X_{16} + e$

Y = (1 for willing and a value 0 for not willing)

X_1 = Age of household head (Years)

X_2 = Sex (Male = 1, Female = 0)

X_3 = Marital status (Married = 1, single = 0),

X_4 = Educational level (years),

X_5 = Household size (Number),

X_6 = Farm size (ha)

X_7 = Farming experience (years)

X_8 = Income (N)

X_9 = Cooperative membership (Yes = 1; No = 0)

X_{10} = Extension contact (Number of visits)

Hypothesis I was tested using Pearson Product Moment Correlation Coefficient. The formula is given below:

$$rxy = \frac{n\sum xy - \sum x \sum y}{\sqrt{(n(\sum x^2) - (\sum (x)^2\,(n(\sum y^2) - (\sum y)^2}}$$

Where:

r = Correlation coefficient

y = Food security index

x = Socio- economic characteristics

n =Total number of observations

∑= Summation.

Hypothesis II was tested using the z-value from the Logit regression

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socioeconomic Characteristic of Respondents in the Study Area

The socioeconomic characteristics under consideration include gender, age, household size, farming experience, education level, farming status, primary occupation, number of farm etc.

4.1.1 Sex

Table 4.1 indicated that majority (82.2%) of the respondents were males while 17.8% were female. This signifies that men were more into farming and fruit trees production in the study area. This might be attributed to the tedious activities involved in farming and fruit trees production and inadequate land ownership among women in the study area. This could also be attributed to women engagement in marketing and other post-harvest handling activities in fruit trees value chain. This finding agrees with FAO (2007) who reported that men are more involved in farming in the Northern parts of Nigeria. Reason being that males are more likely to have access to land for production of tree crops while the women participate mainly in the collection/harvesting, processing and marketing.

4.1.2 Marital status

Result in Table 4.1 showed that 82.7% of the respondents were married while 17.4% were single. This implies that fruit tree production was mostly done by men though a proportion of women also participate in fruit tree production in the study area. This might be associated with common cultural practice of early marriage for labour supply for farming activities such as fruit trees cultivation. The farmers may be more concern about planting of fruit crops as a means of future investment for their children.

Table: 4.1: Distribution of respondents according to socioeconomic characteristics' (n=219)

Variables	Frequency	Percentage	Mean ($\bar{X}$)
Sex			
Male	180	82.2	
Female	39	17.8	
Marital status			
Married	181	82.7	
Single	38	17.4	
Age			
31-40	39	17.8	48.4
41-50	101	46.1	
51-60	58	26.5	
>60	21	9.6	
Household size			
<6	16	7.3	11.0
6-10	93	42.5	
11-15	79	36.1	
16-20	23	10.5	
>20	8	3.7	
General farming experience			
≤ 10	82	37.4	16
11-20	8	3.7	38
21-30	35	16.0	
31-40	102	46.6	
41-50	54	24.7	
>50	20	9.1	
Educational status			
No-formal	15	6.8	
Primary	84	38.4	
Secondary	94	42.9	
Tertiary	26	11.9	
Farming status			
Full time	192	87.7	
Part time	27	12.3	
Secondary occupation			
Carpentry	3	1.4	
Bricklaying	1	.5	
Mechanic	1	.5	
Civil Service	11	5.0	
Trading	11	5.0	

Sources: Field survey (2021)

4.1.3 Age

Result in Table 4.1 revealed that the mean age of the respondents in the study area was 48.4 years. This shows that farmers were within their active and productive age, strong, inquisitive and risk takers. These set of respondents are always ready to adopt innovation and improved practices in fruit trees farming that will enhance their food security and livelihood status. This also implies that the respondents can engage in other activities aside fruit production that can facilitate the provision of food for their households. This result concurs with that of Haruna *et al.* (2018) who reported that majority of farming households in Ondo State, Nigeria were young farmers.

4.1.4 Household size

Finding in Table 4.1 revealed that the mean household size of the respondents in the study area was 11.0 persons. This suggests large household size which could be advantageous in the provision of unpaid family labour for fruit tree cultivation. On the other hand, large household size could contribute to food insecurity due to more expenses on food, most especially households with more dependents. This finding is in consonance with Haruna *et al.* (2018) who reported large family size among farming populace in Ondo State of Nigeria. On the contrary, Oluyole *et al.* (2009) stressed that a unit increase in household size will reduce the probability of household to be food secured. Hence, Silvestri *et al.* (2015) reported that increase in household size would lead to decrease in the food security status of the household because increase in the number of household means more people are eating from the same resources, and the household members may not be able to take enough food when compared to a smaller household size, thus increasing the probability of the household to be food insecure.

4.1.5 General farming experience

Table 4.1 indicated that the mean farming experience of the respondents was 38 years. This implies that farmers in the study area were in farming for years and have acquired knowledge and skills that will enhance their food security. This finding is in consonance with that of Omotesho *et al.* (2013) who reported many years of experience among farmers in Kwara State which enhance their food security.

4.1.6 Educational status

From the result presented in Table 4.1, 93.2% of the respondents had formal education while 6.8% have no-formal education. This implies that majority of the respondents were literate with proper knowledge that fruit trees planting is a future investment. High literate farmers are likely to adopt innovation and improved practices that will enhance their income and food security. This finding agrees with that of Idrisa *et al*. (2008) who reported high literacy level among farming households in Kaduna State of Nigeria which enable them to understand and carryout modern agronomic management practices needed to boost production.

4.1.7 Farming status

Entries in Table 4.1 also indicated that greater proportion (87.7%) of the respondents were full time farmers while 12.3% were part-time farmers. This finding implies that majority of the respondents were into full time farming and hence, depend on farming for livelihood. Thus, farmers engaged in fruit tree production as a source of additional income.

4.1.8 Secondary occupation

Table 4.1 showed that 5.0%, 5.0% and 1.0 of farmers respectively were traders, civil servants and carpenters. These secondary occupations provide farmers with additional income and enable them to diversify to other viable enterprises for improvement in

livelihood especially during lean seasons of fruit trees when low yield is usually recorded and also during total failure of food crops.

4.1.9 Farm size

Result in Table 4.2 showed that the mean farm size of the respondents in the study area was 3.9 hectares, implying that farmers operate on small scale. This can negatively affect their food security status when there are no other sources of income such as fruit crops. In a similar study, Babatunde *et al*. (2007) reported that small farm holding contributes to food insecurity.

Table 4.2: Distribution of respondents according to farm size, annual income, cooperative membership extension contact (n=219)

Variables	Frequency	Percentage	Mean
Farm size			
< 2.1	16	7.3	3.9
2.1 - 4.0	144	65.8	
4.1 - 6.0	55	25.1	
6.1 - 8.0	4	1.8	
Annual income			
< 200,001	9	4.1	422,840
200,001 - 400,000	102	46.6	
400,001 - 600,000	93	42.5	
600,001 - 800,000	15	6.8	
Number of cooperative			
One	204	93.2	1.2
Two	15	6.8	
Extension contacts			
1-5	166	75.8	4.7
6-10	52	23.7	
>10	1	0.5	

Sources: Field survey, 2021

4.1.10 Annual income

Table 4.2 indicated that the average income of respondents in the study area was ₦422,840, suggesting that respondents realized substantial income from farming which will go a long way in ensuring food security. It is expected that the higher the farming income, the higher the probability of being food secured. Babatunde *et al.* (2007) stressed that increase in income will result to better food security status. The more household head

engages in gainful farming activity such as fruit trees cultivation, the larger he/she earns income and the greater the chances of being food secure. The income is expected to increase household's food production and access to more quantity and quality food.

4.1.11 Cooperative membership

Finding in Table 4.2 showed that 93.2% of the respondents belong to one cooperative society while 6.8% belong to two cooperative societies. This finding implies that majority of the respondents belong to one cooperative society. Membership of cooperative society will give fruit trees farmers access to vital information and incentives such as credit facilities. that will enhance their food security. This finding talies with that of Opaluwa *et al.* (2019) who stated that majority farming households in Kogi State belong to cooperative societies.

4.1.12 Extension contact

Table 4.2 revealed that the mean extension contact of respondents in the study area was 5 times in a farming season; implying that farmers received extension services. Access to extension advisory services will expose them to new knowledge, skills and innovation that will increase their income and the likelihood in invest in fruit tress production and as well enhance their food security status. Oguntolu (2018) reported that access to extension services enhance farmers and pastoralists' skill and knowledge to be food secured.

4.2 Perception on the Potential of Fruit Trees

Table 4.3 present perception of the fruit tree farmers on the potential of fruit trees which include: maintenance and restoration of soil fertility and improvement ($\bar{X}$ =3.98), conservation of soil by protecting it from water and wind erosion ($\bar{X}$ =3.89), generation of employment and income from sales ($\bar{X}$ =3.68), source of fodder for animals ($\bar{X}$ =3.46), provision of traditional medicine ($\bar{X}$ =3.38), provision of food resources in different

varieties ($\bar{X}$ =3.31), maintenance of biodiversity ($\bar{X}$ =3.24) and provision of farm inputs and fuel wood ($\bar{X}$ =3.11).

From the finding, maintenance and restoration of soil fertility and improvement ($\bar{X}$ =3.98), conservation of soil by protecting it from water and wind erosion ($\bar{X}$ =3.98), generation of employment and income from sales ($\bar{X}$ =3.68) and source of fodder for animals ($\bar{X}$ =3.49), had the highest perception of potentials in the study area. Hayatu *et al*. (2021) ascertained that fruit trees have tendency of improving soil organic matter maintenance, nitrogen fixation, nutrient recycling and augmentation of nutrient uptake. Fruit trees serve as food that supply minerals, vitamin and other nutrients required for proper functioning of the body. Fruit trees are often the only reliable source of food for the family when crops fail or during the lean periods between harvests. This finding is in consonance with the result of Corina *et al*. (2018). Fruit trees also have the capability of conserving soil by protecting it from rain, wind and erosion, as well as service as windbreaks and shelterbelts which can reduce the velocity of the wind to a speed that is insufficient to move soil particles. Cultivation of fruit trees can serve as source of employment for teeming youths, income generation and food security determinant. This finding agrees with that of Muhammad *et al*. (2017) who reported that larger farming households in Imo State Nigeria got their larger percentage of annual income from fruit farming. Also, fruit trees are rich in vitamins and mineral required for feeding of farm animal. In a related research, Franzel *et al*. (2014) reported that more than 200,000 smallholder dairy farmers in East Africa mostly introduced fodder from fruit trees as supplementary feed for their animals. On the other hand, provision of traditional medicine ($\bar{X}$ =3.98), provision of food resources in different varieties ($\bar{X}$ =3.98), maintenance of biodiversity ($\bar{X}$ =3.68) and provision of farm inputs/fuel wood ($\bar{X}$ =3.49) had the lowest potentials; suggesting that the farmers have not realize the full potential of fruit trees for medicinal purposes,

maintenance of biodiversity and provision of farm inputs. This finding contradicts the result of Adama (2016) who reported that charcoal and farm inputs like hoe, axe, machete handle are obtained from fruit trees as farm inputs and fuel wood.

Table 4.3: Distribution of respondents according to perception on the potential of fruit trees (n=219)

Variables	HP	MP	LP	NP	Sum	Mean	Decision	Ranking
Maintenance and restoration of soil fertility and improvement	214 (97.7)	5 (2.3)	0	0	871	3.98	High	1st
Conservation of soil by protecting it from rain, wind and erosion	195 (89.0)	24 (11.0)	0	0	852	3.89	High	2nd
Maintenance of biodiversity	86 (39.3)	100 (45.7)	32 (14.6)	1 (0.5)	709	3.24	High	7th
Provision of food resources of different varieties	88 (4.2)	111 (50.7)	20 (9.1)	0	725	3.31	High	6th
Provision of traditional medicine	117 (53.4)	69 (31.5)	33 (15.1)	0	741	3.38	High	5th
Provision of farm inputs and fuel wood	68 (31.1)	107 (48.9)	44 (20.1)	0	681	3.11	High	8th
Source of fodder for animals	121 (55.3)	85 (38.8)	13 (5.9)	0	765	3.49	High	4th
Employment generation and income from sales	154 (70.3)	60 (27.4)	5 (2.3)	0	806	3.68	High	3rd

Sources: Field survey, 2021

HP=High potential, MP=Moderate potential, LP=Low potential and NP=No potential

4.3 Food Security Status of Fruit Trees Farmers

Result in Table 4.4 indicated that the food security status of 87.7% of the respondents fell under acceptable food security group while 7.3% and 5.0% were poor and borderline respectively. This finding implies that majority of the respondents were food secured. This finding agreed with that of Zubairu and Maurice (2014) who reported that majority of household in Adamawa State of Nigeria were food secured. Also, Haddabi *et al*. (2019) posited that larger proportion of households in Adamawa State fell under food secured group. This finding is also in line with that of Haruna *et al*. (2018) who reported that larger proportion of farming households in Ondo State, Nigeria were food secured. Fruit trees provide a huge variety of food products including, edible plant-products (e.g., fruits and berries, nuts, leaves, flowers, roots, etc.) and animal products (e.g., 'bushmeat', fish, honey, insects), as well as medicines and aromatic plants that support human health and well-being (FAO 2020).

Many fruit tree and shrub species also provide an important source of feed, enabling farmers and local communities to maintain livestock production and strengthen the intake of meat and milk products in local diets. Headey *et al*. (2018) opined that this makes an important contribution to food security in vulnerable communities that otherwise have limited access to animal-source foods, due to their high prices.

In the same vain, fruit trees also contribute indirectly to food security through employment and income generation. In many places, forest and tree-related jobs and activities, both formal and informal, can represent an important, if not the main source of livelihoods for many people, especially vulnerable people (poor, smallholder, women, or indigenous communities), living in rural areas in developing countries. (Angelsen *et al*., 2014).

Furthermore, fruit trees deliver many non-provisioning ecosystem services essential for agriculture, food production, human health and well-being and sustainable development (Rosenstock *et al*., 2019). This includes ecosystem services critical for current food production, such as local climate and water regulation, pest control, pollination or nutrient cycling, as well as ecosystem services supporting the stability and sustainability of food production in the long term, such as climate change mitigation and adaptation, soil formation and erosion control or biodiversity conservation.

Beyond their immediate contribution to food security, health and livelihoods, fruit trees also shelter a range of auxiliary species, including pollinators and natural pest enemies which provide multiple benefits for availability at different scales, particularly in smallholder agricultural systems with no or little agrochemical use. A somewhat similar view was made by Bale *et al.* (2008) that fruit trees are of enormous importance to the lives of both animals and human beings.

Table 4.4: Food security status of fruit trees farmers (n=219)

Food security status	Frequency	Percentage
Poor (<28)	16	7.3
Borderline (28.5-42)	11	5.0
Acceptable (>42)	192	87.7

Sources: Field survey, 2021 * FAO food security status format

4.3.1 Experience in fruit farming

Data in Table 4.5 showed that the mean farming experience in fruit farming was 16.0 years. This signifies many years of experience in fruit crop production of which proper agronomic management practices in fruits production were acquired. Many years in fruit crop farming will enhance farmers' income and food security. This finding is in agreement with that of Ogunmefun and Achike (2015) who reported that experience assist farmers in boosting crop production through the knowledge acquired over a period of time.

Table 4.5: Distribution of respondents according to experience in fruit farming (n=219)

Variables	Frequency	Percentage	Mean
≤10	82	37.4	16
11-20	78	35.6	
21-30	38	17.4	
31-40	18	8.2	
>40	3	1.4	

Sources: Field survey, 2021

4.3.2 Numbers of fruit trees owned

Result of Table 4.6 revealed that 59.8% of the respondents had between 21-40 number of fruit trees while 30.6% had more than 40 trees. The mean numbers of fruit trees owned by farmers was 36; suggesting that farmers owned reasonable number of fruit trees that can add to their income and food security. Ownership of many fruit trees by farmers provide them with additional source of food, especially during dry season at time of food shortage. This finding agrees with that of FAO (2011) reported that farmers in the rural areas have reasonable number of fruit trees even within their domains.

Table 4.6: Distribution of respondents according to numbers of fruit trees owned (n=219)

Variables	Frequency	Percentage	Mean
≤20	21	9.6	35.6
21-40	131	59.8	
41-60	56	25.6	
>60	11	5.0	

Sources: Field survey (2021)

4.3.3 Varieties of fruit trees owned

Finding of Table 4.7 showed that 48.4% owned one variety of fruit trees while 22.8% owned two varieties of fruits. Also, 21.9% and 5.5% had two and four improved varieties respectively. Access to more improved varieties that are high yielding will ensure food security among farmers in the study area because more income will be This result shows that many fruit tree varieties including exotic fruit trees were grown or retained together with the indigenous fruit trees on the farm by the local farmers in the study area. This

finding agrees with the assertion of Hayatu *et al*. (2021) who stressed that Nigerian soil is so blessed that even if you eat a mango and throw the seed on the ground, it will germinate and become a tree.

Table 4.7 Distribution of respondents according to varieties of fruit trees owned (n=219)

Variables	Frequency	Percentage	Mean
One	106	48.4	1.8
Two	48	21.9	
Three	50	22.8	
Four	12	5.5	
Five	3	1.4	

Sources: Field survey (2021)

4.3.4 Types of fruit trees owned

Table 4.8 indicated that majority (98.2%) of the respondents owned mango; suggesting that mango is the major fruit trees owned by respondents in the study area. This might be due to suitable agro-climatic condition of Niger State that favored such fruit tree production (Rabelo *et al*., 2009). Also, 50.7% owned cashew tree, the economic importance and global demands of cashew nut could have motivated farmers' populace in Niger State to venture into its production. There have been increases in demand for cashew nuts in India and China over the years which increase the price of cashew in Nigeria (Adeigbe *et al*., 2015). Other findings showed that 32.9% and 28.8% of respondents owned orange trees and shea nut trees respectively. Even though (FAO 2015) reported that weather condition of Niger State does not favour high production of orange; but reasonable quantity of the fruit is produced in the study area. Moreover, 26.5%, 24.7% and 8.2% of respondents owned palm trees, locus bean trees and guava respectively. This finding showed that most of the important fruit trees in Middle-belt of Nigeria are produced in Niger State.

Table 4.8: Distribution of respondents according to fruit trees owned (n=219)

Variables	Frequency *	Percentage
Mango trees	216	98.2
Orange trees	72	32.9
Cashew trees	111	50.7
Palm trees	58	26.5
Shea nut trees	63	28.8
Locus bean trees	54	24.7
Guava	18	8.2

Sources: Field survey (2021) Key= ***** Multiple response

4.3.5 Size of farm land for fruit tree production

Result in Table 4.9 revealed that 58.9% of the respondents used between 0.1-0.5 hectare of land for fruit farming while 39.7% used between 0.6-1.0 hectare for fruit farming. The mean farm land size used for fruit tree production in the study area was 0.6 hectare. This signifies that fruit farmers operate on small scale. Looking at geometry of fruit tree plantations, effectiveness and efficiency of cultivation can only be optimally obtained on reasonable hectare of land. As such, operating on small hectare of land could negatively affect the food security status of farmer in the study area. This finding is in line with that of Ibeawuchi *et al*. (2015) who reported that lack of substantial farm land to operate on, can reduce farmers' efficiency and food security status.

Table 4.9: Distribution of respondents according to size of farm land for fruit tree (n=219)

Variables	Frequency	Percentage	Mean
0.1-0.5	129	58.9	0.6
0.6-1.0	87	39.7	
>1.0	3	1.4	

Sources: Field survey (2021)

4.3.6 Annual yield from fruit tree

From Table 4.10, 51.1% of the respondents had annual yield of less than or equal to 25,000kg while 40.2% realized annual yield of between 25,001kg-5,000kg. The mean annual yield recorded was 2,906.9kg; signifying low yield because according to Ladipo (2003), the standard mean yield of fruit trees is 3,100kg-3,500kg. This low yield could affect the farmers' income and food security; hence in need to improve management

practices for maximum benefits. This finding contradicts that of Oosthuyse (2009) who reported that the annual yield of most rural farmers in Nigeria is about 20,000kg per hectare per year.

Table 4.10: Distribution of respondents according to annual yield from fruit tree (n=219)

Variables	Frequency	Percentage	Mean
≤25000	112	51.1	2906.9
25001-5000	88	40.2	
>5000	19	8.7	

Sources: Field survey (2021)

4.3.7 Annual income from fruit trees

Table 4.11 indicates that 42.5% of the respondents had between ₦51,000-₦100,000 while 29.2% had above ₦150,000. The mean annual income from fruit trees was ₦137,858, This mean income is fair, and it will go a long way in complementing farm income, alleviating poverty and improve food security among small-scale farmers with limited sources of income. Idrisa *et al.* (2008) reported low income among farming households in Borno State, Nigeria. In a similar study, Sanusi *et al.* (2012) reported that a unit increase in the level of income will increase the probability of household to be food secured. This could be expected because increased income, other things being equal, means increased access to food.

Table 4.11: Distribution of respondents according to annual income from fruit tree (n=219)

Variables (₦)	Frequency	Percentage	Mean
≤50000	13	5.9	137, 858
51000-100000	93	42.5	
101000-150000	49	22.4	
>150000	64	29.2	

Sources: Field survey (2021)

4.3.8 Fruit trees management practice

Finding in Table 4.12 showed that all the respondents (100%) engaged in pruning, weeding, fire tracing and pollarding. This signifies that management practices of fruit trees are common in the study area. It is expected that proper management practices will prevent diseases and pest infection, wind damage, erosion and make farmers food secured. This discovery confutes that of Dirceu and Jose (2017) who reported that majority of farmers in Nigeria do not carry out proper agronomic management practices on their tree crops.

Table 4.12: Distribution of respondents according to fruit trees management (n=219)

Variables	Frequency	Percentage
Pruning	219	100.0
Weeding	219	100.0
Fire tracing	219	100.0
Pollarding	219	100.0

Sources: Field survey (2021)

4.3.9 Crops intercropped with fruit trees

Data in Table 4.13 revealed that 69.4% and 49.3% of the respondents intercropped groundnut and cassava with fruit trees while 25.6% and 20.5% intercropped sorghum and millet with fruits trees respectively. Intercropping of crops with fruits could serve as means of adding and replenish nutrient in the soil that will favoured the growth of both produce and ensure food security. Many farmers said they are not willing to grow and manage fruit trees alone, but prefer to retain or plant fruit trees together with food or cash crops. This is in line with the finding of Ayeleagbe (2012) who reported that farmers in Ibadan and Agege usually intercrop cassava and soybean with fruit trees.

Table 4.13: Crops intercropped with fruit trees (n=219)

Variables	Frequency *	Percentage
Millet	45	20.5
Sorghum	56	25.6
Cassava	108	49.3
Groundnut	152	69.4

Sources: Field survey (2021) Key: ***** Multiple response

4.3.10 Availability, accessibility and affordability and nutritional value of fruit

Table 4.14 indicated that 86.3% of the respondents reported that fruits were always available throughout the year round for family use, which enhance the food security status in the study area. Also, the indirect pathway to availability results from the fact that fruit trees provide ecosystem services that critically support agriculture. Their root systems transport deeper water and nutrient resources close to the soil surface and making them accessible for other crops intercropped with them to enhancing agricultural productivity (FAO 2010). Furthermore, 76.3% of the respondents revealed that fruits were accessible at all time of the year. This signifies that most of the farmers had access to fruits in the study area which is expected to improve food security status of the farmers. Karjalainen *et al.* (2010) ascertained that fruits play an important role as a safety net during drought or lean seasons, as well as during periods of crises and conflicts. Similarly, majority (79.9%) of the respondents reported that fruits were affordable. This denotes that fruits were affordable by farmers and consumers in the study area. This might be attributed to prevalence of fruit trees and low prices of fruits in most of the rural areas.

On the safety of fruits, majority (89.9%) of the respondents reported that fruits were safe for consumption of the family. Safety of fruits is highly desirable and one of the essential components of food security required by the farmers for good healthy living. Powell *et al.* (2015) reported that fruits are of particular importance to nutrition.

Table 4.14: Available, accessible, affordable and nutritional value of fruit (n=219)

Variables	Frequency	Percentage
Availability		
Yes	189	86.3
No	30	10.3
Accessibility		
Yes	167	76.3
No	52	23.7
Affordability		
Yes	175	79.9
No	44	20.1
Safe for consumption		
Yes	197	89.9
No	22	10.1

Sources: Field survey (2021)

4.3.14 Reasons for cutting down of fruit trees

Table 4.15 indicated that charcoal production (100%) and firewood making (100%) were the major reason for cutting down of fruit trees. Also, outbreak of wild fire (97.7%), cutting for timber and house construction (84.5%) and land cultivation for agriculture (77.2%) were some of the major reasons. This implies that charcoal and firewood making were the major reason for cutting of fruit trees and this is expected to affect food security negatively in the study area because most of fruit trees were cut down without replacement. Achille *et al*. (2019) reported that cutting down of trees for the purposes of charcoal and firewood had reduced the population of trees in the forest which poses serious threat to food security status of fruit tree farmers.

Table 4.15: Distribution of respondents according to reasons for cutting down of fruit trees
(n=219)

Variables	Frequency *	Percentage	Ranking
Charcoal production	219	100.0	1st
Firewood making	219	100.0	1st
Outbreak of wild fire	214	97.7	3rd
Land cultivation for agriculture	169	77.2	5th
Cutting for timber and house construction	185	84.5	4th

Sources: Field survey (2021) Key= ***** Multiple response

4.4 Effect of Fruit Trees on Food Security

Ordered Logit regression analysis was carried out to determine effect of fruit trees on food security. The result in Table 4.16 showed Pseudo R^2 of 0.6577, indicating that about 65.8% of variation of effect of fruit trees on food security was explained by the independent variables included in the model, while the remaining 34.2% were due to external factors not captured by the researcher. The chi-square statistics 131.41 was significant at 1% level of probability indicating fitness of the model.

Table 4.16: Ordered Probit regression result of perceived effect of fruit trees on food security (n=219)

Variables	Coefficient	Z-Value
Age	0.0056	0.03
Gender	17.4935	0.01
Marital status	-1.3963	-1.42
Educational status	1.0882	2.06**
Household size	-0.0993	-0.60
Experience	0.1244	0.96
Income	-8.65e-08	-0.02
Cooperative	1.8327	1.83*
Extension	0.5998	2.67***
Land ownership	4.3584	2.71***
Number of fruit trees	0.0690	1.13
The variety of fruit tree	-0.7765	-1.07
Annual income from fruit trees	0.0000	1.72*
Yield from fruit trees	0.0002	0.64
Size of farm land for fruit trees	-5.6067	-2.44**
Availability	1.0854	1.07
Accessibility	-1.4077	-1.09
Affordability	-15.6252	-0.01
Safety of fruit consumption	-12.4667	-0.00
Chi-square	131.41***	
Pseudo R^2	0.6577	

Sources: Field survey (2021)

Keys:*** Significant at 1% level of probability, **=Significant at 5% level of probabilit y and *=Significant at 10% level of probability

Table 4.16 also revealed that the coefficient of educational status (1.088245) was positive and significant at 5% level of probability; implying that increases in literacy level among fruit trees farmers will increase their food security. This is in conformity with the a priori expectation. This result tallies with the finding of Haruna *et al*. (2018) who found

education to be positively related with food security, and reported that households with high education attainment were more food secured.

Moreso, the coefficient of cooperative membership (1.83279) was positive and significant at 10% level of probability, implying that membership of cooperative will increase the likelihood of fruit trees farmers to be food secured. This might be due to derivable benefits from cooperative such as incentives, capital and training. This finding is in line with that of Abimbola and Kayode (2013) who reported that membership of association increases the chance of household to be food secured. Also, the coefficient of extension services (0.5998) was positive and significant at 1% level of probability; implying that access to extension services will increase the food security of fruit trees farmers. This result agrees with the finding of Enujeke and Ofuoku (2012) who postulated that one of the reasons for extension service is to increase agricultural production. As expected, the coefficient of land ownership (4.3584) was positive and significant at 1% level of probability; indicating that fruit farmers with larger access to farm lands are likely to be food secured in view of the fact that they can expand their fruit trees plantation for more income generation that can lead to availability and accessibility of food. The coefficient of annual income (0.0000) was positively significant at 10% level of probability; suggesting that higher incomes will make fruit farmers' more food secured and as well give the farmers the opportunity to diversify their investment in fruit production. This is because increase in income will increase access to food among fruit trees producers. This is in conformity with Arene and Anyaeji (2010) who reported that improved income has the potential to increase household's food security. The coefficient of size of farm land allocated for fruits crops (-5.6067) was negatively significant at 5% level of probability; indicating that increase in farm size will lead to food insecurity among farmers. Increase in farm size is expected to increase the likelihood of food security among farming households. However,

increase in the farm size of fruit crops may create fruit crops management problems which may negatively affect food security status of farmers.

4.4.1 Marginal effect

From Table 4.17, The coefficient of education status (-.0232) was negatively significant at 5% level of probability, indicating that a unit increase in educational status will result to reduction in food security by 2.10% since most people who are advanced in education do not longer see farming as an occupation as such, they opt for searching for white collar jobs in the urban areas. Furthermore, the coefficient of cooperative society (.03915) was positively significant at 10% level of probability. This indicates that a unit increase in cooperative membership will lead to more cross breed of ideas which can translate to accessibility of food by 1.78%. The coefficient of extension contact (.01281) was positively significant at 1% level of probability. This shows that a unit increase in extension contact will lead to more acquisition of knowledge and skills on the production of fruit trees by 2.87%.

Also, the coefficient of land ownership (.0931) was positively significant at 1% level of probability. This implies that a unit increase in ownership of land will lead to increase in food security by 3.17% because farmers can comfortably plant fruit crops without any hindrance. It is a known fact that trees generally are not allowed to be planted on leased land. The coefficient of size of farm land for fruit trees (.1197) was positively significant at 5% level of probability; indicating that a unit increase in size of farm land for fruit trees by 2.55% will ensure more yield because fruit trees require big size of land to enable proper spacing between plants which will result to availability of fruits all the time and give rise to increase in food security. This is in accordance with Sanusi *et al.* (2012) who reported that increase in the level of income will increase the probability of household to be food secured.

Table 4.17: Average marginal effects of fruit trees on food security (n=219)

Variables	Coefficient	Z-value
Educational status	-.0232	-2.10**
Cooperative	.0391	1.78*
Extension	.0128	2.87***
Land ownership	.0931	3.17***
Annual income from fruit trees	-5.82e-07	-1.74*
Size of farm land for fruit trees	.1197	2.55**

Sources: Field survey (2021)

4.5 Willingness of Rural Farmers to Plant Fruit Trees

Logit regression was used to determine the willingness of rural farmers to plant fruit trees. The result in Table 4.18 showed Pseudo R^2 of 0.3562, indicating that about 35.6% of variation in farmers' willingness to plant trees was explained by the independent variables included in the model, while the remaining 64.4% were due to external factor not captured by the researcher. The chi-square statistics 70.73 was significant at 1% level of probability; indicating fitness of the model.

Table 4.18 indicated that the coefficient of age (-0.1344) was negatively significant at 10% level of probability; This implies that as farmers advances in age, their willingness to plant fruit trees reduces. This finding is in line with Abdullahi and Tashikalma (2016) who reported that as farmers' advances in age, the willingness to engage in improving farming practices reduces. Similarly, the coefficient of sex (-2.2879) was negatively significant at 1% level of probability, indicating that increase in the number of male farmers at the long run will decrease the willingness to plant fruit trees. This may result from inadequate land because of more pressure on farmland.

However, the coefficient of experience (0.2350) was positively significant at 1% level of probability, implying that increase in farming experience will increase willingness to plant trees which will serve as booster to their food security. This finding is in agreement with that of Babatunde *et al*. (2007) who reported that increase in farming experience increase the likelihood of house to be food secured.

Furthermore, the coefficient of extension (0.4646172) was positively significant at 1% level of probability; suggesting that access to extension services will increase farmers' willingness to plant fruit trees. In a related study, Abubakar *et al.* (2009) stated that regular and timely extension contact is needed to explain new technology to farmers and teach them how to increase their production and income.

Table 4.18: Logit Regression result of farmers' willingness to plant fruit trees (n=219)

Variables	Coefficient	Z-Value
Age	-0.1344	-1.67*
Gender	-2.2879	-4.05***
Marital status	0.1231	0.37
Educational status	0.0772	0.22
Household size	0.0141	0.16
Farm size	-0.3631	-1.34
Experience	0.2350	3.68***
Income	-9.19e-07	-0.44
Cooperative	-0.2957	-0.68
Extension	0.4646	3.52***
Constant	6.4784	2.36***
Chi^2	70.73***	
Pseudo R^2	0.3562	

Sources: Field survey (2021)
Keys = *** Significant at 1% level of probability, *=Significant at 10% level of probability

4.5.1 Marginal effect

Table 4.19 shows the result of marginal effect of the willingness to plant trees by farmers. The result indicated that a unit increase in age will result to 1.69% decrease in willingness of farmers to plant fruit trees. This implies that as farmers advance in age, the zeal for planting fruit trees will reduce drastically because they are not more energetic to carry out the task involved. Also, the result revealed that a unit increase in sex will lead to 4.68% decrease in willingness of farmers to plant fruit trees since large number of male farmers will lead to serious competition on land and thereby translating to land fragmentation. However, the result showed that a unit increase in farming experience will increase farmers' willingness to plant fruit trees by 4.04%. This is based on the fact that,

knowledge acquired from years of farming will enable the farmers to know varieties suitable for their environment and agronomic management practices to be carried out at the appropriate time in order to boost yield. Also finding indicated that a unit increase in extension contact by will reduce farmers' willingness to plant fruit trees by 3.95%. This may be because of other information that the farmers may receive from extension agents on diversification of farm enterprise.

Table 4.19: Marginal effect of willingness of farmers to plant fruit trees (n=219)

Variables	dy/dx	Z-value
Age	-.0120	-1.69*
Sex	-.2046	-4.68***
Experience	.0210	4.04***
Extension	-.0415	-3.95***

Sources: Field survey, 2021

Keys = *** Significant at 1% level of probability, *=Significant at 10% level of probability

4.6 Constraints Associated with Fruit Trees Farming

Table 4.20 showed the following constraints were severe; long gestation period of fruit trees ($\bar{X}$ =2.83) and problem of security ($\bar{X}$ =2.83) both ranked 1st; implying that the perennial nature of fruits which normally take time before producing and security problem were major constraints faced by fruit trees farmers in the study area. This finding is line with that of Mohammed *et al.* (2021) who reported that banditry activities had severe effect on food security in Niger State. Lack of credit facilities for fruit trees production ($\bar{X}$ =2.73) ranked 3rd. Most government intervention programmes in Niger State focused on arable crops and do not make other crops such as fruits their priority. These were followed by lack of adequate farm land ($\bar{X}$ =2.76) and high cost of seedlings ($\bar{X}$ =2.74) which ranked 4th and 5th respectively. Land is one of the major problems confronting farmers in Niger State. The activities of herdsmen have rendered some available farm lands uncultivatable for fruit trees. This finding is in consonance with that of Dolaree *et al.* (2017) who stressed that land is one of the major problem faced by

farmers in Adamawa State, Nigeria. The cost of acquiring improved varieties of seedlings is high in Nigeria, which is affecting fruit trees cultivation. Farmers also faced severe constraints of birds attracted by fruits that destroy crops ($\bar{X}$ =2.60) and problem of planting materials ($\bar{X}$ =2.06) which ranked 6th and 7th respectively. The activities of bird, rodents and other pest could negatively affect food security in the study area. The Problem of planting materials ($\bar{X}$ =2.06) that was reported by the respondents suggests that farmers do not have access to improve planting materials in the study area.

Table 4.20: Constraints associated with fruit trees farming (n=219)

Variables	Very severe	Severe	Not severe	Sum	Mean	Decision	Rank
Lack of adequate farm land	178 (81.3)	30 (13.7)	11 (5.0)	605	2.76	Severe	4th
High cost of seedling	166 (75.8)	49 (22.4)	4 (1.8)	600	2.74	Severe	5th
Inadequate information on fruit trees	21 (9.6)	161 (73.5)	37 (16.9)	422	1.93	Not severe	9th
Problem of security	182 (83.1)	37 (16.9)	0	620	2.83	Severe	1st
Lack of credit facilities on fruit trees production	170 (77.6)	49 (22.4)	0	608	2.78	Severe	3rd
High level of knowledge requirement	15 (6.8)	187 (85.4)	17 (7.8)	436	1.99	Not severe	8th
Problem of cultural belief and tradition	16 (7.3)	111 (50.7)	92 (42.0)	362	1.65	Not severe	13th
High labour requirement	29 (13.2)	133 (60.7)	57 (26.0)	410	1.87	Not severe	10th
Problem of planting materials	58 (26.5)	117 (53.4)	44 (20.1)	452	2.06	Severe	7th
Problem of market for fruit trees	16 (7.3)	17 (7.8)	186 (84.9)	268	1.22	Not severe	14th
Fruit trees attract birds which destroy crops	133 (60.7)	84 (38.4)	2 (0.9)	569	2.60	Severe	6th
Inadequate awareness on benefits of fruit trees	20 (9.1)	138 (63.0)	61 (27.9)	397	1.81	Not severe	11th
Long gestation period of fruit trees	186 (84.9)	28 (12.8)	5 (2.3)	619	2.83	Severe	1st
Inadequate knowledge of fruit trees (charcoal making)	29 (13.2)	117 (53.4)	73 (33.3)	394	1.80	Not severe	12th

Sources: Field survey (2021)

Hypotheses Tested

Hypothesis I

Table 4.21 showed that there is significant relationship between age (0.1607), annual income (0.1384) and food security at 1% and 5% level of probability respectively. This signifies that as farmers advance in age, they tend to be food secured because of the availability of already established fruit trees that will serve as future source of income even at old age. The result of PPMC also shows that income had significant relationship with food security; indicating that increase in income will improve the food security status of farmers because of their financial abilities that will enable them to access and afford food varieties. However, the null hypothesis which states that there is no significant relationship between some selected socio-economic characteristics and food security status is rejected while the alternative is accepted.

Table 4.21: Relationship between selected socio-economic characteristics and food security (n=219)

Variables	Coefficient	P-value
Age	0.1607	0.0173***
Educational status	0.0735	0.2787
Income	0.1384	0.0408**
Farm size	-0.1701	0.0117

Sources: Field survey (2021)

Hypothesis II

The result of the regression analysis reveals that educational status, cooperative membership, extension contact, land ownership, annual income from fruit trees and size of farm land for fruit trees had significant effect on food security. This indicates that fruit trees had significant effect on food security of the rural farmers. Therefore, the null hypothesis that stated that fruit trees have no significant effect on food security is thereby rejected and the alternative accepted.

Table 4.22: Significant effect of fruit trees on food security (n=219)

Variables	Coefficient	P-value
Educational status	1.0882	2.06**
Cooperative	1.8327	1.83*
Extension services	0.5998	2.67***
Land ownership	4.3584	2.71***
Annual income from fruit trees	0.0000	1.72*
Size of farm land for fruit trees	-5.6067	-2.44**

Sources: Field survey (2021)

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Based on the findings, it can be concluded that majority of the fruit trees farmers were males in their active age with large family size. Also, majority of the respondents had formal education and farming as major occupation. Further findings showed that respondents belong to cooperative societies. Maintenance, restoration of soil fertility and improvement, conservation of soil by protecting it from rain, wind/erosion and generation of employment and income from sales were the potentials of fruit trees in the study area. Also, majority of the respondents had acceptable food security status.

Furthermore, findings showed that mango and cashew trees were the common fruit trees owned by the respondents. Meanwhile, all the respondents were fully involved in fruit trees management practices. Majority of the respondents revealed that fruit crops were available, accessible and affordable in the study area. Charcoal production and firewood making were the major reasons for decrease in fruit crop in the study area. The coefficients of educational status, cooperative societies, land ownership and annual income from fruit trees have positive effect on fruit trees production as well as food security status of the farmers. The result of logit regression analysis shows that farming experience and extension services had significant positive effect on the willingness of farmers to plant fruit trees and also had effect on food security. The major constraints associated with fruit trees farming were long gestation period of fruit trees, problem of security and lack of credit facilities for fruit trees production.

5.2 Recommendations

i. Majority of the respondents were male. However, extension agents should encourage women to plant fruit trees in the study area.

ii. Farmers should be encouraged to intercrop fruit trees with other arable crops to make food available, accessible, affordable and safe for consumption all year round

iii. The annual income realized from fruit trees was found to be low. Thus, farmers should be encouraged by extension agents to improve on management practices for better yield, livelihood and food security

iv. Charcoal and firewood making should be discouraged by forestry officers and other relevant stakeholders in order to reduce deforestation of fruit trees to the bearest minimum

v. The coefficient of age negatively influences willingness of farmers to plant trees. Hence, youth should be sensitized and encouraged by extension agents to plant fruit trees in the study area.

vi. Long gestation period is one of the constraints of fruit trees cultivation in the study area. Thus, early maturing varieties of fruit tree seedlings should be developed for adoption by farmers.

vii. Credit and other incentives should be provided by Government for farmers to subsidize improved fruit trees planting materials to enhance income and food security status in the study area.

Contribution to Knowledge

Farmers involved in fruit trees production were food secured. The study revealed that educational status, cooperative membership, extension contact, land ownership and annual income from fruit trees were instrumental to the food security status of the farmers. Identification of the determinants of willingness of farmers to plant fruit trees which include: farming experience and extension service.

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APPENDICES

DEPARTMENT OF AGRICULTURAL EXTENSION AND RURAL DEVELOPMENT, SCHOOL OF AGRICULTURE AND AGRICULTURAL TECHNOLOGY, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
TOPIC: ASSESSMENT OF POTENTIALS OF FRUIT TREES ON FRUIT SECURITY OF RURAL FARMERS IN NIGER STATE, NIGERIA.
QUESTIONNAIRE

Dear Respondent,

I am a student of the above named university, I am carrying out a research project on the aforementioned topic. Information supplied here shall be solely for research purposes and will be treated as confidential. You are required to fill in the answer for the following questions.

SECTION A: SOCIO-ECONOMIC CHARACTERISTICS

1. Name of the town/village…….
2. Local government area……
3. What is your sex? Male ☐ Female ☐
4. Marital status: Married ☐ Single ☐
5. How many years are you?.....
6. How many persons are living in your house?.....
7. For how long have you been farming?.....
8. No. of formal education (mark only one)

(a) Level of education: (b) Primary School ☐ (c) Secondary/modern school ☐

(d) Tertiary institution ☐

9. Are you a full-time farmer? Yes ☐ No ☐
10. If No, name other occupation(s) you engage in apart from farming ……
11. How many farms do you have?.....
12. What is the size of your farm(s)……. (Hectares)

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13. What is your estimated annual income?.....

14. How many cooperatives do you belong to?.....

15. How many times have you been visited by an extension officer this farming season?.....

SECTION B: POTENTIALS OF FRUIT TREES FOR FOOD SECURITY OF THE FARMERS

16. What are your perceptions on the following potentials of fruit trees for food security?

Statements on potentials of fruit trees (positive)	**High potential (HP)**	**Moderate potential (H)**	**Low potential (LP)**	**No potential (NP)**
Maintenance and restoration of soil fertility and soil improvement				
Conservation the soil by protecting it from rain, wind, and soil erosion				
Maintenance of biodiversity				
Provision of food sources in a variety of forms				
Provision of traditional medicine				
Provision of farm inputs and fuel wood				
Source of fodder to animals				
Generation of employment and income from the sale and exchange of gathered and processed products				

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SECTION C: FOOD SECURITY STATUS OF THE FARMERS

Food Group	Food items belonging to group	How many times do you consume food items in this group in a week
1. Cereals and grain:	Rice, pasta, bread/cake and/ or donuts, sorghum, millet, maize.	
2. Roots and tubers:	Potato, yam, cassava, sweet potato, taro and/or other tubers.	
3. Legumes/nut:	Beans, cowpeas, peanuts, lentils, nut, soy, pigeon pea and/or other nuts.	
4. Orange vegetables (vegetables rich in Vitamin A):	Carrot, red pepper, pumpkin, orange sweet potatoes.	
5. Green leaf vegetables:	Spinach, broccoli, amaranth and/or other dark green leaves, cassava leaves.	
6. Other vegetables:	Onion, tomatoes, cucumber, radishes, green beans, peas, lettuce, etc.	
7. Orange fruits (fruits rich in Vitamin A):	Mango, papaya, apricot, peach.	
8. Other Fruits:	Banana, apple, lemon, tangerine	
9. Meat:	Goat, beef, chicken, pork (meat in large quantities and not as a condiment)	
10. Liver, kidney, heart and /or other organ meats		
11. Fish / Shellfish:	Fish, including canned tuna, escargot, and/or other seafood (fish in large quantities and not as a condiment).	
12. Eggs		
13. Milk and other dairy products:	Fresh milk/sour, yogurt, cheese, other d airy products (Exclude margarine/butter or small amounts of milk for tea/coffee)	
14. Oil/fat/butter:	Vegetable oil, palm oil, shea butter, margarine, other fats/oil	
15. Sugar, or sweet:	Sugar, honey, jam, cakes, candy, cookies, pastries, cakes and other sweet (sugary drinks).	
16. Condiments / Spices:	Tea, coffee/cocoa, salt, garlic, spices, yeast/baking powder, lanwin, tomato/sauce, meat or fish as a condiment.	

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17. Years of farming experience of in fruit trees ----------

18. Do you own a land? Yes ☐ No ☐

19. What is the number of fruit trees own by you? ----------

20. What is the varieties of fruit trees own by you? in numbers ----------

21. What is your estimated annual income from fruit trees? N----------

22.What is your annual yield from fruit trees? ---------- kg

23. What is the size of your farm land for fruit trees? ---------- ha

24. Indicate the kind of management practice you carryout on fruit trees

Pruning	
Weeding	
Fire tracing	
Pollarding	

25. Tick agricultural crops grown alongside with fruit trees

Millet ☐ Sorghum ☐ Cassava ☐ Groundnut ☐ Cassava ☐

SECTION D: EFFECT OF FRUIT TREES ON FOOD SECURITY

Tree fruits are always available Yes ☐ No ☐

Tree fruits are accessible Yes ☐ No ☐

Tree fruits are affordable Yes ☐ No ☐

Tree fruits have nutritional value Yes ☐ No ☐

26. What is your reason (s) for growing fruit trees?

Domestic purpose ☐ Cash value ☐ Medicinal purpose ☐ Easy to manage ☐

Drought resistance ☐ Nutritional value ☐ Provision of shade in the house ☐

Provision of building materials ☐ Amenity ☐ Others specify

……

SECTION E: WILLIGNESS OF RESPONDENTS TO PLANT FRUIT TREES

27. Are you willing to plant fruit trees in your farm? Yes ☐ No ☐

How did you propagate your fruit trees? Planted ☐ Transplanted ☐

28. Which area did you receive information from extension agents on fruit trees?

Land preparation ☐ Pest control ☐ Weeding ☐ Pruning ☐ Harvesting

Post harvest handling and processing ☐

SECTION F: CONSTRAINTS ASSOCIATED WITH FRUIT TREES FARMING

29.What are the challenges faced in your bid to farm fruit trees? Tick as appropriate.

Constraint faced	**Very severe**	**Severe**	**Not severe**
Lack of adequate farm land			
Financial cost of seedlings			
Inadequate information			
Lack of security			
Lack of credit facilities			
High knowledge requirement			
Cultural beliefs and tradition			
High labour requirement			
No planting materials			
No market for fruit trees			
Fruit trees attract birds which destroy crops			
Lack of awareness on fruit trees cultivation			
Long gestation period of fruit trees			

Inadequate knowledge of its cultivation			

Other constraints (Please specify) ……

30. Reasons for decrease in fruit trees in recent times

Charcoal making ☐ Fire wood ☐ Wild fire ☐ Land cultivation for agriculture ☐

Cutting for timber and house construction ☐

31. Suggest possible ways of improving fruit trees cultivation

a. ……

b. ……

c. ……

d. ……

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