Utilisation pattern and economic potential of indigenous fruits and vegetables among rural communities in Akure, Nigeria

S.F OLOWO

orcid.org/0000-0003-0823-041X

Dissertation accepted in fulfilment of the requirements for the degree Master of Indigenous Knowledge Systems (MIKS) at the North West University

Supervisor: Prof Adeyemi O. Aremu

Graduation ceremony: November, 2022

Student number: 34340734

DECLARATION

Student number: 3434034

I, **Similoluwa Felicia Olowo** with student number: **34340734** hereby declare that this study titled 'Utilisation pattern and economic potential of indigenous fruits and vegetables among rural communities in Akure, Nigeria' is my work. I acknowledged and recognized all the sources used for this work in complete references. In addition, I declare that this work has not been submitted to any institution of higher learning for examination or other purpose.

Olowo Similoluwa
Digitally signed by Olowo Similoluwa
DN: cn=Olowo Similoluwa, o=NWU, ou=FNAS, email=olowosil@yahoo.com, c=ZM
Date: 2022.05.31 13:30:16 +02'00'

---------- ----------

Miss S.F Olowo — Date
(Student)

---------- ----------

Prof AO. Aremu — Date
(Supervisor)

Omotayo Abiodun O.
Digitally signed by Omotayo Abiodun O.
DN: cn=Omotayo Abiodun O., o=NWU, ou=FNAS, email=omotayoabiodun777@gmail.com, c=US
Date: 2022.05.31 13:26:45 +02'00'

---------- ----------

Dr O.A. Omotayo — Date
(Co-Supervisor)

---------- ----------

Dr I.O. Lawal — Date
(Co-Supervisor)

DEDICATION

I dedicate this work to God Almighty, the vulnerable rural poor and the researchers, botanists, agriculture-food-nutrition experts all around the globe.

To God, for wisdom, knowledge, understanding, inspiration and power to deliver the poor. The all-sufficient God, the pillar that holds my life that carried me on His eagle wings all through the program. To Him alone be all the Glory, honour and adoration forever more.

To the vulnerable rural poor, respect to those who have died of malnutrition, hunger and poverty related challenges, as well as a token of concern for those that are poor, malnourished and food insecure. To the malnourished and poor as they endure the battle against food related challenges. Knowing fully well that "we will all have prosperous nations, sufficient and well-nourished food as well as sustainable communities someday" as desired by the 1st, 2nd and 11th United Nation's Sustainable Development Goals.

To researchers, botanists, agricultural-food and nutrition experts, for their tireless research effort in the constant fight against food insecurity, malnutrition and poverty and poor livelihoods, recommending timely policy and advice to the government and NGOs. It is quite impossible to carry out a trans-disclinnary research like this without the relationship between you all.

ACKNOWLEDGEMENTS

I thank God for making this work possible despite the challenges faced during running my M.IKS Programme, I sought him in my trouble, He answered me and delivered me from all my distresses. He guarded and guided me through the thick and thin of this work, not only during the completion stages but right from its inception, He is truly the Alpha and Omega of my entirety.

I am indebted to my supervisor Prof. O.A. Aremu and co-supervisors Dr. O.A. Omotayo and Dr. I.O. Lawal for their guidance and encouragement during this project work. Indeed, I appreciate all your efforts all through the programme, the commitment, patience and understanding you showed, thanks for being there for me and for bringing the best out of me. May the Good Lord reward you greatly.

I am so grateful to the traditional ruler of Isolo kingdom Osolo of Isolo, for giving me access to all the local communities to conduct my research. May the Good Lord cause you to see the good of Akure kingdom in your lifetime in Jesus' name. In addition, my profound gratitude to all the participants who took part in the study, without you this programme would not have been a success. You are all appreciated.

My sincere thanks to Mr P.T. Ndhlovu and Dr. John Asong for their expertise, contributions and the support provided during this research work. God bless you all. I appreciate all my team members, that were with me on the field for the data collections, most especially Mrs Ariyo the team leader. May the good Lord bless you greatly. In addition, my sincere gratitude also goes to Mr Oba, Mr.A. Adeyemo and Mr.A.J. Egunjobi FRIN staff at the herbarium who assisted with the identification and preparation of the voucher specimens for the selected indigenous fruits and vegetables. I am grateful to the North-West University for offering me a post graduate bursary for this study. Thanks for adding a feather to my cap.

Special thanks to my friend Dr. (Mrs) Caroline Fadeke Ajilogba, a true friend in need and indeed, thanks for being there for me, and you are part of my success story. I could recall the last statement you made in 2013 in Akure when you came searching for me you said, 'Simi you are not yet where you are meant to be, I see you bagging your doctorate degree'. You said it and God used you to start the process; you will never lose your eternal reward in Jesus' name.

My heartfelt gratitude also goes to my wonderful family and friends in the Lord for their love, care, and labouring in the place of prayers: Pastor John, Mrs Opeyemi, Mrs Akindeko, Mr and Mrs Royal, Mr and Mrs Adeluwoye, Mr and Mrs Olorunkiyesi, Pastor and Mrs Nenuwa, Rev. (Mrs) Ajibola, Pastor and Pastor (Mrs) Kolapo-Bello, Mr and Mrs Boluwaji and Rev and Mrs Jesuloluwa. So also, to my big family Olowo dynasty I cannot thank you enough. God bless you all for your care, patience and understanding.

Finally, my profound gratitude goes to my "Foundational level" people for their support, help, encouragement, sense of humour and prayer. Special thanks to my friend, darling husband, a father with a large heart Pastor Adetomiwa Emmanuel Adeyonu, and to my children in the womb of the spirit, I cannot thank you enough, thanks for being there for me always who love but missed me so much during my research years. My best mentors and pastors to whom I lovingly say "THANK YOU" for your counsels, prayers and believe in my DREAM. My spiritual parents in the Lord Apostle and Dr. (Mrs) Gbenga Adegbenro, thanks for being there for me and believing in me that I can be all that God has made me to be, your prayers and counsel are well appreciated. I cannot but say a big thank you to Prof. and late (Mrs) Ademosun, a true parent indeed who stood by me in my trying years, your prayers, counsel, encouragements have gone a long way to see me through in life. You opened your heart and home to me. May the Good Lord reward you greatly.

ABSTRACT

Plants including indigenous/naturalised fruits and vegetables (IFVs) have the potential towards meeting the food and nutrition needs of humans. Currently, IFVs are threatened by human activities such as deforestation, environmental degradation and acculturation. As a result, the need for ethnobotanical surveys that focus on the documentation of IFVs remains pertinent. The aim of the study was to explore the diverse uses, knowledge and economic potential of indigenous fruits and vegetables among 40 rural communities in Akure, Nigeria. Ethnobotanical information was collected among 400 participants using semi-structured questionnaires. Thereafter, the frequency of citation (FC) was calculated. An inventory of 46 indigenous and naturalised plant species from 19 families were identified as a source of food, nutritional and therapeutic purposes as well as energy source (fuel) in the study area. The FC ranged from approximately 32-90% and IFVs such as *Ageratum conyzoides* (L.) L. (89.5%), *Citrus aurantiifolia* (Christm.) Swingle (89.5%), *Talinum fruticosum* (L.) Juss. (88.8%), *Amaranthus hybridus* L. (87.8%), *Vernonia adoensis* var. *adoensis* (86.8%) and *Vernonia amygdalina* Delile (86.8%) were the most cited plants. The dominant plant families were Asteraceae (8 IFVs) and Malvaceae (6 IFVs) while the leaves (35%) and fruit (21%) were the most frequently used plant parts. In terms of use-categories, the IFVs served as food (53%), medicine/health benefits (46%) and fuel/energy source (1%), which is an indication of their diverse potential in the study area. *Elaeis guineensis* Jacq. was recorded as a highly diverse IFV with applications in the three use-categories. The demographic overview of the study area revealed that male participants (60.5%) are more than female (39%). In addition, the study indicated that most of the participants acquired formal education at the secondary (42.3%), primary (36.8%), and tertiary level (7.3%), while 7.5% of the participants had no formal education. Overall, the current findings contribute to the on-going global research efforts aimed at documentation of indigenous plants. The value of the efficient utilisation of rural lands to cultivate indigenous fruit and vegetables to improve the livelihood of farming households cannot be overemphasized. This study applied probit regression, principal component analysis (PCA) and propensity score matching (PSM) models to investigate the factors that determine the decisions of households to utilize their lands to cultivate indigenous fruit and vegetables. The impact of their cultivation on the participants' livelihood was assessed and found that they were profitable (₦19,187.8/USD 42.60/Ha). The farmers who cultivated indigenous fruits and vegetables (n= 277) made an additional 29.40% average total farm revenue than those (n=123) who did not. Based on the probit regression analysis, factors such as educational attainment,

access to government subsidies and knowledge of the nutritional benefits of the indigenous fruit and vegetables influenced the farmers' decisions to cultivate indigenous fruit and vegetables. The PSM model established that indigenous plant's cultivation increases farm revenue and livelihoods outcomes by 17604.85 and 2.265, respectively. In this context, the cultivation of indigenous fruits and vegetables in the selected rural communities is important for the improving the livelihoods of households and suggests the need to rethink present dominant policy narrative that neglects these indigenous products. Concerted effort needs to focus on increasing their productivity and commercialization as a primary pathway to improved rural livelihood and transformation. The current findings reveal the rich biodiversity and potential of IFV for nutrition and health benefits in the study area. However, the determination of the nutritional and phytochemical content of identified IFVs collected from the study area will be essential for their characterisation which may enhance their acceptance among the local and wider populations.

Keywords: *Amaranthus*, Asteraceae, Biodiversity, Economic botany; Ethnobotany; Food security, Food sovereign; Indigenous knowledge, Rural development; Rural transformation; Socio-economic empowerment, Traditional medicine, Welfare

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONOMYS AND ABBREVIATIONS

ATL	Average treatment on individual
ATT	Average treatment on the treated
ATU	Average treatment on the untreated
FC	Fixed cost
FC	Frequency of citation
FNASREC	Faculty of Natural and Agricultural Sciences Research Ethics Committee
FRIN	Forestry Research Institute of Nigeria
FAO	Food and agricultural association
GM	Gross margin
IFV	Indigenous fruit and vegetable
IK	Indigenous knowledge
IKS	Indigenous knowledge systems
NR	Net return
PCA	Principal component analysis
PSM	Propensity score matching
RFC	Relative frequency of citation
SATA	Serial advanced technology attachment
SD	Standard deviation
SDG	Sustainable development goal
SPSS	Stastical package for the social sciences
TR	Total revenue
TVC	Total variable cost
UV	Use value
UN	United nations
WHO	World Health Organisaton

LIST OF APPENDICES

CONFERENCE OUTPUT FROM THIS DISSERTATION

S.F. Olowo, A.O. Omotayo, I.O. Lawal, P.T. Ndhlovu, A.O. Aremu 'An inventory of Indigenous fruits and vegetables among local communities in Ondo state, Nigeria' 21st International congress of the International Society for Ethnopharmacology (ISE)s, 28th-31st May 2022 in China Medical University (CMU) in Taichung, Taiwan, China.

PUBLICATIONS FROM THIS DISSERTATION

Olowo, S.F., Omotayo, A.O., Lawal, I.O., Ndhlovu, P.T. and Aremu, A.O., 2022. Ethnobotanical use-pattern of indigenous fruits and vegetables among selected communities in Ondo state, Nigeria. *South African Journal of Botany* 145: 501-511

Olowo, S.F., Omotayo, A.O., Lawal, I.O. and Aremu, A.O., 2022. Improving rural livelihood through the cultivation of indigenous fruits and vegetables: Evidence from Ondo State, Nigeria. *Agriculture*, *12*(3): doi:10.3390/agriculture12030372

Olowo, S.F., Omotayo, A.O., Lawal, I.O. and Aremu, A.O., 2022. Exploring the potential of some selected indigenous fruits and vegetables for dietary and diversity health: A review. *Manuscript-in-preparation*

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION

1.1 Background

In the last few decades, the world food supply and pattern of dietary have changed substantially (Akinola et al., 2020; Willett et al., 2019). The attention has been on crops yield and production practices that promotes reduction of hunger, life expectancy improvement and decreasing of children mortality rates (Willett et al., 2019). In the same line of action existing literature shared the same view that 1960s green revolution has changed the face of agriculture in which more attention is now on the production of cereals and other horticultural crops making them more popular and acceptable thereby allowing other crops to become underutilized. Despite the increase in food production the level of increase in disease associated with high calorie is at an alarming rate so is the case of unhealthy diets which makes morbidity and mortality to be riskier than unsafe sex, alcohol and tobacco. Globally, over 820 million are undernourished, 151 million children are stunted, 51 million children are wasted while over 2 billion people are micro nutrient deficient. All these contribute to environmental degradation (Akinola et al., 2020; Willett et al., 2019).

According to Bvenura and Sivakumar (2017), an estimated 821 million people are undernourished globally. The rising population has made the demand for food to be very high, yet food production has been on a decrease thereby threatening the food chain, and the most affected are the poor individual (Bvenura and Sivakumar, 2017). In addition, the amount of food lost yearly due to postharvest losses before reaching the final consumer is much compared to the amount of food produced for human consumption and this further compounds the problem of food insecurity in the developing nations most especially in the sub-Saharan Africa and Asia (Bvenura and Sivakumar, 2017). Therefore, the global community has been devising solution on the reduction of hunger and improving nutrition based on policies including the UN sustainable development goals.

Over the years, the indigenous people have depended on the natural resources found in their environment for their basic needs such as food, clothing and shelter and they have gained this knowledge through interactions which has stimulated the relationships between man and his environment (Mashile et al., 2019). Abah *et al.* (2015), opined that indigenous knowledge is based on experience, often tested over centuries of use, adapted to local culture and environment, dynamic and changing. People have an intimate knowledge of many aspects of their surroundings and their daily lives. Indigenous knowledge is the systematic body of

knowledge acquired by local people through accumulation of formal and informal experiences, as well as intimate understanding of the environment in a given culture (Warren, 1991). Indigenous knowledge systems (IKS) have been used in the past to help ensure household food security, especially in rural communities. According to Kamwendo and Kamwendo (2014), a restricted statistics of research findings have explored the extent to which IKS can contribute to the achievement of food security. The use of indigenous foods, especially fruits and vegetables which were initially primary sources of food in many societies (Bvenura & Afolayan, 2015).

The neglect of indigenous plants in preference for a few exotic crops has partly affected the achievements of food policies globally, particularly in the developing countries (Ateba et al., 2012; Mabhaudhi et al., 2019). As result, high level of under-nutrition persists with high rate of overweight, obesity, and non-communicable diseases. The consumption of indigenous fruit and vegetables may mitigate the insufficient food in developing countries. Relative to other continents, Africa has one of the highest rates (20%) of poor nourishment (United Nations, 2019). This is particularly well pronounced in East Africa countries such as Ethiopia, Somalia and Kenya. For instance, about 100,000 children suffering from nutrient-deficiency were treated in 418 nutrition centres in south Somalia from January to May (Isaiah, 2011). Similar high incidence of hunger and nutrient deficiency have been reported from all the regions in Africa Forum (2019).

In Nigeria, indigenous food crops contribute to the livelihood of the people especially the local populace (Aworh, 2014). These indigenous fruits and vegetables (IFV) can enrich the diet of the rural populace and thrive with minimum agricultural inputs such as fertilizers, herbicides and pesticides (Schreckenberg et al., 2006). The indigenous fruits and vegetable crops which occur across different zones in Africa are rich sources of vitamins, minerals, proteins and valuable phytochemicals (Stadlmayr et al., 2013). They are known over the years to be sources of food and income for the communities thereby increasing the rate of living conditions among the indigenous people. Kahane et al. (2013) reported that local fruits and vegetables have valuable nutrients and essential vitamins, which are very crucial for human health preservation, particularly for the vulnerable children suffering from malnutrition and diseases.

Generally, fruits and vegetables have high concentrations of dietary fiber, vitamins, minerals, and phytochemicals, especially antioxidants (Slavin and Lloyd, 2012). Their intake has been reported to cure chronic diseases such as cardiovascular diseases, blood pressure,

hypercholesterolemia, osteoporosis, many cancers, chronic obstructive pulmonary diseases, respiratory problems as well as mental health (Adebawo et al., 2006; Payne et al., 2012). In addition to its significant role in nutritional security, fruits and vegetables also enhance the local economy and entrenched traditional medicine as leaves of fruits and vegetables, serve as both food and a medical channel. Nearly all the plants use to grow locally in the wild and or are nursed on a very base scale (Mudhara and Ndwandwe, 2014; Tumwet et al., 2014). Indigenous fruits and vegetables need to be systematically explored due to their role in mitigating malnutrition and poverty as well as food insecurity in Nigeria (Schreckenberg et al., 2006).

1.2 Rationale of the Study

Generally, indigenous fruits and vegetables possess numerous advantages relative to exotic plants (Chivandi et al., 2015). For instance, they are well-adapted to the local environment thereby requiring low agricultural inputs (Aworh, 2015). Fruits and vegetables are essential toward poverty reduction, guarantee nutrition and food security for rural households (Awodoyin et al., 2015). Researchers have highlighted the diversity and abundance of indigenous plants in Sub-Saharan Africa including Nigeria (Akinola et al., 2020). These untapped plant reservoirs have the potential for the development of indigenous food products. Since time immemorial, the indigenous people have acknowledged that the consumption of indigenous plants holds immense potential in nurturing and nourishing the human body.

Despite this enormous potential, the development and cultivation of indigenous fruits and vegetables remain severely undervalued. As a result, concerted effort especially the documentation of existing inventory and knowledge of indigenous fruits and vegetables remain pertinent. Crane et al. (2017) opined that indigenous, traditional and local knowledge about nature is going into extinction faster than biodiversity and once lost very difficult to gain such knowledge. A clarion call to all scientists to work together with the holders of these knowledge to be able to acknowledged and acquired the sustainable environmental stewardship that will link up cultural diversity with generic diversity is very vital for future food security (Crane et al., 2017). More stringent studies are necessary to evaluate the unexplored potential of indigenous plants in Nigeria. Thus, documenting indigenous fruits and vegetables together with associated uses and benefits will provide baseline information that are necessary toward fully exploring their potential for economic benefit.

1.3 Problem statement

Currently food security is a big problem due to the limited food supply available to human. In the face of this, we have neglected indigenous fruits and vegetables, which may help mitigate this problem. According to (Akinola et al., 2020) indigenous and traditional food crops have diverse usage in the society and they play a major role in food diversification to promote food and nutrition security. Healthy life can often be achieved by having access to essential nutrients which are abundant in fruits and vegetables (Bvenura and Sivakumar, 2017; Stadlmayr et al., 2013). Many of the indigenous people lack the knowledge of the nutritional contents of the indigenous fruits and vegetables to provide the essential micro and macronutrients that the body needs for good health.

Despite the potential values and benefits of these plants, their acceptance and intake are low among local communities. These indigenous fruits and vegetable crops are being neglected and underutilized due to many factors such as cultural norms, human perception, lack of awareness of their benefits among the consumers (Pitso and Lebese, 2014) and they are not being valued. According to Adegbilero-Iwari et al. (2021)the people belief that exotic food crops are more superior than indigenous crops. In addition, Ayanwale et al. (2016), reported that the main reason for the underutilization of these food crops is due to low production by the local farmers. The low intake can also be due to ignorance and neglect among the people. Food and nutrition insecurity is one of the challenges in Sub-Saharan Africa including Nigeria.

Indigenous fruits and vegetables are well known among the people in the local communities where it has come part of their culture, a heritage handed over to them by their ancestors and yet these crops are being underutilized and neglected by the younger generation (De Beer and Van Wyk, 2011). The elders of the land that are custodian of culture in passing on the norms of the land to the next generation are no longer doing that because of civilization and the values of these crops are not known. In addition, the rural and urban migration in search of white-collar job by the youth in the local communities is another factor that contributes to the neglect of these indigenous fruits and vegetables crops (Mashile et al., 2019). This current study seeks to bridge the gap between the culture of the land and the younger generation. The elders of the land are the holders of the indigenous knowledge on the usage of different types of local plants and they transfer this knowledge orally but many of these elders passed on without disseminating this knowledge to the younger generation.

Furthermore, there is lack of proper documentation of the potentials and the benefits associated with the indigenous fruits and vegetables (Pitso and Lebese, 2014). In most of the African nations the ethnobotany of the indigenous crops is inadequately documented some lists of plants names are having little or no information on their uses and management (Pitso and Lebese, 2014). How can knowledge be preserved to the next generation? According to (Mbhenyane, 2017) the potential values and benefits of these indigenous plants are yet to be fully investigated for their values to be known and appreciated in the communities, hence there is need for proper documentation of their uses and importance in the rural economies.

1.4 Aim and objectives

The aim of the study is to explore the diverse uses, knowledge and economic potential of indigenous fruits and vegetables among rural communities in Akure, Nigeria.

The research objectives are as follow:

i. To identify the types and uses of indigenous fruits and vegetables in the study area
ii. To document common practices and knowledge associated with the uses of indigenous fruits and vegetables
iii. To determine the economic value and the potential livelihood benefits of the indigenous fruits and vegetables.

1.5 Research questions

In other to accomplish the aim of this study, the following research questions will guide the research.

i. What are the indigenous fruits and vegetables existing in the study area?
ii. How do the indigenous fruits and vegetables contribute to the nutritional and medicinal needs of community members?
iii. What are the common practices and knowledge associated with the uses of indigenous fruits and vegetables found in the study area?
iv. How can the indigenous fruits and vegetables contribute to livelihood of the people in the study area?

1.6. Significant of the study

The findings of the proposed study will generate an inventory and create awareness on the role of indigenous fruits and vegetables for nutritional, health and livelihood. As a result of the

seasonality of these indigenous fruits and vegetables, a high degree of wastage is often during their peak harvest period. The economic potential will enhance research that focuses on the value addition processes. Given the multi-disciplinary nature of the project, the potential impact is also in multi-facets including knowledge generation, bio-economy development as well as skills and human resources development. In the course of the project, regular interaction will be undertaken to engage with community members who have interest in product development from the indigenous fruits and vegetables.

Research findings from the proposed project, which is related to the nutrition, of the identified indigenous fruits and vegetables, will provide critical insights about their potential in adding diversity to human diets. Thus, these indigenous plants may provide the ultimate weapon against dietary deficiency. The proposed research has potential to enhance the value associated with the indigenous fruits and vegetables and contribute to the livelihood of rural dwellers.

1.7 Division of chapters

The dissertation is divided to six chapters:

Chapter 1: presents the background of the study on the utilisation pattern of indigenous fruits and vegetables, the rationale of the study, problem statement, aim and the objectives, research questions, significance of the study and the division of the study chapters.

Chapter 2: entails the general orientation of the study and the key concepts used in the study.

Chapter 3: provides an in-depth of the literature review of the study.

Chapter 4: focuses on the ethnobotanical use-pattern of indigenous fruits and vegetables among the selected communities in Ondo state, Nigeria.

Chapter 5: presents the findings on the influence of indigenous fruits and vegetables on the livelihood of the selected communities in Ondo state, Nigeria.

Chapter 6: This gives the summary of the findings, conclusion based on the result and also recommendation on how to promote the utilization of indigenous fruits and vegetables.

CHAPTER 2: INDIGENOUS UNDERPINNINGS OF THE STUDY

2.1 Introduction

This chapter gives an overview of the general research design used in the study and the theory that backs up the underpinnings of the indigenous research. This includes the conceptual framework, theoretical framework and the indigenous theory that support the study. It also explains the definitions of some key concepts.

2.2 Definitions of key concepts

Biodiversity: is the existence of many different kinds of plants and animals in an environment. It is the variety of life on Earth, in all its forms and all its interactions. Biodiversity is the most complex feature of our planet, and it is the most vital.

Community: group of people living in the same place or having a particular characteristic in common (Oxford dictionary).

Ethno-botany: implies researching plants used in various parts of the world by social orders. The field of ethno-botany has grown from collecting ethno-botanical knowledge to applying it to a creative society, essentially as pharmaceutical. Intellectual property rights and advantage sharing courses of action are significant issues in ethno-botany.

Food Security: this is conceptualized as when the citizenry could visibly, socially and economically access sufficient and nutritionally enriched foods that enhance needed diet and desires for a well built and healthy life (Bhaskara, 1997).

Health: is a state of physical, mental, and social health, not just the lack of disease or illness.

Indigenous fruits and vegetables: these are fruits and vegetables that are native or local to a specific country, region and locality.

Indigenous Knowledge: defined as the knowledge aimed at social and natural well-being, which is continually influenced by local creativity, experimentation and contact with external systems (Mudhara and Ndwandwe, 2014).

Livelihood: it includes incomes, wealth and affluence necessary for human life. The sustainability of life if scored high when the people could meet the basic needs of life and it is shock and stress free. The measuring standards are capacity to address natural disasters, economic or social insecurity). It also extends to ability to promote and people's minimum

standard of living and guarantee a secured future without demeaning the natural environment or resource channel (Roberts, 1982).

Nutrition: is the consumption of food for the dietary needs of the body. Good nutrition, for example, is when you have a well-balanced diet and exercise (Chakravarty et al., 2016)

2.3 Conceptual framework

Conceptual framework depicts an architecture that defines natural advancement of any given study field (Camp, 2001), a visual display or picture of relationship of shared studied ideas (Osanloo and Grant, 2016). The researcher is aided to investigate and gives the meaning of the concepts in the threshold of research problem of the study (Luse et al., 2012). A conceptual framework is the significant bearing or route of the research expedition. It analyses connection between specific variables distilled in the research. It equally analyses the input, process and output of the entire findings.

As shown in Figure 2.1, Indigenous fruits and vegetables are central to the proposed study Indigenous fruits and vegetables are well known among Akure community, their uses and values cannot be underestimated among the local people. Some of the fruits and vegetables have been used by the local people to treat ailments contributing to the well-being and health of the people. The nutritional contents of these crops are very high they contain the essential vitamins and minerals, which are essential for sound health, and they can be a source of income to the indigenous people, thereby enhancing their livelihood. Furthermore, the elders of the community are custodian of culture, they have in-depth knowledge of the values of these crops, hence preserve their heritage. In addition, these indigenous fruits and vegetables are readily available and accessible in their seasonal periods; most of the older generation of indigenous people depend solely on them as source of food, thereby promoting food security. Indigenous fruits and vegetables are all encompassing; hence, they play a major role in the local community.

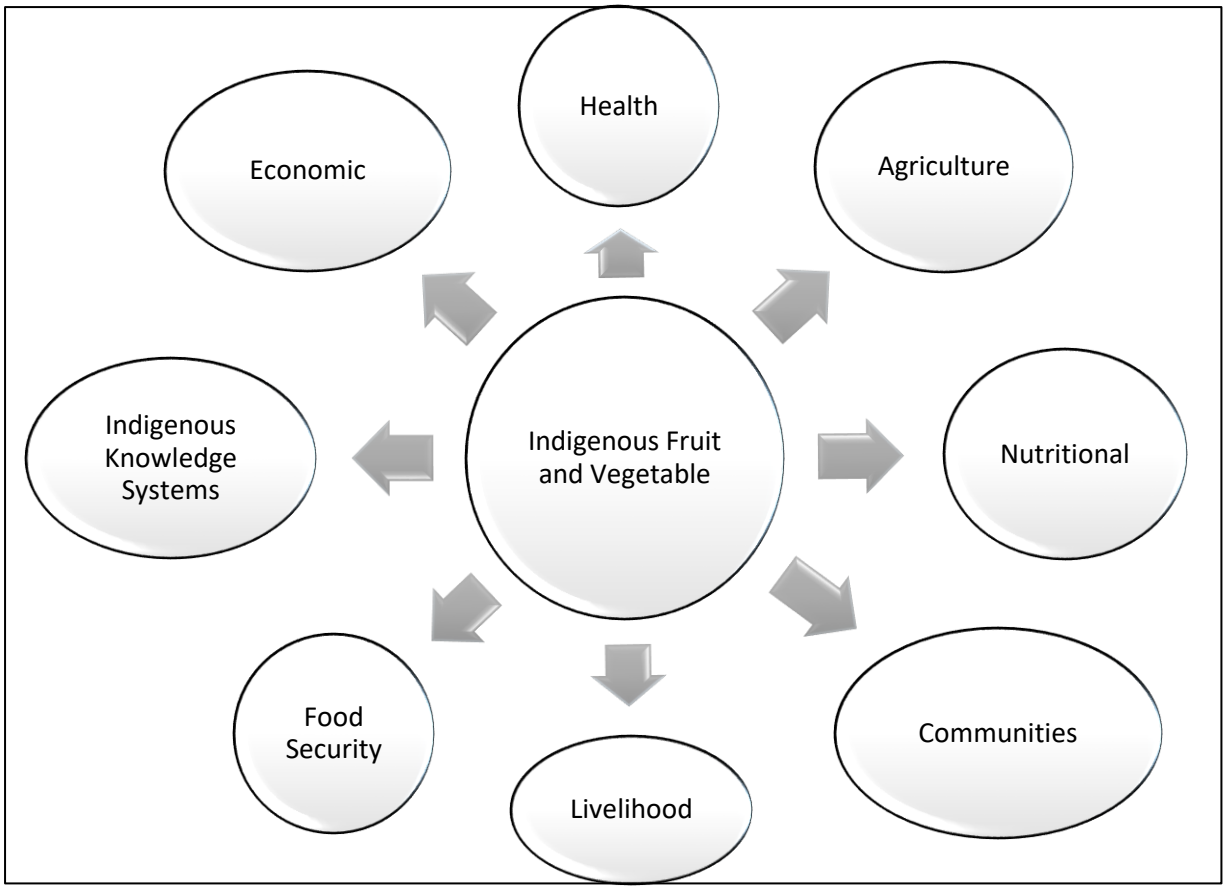


Figure 2.1 Conceptual framework applied for the study

2.4 Theoretical framework

Theoretical framework depicts how the researcher structures his/her philosophical, epistemological, methodical and analytical definition of his/her studies (Osanloo and Grant, 2016). This is the central focus of the research finding and maintains logical connection with research problem of the study. Researcher's framework of research design and analysis of research plan. It guides a researcher's choice of design finding and finding analysis plans guided by theoretical framework. Similarly, Osanloo and Grant (2016) reported that it enhances a global scope to aid one's idea on the problem and analysis of the variables. The theoretical framework supports and shows each phase of the study like Statement of the problem, Literature Review, Methodology, Presentation and Discussion of Findings.

Lester (2005) opined that theoretical framework guides the types of variables to be assembled while Maxwell (2012) suggests that theoretical frameworks expand the core of the research. Readers are assured that the research has no relation with researcher's instinct but on the

established principle assembled through reliable findings. This study will make use of the indigenous creativity theory, Indigenous holistic theory, and ethnography. These theories will ensure make the researchers and the participant have good relationship with the knowledge holders; hence the knowledge holders will be part of the research work till the end.

2.4.1 Indigenous theory creativity

Guntarik and Daley (2017) stated that indigenous theory creativity aids creative researchers to have in-depth into ways of knowing alternative approaches to conducting and presenting knowledge. Through their creative practices, they map the historical trajectories of Indigenous survival in the modern world, fracturing the lines between convention and creativity by overturning research 'norms' and framing knowledge in forms that express socialites relevant to indigenous people's perspectives (Paton, 2012). Indigenous creativity allows individuals to practice what they know and to make use of the original information collected from the study area to bring about meaningful impacts in the community. It will also reveal the role of indigenous knowledge, practices in the local community of Akure, Nigeria.

2.4.2 Indigenous holistic theory

According to Absolon and Herbert (1997), indigenous holistic theory comprises of the spiritual, emotional, mental, and physical elements of a being. There is need for researchers that are undergoing research study in the local community to identify with the way of life of the indigenous people to get maximum result from the people. Relating with the physical environment and the people of the land before the commencement of the research work is essential for establishing good relationship during the study, hence promoting this theory. The proposed study is based on the indigenous practices that are holistic, as it will encourage socio-economic conditions among the participants in the Akure South Local Government, Nigeria.

2.4.3 Ethnography theory

Ethnography theory explores a set of facts and their relationship to each other. Historically, ethnography involves living and talking to people, observing them in an attempt to understand how people interact with their world (Nader, 2011), while Iloh and Tierney (2014) articulated that ethnography is a theory of description. These sentiments are described different by (McGranahan, 2018), that ethnography is never mere description, rather it is a theory of describing that has always been controversial as to the what and how thus inspiring a dynamic intellectual process.

The current research shares the views of previous relevant researchers that indigenous knowledge and ethnobotany are a set of facts that are interrelated and in order to study them, the researcher must familiarize him/herself with the people, studying them to understand how they relate with their environment, culture, economic and their social aspects. This means the researchers must learn from the community people by observing them and see how things are being done locally. Identify with their ways of life, familiarize herself with the local practices that are used for the cultivation of the indigenous fruits and vegetables.

2.5 The indigenous philosophical underpinnings of the study

2.5.1: African indigenous worldview

African indigenous worldview is a philosophy that has its root in ancient African which has to do with the beliefs and the customs of the elders given to them by the knowledge holders (Mbiti, 2015). The ancient Africans people, the elders believe so much in their ancestors made sacrifices to them for appeasement in times of sorrow and happiness, received directions and guidance from them (Molobela, 2017) .This ranges from scientific to religious and the society as a whole. In the worldview of the society, it is believed that there are certain rules and orders that one need to follow, if those rules are broken, set of punishments are awaiting the offenders. In the light of this the Yoruba people, most especially the elders valued the indigenous values and principles, and they passed these values to the next generation orally. This philosophy is based on their belief system, tradition, respect and reciprocity (Shai, 2019). The elders of the land teach the younger ones the survival skills in times of famine on how to depend on IFV (Mashile et al., 2019). The cultivation of these plants and all the processes that are involved to the processing and the preservation stage are taught with the norms that are attached to them. There is a mutual association among the people of the community where IFV are found because they share the resources together.

2.5.2: African cosmology

This is people's worldview, derived from the Greek word "*Kosmos*" which means world and (logos) which means Knowledge (Udefi, 2012). In literal terms it means the knowledge acquired from the people. African cosmology consists of complex beliefs that deals with the source of nature, the universe structure and the interactions of the individuals with their environments (Ekeke, 2011). This present study has connection with African cosmology because the local communities understudy interacts with nature. The environment is surrounded by work of nature, affect the way they think and do things most especially in the

area of planting, harvesting and utilisation of IFV. This is also tied to their religion, beliefs and the various cultural practices (Holbrook, 2009).

2.5.3 Axiology (Ethics)

Axiology are the core values of African people that focus on moral values. It has to do with respect for one another known as 'Omoluabi' in Yoruba land. African people value respect for one another most especially the elders. The ideology behind this principle is once you are an African you belong to certain community. It expresses the social and mutual benefits derived as an individual from the society (Viriri and Mungwini, 2010). In African setting the community is more important than the individual, so as the researcher will be going into the local communities with the mind of love, care, and respect when carrying out the research work (Chilisa, 2012). It is believed that the survival and purpose of an individual is tied to the community where he/she comes from and is rooted in the life of others (Kanu, 2013). Based on this principle, the researcher will give room for other people's view, basically those that have indigenous knowledge on the cultural practices that are tied to IFV. The means of communication will be in the dialect of the local communities' (the peoples' language which is Yoruba. There will be smooth interaction since the researcher is from the same ethnic group. The ethics values are rooted in four Rs known as respect, reciprocity, relationship and relevance. (Hart, 2010; Lavallée, 2009)

2.5.4 Afrocentricity

Afrocentrism has its root from Egyptian Kemetian philosophy. This is a generation of knowledge that starts with African scholar in order to disabuse the existing research paradigm that is Eurocentric in nature to establish an African-centred paradigm that meet the needs of the African people and bringing solutions to their problems (Dastile, 2013). It is a wholistic paradigm that addresses both the physical and the spiritual aspect of man. It is the worldview on philosophy of African perspective on the reality of life and having African people at the core centre (Asante, 1988; Mkabela, 2005) This current study reveals the indigenous knowledge of the selected communities from an African perspective (Chawane, 2016). This will be achieved by using indigenous methods to stand against Eurocentric research paradigm. Afrocentricity addresses objective 2 of this study in documenting the common knowledge and the indigenous practices of IFV that are found in the various communities (Asante, 1988).

2.5.5 Indigenous Research Methodology

Indigenous methodology is conceptualized as a finding carried out by indigenous community, which is to the benefit of their people, through skilful way of getting things done faster and easily with respect to the local areas and study of the people as the object of research. Paradigmatic method is an indigenous methodology applied to finding, the paradigm changes, the approached choices and methods, ways those methods are applied, and ways the statistic will be interpreted and explained (Kovach, 2010). According to Lavallée (2009) indigenous methodologies identify local community people's global views, experiences and facts as peculiar and fundamental to their survival and existence Likewise, they propounded the use of local information processing and gathering methods recognized, providing in-depth information, and include values, beliefs and indigenous protocols, of indigenous communities.

2.5.6 Epistemological grounding of the study

Epistemology is the approach or way of knowing the reality that exists, particularly when phenomenon is about to be formed, developed or built. In African setting, this is the knowledge you gathered from the society through interaction with nature. It is a way of knowing what to and how to do it (Baloyi and Makobe-Rabothata, 2014). During this study epistemology will be used to investigate how the knowledge of indigenous practices on IFV are acquired and passed on to the next generation in the selected local communities in Akure. This knowledge is usually passed on to the younger generation through observation and imitation, they learn the skill in the process. It can also be in form of folk tales stories at night during moonlight, normally done by the native language (Lombo, 2017). In African setting the indigenous knowledge of food production, processing and preservation are usually passed on verbally and through imitation by the older generation to the younger generation and it differs from one ethnic group to the other (Mazonde, 2001).

2.6 Research approach

The study will employ mixed method approach. Lindsay (2013) indicated that mixed method research is a reliable choice when leading look into on marginalized people as gives them a voice when research is led concerning them, which in impact is empowering them. Tashakkori and Teddlie (2003) highlighted that there are three different approaches applied in a mixed method study: these being concurrent, sequential and conversion. Thus, this study will apply the concurrent transformative approach whereby the researcher will be guided by specific

theories such as Afrocentricity, indigenous paradigms as well as the concurrent collection of both quantitative and qualitative data.

This research will use the qualitative approach. Qualitative approach is construed conduct of investigation which intends to build a comprehensively, hugely an in-depth analysis to inform the researcher's knowledge of norms and social phenomenon. Qualitative finding approach intends at acquiring knowledge of a phenomenon by creating raw information that is not number-based, but raw information data that can be explained in words (Bricki and Green, 2007). Numerical data is generated through qualitative research approach like numerical data on population and household data etc.

2.7 Research design

A research design is the conceptual blueprint within which research is conducted (Akhtar et al., 2016). Research design is applied to arrange the study, show central parts of the research project, the groups or samples, actions procedures and device of project work to try to address the overall research question. Creswell (2013) asserts that the standard for a research design is to design and prepare a finding in a way that the final proof of the investigation is maximized. The latter parts of components of a research design that will be applied are population, sampling techniques, and statistics collection methods and data analysis.

This study employed observational, exploratory-descriptive design to explore and describe utilisation pattern and the economic potential of indigenous fruit and vegetables among rural communities in Akure, Nigeria. This design was used because little research has been done in Akure, Nigeria to explore the diverse uses, knowledge and the economic potential of indigenous fruit and vegetables among local communities. This involve in-depth interview, observation, focus group discussion and thematic analysis was employed to interprete the data collected during the in-depth interview, focus group discussion and the participant observation.

2.8 Study area

Akure South local government area (L.G.A) is in south-western part of Nigeria and is the capital of Ondo state (Figure 2.2.). The city has a population of 665,524 (UN World Urbanization Prospects, 2020) and has an area of 332 km^2. Akure has eleven (11) wards. There are about 320 communities out of which some are predominantly rural, which are Aponmu, gbogi, Isinkan II,

Iilisa, Oda, Irese, Ibule, Isolo, Ologede, Owode, Imuagun. Akure lies about 7°25" North in equator and 75°19" east of the Meridian. It is about 900km south-west of Abuja and 311km North of Lagos State. Akure is an agricultural trade centre for cassava, corn (maize), bananas, rice, palm oil and kernels, okra, rubber, coffee, and various vegetables. Although cocoa is by far the most important local commercial crop, cotton, teak, and palm produce are also cultivated for export. The resident districts are of varying density some of these areas are Arakale, Ayedun Quarter, Ijoka, Oja Oba, Ijapo Estate, Idofin. Akure is situated in the tropical rain forest zone in Nigeria.

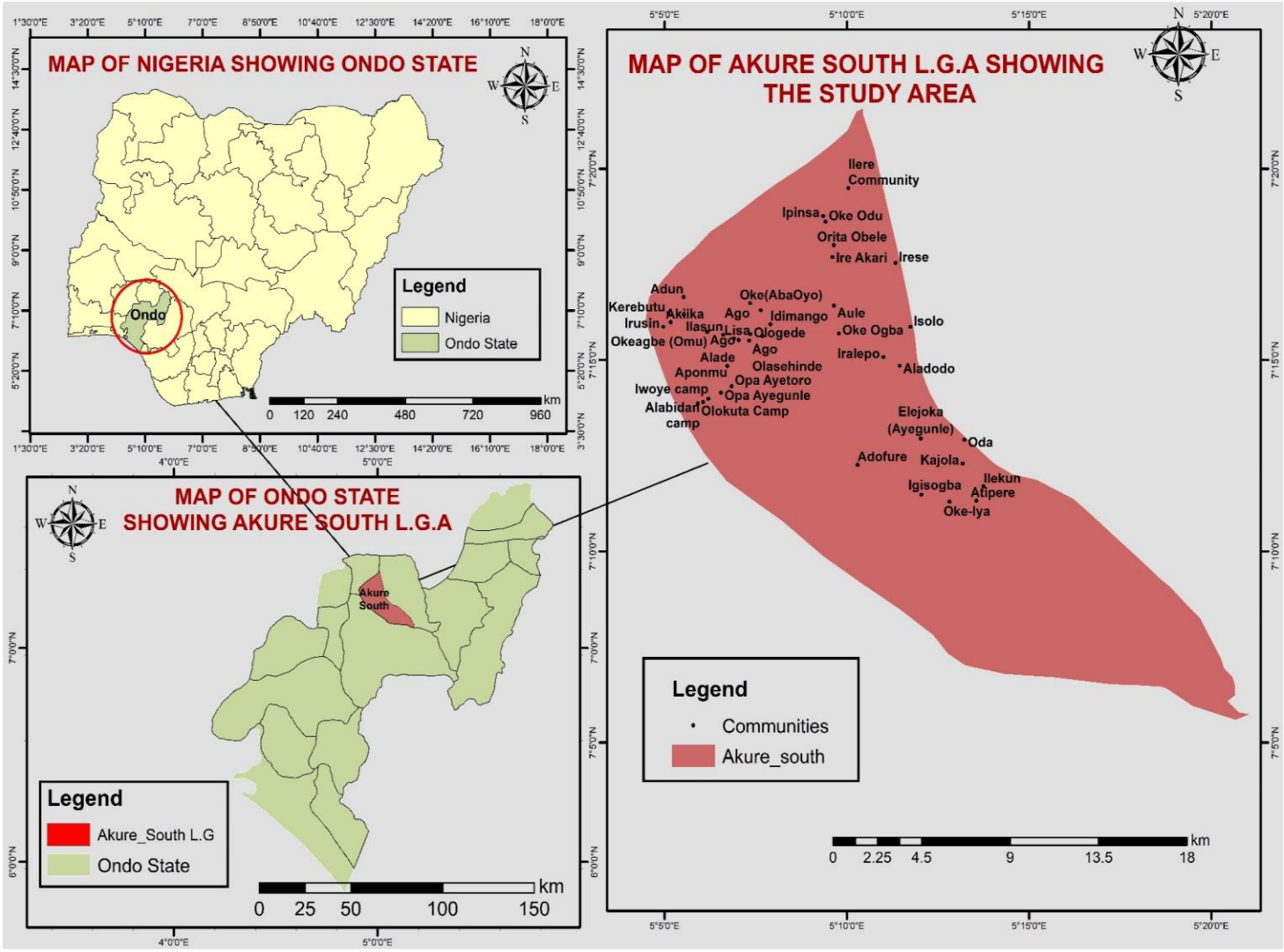


Figure 2.2 Geographical location of the selected communities in Akure South Local Government, Ondo State, Nigeria

2.9 Overview of the study area

Akure is the capital city of Ondo state. It is found in the South-West of Nigeria. The climate of Akure is both hot and humid, usually caused by rain-bearing southwest monsoon winds from the ocean and dry northwest winds from the Sahara Desert. The rainy season is from April to October, with rainfall of about 1524mm per year. Temperatures is between 28 °C to 31 °C with mean annual relative humidity of about 80% (Ajibefun, 2011). The GPS of Akure 7° 15' 0'N 5°11' 42'E. The city has a population of 665,524 people and a land area of 332 km^2 (Buettner, 2015). It is a city that allows freedom of worship, the three major religions are Christianity, Islam and Traditional. There are different churches ranging from the Orthodox to the Pentecostal. The central Mosque is along Oba Adesida Road. The two major rivers in the land are River Owena and River Ala.

According to oral tradition, Akure came into existence through a prince known as Omoremilekun, son of Ekun the grandson of Okanbi and great-grandson of Oduduwa Omoluabi the Yoruba tribe royal progenitor. He was a hunter. The prince decided to have a place as settlement, so he left Ile-Ife his fatherland as he got to a certain place in the city, history recounts that the string that held the royal bead he was wearing as prince broke and the people that were with him shouted out 'Akun re' which means that the beads has broken or "your beads!" and the exact place is now known as Akure. Presently, the title for the paramount ruler of Akure kingdom is called 'Deji of Akure'. The native language of the people of Akure land is 'Yoruba'. The people of Akure are very friendly and welcome other tribes, across the land are other ethnic groups including Ibo, Hausa, and Fulani. The Akure people are known as 'Omo Oloyemekun' which means "Leopard's children", noted as warriors. The major occupation is farming. The land is endowed with rich floral with a wonderful landscape.

Akure is a land noted for peace, everyone enjoys peaceful co-existence. In the modern Akure kingdom, there are two constituent communities that have their own separate chiefs and traditions. The prominent one is Isinkan while the second one is Isolo. They were separate towns in the olden days but were brought together by wars under the nominal control of Akure. The title for the Baale of Isinkan is Iralepo while that of Isolo is known as the Osolo of Isolo. The nearby towns that surround Akure are Isarun, Ilara, Igbara oke, Iju, Itaogbolu, Idanre, Owo, Ikere and Ondo There are two local governments in Akure which are Akure South local government and Akure North local government.

2.9.1 The selected study area

Akure South local government of Ondo State has 320 communities out of which 40 communities were selected for the study based on the availability of these indigenous plants in their natural habitat, rural nature and culture **(Table 2.1).** These communities are listed below.

Table 2.1 The 40 selected local communities used as the study area in Akure South

Community	Description	GPS Coordinate
Aba gold	This is a natural habitat of indigenous fruit and vegetables. Climatic conditions are favourable for the growth of plant. The community is noted for farming activities.	Latitude: 7.26035 N7"1537.206 Longitude: 5. 12811 E5"741.178
Adofure	This is a hot and humid community with good fertile soil that promote crop production.	Latitude:7.20433 N7'12'15.60492" Longitude:5.17158 E 5'10'17.69772"
Adun	A serene, humid and hot environment that favour agricultural practices such as crop production.	Latitude:7. 27739 N7"1638616 Longitude:5.09198 E5"531.116
Ago Alade	Predominant rural area that cherishes culture and tradition. The people of the land place so much value on indigenous plants.	Latitude:7.25928 N7’1533432 Longitude:5.11554 E5’655968
Ago lisa	Predominant rural area that cherishes culture and tradition. The people of the land place so much value on indigenous plants.	Latitude: 7.25939 N7"15153381 Longitude: 5.11504 E5"654.1: 62
Ago Olaseinide	A cool and quiet community with beautiful flora and fauna.	Latitude: 7.25847 N7"1530702 Longitude: 5.12197 E5"719.104

Akiika	Rural area with a natural habital for wild fruit and vegetables.	Latitude:7.26651 N7"1559.478 Longitude:5.08611 E5"510008
Aladodo	A hot and humid environment with good climatic conditions.	Latitude:7.26005 N7"15'34.272 Longitude:5.0749 E5"429.886'
Alapidan	A land dominated by rural people predominantly farmers. A linear settlement with good fertile soil.	Latitude: 7.2317 N7"13"54.162" Longitude: 5.10092 E5'6"3.342"
Aponmu	This is a small village surrounded by forest known as ‘Forest reserve’ natural habitat of indigenous fruit and vegetables. The land is rich in culture and tradition. Climatic conditions are favourable for the growth of plant.	Latitude:7.23934 N7"1421.414" Longitude:5.06457 E 5"352.698"
Atipere	Predominant rural area that cherishes culture and tradition. The people of the land place so much value on indigenous plants.	Latitude:7.18872 N7”11’19.356 Longitude:5.22585 E5”13’33.012
Aule	A hot and humid environment with good climatic conditions.	Latitude: 7.2737 N7'1625506 Longitude: 5.16078 E5"938.814
Elejoka	This is a natural habitat of indigenous fruit and vegetables. The land is rich in culture and tradition. Climatic conditions are favourable for the growth of plant.	Latitude: 7.21579 N7^{o}12'56.84184" Longitude: 5'2004 E 5^{o}12'1.45368"

Faleye camp	Rural area with a natural habitat for wild fruit and vegetables. The climate of the community is favourable	Latitude: 7.27172 N7"1618.174 Longitude: 5.12733 E5"738.4"
Idimango	Predominant rural area that cherishes culture and tradition. The people of the land place so much value on indigenous plants.	Latitude;7,26566 N7'15'56.238 Longitude:5,1317 E 5,1317 E5'7'54.102"
Igisogba	A rural community with a beautiful fauna and flora. Dominated with indigenous fruit and vegetables.	Latitude:7.19133, N 7'11'28.77252" Longitude:5.20075, E5'122.70504"
Ilasun	A rural community with good climatic conditions, fertile soil and good vegetation.	Latitude: 7.26101 N7"1539612 Longitude: 5.11009 E 5"636336
Ilekun	Rural area with a natural habitat for wild fruit and vegetables. The climate of the community is favourable.	Latitude: 7.19493N7’114.442 Longitude:5.22909 E5’13’44.748
Ilere	A community dominated by different tribes. The climate of the place is tropical savannah supported by good fertile soil.	Latitude:7^0 19’ 23” N Longitude: 5^0 10’ 17” E
Ipinsa	A serene community with a beautiful fauna and flora. Dominated with indigenous fruit and vegetables	Latitude: 7^0 20’ 0” N Longitude: 5” 9’ 0” E
Iralepo	A humid and hot environment that favour agricultural practices such as crop production.	Latitude: 7.2513N7"155.046 Longitude: 5.1833 E 5.1059.88

Ire akari	This is a natural habitat of indigenous fruit and vegetables. The land is rich in culture and tradition. Climatic conditions are favourable for the growth of plant.	Latitude: 7.2949 Longitude: 5.1601
Irese	The climate of the place is tropical savannah supported by good fertile soil.	Latitude:7.29247 N7’1732.778’ Longitude:5.19275 E5”11’33.954”
Irusin	A cool and quiet community that promote crop production. The climatic conditions are favourable.	Latitude: 7.26446 N7".1551.63 Longitude: 5.08273 E5"4"57.820
Isolo	A humid and hot environment that favour agricultural practices such as crop production.	Latitude:7.25356 N7”1512792 Longitude: 5.6964 E 5”1147064
Itaoniyan	This is a cool and quiet community. The climatic conditions are favourable	Latitude:7.26979 N7"16"11.244 Longitude:5.09215 E5"5"31.728"
Iwoye camp	A humid and hot environment that favour agricultural practices such as crop production.	Latitude: 7.23317 N7"13"59.406 Longitude: 5.10332 E5"6"11.988"
Kajola	This is a natural habitat of indigenous fruit and vegetables. The land is rich in culture and tradition. Climatic conditions are favourable for the growth of plant.	Latitude: 7.24877 N7"14'55.56" Longitude: 5.06537 E 5"3"55.332"

Kerebutu	A rural community of linear settlement with good climate and good vegetation.	Latitude:7.26852 N7’16’6.102 Longitude:5.0857 E5”5’8.52”
Obele	The climate of the place is tropical savannah supported by good fertile soil.	Latitude: 7.291.73950082 Longitude: 5.16101200054
Oda	A humid and hot environment that favour agricultural practices such as crop production.	Latitude:7.21531 N7”1255.104 Longitude:5.22042 E5”13’13.494
Oke Agbe	A humid and hot environment that favour agricultural practices such as crop production.	Latitude: 7.26224 N7"1544.07 Longitude: 5.10285 E 5"610254”
Oke Ekun	This is a natural habitat of indigenous fruit and vegetables. The land is rich in culture and tradition. Climatic conditions are favourable for the growth of plant.	Latitude:7.27481 N7'1629286' Longitude;51224 E5'720.616
Oke odu	Predominant rural area that cherishes culture and tradition. The people of the land place so much value on indigenous plants.	Latitude: 7.310680 Longitude: 5.156932
Oke ogba	A humid and hot environment that favour agricultural practices such as crop production.	Latitude:7.2616 N7"11541.994 Longitude:5.16304 E5"9.470341
Oke iya	A rural community with a beautiful fauna and flora. Dominated with indigenous fruit and vegetables.	Latitude:7.18832 N7’11’7.96316” Longitude:5.2136 E5’12”148’95208”

Olokuta	The climate of the place is tropical savannah supported by good fertile soil.	Latitude: 7.23101 N 7"13"51618" Longitude: 5.09852 E 5' 54.588
Ologede	A humid and hot environment that favour agricultural practices such as crop production.	Latitude: 7.26136 N71540.908 Longitude: 5.12247 E5'720.892
Opa Ayegunle	A cool and quiet community dominated by dense tree and vegetables. The inhabitant of the land engages in farming.	Latitude: 7.23577N7"14'8.694" Longitude: 5.10908 E5"6"32.742"
Opa Ayetoro	A rural community with a beautiful fauna and flora. Dominated with indigenous fruit and vegetables.	Latitude: 7.23862 N7'1418.17" Longitude: 5.11393 E5'6"501

CHAPTER 3: LITERATURE REVIEW

3.1 Introduction

This is an in-depth literature review that provides an overview of the current information on the utilisation of indigenous fruits and vegetables and the indigenous knowledge systems connected to them.

3.2 Ethnobotany of indigenous fruits and vegetables

Over the years the local people have depended on different plants for their sustenance with little or no documentation of their traditional uses (Pitso and Lebese, 2014). According to Van Wyk (2015), biological properties of plant extracts and compounds are of great interest in Ethno-pharmacology. Indigenous fruits and vegetables (IFV) are in abundance and readily available to the local people (Awodoyin et al., 2015) and the indigenous knowledge of their utilisation as major sources of health and nutrition for the local people has been known for decades (Vinceti et al., 2015). The type of IFV found in one locality differs from one another due to socio economic and cultural belief of the society. Indigenous knowledge on the utilization of IFV's have their own peculiarity to each community and is made known to the next generation verbally (De Beer and Van Wyk, 2011). They are sources of food and income to the indigenous people (Awodoyin et al., 2015) and enhance the livelihood of the local people in the community most especially the women (Shackleton et al., 2000).

3.3 Indigenous knowledge systems

According to Abah et al. (2015), indigenous knowledge is based on the experience, often tested over centuries of use, adapted to local culture and environment, dynamic and changing. Indigenous knowledge systems refer to experience of people in the community which have grown to become their lifestyles. They also connote trans generational practices that metamorphosed from trial and error and factually flexible to adapt to change (Eyong, 2007). Similarly, Warren (1991) conceptualises Indigenous Knowledge System to be localised knowledge systems unique to a particular society or ethnic group, in contrast to the international knowledge systems generated through global networks of universities and research centre. Indigenous Knowledge is the systematic body of knowledge acquired by local people through accumulation of formal and informal experiences, as well as intimate understanding of the environment in each culture. People have an intimate knowledge of many

aspects of their surroundings and their daily lives and pass this indigenous knowledge from generation to generation usually by word of mouth

3.4 Indigenous Knowledge Systems and Way of Life

Many authorities like Abah et al. (2015) and Senanayake (2006) opined that Indigenous Knowledge is a special knowledge adopted by a distinct society, culture or assimilated by local people as a result of experiences gathered by same, informal practices, and immediate study of the milieu of such given culture. It should be noted that, the intervention of the cultural and the traditional food systems particularly among the people in a community for promotion of their nutrition and food security are not largely written down as mentioned before. Briones (2015) asserts that choice of food of a given society is influenced by culture through established rules and accepted practices, which influence whether people would accept or reject foods.

Furthermore, Briones (2015) reported that the food production systems is also influenced by culture, and that culture similarly plays roles in determining preparation of food and procedures for distribution of intra-household food. All these have necessary impacts on the status of food and nutrition security in the household. In addition, people in a community are seen as the preservers of traditional experience. Therefore, traditional and cultural food systems flow down from former generations and becomes a standard for the use of natural resources and their preservation causing the growth of the community. The traditional foods of indigenous people in Nigeria stand for their cultural pride and agricultural biodiversity which influences their daily healthy and robust diet

3.5 Indigenous knowledge systems and food security

Food security remain a vital issue globally (Deng et al., 2014). The world food summit (1996) defines food security as a situation where people of all climes have unfettered economic, social and physical access to needed and nutritious food that supply dietary needs and food choices for a functional and healthy life (Bhaskara, 1997). Currently, the concept of food security is generally understood to incorporate four main components availability, accessibility, utilization and stability. For a state of food security to exist, all these components must be sufficiently present. Despite the increasing efforts aimed at enhancing quality and abundant food supply, food insecurity remains a major problem especially in Africa (Akerele et al., 2013). The importance of Indigenous Knowledge on enhancement of food sustenance in Africa has been recognised in recent times. Recent finding has shown the significance of how

indigenous people make use of their own culturally created knowledge for the advancement of their daily activities.

Indigenous knowledge systems (IKS) have been used in the past to help ensure household food security, especially in rural communities. According to Kamwendo and Kamwendo (2014), a restricted statistics of research findings have explored the extent to which IKS can contribute to the achievement of food security. The use of indigenous foods, especially fruits and vegetables which were initially primary sources of food in many societies, has been marginalised in favour of exotic vegetables (Bvenura and Afolayan, 2015). Food security issues have become the concern of local, national, as well as international governments.

3.6 Indigenous fruits and vegetables

In Sub-Saharan Africa, indigenous fruit plants are nutritional to health and source of income to various local groups, especially at the period of prevalent environmental insecurity. At the rainy season when produces not yet ripe for harvesting and when conserved produce have declined. By illustration, the baobab is available in Africa at reduced altitudes and at the farming times. The fruits serve as main channel of vitamins and minerals but underutilised several times.

According to Kermali et al. (1997) industrial and health sector always depend on plant species to advance their course, about 80 000 species of plant are known to produce food and fibre. Similarly, Kunkel (1984) documented that about 10000 varieties of plants are known as edible plants. The necessity for food and growing demand for food is driven up by high growth in the global population for the past 20 years. The distinct propensity in horticulture and agriculture practices is initiated by increased in world's population and increased the rate at which crop diversity is lost. It is conspicuous that diversity problem caused by concentration on fewer crops can have adverse implications on the health of man, which could lead to health deficiency and malnutrition-related diseases.

3.6.1 Importance of indigenous fruits and vegetables

Given that fruits and vegetables are robust in nutrients and health-enhancing chains with precaution against malnutrition and some deadly diseases, they are robust enough to improve diet and wellness in local communities of the world. Hence, there is need to diversify the value chain of fruits and vegetables to improve overall health and human nutrition. Fruits and vegetables are inherently valuable to local nutrition; they also could enhance diet diversity on a regional level.

Most indigenous fruit trees generally grow wild. The fruits are harvested and eaten at home, sold at the market or processed into jams and juices to add additional value. But many fruit trees are used for more than just their fruits. Trees grown on the homestead provide important shade for crops. Leaves may be used for fodder or as compost. Leaves, fruits and other tree parts may also be used for medicinal purposes. Bark is often used for fibre and the timber for furniture, house-building poles, fences or other construction.

3.7 Potentials of indigenous fruits and vegetables

3.7.1 Nutritional values

The nutritional value of indigenous fruits and vegetables are very high; they contribute to the nutrient requirements of man in combating malnutrition. They add variety to the diets of the poor populace in the community. With reference to food security and nutrition they improve palatability. Indigenous fruits and vegetables are highly nutritious. They contain carbohydrates, proteins, fats, fibres, vitamins, minerals and organic acids which are the requirements for healthy life of any human as nutrition is concerned (Stadlmayr et al., 2013). The vitamins found in indigenous fruits and vegetables are vitamin A, vitamin B complex (B1, B2, B3, B5 and B9), vitamin C, vitamin D, vitamin E and vitamin K which have their various functions in the body.

They protect the body against diseases (Bvenura and Sivakumar, 2017). They have high amounts of minerals such as calcium, magnesium, sodium, phosphorus, iron, potassium, cupper, and zinc which also protect the body against diseases. The common organic acids present in them are acetic, malic, tartaric, oxalic, lactic and citric which role is significant to the blood regulation system of man. In addition, dietary fibres such as cellulose, lignin, and pectin found in the indigenous fruits and vegetables also build the body immunity against any diseases (Slavin and Lloyd, 2012). Amino acids are also in abundance in indigenous fruits and vegetables, which helps in building up the body tissues, and repair worn out tissues. Some of these amino acids are aspartic, proline, glycine, cystine and glutamic (Stadlmayr et al., 2013). There is low yield of calories and fat from Indigenous fruits and vegetables.

3.7.2 Health benefits

The medicinal properties present in indigenous fruits and vegetables have contributed a lot to the medical world and they are of great health benefits. Van den Heever and Venter (2006) reported that Spider plant (*Cleomegynandra)*, controls constipation and enhances child birth, while there is evidence for African nightshade (*Solanum scabrum)* that it cures stomach ache (Adesina and Gbile, 1984). Recent research has also documented those indigenous fruits and

vegetables have curing ability for ailments such as cancer, inflammations, digestive tracts disorders, diabetes and cardiovascular diseases due to their antioxidant's components. Table 3.1 shows the health benefits of some IFVs.

3.7.3 Value addition

The practice of value addition to fruits is one of the hidden buffers that are yet to be explored in indigenous fruits and vegetables in the local communities. A plausible way of storing is by converting fruits into jam and juice, retaining and nurturing them for their benefits. The local communities can also benefit from them offering the indigenous people empowering opportunities hence enhanced livelihood. The vitamins and minerals found in these fruits can also be stored for a longer period. Value addition to unprocessed fruits connotes that profit can be made by local farmers. Joshi et al. (2018) reported that *Hippophae* spp., *Rhododendron arboretum* and *Prunus armeniaca* are being processed to value added products, like squash and other beverages at the commercial level in the rural community of Himalaya, India. However, they must be processed in such a way as to retain the nutrients which are beneficial to the consumers.

3.7.4 Income generation

Surveys of socio-economic group in various parts of Nigeria showed that indigenous vegetables and fruits create opportunities for employment and serve as income generation for the rural population. Akinnifesi et al. (2007) reported that the trading of indigenous fruits and vegetables is a profitable enterprise in the local community among the indigenous people for example egg plants leaves are consumed widely in Akure which serves as source of income for some family. African Star Apple, Hog plum and Tamarind have been documented in the production of jam, jelly and fruit juices Aina (1991) creating job opportunities for the youth. This, however, will not be possible if the knowledge about the IFVs is lost and the younger generations are not encouraged to consume them.

3.8 Over view of Indigenous fruit and vegetables in the rural community of the world

The ethnobotanical survey of the diverse uses of edible wild plants in the rural community of Himalaya, Utarrahand, India revealed that most of these indigenous plants are utilized or consumed as either food or for their medicinal values by the rural people. Notable among these wild edible plants which have received worldwide attention are *Hippophae rhamnoides* L. because of its medicinal and nutritional values, *Hippophae salicifolia* D. Don. edible and very rich in Vitamins A, B, C, K and E, add nitrogen to the soil advantage for high productivity.

The fruit of Myrica esculenta Buch. -Ham. ex D. Don areprocessed to health benefit beverage and sold in the local government to generate income, improving livelihood. While *Diploknema butyracea* (Roxb.) H.J. Lam is recognized for its edible fruit, oil producing seed used for cooking purpose, the leaves and wood used as fodder and fuel (Joshi et al., 2018).

3.9 Overview of Indigenous fruit and vegetables in Africa

Africa has an abundance of diversity of native and naturalized plant species which are used as food by rural communities. Most of these species used as vegetables are obtained from fruits, seeds, stems, flowers, roots and tubers (Maundu et al., 2009). Omotayo et al. (2020) recorded an inventory of 31 indigenous and naturalized plants among 12 communities in the Northwest Province of South Africa. The reported species that were mostly used were *Sorghum bicolor, Vigna unguiculata, Amaranthus* sp., *Sclerocarya birrea, Persea americana, and Mimusops zeyheri* as foods, fruits, beverages and fodder. Among the Mapulana people in Mpumalanga Province (South Africa), 52 indigenous fruits from 26 families which are mostly shrubs and trees were identified for product development purposes (Mashile et al., 2019). The most popular species used were *Ximenia caffra, Carissa edulis, Ficus sur, Sclerocarya birrea* and *Vangueria infausta*.

In Zimbabwe, 67 edible wild plant species comprised of fruit trees and vegetables belonging to 30 families were recorded. The findings from the study revealed that majority of the plant species had diverse uses which can be used for food, medicine and construction purposes. The multipurpose plants identified were *Parinari curatellifolia* and *Sclerocarya birrea* (Maroyi, 2011). In addition, the vegetables (e.g., *Amaranthus hybridus, Chenopodium album, Cleome gynandra, Corchorus asplenifolius, Cucumis anguria*, and *Solanum nigrum*) were recorded as weeds found on farms, abandoned places and, river side. the local community integrate them as part of their daily diets. Local people use plants that are available as food (Della et al., 2006). Maundu et al. (2009) also asserted that many plants classified as vegetable are used by the local communities in respect to their cultural diversity is a primary force of vegetable diversity which is also valid at the continental level. In Uganda, Tororo district, Eilu et al. (2007) reported 87 indigenous plant species from 37 families used for firewood, medicine, construction, food, pest control and cultural purposes.

3.10 Overview of Indigenous fruit and vegetables in West Africa

Dansi et al. (2008) reported the ethnobotanical survey conducted in the Republic of Benin to assess the diversity and uses of traditional leafy vegetables in 73 villages. 187 plant species

belonging to 141 genera and 52 families were studied. Leafy plant of highest importance recorded was *Solanum macrocarpon, Corchorus olitorius, Amaranthus cruentus* and *Gymnanthemum amygdalinum.* The five most important families were Asteraceae (19 species) Cucurbitaceae (13 species), Amaranthaceae (12 species), Leguminosae (9 species) and Solanaceae (9 species). The findings revealed that majority of the rural people depend on the leafy vegetables gathered from the wild (74.87%) for nutritional and health. Another ethnobotanical survey conducted in Benin republic on the diversity and patterns of use, the implication for domestication and utilization of traditional vegetables by Achigan-Dako et al. (2011) reported 245 species and 62 families were used as vegetables. The commonly consumed traditional vegetables were *Ceratotheca sesamoides, Crassocephalum crepidioides* (Benth.) S. Moore, *Crassocephalum rubens, Corchorus tridens, Justicia tenella* (Ness) T, *Talinum triangulare, Starchytarpheta indica, Alternanthera sessilis* (L.) R. Br. Ex Roth, *Struchium sparganophorum* (L.) *Kuntze, Cleome gynandra, Crassocephalum crepidioides, Crassocephalum rubens,* and *Launaea taxaxacifolia.* Amaranthaceae, Asteraceae, Cucurbitaceae, and Leguminoseae were the commonly used and majority are from the wild (80%) this also confirmed the abundance of leafy vegetable for consumption in Benin (Achigan-Dako et al., 2011).

3.11 Overview of Indigenous fruit and vegetables in Southwest of Nigeria

The inventory of useful plants taken in Yoruba Southwest for diverse uses recorded 493 species from 99 families. The family of Fabaceae were the most cited and recognized as the highest number of useful plants having 72 species in those categories, next to it was Euphorbiaceae (32 species), Malvaceae (30 species), and Asteraceae (25 species) (Ajao et al., 2021). Furthermore, Ajao et al. (2021) also reported that most of the plants are used for medicine, food, clothing(*Gossypium barbendense*), construction (the trunks of *Cocos nucifera* and *Elaeis guineensis* for roofing), building, games, fuel (Kernel oil a byproduct from *Elaies guineense* known as 'oguso' useful in making wood to burn effectively) instructional materials (*Chrysophyllum albidium* seeds used in elementary mathematics), paint (*Mucuna pruriens* roots soaked in water is used for blackboard darkening in schools) and for preservation (*Theobroma cacao* dried leaves are used for *Cola spp*. preservation during transportation).

Furthermore, the findings of Adebooye et al. (2003) recorded twenty-four leafy vegetables that are indigenous consumed in the southwest of Nigeria. Some of these indigenous vegetables are: *Curcubita pepo, Solanum nigrum, Veronia omygdalina, Solanecio biafrae, Crassocephalum crepidioides, Telfairia occidentalis* f. Hook, *Celosia argentea* L., *Amaranthus*

cruentus, Solanum macrocarpon L *and Amaranthus viridis.* The study carried out by Oladele (2011) in Oyo state, Nigeria, on the contribution of indigenous vegetables and fruits to poverty alleviation revealed that mushroom (92%), *Ocimum grattissium* (88%) and Bush mango (80%) were the most common in that locality. He also reported that mushroom (80%) was widely used as food while *Momodica charantia* (50%) was the most used plant for medicine.

Table 3.1: Examples of indigenous fruits and vegetables occurring in Nigeria

S/N	Botanical Name	Family	*Vernacular name	Plant parts used	Usage	References
1.	*Artocarpus communis* (Parkinson ex F.A. Zorn) Fosberg	Moraceae	Breadfruit (E), Berefuutu (Y)	Fruit, leaves, stems, seeds and	Food, medicine (cure hypertension, diabetes, malaria, fever, diarrhoea arthritis).	(Ajao et al., 2021)
2.	*Blighia sapida* K.D. Koenig	Sapindaceae	Ackee (E), Ishin (Y)	Fruit, bark, seeds and root	Food, medicine (cure espilepsy, laxative, fever, malaria, dysentery, constipation) seed and capsules for soap making.	(Obata and Aigbokan, 2012)
3.	*Citrus aurantifolia* L.	Rutaceae	Lime (E), Oronbo were (Y)	Fruit	Improves digestion, lower blood sugar, liver cleanser, boost immunity, cure cancer, diabetes, hypertension, protect the heart.	(Obata and Aigbokan, 2012; Soladoye et al., 2012)
4.	*Citrus aurantium* L.	Rutaceae	Orange (E), Ganinganin (Y)	Fruit, bark and seed	Cure indigestion, cancer, headache, sleeplessness, constipation, stimulant, ease anxiety.	(Jyotsna and Saonere, 2011)

5.	*Cocos nucifera* L.	Arecaceae	Coconut (E), Agbon (Y)	Fruit and seed	Food, medicine (cure diarrhoea, diabetes, cholera, promote weight loss, promote healthy bone).	(Adeniran and Falemu, 2017; Ariwaodo et al., 2012; Soladoye et al., 2010)
6.	*Chrysophyllum albidum* G. Don	Sapotaceae	Africa star apple(E), Agbalumo (Y)	Fruit, bark and root	Food, medicine (cure yellow fever, fibroids, malaria, anaemia, boost immunity, aid digestion, strengthen the bone).	(Soladoye et al., 2010)
7.	*Dialium guineense* Willd	Leguminosae	Black velvet tamarind (E), Awin (Y)	Fruit	Food, medicine (treatment of cough, toothache, used to prevent abortion of pregnancy, cure stomach ache, diarrhoea, hypertension).	(Ajao et al., 2021; Besong et al., 2016)
8.	*Elaeis guineensis* Jacq	Asteraceae	Oil palm (E), Eyin (Y)	Fruit, seed and oil	Food, medicine (cure headache, pains, rheumatism, gonorrhoea, cancer, measles diabetes laxative agent, aid lactation, anaemia)’	(Obata and Aigbokan, 2012; Soladoye et al., 2012)
9.	*Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill.	Irvingiaceae	Bush mango (E), Oro (Y)	Fruit, bark, seeds and root	Food, medicine (treatment for dysentery, toothache, diabetes,	(Ariwaodo et al., 2012; Ngondi et al., 2005; Obata

					regulate blood sugar, protect the heart).	and Aigbokan, 2012)
10	*Irvingia wombolu* Vermoesen	Irvingiaceae	Bitter bush mango (E), Oro (Y)	Fruit and bark	Cure diarrhoea, scabies, toothache, yellow fever, pains, wounds, diabetes.	(Asaah et al., 2003)
11	*Parkia biglobosa* (Jacq.) G. Don	Leguminosae	Locust beans (E), Iru (Y)	Fruit and seeds	Food, medicine (prevent stroke, aid digestion, improve blood sugar levels, promotes good eye sight, cure cough, diarrhoea, hypertension).	(Ajao et al., 2021)
12	*Plukenetia conophora* Müll.Arg.	Euphorbiaceae	Walnut (E), Awusa (Y)	Fruit, seed and root	Food (the leaves are edible), medicine (cancer, diabetes, reduce excess weight, antidote for snake bite, indigestion, constipation, hiccupps, promote good eye sight), soap making and soup.	(Suara et al., 2016)
13.	*Solanum indicum* L.	Solanaceae	African eggplant (E), Ajegun Were(Y)	Fruit	Food, medicine (treatment for wound infection, toothache, fever, tuberculosis, cough, sore throat, indigestion, asthma).	(Ajao et al., 2021)

14.	*Solanum aethiopicum* Jacq.	Solanaceae	Garden egg (E), Igba (Y)	Fruit	Food, medicine (treatment for diabetes, asthma, dysentery, helps with digestion, prevent cancer, healthy bone, control blood sugar, weight reduction).	(Gürbüz et al., 2018)
15.	*Spondias mombin* L.	Anacardiaceae	Hog plum (E), Iyeye (Y)	Fruit	Food, medicine (cure stomach ache, diarrhoea, dysentery, gonorrhoea, inflammation).	(Ajao et al., 2021; Innih et al., 2020)
16.	*Theobroma cacao* L.	Malvaceae	Cocoa (E), Koko (Y)	Fruit, bark, seed	Food, medicine (lower blood pressure, prevent anaemia, diarrhoea, leprosy, prevent heart attack).	(Adeniran and Falemu, 2017)

Indigenous vegetables

	Botanical Name	Family	Vernacular Name	Plant Parts	Usage	References
1.	*Ageratum conyzoides* Hieron.	Asteraceae	Billy goat weed (E), Imiesu (Y)	Fruit, leaves, seeds and root	Root used for the treatment of tumor and boil, wound healing herbs, cure pneumonia, fever, rheumatism headache, constipation, typhoid diarrhoea.	(Ajao et al., 2021; Obata and Aigbokan, 2012)

2.	*Amaranthus hybridus* Vell	Amaranthaceae	Africa spinach (E), Tete (Y)	Leaves and stems	Food, medicine (aid digestion, improve eyesight, prevent constipation, promote healthy bone).	(Nana et al., 2012)
3.	*Amaranthus spinosus* L	Amaranthaceae	Spiny amaranthus (E), Teteelegun (Y)	Fruit, leaves and stem	Treat dysentery, fever, malaria.	(Obata and Aigbokan, 2012)
4.	*Amaranthus viridis* All	Amaranthaceae	Green amaranth (E), Teteabalaye (Y)	Leaves and stems	Food, medicine (treatment for fever, pain, dysentery, diabetes, asthma, correct eye defect).	(Obata and Aigbokan, 2012)
5.	*Andrographis paniculate* (Burm.f.) Nees	Acanthaceae	King of bitter (E), Mejemeje (Y)	Leaves, stems and root	Used as tea, cure cancer, heart attack, ulcer, leprosy, dysentery, malaria, diarrhoea, fever, gonorrhea, scabies, flu, anaemia, hypertension, cold, cough, headache, diabetes, lower high blood pressure.	(Bhan et al., 2006; Md. Sanower Hossain. et al., 2014)
6.	*Basella alba* L.	Basellaceae	Malabarspinach (E), Amunututu (Y)	Leaves and stems	Food, medicine (boost libido, blood wound healing plant, cure ulcer, dysentery, cancer, diabetes, anaemia, diarrhoea, laxative agent,	(Deshmukh and Gaikwad., 2014)

					treat boil and sores, conjunctivitis, hasten quick delivery).	
7.	*Boerhavia diffusa* L.	Nyctaginaceae	Hog weed (E), Eemo/Olowojeja (Y)	Leaves and stems	Pain reliever, prevent cancer, jaundice, epilepsy, reduce blood sugar, renew the body, treatment of indigestion, regulate blood sugar.	(Soladoye et al., 2010)
8.	*Bryophyllum pinnatum (*Lam.) Oken	Crassulaceae	Miracle leave (E), Abamoda (Y)	Leaves and roots	Treatment for convulsion, measles, polio, headache, cough, rheumatism, asthma, body pains, diabetes, arthritis, used for detachment of umbilicus of infants, the root of the plant to treat high blood pressure, leaf for fever and the juice of the plant to treat stomach ache.	(Obata and Aigbokan, 2012)
9.	*Ceiba pentandra* (L.) Gaertn.	Malvaceae	Baobao (E), Eegungun (Y)	Leaves and seeds	Food, medicine (treat headache, diabetes, pain reliever, tumour, cancer, dysentery, diarrhoea, ulcer, leprosy, dizziness, hypertension, fever, skin infection).	(Bello et al., 2018)

10.	*Chromolaena odorata* L.	Asteraceae	Siam weed (E), Akintola (Y)	Leaves and roots	Treat wounds, burns, skin infection, cut, diabetes, cancer, infertility, ulcer, decrease in manhood, lower blood pressure, reduction of big tummy, decrease cholesterol.	(Ajao et al., 2021)
11.	*Cnidoscolus aconitifolius* (Mill.) I.M. Johnst.	Euphorbiaceae	Chaya (E), Iyanapaja (Y)	Leaves and stem	Food, medicine (treat diabetes, venerable diseases, scorpion sting, fever, strengthen fingernails, darken grey hair, improve brain function and memory, increase blood flow, reduce high blood pressure).	(Oikpefan et al., 2019; Silalahim, 2021)
12.	*Crassocephalum rubens* (Juss. ex Jacq.) S'more	Asteraceae	Coriander (E), Ebolo (Y)	Leaves, stem and seed	Food, medicine (treat diabetes, cold, stomach ache, fever, laxative effect after child birth, leaf sap applied to sore eyes, ear ache).	(Adjatin et al., 2013)
13.	*Celosia argentea* L.	Amaranthaceae	Lagos spinach (E), Shokoyokoto (Y)	Leaves and stems	Food, medicine (improve eye sight, ulcer, stop purging, increase blood flow, cure cold, arthritis, diabetes, gonorrhoea, eczema, rheumatism, antidote for snake bite, improve fertility).	(Priya et al., 2004; Soladoye et al., 2010)

14.	*Clerodendrum volubile* P. Beauv.	Lamiaceae	White butter fly (E), Dagba(eweata) (Y)	Leaves and roots	Treat arthritis, diabetes, rheumatism, oedema, hypertension, cleansing of bowel, prepare for women after child birth.	(Ajao et al., 2021; Ajao et al., 2018; Soladoye et al., 2010)
15.	*Corchorus olitorius* f. grandifolius De Wild.	Malvaceae	Jute leaves (E), Ewedu (Y)	Leaves and roots	Food, medicine (treat pain, piles, tumours, fever, gonorrhoea, typhoid, ulcer, malaria, infertility, immune booster).	(Ayoola et al., 2010; Okunlola et al., 2017)
16.	*Eclipta prostrata* Lour.	Asteraceae	False daisy (E), Abikole (Y)	Leaves and stem	Treatment for skin diseases, hair loss, snake bites and scorpion, anaemia, eczema, catarrh, cancer, pimples, wound, cut and sores.	(Feng et al., 2019)
17.	*Gossypium barbadense* L.	Malvaceae	Cotton seed (E), Owu (Y)	Fruit, and seed	Food, medicine (treat diarrhoea, fever, headache, increase lactation, use after birth to expel the placenta).	(Ajao et al., 2021)
18.	*Hibiscus asper* Hook.f.	Malvaceae	Hibiscus (E), Isapa (Y)	Leaves, seed, bark, root and flower	Food, medicine (root and the bark used to treat difficult or irregular menstruation, leaves for blood pressure treatment, treat itching), making clothes and pillow.	(Olivia et al., 2021)

19.	*Launaea taraxacifolia* (Willd.) Amin ex C. Jeffrey	Asteraceae	Wild lettuce (E), Yanrin (Y)	Leaves and stem	Treat vomiting, teeth pain, diabetes, decoction of the leaves is used to treat wounds. The boiled leaves are applied to the head of a newly born baby.	(Michael Buenor Adinortey et al., 2018)
20.	*Manihot utilissima* Pohl	Euphorbiaceae	Cassava leaves (E), Ege (Y)	Leaves	Food, medicine (treat mild fever, diarrhoea, constipation, dysentery and wounds).	(Awoyinka et al., 1995)
21.	*Mucuna pruriens* (L.) DC.	Leguminosae	Mucuna leaves (E), Esisi/Iwerepe (Y)	Leaves and root	Used as blood tonic, sperm motility, treat bone fracture, cough, dog bite, madness, ringworm, scorpion and snake bite.	(Kavitha and Thangamani, 2014)
22.	*Ocimum gratissimum* L.	Lamiaceae	Scent leaves (E), Efirin (Y)	Leaves, seeds and root	Food, medicine (used as blood tonic, cure diarrhoea, headache, fever, malaria, stomach ache, promote good eye sight, aid digestion, lower blood sugar, stop vomiting and dysentery).	(Ugbogu et al., 2021)
23.	*Sida acuta* Burm.f.	Malvaceae	Wire weed (E), Iseketu (Y)	Leaves, stem and root	Treat urinary disease, headache, tuberculosis, asthma, diabetes, fever, infertility, weight loss, ulcer,	(Obata and Aigbokan, 2012;

					tuberculosis, rheumatism and used to stop bleeding. The root used as blood tonic while the bark is to cure measles and abdominal pain.	Soladoye et al., 2012)
24.	*Solanum erianthum* D. Don	Solanaceae	Big eggplant (E), EwuroIjebu (Y)	Leaves, stem and root	Food, medicine (heated leaves applied to the head to cure headache, root decoction treat dysentery, fever, diarrhoea, arthritis).	(Ajao et al., 2021; Gbadamosi and Oloyede, 2014)
25.	*Solanum macrocarpon* Pav. ex Dunal	Solanaceae	Africa eggplant (E), Igbagba (Y)	Leaves, stem, bark and root	Food, medicine (teeth cleanser, cure worms in the stomach, asthma, laxative, healing of wound).	(Kadiri and Olawoye, 2015)
26.	*Solanum nigrum* Acerbi ex Dunal	Solanaceae	Black nightshade (E), Efoodu (Y)	Leaves, stem, and whole plant	Food, medicine (treat pneumonia, aching teeth, stomach ache, pain reliever, fever, tumour, dysentery, tuberculosis, whooping cough and the leaves to treat mouth ulcer).	(Adeniran and Falemu, 2017; Obata and Aigbokan, 2012)
27.	*Senecio biafra*e Oliv. & Hiern	Asteraceae	Bologi (E), Woorowo (Y)	Leaves and stem	Food, medicine (treat infertility in female, blood booster, diabetes, sore eyes, cough, rheumatism, stop bleeding from cut).	(Adebooye and Opabode, 2004; Lienou et al., 2015)

28.	*Talinum triangulare* Jacq.) Willd.	Talinaceae	Waterleaf (E), Gbure (Y)	Leaves and stem	Food, medicine (treatment for scabies, fresh cut, ulcer, blood tonic, lower high blood pressure, anaemia, laxative and aid digestion).	(Obata and Aigbokan, 2012; Soladoye et al., 2010)
29.	*Vernonia adoensis* var. adoensis	Asteraceae	Bitter leaf (E), Ewuroodo (Y)	Leaves, stem and whole plant	Food, medicine (treat veneral diseases, gonorrhoea, tuberculosis, stomach ache), the root is used as chewing stick.	(Mozirandi et al., 2019)
30.	*Vernonia amygdalina* Del.	Asteraceae	Bitter leaf (E), Ewuro (Y)	Leaves and stem	Food, medicine (treat fever, malaria, diarrhoea, dysentery, hepatitis, cough, fertility inducer, head ache, stomach ache, diabetes, hypertension, reduce weight, lower high blood pressure).	(Ijeh and Ejike, 2011; Toyang and Verpoorte, 2013)

3.12 Concept of Livelihood

A livelihood depicts a way of getting a living. It cuts across the strength of the people, their wealth and financial health to procure essential requirements of life. Livelihood accepts different definitions depending on the perceptions of people. Chambers and Conway (1992) defines it as encompassing people, their what they are capable of and their source of living, food, financial health, Asset is defined as concrete (natural and physical resources) and in concrete things (social resources including claims and access). According to Mendez et al. (2005) largely in rainy parts of Africa, the local food systems of indigenous people are enriched in agricultural biodiversity which significantly and daily supply food needs and secure livelihoods for the people). Ezeomah and Farag (2016) also reported that third world countries have conservation of greatest biodiversity in local area environments. These communities are endowed with resources and there is large reliance on these resources for diet and livelihood. Therefore, a traditional food system should be construed to enhance sustainable means of advancing food security and nutrition in third world countries.

Over the years, indigenous fruits and vegetables have remained vital providing livelihood of the rural populace. (Omotayo and Aremu, 2020), reported that indigenous fruits and vegetables create species of contributions to livelihood and profit both the smallholder and commercial farmers depending on the locality. Some of these fruits and vegetables products are both sold in the rural and urban market and is a means of providing substantial income to the small-scale farmers thereby improving their livelihood. Existing studies revealed that indigenous fruits and vegetables are profitable enterprise Bennett (2006) reported that currently, those employed in gathering *Schinziophyton rautanenii* fruits are around about 200,000 people marketing the varieties and its products have yielded around US $20 million in Southern Africa thereby improving the livelihood of the indigenous people.

The seed oil obtained from *Schinziophyton rautanenii* has a value chain in lubricants, soaps; personal cosmetics care products and health products (Zimba et al., 2005). They are also used in ailment treatments such as treating of hair dandruff, muscle spasm, varicose veins and wounds. In Sudan, women and children earn a significant income from collecting and selling wild fruits. All these enterprises impact the local areas positively and add up to domestic economy and livelihood.

3.13 Indigenous knowledge systems and agriculture

Agriculture is the mainstay of the economy of any nation FAO (1995). The wealth of any nation is tied or linked with her agricultural production in terms of food production. From time immemorial, indigenous people have employed agriculture based indigenous knowledge in producing different types of crops. According to Nakhauka (2009) agricultural diversity is the foremost in the food chain evolved and protected universally by the indigenous people which enhance food sustenance in the universe. It is the greatest story of human development to be able to make food available for her sever-increasing population. The basic of human advancement is the diversity of the wild species utilization (Jessica Fanzo. et al., 2013).

In the ancient times the ancestors known as the wanderers move from one place to another in search of food and shelter. They metamorphosed from gathering of wild plants which gave birth to agriculture through domestication of the wild species. The interactions between the ancient and the domesticated plants led to the diversity of crops we have today (Jessica Fanzo. et al., 2013). Hence, there is relationship between indigenous knowledge systems and agriculture. The knowledge gathered over the years on agricultural practices is passed down to the next generation orally to preserved the heritage (Mashile et al., 2019). Wild plants utilisation among the local communities have been part of indigenous systems and practices that have started in generation past and which have played a major role in decision making in rural agriculture, food production, health of the people and management of natural resources (DeWalt, 1994). Fruit and vegetable are one of the mainstreams of the world agriculture production according to the statistics revealed in 1991 by the FAO.

Indigenous agricultural practices used by local people depend on traditional knowledge, which is common in agricultural systems to conserve ecosystems and biodiversity, as well as to ensure sustainable food and human health (Sharma et al., 2020). Indigenous agricultural practices were based on years of experience, and in depth knowledge of their environments (Abioye et al., 2011). Most of the indigenous methods are not costly, readily acceptable, very economically, and also enhance nutrients level (Okoye and Oni, 2017). The factors that affect application of indigenous practices among the indigenous people are soil fertility management, weeding, pest control, seed storage, soil preparation, harvest processing, and storage (Ndwandwe, 2013). In addition, Okoye and Oni (2017) opined that indigenous people have their own practices and technology for storing, processing, and preservation of food which have been developed over the years.

The local people in Nigeria depend on indigenous methods of processing and preservation which they have imbibed from the older generation which have been passed on to them from generation. The indigenous methods are very cheap and economical to use. Forum. (2013) reported that drying of green vegetables and fruits are common practices in Asia and Europe. Fruits and vegetables by nature are perishable foods due to the high level of their water contents, hence spoilage begins the moment they are harvested. Shade drying is one of the ancient and commonest means of drying foods in the local populace in Africa (Bikam, 2015).

In Tanzania 70% of IFV are being lost annually after harvesting to prevent this level of wastage, shade drying was employed and the lost was drastically reduced. The local people do not have to consume their harvest immediately, the rest can be preserved for future use (Asogwa I.S. et al., 2017). Other studies also confirm the effectiveness of shade drying (Kock, 2017) also reported that shade drying was used in New Forest village Bushbuckridge to preserve some leafy vegetables such as Jute and stored inside a maize bag after drying. The dried food can be preserved either to extend their shelf life or for future use. Sun drying is another indigenous method which is still being used till date handed over from generations past to preserve fruits and vegetables (Kamwendo and Kamwendo, 2014; Taiwo et al., 1997). The method is very cheap and available. It makes use of solar a natural resource and is a common means of preservation enabling food to be kept and stored for a long time

3.14 Implications of food processing and storage on nutrients and phytochemicals of Indigenous fruits and vegetables

According to Bvenura and Afolayan (2015) food processing which has to do with preservation has played a major role in the aspect of making food available during the period when food is not in season. Food processing has to do with washing, peeling, pounding, boiling, and blanching of the fruits and vegetables after harvesting. Fruits and vegetables deteriorate very fast after harvesting because their water level contents are very high and also due to their state of acidity (Bvenura and Sivakumar, 2017). FAO (1995) stated out some of the reasons for food preservation; to lessen the rate of losses after harvesting, to retain the nutrients, sources of income generation and job opportunities. Many researchers have revealed the effects of cooking, processing and storage on the nutritional contents of fruits and vegetables (Bvenura and Sivakumar, 2017; FAO, 1995; Ngadze et al., 2016; Rickman et al., 2007). Reduces deterioration (FAO, 1995). Vitamin C and thiamine are drastically reduced by heat (Rickman et al., 2007). losses of some phytochemical properties (Howard et al., 2012). While some also

argued that sun drying and blanching causes reduction of nutrients in some vegetables like *Corchorus olitorius* (Ekpa et al., 2016). Some opined that blanching reduces the toxic nature of some leafy vegetables and make them tasty after cooking which reduces anti-oxidants of the vegetables (Oboh, 2005). Temperature, drying and storage temperature do affect the nutritional and phytochemical components of fruits and vegetables (Bvenura and Sivakumar, 2017). Furthermore, if fruits and vegetables are well processed and their storage aspect are properly done, they have the advantage of being source of income to the rural populace, by being exported.

CHAPTER 4: ETHNOBOTANICAL USE-PATTERN FOR INDIGENOUS FRUITS AND VEGETABLES AMONG SELECTED COMMUNITIES IN ONDO STATE, NIGERIA

4.1 Introduction

The prevalence of food insecurity has been of great concern globally and is one of the key challenges in Sub-Saharan Africa (Anderson et al., 2021; Aworh, 2015; Crush and Frayne, 2010). High levels of under-nutrition persist along with high rates of overweight, obesity and non-communicable diseases (Nkambule et al., 2021). In addition, the public health crisis triggered by SARS-CoV-2, the cause of the COVID-19 disease, has exacerbated food insecurity among local communities (Ayanlade and Radeny, 2020). Since the Green Revolution in the 1960s, agriculture has mainly focused on developing conventional cereal and horticultural crops. As a result, exotic foods displaced many locally produced crops resulting in the severe neglect of indigenous and naturalised plants (Conway and Barbier, 2013). The neglect of indigenous and naturalised plants in preference for a few exotic crops has partly affected the achievements of food policies globally, particularly in developing countries (Akinola et al., 2020; Aworh, 2015; Mabhaudhi et al., 2019). Indigenous fruits and vegetables (IFVs) often have multiple uses within society, especially for diversifying the food-types to meet food and nutrition security (Chivenge et al., 2015; De Vynck et al., 2016; Jones, 2020). Despite the diverse potential uses of IFVs, they are often neglected and associated with negative perception which has contributed to their low consumption and utilisation in Africa (Bvenura and Sivakumar, 2017; Van der Hoeven et al., 2013).

The World Health Organisation (WHO) recommends a daily consumption of at least five portions or 400g of fruits and vegetables in order to reduce the risk of non-communicable diseases (FAO/WFP, 2014; Mishra et al., 2022). Intriguingly, IFVs are readily available plants with the potential to provide the dual benefits of nutritional and medicinal needs (Moyo et al., 2018; Oseni and Olawoye, 2015). Increasing evidence has indicated that IFVs are rich in antioxidants which act as scavengers against reactive oxygen species that are linked to many diseases in humans (Akinola et al., 2020; Jideani et al., 2021; Moyo et al., 2018). Particularly, IFVs have been linked with reduced risk of many non-communicable diseases such as cancer, cardiovascular disease, type 2 diabetes and obesity (Matos et al., 2021).

Nigeria is rich in plant biodiversity and culture, with many people still using plants to fulfil their food, shelter, water, fuel, and medicinal needs (Ajao et al., 2022; Erinoso and Aworinde,

2018; Oseni and Olawoye, 2015). However, in the last few decades, several changes have taken place in Nigeria. As indicated by Huang et al. (2018), changes such as urbanisation, farmers shifting from subsistence to cash cropping, increased population pressures, and environmental degradation have impacted the socio-cultural practices of many people and their biodiversity. These changes are an indication of the urgent need to document indigenous plants among local communities (Crane et al., 2019). In addition, the potential to contribute to the sustainable utilisation and associated knowledge of local floras as well as their conservation for current and future generations cannot be overemphasized (Ajao et al., 2022; Crane et al., 2019; Erinoso and Aworinde, 2018). Hence, the aim of this study was to explore the utilisation patterns, common indigenous practices, and knowledge of IFVs among selected rural communities in Ondo State, Nigeria.

4.2 Materials and method

4.2.1 Study Area

The study was conducted in 40 out of 320 communities in Akure South local government area of Ondo State. The Akure South local government area is in the south-western Nigeria (9° 4' 55.1964"N, 8° 40' 30.9972"E) and serves as the capital city of Ondo State **(Figure 2. 2)**. Furthermore, it is approximately 900 km south-west of Abuja and 311 km north of Lagos State. The city has an estimated population of 665,524 people and a land area of 332 km^2 (Buettner, 2015). Akure south is divided into eleven wards and approximately 320 communities, many of which are largely rural and are in the tropical rainforest zone of Nigeria (Ogunrayi et al., 2016).

4.2.2 The data sampling technique and sample size

The study targeted farmers and knowledgeable holders with experience in indigenous plants (indigenous fruits and vegetables) for the documentation of the common practice of the indigenous knowledge in the community in Akure South Local Government, Ondo State in Nigeria. Both random and purposive sampling technique was used for the current study. The study was conducted in 40 communities out of 320 communities in Akure South. The selection of the communities was based on the availability of these indigenous plants in their natural habitat, rural nature and culture. The total sample size were 400 participants (10 individuals from each community). A well-structured questionnaire developed based on the objectives of the study was used to collect data. The field work also involved focus group discussion. Interview was conducted face to face in the native language (Yoruba). Kothari (2004) reported that purposive sampling technique has the advantage to generate greater knowledge because

participants sampled are considered most knowledgeable in the field of interest or most experience and successful in the discipline.

4.2.3 Validity and trustworthiness

A pilot study prior to the actual research study was carried out in five (5) local communities in Akure South to test the adequacy of the research instruments. According to Golafshani (2003) to determine the research performance and acceptability the main criteria is validity. The 5 communities selected have similar characteristics as present study area in terms of population and the language spoken. The major language is Yoruba. Using purposive expert sampling, twenty (20) farmers and knowledgeable holders with experienced knowledge in indigenous fruits and vegetables were selected to test the accuracy and trustworthiness of the research methods and techniques.

The pilot study helped the researcher to know the reasonable duration of the interview, clarity and the relevancy of the objective questions. This was done to ensure the quality and accuracy of the research instrument. Photographs were taken during the research process to assert the trustworthiness of the study. The questions were answered in a premium of time due to clarity of language since the researcher and her team speak the same language with the participants. These concepts helped the researchers to meliorate the reliability and trustworthiness of the research instruments and data (Zohrabi, 2013).

A semi-structured questionnaire was administered for data collection alongside with a photo album for ease of identification. The questionnaire was divided into three sections: Section A comprised of the demographic characteristics of the participants; Section B focused on the documentation of indigenous knowledge and practices on indigenous fruits while Section C comprised of questions on how indigenous fruits and vegetables were produced and enhanced livelihood among the communities.

4.2.4 Ethnobotanical survey

The data for the study was collected on the field between September to November 2021. A well-structured questionnaire was used to collect the data (**Appendix 3**), and this was supplemented with a photo album of 46 common IFV **(Appendix 4)**. This was used as a visual aid for easier identification of the plants by the indigenous people during the survey. A tape recorder was used to gather information from the participants during the face-to-face interview. Some of these fruits and vegetables are known as naturalised in the study area. Information such as local names, uses, parts commonly eaten for the selected IFV were collected from the

participants. The use of photo album for collecting ethnobotanical data is often effective among local communities (De Vynck et al., 2016; Omotayo et al., 2020). A total of 46 IFVs were collected with the assistance of participants during the fieldwork. Voucher specimens of the IFVs were prepared and identified at the herbarium of the Forestry Research Institute of Nigeria (FRIN), Ibadan, Oyo State, Nigeria **(Figure 4.1)**.

A

The researcher and Mr Oba one of the official at FRIN herbarium, with Dr. I.O. Lawal Co-Supervisor in Nigeria

B

The researcher with Mr. Egunjobi and Mr Oba at the herbarium in FRIN receiving lecture for the plants pressing procedure..

C

The researcher and Staff of Forestry research Institute of Nigeria (FRIN) preparing the plants for pressing in the herbarium

D

The researcher and other staff of FRIN during plant pressing in preparation for the herbarium specimen

Figure 4.1 The researcher, Dr.I.O. Lawal and staff of Forestry Research Institute of Nigeria (FRIN) at the herbarium preparing the pressing of the plants collected from the field.

4.2.5 Data analysis

The collected data was analysed using SPSS and SATA 16 software. In terms of the ethnobotanical index, the frequency of citation (FC) was calculated as described by Tardío and Pardo-de-Santayana (2008).

$$FC = \frac{Np}{N} x100$$

Where Np = number of citations for a particular IFV, and N is the total number of participants in the study.

Thematic data analysis was used to develop the themes in the study (Bless et al., 2006). Thematic analysis is an accessible, flexible, and increasingly popular method of qualitative data analysis. Several authors argued that thematic analysis moved beyond counting explicit phrases and words to focusing on the identification and describing both the implicit and explicit ideas within the data (Braun and Clarke, 2006; Guest et al., 2011).

4.2.6 Ethical approval

The ethical clearance (certificate no: NWU-01771–20-A9) for the research was approved as a low risk by the Faculty of Natural and Agricultural Sciences Research Ethics Committee (FNASREC), North-West University, South Africa **(Appendix 1**). The permit to access the study area was granted by the Osolo of Isolo Oba Edward Kolawole Adejoyegbe Adewole (Osalade 11) who is one of the paramount rulers in Akure South Local Govt Area **(Appendix 2).** The ethnobotanical survey was conducted with the full consent of the participants. This included voluntary participation before the administration of questionnaires in the study area **(Appendix 3).** During this study, the principle of privacy, autonomy, dignity, and respect was handled with diligence.

4.3 Results and discussion

4.3.1 Demographic overview of the participants

The study included 400 participants aged from 18 to 73 years **(Table 4.1)**. The mean age of the participants was 49 years which is an active labor force available in the rural communities of the state. Male participants were more (60.5%) than the female counterparts (39%). The number of male in this study was similar to the findings of previous studies that reported similar dominance of male in agricultural enterprise in Nigeria (Mbavai, 2013; Okonji and Awolu, 2021). In addition, the study indicated that most of the participants acquired formal education

at the secondary (42.3%), primary (36.8%), and tertiary level (7.3%), while 7.5% of the participants had no formal education. The household size variable also shows that the majority (52%) of households had 6-10 individuals. Similar results for a relatively high number of individuals have been observed in South Africa and Nigeria (Ele et al., 2013; Stats SA, 2015). In terms of occupation, 72% of the participants were farmers. Ethnicity distribution of the participants indicated that Yoruba (88.3%), Igbo (8.0%), Hausa (2%) and others (1.8%) were engaged in the survey. Based on the years of experience, the majority (35%) of the participants **(Figure 4.2)** had 11-20 years' experience in the production of indigenous fruits and vegetables in the study area **(Table 4.1)**.

The researcher with Madam Elizabeth and Chief Adeoya at Adofure community

C

The researcher and Chief Adeoya during the face-to-face in-depth interview at Adofure community.

D

Madam Akindeko in her home vegetable garden during the interview

Mr Fesobi in his vegetable farm in Aponmu community displaying the importance of *Cnidoscolus aconitifolius* (Chaya)

Figure 4.2 Researcher and the knowledge holders of IFV that took part in the face-to-face interview.

Table 4.1 Socio economic characteristics of the participants

Variables	Frequency	Percentage (%)
Gender		
Male	242	60.5
Female	158	39.5
Age		
18-27	8	2.00
28-37	23	5.80
38-47	108	27.00
48-57	167	41.80
58-67	79	19.80
68-77	15	3.80
Marital Status		
Single	22	5.50
Married	344	86.00
Divorced	17	4.30
Widow/Widower	17	4.30
Educational Level		
Primary School	147	36.80
Secondary	169	42.30
Diploma	25	6.30
Degree	23	5.80
Postgraduate degree	6	1.50
No formal education	30	7.50
Household Size		
1-5	168	42.00
6-10	224	56.00
11-15	8	2.00
Occupation		
Civil Servant	30	7.50
Farming	291	72.80
Self Employed	48	12.00
Entrepreneur	22	5.50
Others	9	2.30
Ethnic Groups		
Yoruba	353	88.30
Igbo	32	8.00
Hausa	8	2.00
Ijaw	6	1.50
Others	1	0.30
Years of Experience		
1-10	113	28.30
11-20	141	35.30
21-30	98	24.50
31-40	37	9.30
41-50	10	2.50
51-60	1	0.30

4.3.2 Diversity of indigenous fruits and vegetables in the study area

An inventory of 46 IFVs that were considered as a source of food security, nutrition and medicinal aid among the participants was generated **(Table 4.2)**. Asteraceae (8), Malvaceae (6), Solanaceae (5) and Amaranthaceae (4) were the most frequently mentioned families **(Figure 4.2)**, which accounted for 50% of the documented 46 IFVs. The significance of Asteraceae as being highly cited in the study, may be associated with their wider distribution and abundance in the selected communities. Similar patterns and popularity of members of the Asteraceae are well-documented in ethnobotanical surveys for edible and medicinal plants (Rolnik and Olas, 2021; Welcome and Van Wyk, 2020). The Asteraceae is distributed worldwide in a range of environments. They can be found in forests, high-altitude grasslands, and even urban green spaces, but they are far less prevalent in tropical conditions. The morphology of members of the Asteraceae is highly diverse which likely account for their success in several environment, except for Antarctica (Bohm and Stuessy, 2001). As one of the other dominant plant family in the current study, Malvaceae is generally recognised for producing a variety of fruit crops (Ogbu and Umeokechukwu, 2014; Welcome and Van Wyk, 2020).

Based on their FC values that ranged from approximately 32-90%, the most popular IFVs used by the participants were *Ageratum conyzoides* (L.) L. (89.5%), *Citrus aurantiifolia* (Christm.) Swingle (89.5%), *Talinum fruticosum* (L.) Juss. (88.8%), *Amaranthus hybridus* L. (87.8%), *Vernonia adoensis* var. *adoensis* (86.8%) and *Vernonia amygdalina* Delile (86.8%) **(Table 4.2)**. The result is an indication that the participants have a wide understanding of the potential of these indigenous and naturalised plants. Increasing evidence suggest that the population living in rural areas are often aware of the medicinal properties and nutritional value of their local plants (Mashile et al., 2019; Ogle and Grivetti, 1985; Thomas et al., 2009).

Table 4.2 Ethnobotanical information on indigenous (and naturalized) fruits and vegetables (IFVs) documented among participants in 40 selected rural communities in Akure South local government area of Ondo State, Nigeria. The botanical names of the plants were verified using the World flora online (http://www.worldfloraonline.org/)

Scientific name, Family, Voucher specimen number	# Vernacular name	Recorded use(s)	Plant part(s) used	*O	N	FC (%)
^Ageratum conyzoides (L.) L. Asteraceae OSF 113112	Billy goat weed (E), Imiesu (Y)	Food and medicine (tumours, boils, pneumonia, fever, rheumatism, headache, constipation, typhoid and diarrhoea)	Fruit, leaves, seeds, roots and whole plant	W	358	89.5
^Amaranthus hybridus L. Amaranthaceae OSF 113074	Africa spinach (E), Tete (Y)	Food	Leaves and stem	D	351	87.8
^Amaranthus spinosus L. Amaranthaceae OSF 113054	Spiny amaranthus (E), Tete-elegun (Y)	Food and medicine (dysentery, fever and malaria)	Fruit, leaves and stem	W	296	74
^Amaranthus viridis L. Amaranthaceae OFS 113073	Green amaranth (E), Tete-abalaye (Y)	Food	Leaves and stem	D	247	61.7
^Andrographis paniculata (Burm.f.) Nees Acanthaceae OSF 113121	King of bitter (E), Mejemeje (Y)	Medicine (cancer, heart attack, ulcer, leprosy, malaria, diarrhoea, fever, gonorrhoea, scabies, diabetes, lowers high blood pressure)	Leaves, stem and roots	D	287	71.8
^Artocarpus altilis (Parkinson ex F.A. Zorn) Fosberg Moraceae OSF 113053	Breadfruit (E), Berefuutu (Y)	Food and medicine (hypertension, diabetes, malaria, fever and diarrhoea)	Fruit, leaves, stem, seeds and roots	D	324	81
^Basella alba L. Basellaceae OSF 113030	Malabar spinach (E), Amunututu (Y)	Food and medicine (wound healing, ulcer, dysentery, cancer, diabetes, anaemia, diarrhoea, boils, sores, conjunctivitis), boosts libido, promotes labour and used as a laxative	Leaves and stem	D	314	78.5
Blighia sapida K.D.Koenig Sapindaceae OSF 113060	Ackee (E), Ishin (Y)	Food and medicine (epilepsy, fever, malaria, dysentery, constipation), use as a laxative	Fruit, bark, seeds and roots	W	240	60
^Boerhavia diffusa L. Nyctaginaceae OSF 113176	Hog weed (E), Eemo/Olowojeja (Y)	Food and medicine (pain reliever, cancer, epilepsy, lowers blood sugar, blood tonic)	Leaves and stem	W	240	60
^Bryophyllum pinnatum (Lam.) Oken Crassulaceae OSF 113122	Miracle leave (E), Abamoda (Y)	Food and medicine (convulsions, measles, headache, coughs, rheumatism, asthma, body pains, diabetes and arthritis)	Leaves and roots	D	146	36.5
^Ceiba pentandra (L.) Gaertn. Malvaceae OSF 113075	Baobao (E), Eegungun (Y)	Food and medicine (headache, diabetes, pain relievers, cancer, diarrhoea, ulcers, leprosy, dizziness, hypertension, fever and skin infection)	Leaves and seeds	W	129	32.3
Celosia argentea L. Amaranthaceae OSF 113072	Lagos spinach (E), Shokoyokoto (Y)	Food and medicine (stops vomiting, increases blood flow, colds, arthritis, diabetes, gonorrhea, eczema, rheumatism and snake bite antidote)	Leaves and stem	D	196	49
^Chromolaena odorata (L). R.M.King & H.Rob Asteraceae OSF 113113	Siam weed (E), Akintola (Y)	Medicine (skin-related diseases such as infections and wounds)	Leaves and roots	W	321	80.3
Chrysophyllum albidum G.Don Sapotaceae OSF 113057	Africa star apple (E), Agbalumo (Y)	Food and medicine (yellow fever, fibroids, malaria, and anemia)	Fruit, bark and roots	D	269	67.3
^Citrus aurantiifolia (Christm.) Swingle Rutaceae OSF 113051	Lime (E), Oronbowewe (Y)	Food	Fruit	D	358	89.5
Citrus aurantium L. Rutaceae OSF 113050	Orange (E), Ganinganin (Y)	Medicine (improves digestion, lowers blood sugar, cleanses liver, enhances immunity, cancer, diabetes and hypertension)	Fruit, bark and seeds	W	287	71.8
Clerodendrum volubile P.Beauv. Lamiaceae OSF 113118	White butterfly (E), Dagba(eweata) (Y)	Food and medicine (arthritis, diabetes, rheumatism, oedema and hypertension)	Leaves and roots	D	176	44
^Cnidoscolus aconitifolius (Mill.) I.M. Johnst. Euphorbiaceae OSF 113123	Chaya (E), Iyanapaja (Y)	Food and medicine (Leaf sap applied to irritated eyes and used for earaches)	Leaves and stem	D	199	49.8
Crassocephalum rubens (Juss. ex Jacq.) S.More	Coriander (E), Ebolo (Y)		Leaves, stem and seeds	D	313	78.3

Table 2 (Continued)

Scientific name, Family, Voucher specimen number	# Vernacular name	Recorded use(s)	Plant part(s) used	*O	N	FC (%)
Asteraceae OSF 113057		Food and medicine (diabetes, stomach-ache, fevers, postpartum constipation, eye sores, and earaches)				
^Corchorus olitorius L. Malvaceae OSF 113049	Jute leaves (E), Ewedu (Y)	Food and medicine (pain relief, piles, tumors, fever, gonorrhea, typhoid, ulcer, malaria, and immune booster), treating infertility	Leaves and roots	D	322	80.5
^Cocos nucifera L. Arecaceae OFS 113047	Coconut (E), Agbon (Y)	Food and medicine (diarrhoea, diabetes, and cholera)	Fruit and seeds	D	251	62.8
Dialium guineense Willd. Fabaceae OSF 113120	Black velvet tamarind (E), Awin (Y)	Food and medicine (toothache, diarrhoea, hypertension)	Fruit	W	219	54.8
^Eclipta prostrata (L.) L. Asteraceae OSF 113128	False daisy (E), Abikole (Y)	Food and medicine (snake bites, pimples, wounds, cuts, eczema, sores and cancer)	Leaves and stem	W	140	35
Elaeis guineensis Jacq. Arecaceae OSF 113067	Palm oil (E), Eyin (Y)	Food, medicine (headache, pains, rheumatism, gonorrhea, cancer, measles, diabetes, and anemia) enhances lactation and as fuel	Fruit and seeds	D	323	80.8
^Gossypium barbadense L. Malvaceae OSF 113058	Cotton seed (E), Owu (Y)	Food and medicine (diarrhoea, fever, headache), enhancing lactation	Fruit and seeds	D	243	60.8
Hibiscus asper Hook.f. Malvaceae OSF 113078	Hibiscus (E), Isapa (Y)	Food and medicine (immune booster and general well-being)	Leaves, seeds and flowers	D	295	73.8
Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill. Irvingiaceae OSF 113055	Bush mango (E), Oro (Y)	Food and medicine (dysentery, toothache and diabetes)	Fruit, bark, seeds and roots	D	266	66.5
Irvingia tenuinucleata Tiegh. Irvingiaceae OSF 113079	Bitter bush mango (E), Oro (Y)	Food and medicine (diarrhoea, scabies, toothache, yellow fever, inflammation and diabetes)	Fruit and bark	D	170	42.5
Launaea taraxacifolia (Willd.) Amin ex C.Jeffrey Asteraceae OSF 113066	Wild lettuce (E), Yanrin (Y)	Food and medicine (stops vomiting, toothache, diabetes, wounds)	Leaves and stem	W/D	168	42
Manihot esculenta Crantz Euphorbiaceae OSF 113068	Cassava leaves (E), Ege (Y)	Food	Leaves	D	248	62
Mucuna pruriens (L.) DC. Fabaceae OSF 113118	Mucuna leaves (E), Esisi/Iwerepe (Y)	Food and medicine (blood tonic, bone fractures, coughs, dog bites, madness, ringworm, scorpion bites and snake bites), to manage male fertility	Leaves and roots	W	153	38.3
Ocimum gratissimum L. Lamiaceae OSF 113069	Scent leaves (E), Efirin (Y)	Food and medicine (blood tonic, headache, fevers, malaria, stomach-ache, promotes good eyesight, lowers blood sugar, stops vomiting and dysentery)	Leaves, seeds and roots	D	292	73
Parkia biglobosa (Jacq.) G.Don Fabaceae OSF 113076	Locust beans (E), Iru (Y)	Food and medicine (prevents stroke, lowers blood sugar, promotes good eyesight, coughs, diarrhoea, and hypertension)	Fruit and seeds	W	320	80
Plukenetia conophora Mull.Arg. Euphorbiaceae OSF 113059	Walnut (E), Awusa (Y)	Food and medicine (alleviates indigestion, constipation, hiccups, eyesight) cosmetic purposes including its use as soap	Fruit, seeds and roots	D	265	66.3
Senecio biafrae Oliv. & Hiern C.Jeffrey Asteraceae OSF 113117	Bologi (E), Woorowo (Y)	Food and medicine (diabetes, sore eyes, coughs and rheumatism), to manage female infertility	Leaves and stem	D	257	64.3
^Sida acuta Burm.f. Malvaceae OSF 113114	Wire weed (E), Iseketu (Y)	Medicine (urinary disease, headache, tuberculosis, asthma, diabetes, fever, ulcer, tuberculosis, rheumatism, and stops bleeding, blood tonic, measles and abdominal pain), to manage infertility and weight loss	Leaves, stem, roots and whole plant	W	255	63.8
Solanum aethiopicum L. Solanaceae OSF 113116	Garden egg (E), Igba (Y)	Food	Fruit	D	281	70.3
Solanum erianthum D.Don Solanaceae OSF 113070	Big eggplant (E), Ewuro Ijebu (Y)	Food and medicine (headache, dysentery, fever, diarrhoea, arthritis)	Leaves, stem and roots	W	171	42.8

Table 2 (Continued)

Scientific name, Family, Voucher specimen number	# Vernacular name	Recorded use(s)	Plant part(s) used	*O	N	FC (%)
Solanum macrocarpon L. Dunal Solanaceae OSF 113056	Africa eggplant (E), Igbagba (Y)	Food and medicine (stomach worms, asthma, and wounds), used as a laxative and teeth cleanser	Leaves, stem, bark and roots	D	244	61
Solanum nigrum L. Solanaceae OSF 113115	Black nightshade (E), Efoodu (Y)	Food and medicine (pneumonia, toothache, stomach-ache, pain reliever, fever, tumour, dysentery, tuberculosis and ulcer)	Leaves, stem and whole plant	D	197	49.3
^Solanum violaceum Ortega. Solanaceae OSF 113048	African eggplant (E), Ajegun Were (Y)	Food	Fruit	D	169	42.3
^Spondias mombin L. Anacardiaceae OSF 113071	Hog Plum (E), Iyeye (Y)	Food and medicine (stomach-ache, diarrhoea, dysentery, gonorrhoea, inflammation)	Fruit	W	187	46.8
Talinum fruticosum (L.) Juss. Talinaceae OSF 113111	Waterleaf (E), Gbure (Y)	Food and medicine (scabies, ulcer, high blood pressure and anemia)	Leaves and stem	D	355	88.8
^Theobroma cacao L. Malvaceae OSF 113052	Cocoa (E), Koko (Y)	Food	Fruit and seeds	D	225	63.8
Vernonia adoensis var. adoensis Asteraceae OSF 113065	Bitter leaf (E), Ewuroodo (Y)	Food and medicine (gonorrhoea, tuberculosis, stomach-ache)	Leaves, stem and whole plant	W, D	347	86.8
Vernonia amygdalina Delile Asteraceae OSF 113065	Bitter leaf (E), Ewuro (Y)	Food and medicine (fever, malaria, dysentery, hepatitis, cough, head-ache, stomach-ache, diabetes, hypertension and high blood pres-sure), used as fertility inducer	Leaves, stem and whole plant	W, D	347	86.8

Vernacular name: E - English and Y - Yoruba; ^ = naturalized plants; O* Occurrence = (D - domesticated and W - wild). N = Number of mentions among the participants; FC = frequency of citation

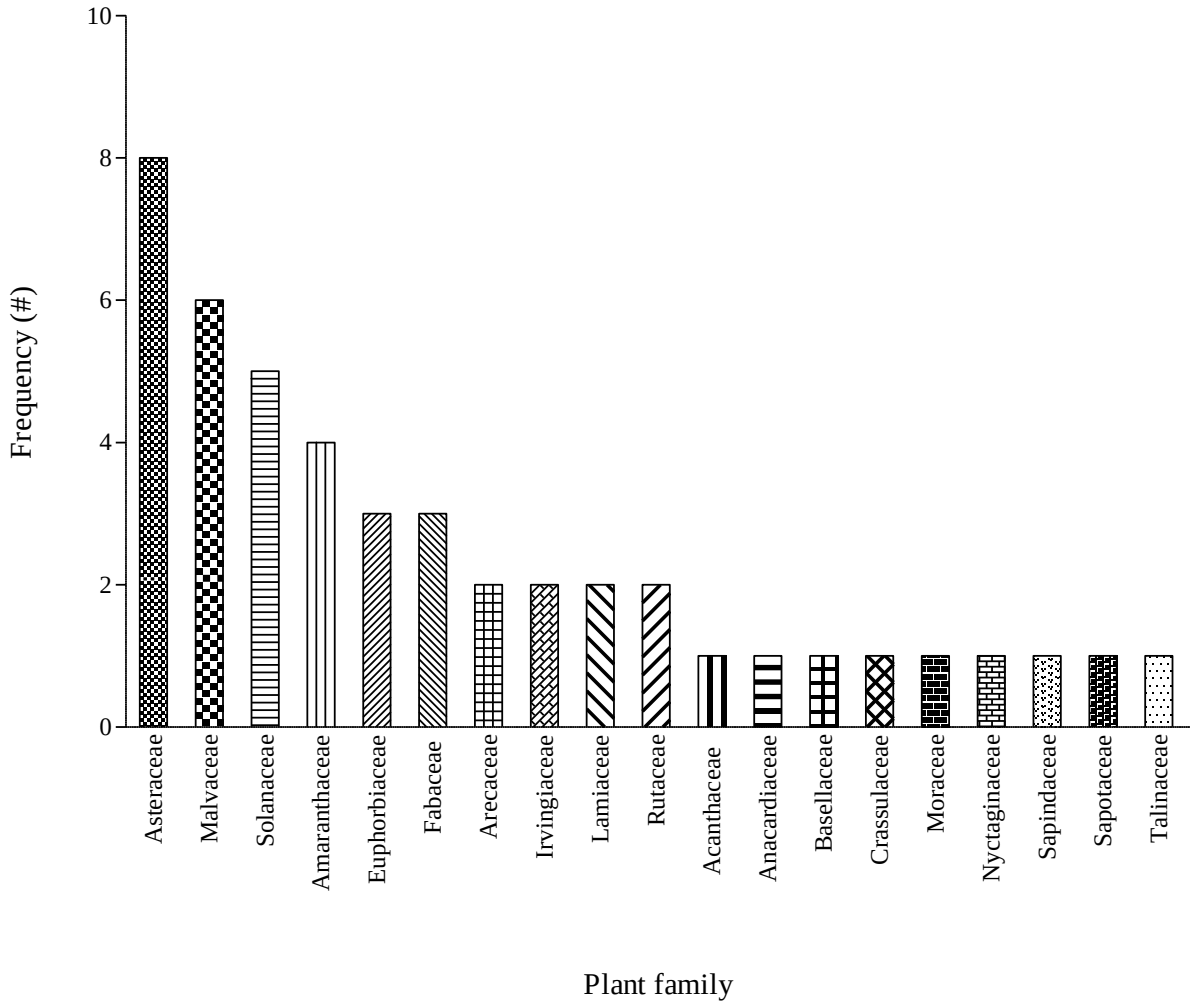


Figure 4.3 Plant families of indigenous fruits and vegetables documented among the selected 40 communities in Akure South local government of Ondo State, Nigeria

4.3.3 Use pattern for plant parts of indigenous fruits and vegetables (IFV)

Based on the plant parts used and the method of consumption of the IFVs identified in the study, 56% of the participants utilise the leaves and fruits, whereas 44% of the participants indicated the use of other plant parts as a food and for medicinal purposes **(Figure 4.4)**. These findings are like previous studies that indicated that leaves and fruits are the dominant plant parts used as food (Adebooye et al., 2014; Magwede et al., 2019; Manlosa et al., 2019; Mayes et al., 2012; Oseni and Olawoye, 2015; Welcome and Van Wyk, 2019). Furthermore, these results identified the existence of closely related cultural practices and knowledge regarding plant parts used and in the consumption pattern of IFV plants among different local communities in Sub-Saharan countries (Dejene et al., 2020; Mashile et al., 2019). Particularly, indigenous/naturalised fruits

have continuously played a crucial but largely neglected role in household food security (Jideani et al., 2021).

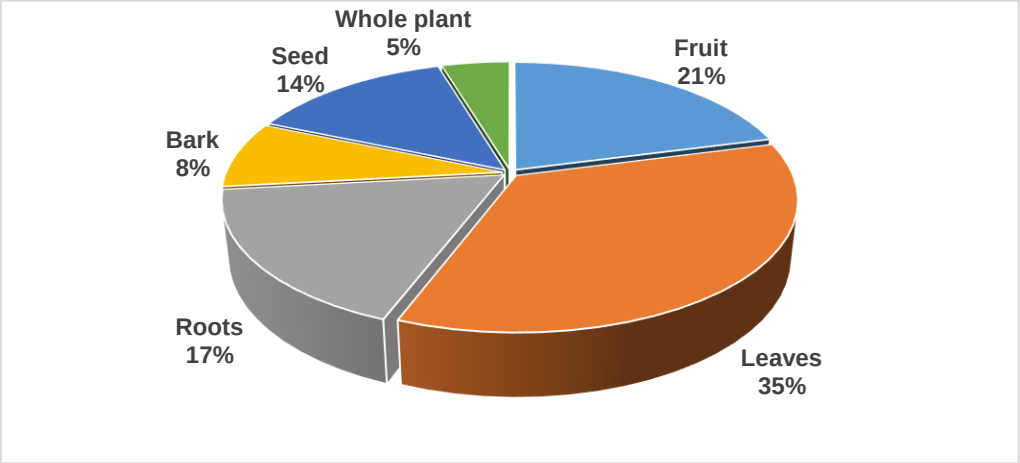


Figure 4:4 Plant parts of the indigenous fruits and vegetables used among 40 communities in Akure South local government of Ondo State, Nigeria (n=86)

4.3.4 Use-categories for indigenous fruits and vegetables (IFVs)

As indicated by Shai et al. (2020), indigenous fruits are often abundant in the rural areas, readily available and cheap which may explains why many community members rely solely on them for diverse uses especially nutritional and medicinal needs. Indigenous fruits and vegetables form an important part of the human diet and livelihoods, with a significant number of plant species known for their untapped potential (Aworh, 2015; Ekesa et al., 2009). Research has shown that consumption of IFVs is a sustainable way of reducing and controlling micronutrient deficiencies in resource poor communities (Akinola et al., 2020; Mabhaudhi et al., 2019; Moyo et al., 2018). In this study, of the IFVs were mainly used as food (53%), medicine (46%) and fuel (1%) **(Figure 4.5)**. It has been reported that plants such as *C. aurantifolia, M. utilissima* and *C. olitorius* are readily available in local communities and majority were being cultivated at the homesteads (Abdoulaye et al., 2014; Mashile et al., 2019; Shackleton et al., 2000). A similar observation was made during a market survey conducted in western Kenya to assess production, marketing and utilisation of IFVs (Ngugi et al., 2007). The only plant identified as being useful for fuel was *E. guineensis* based on the response from 1% of the participants.

Indigenous fruit and vegetables form a significant part of the traditional diets of agricultural communities (Oseni and Olawoye, 2015). Many underutilised indigenous plants contain high nutritional value and could improve the nutritional status of many impoverished individuals

(Omotayo et al., 2020). In the current study, *A. conyzoides*, *A. hybridus*, and *T. triangulare* were among the plants that had two use-categories, namely food and medicine. It is evident that these aforementioned plants are largely cultivated in arid and semi-arid regions of Africa for human consumption (Oseni and Olawoye, 2015).

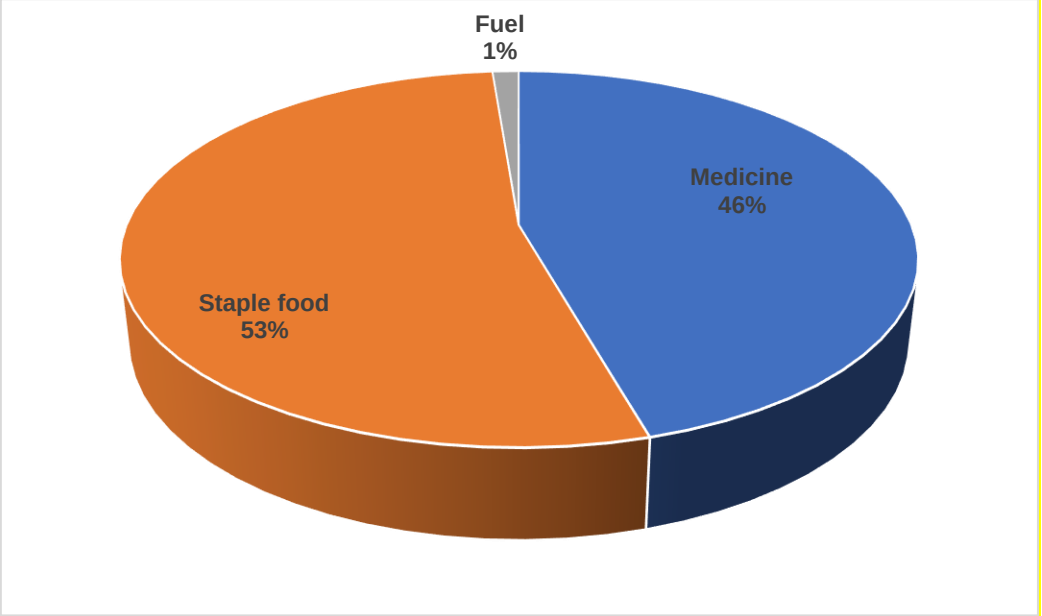


Figure 4.5 Use-categories for indigenous fruits and vegetables among the participants in the 40 selected communities of Akure South local government, Ondo State, Nigeria (n = 79)

4.3.5 Occurrence status for the indigenous fruits and vegetables

In various communities, the cultivation of indigenous vegetables is often essential to meet the needs of the households in terms of food and income sustenance (Alagba et al., 2015; Aworh, 2015; Olowo et al., 2022; Omotayo et al., 2020; Phillip et al., 2009). This study revealed that 65% of the IFVs were domesticated while 35% grow in the wild **(Figure 4.6)**. Similar results were observed in a previous study in Nigeria (Akinnifesi et al., 2007), whereby domesticated plant species were more dominant when compared to the plants collected from the wild, this could be as a result of decimation of our forests. Furthermore, Van Rensburg et al. (2007) and Maroyi (2017) established that people have always depended on domesticated and wild plants for food. This dependence continues today and has remained relatively unchanged especially for inhabitants of rural areas (Ajesh et al., 2012).

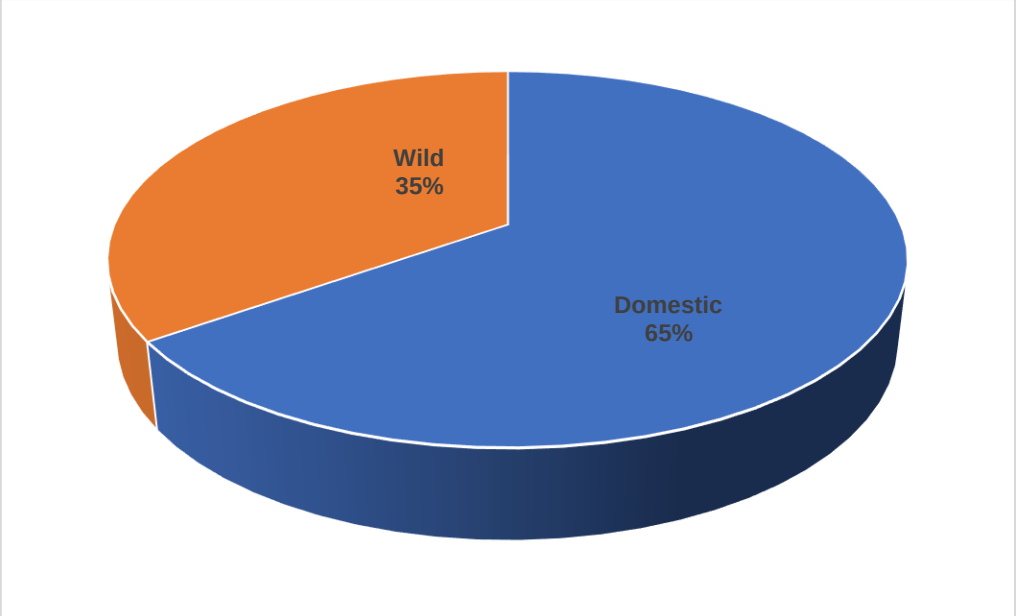


Figure 4.6 Occurrence of indigenous vegetables and fruits documented in the 40 selected communities of Akure South local government area of Ondo State, Nigeria (n=46)

4.3.6 Relationship of the finding in the study area with previous studies

In relation to earlier ethnobotanical studies conducted in Ondo State and other parts of Nigeria, the present study revealed some trends with respect to the uses of the documented plants **(Table 4.2)**. In the present study, *E. guineensis* was mentioned as being used for fuel purposes. However, the findings of Erinoso et al. (2020), reported that the plant was used for making brooms, palm oil, palm wine, and for hunting purposes. Plants such as *A. hybridus*, *O. grattissimum*, *A. conyzoides*, *Artocarpus altilis* (synonyms: *A. communis*), *C. olitorius*, (synonyms: *T. triangulare*), *V. adoensis* and *V. amygdalina* had similar uses in previous studies (Omara-Achong et al., 2012; Shomkegh et al., 2013). In rural areas, some of these IFVs are essential to reduce malnutrition as they are a valuable source of minerals, proteins and fats/oils (Moyo et al., 2018; Stadlmayr et al., 2013). The current uses for these aforementioned plants demonstrate the importance of collecting new ethnobotanical information, even on well-known plant species (Mashile et al., 2019). In a previous study (Lawal et al., 2020), *C. aurantifolia* and *A. conyzoides* were among the most common indigenous plants used in the treatment of cough associated with respiratory conditions among local communities in Osun State, Nigeria.

4.3.7 Common practices and knowledge associated with the documented indigenous fruits and vegetables (IFVs)

Indigenous agricultural practices used by locals rely heavily on traditional knowledge, which is prevalent in agricultural systems to conserve ecosystems and biodiversity, as well as to ensure sustainable food and human health (Sharma et al., 2020). Participants use a variety of indigenous agricultural practices based on years of experience, informal education, and extensive knowledge and interaction with their environments (Šūmane et al., 2018). According to (Okoye and Oni, 2017), indigenous preservations are less expensive, economically practical, and sustainable way to ensure the integrity of micronutrients in plants. The application of indigenous practices amongst the participants encompasses a wide range of factors, including soil fertility management, weeding, pest control, seed storage, soil preparation, harvesting, and storage (Ndwandwe, 2013). Furthermore, there have been several developments among indigenous people concerning their practices and technology for storing, processing, and preservation of their food and associated nutrients (Okoye and Oni, 2017).

One of the participants indicated that the cultivation of *C. nucifera* requires some indigenous measures that need to be taken before planting can occur. For example, *C. nucifera* (10 to 20) must be kept outside under a tree, inside a sack, to receive rain and dew for a long period of time, and it must not be touched or shaken (or peeped at), or else it is no longer good for planting. The participants indicated in Yoruba dialect: *"Eewo ni lati fowo kan tabi kan jiwo leti,"* meaning "it is taboo for it to be touched, held, or shaken". It will grow on its own without any interference. With respect to its harvesting, it must drop the fruit by itself before it can be picked because of its height, so the elderly ones will say during harvesting in Yoruba dialect, *"A wo moju lawo ausa,"* meaning "if it does not drop, it cannot be picked." In terms of storage, some of the participants believed that the best way to preserve IFVs is to sun-dry or dry in shade, placed inside a calabash (*Akeregbe*) with a cover and left on roof-top of their hut.

Furthermore, some interesting sayings associated with some of the IFVs were recorded. For instance, a participant described *C. rubens* as follow*: 'A o ti se ebolo ti ko ni rungbe'* which means there is no way you will cook coriander without bringing out its smell. Some people detest it because of its smell. *Corchorus. olitorius 'Ki omode ati agba ilu ko ma yonu si mi'* which means anytime you eat jute leaves, you will be in favour with both children and adults in society. This may also be attributed to the slippery nature of *C. olitorius* when cooked. Some of the participants described *C. aurantifolia* as *"Koko moni osan"* due to its diverse application in the treatment of several ailments and it is often regarded as an indispensable orange among households.

According to 65% of participants, ensuring the soils maintained their fertility is an essential way to support the growth and productivity of IFVs. Some of the participants described this process as soil conservation which entails the soil is being enriched with essential nutrients required for the growth and survival of IFVs. According to Garutsa and Nekhwevha (2016), soil conservation refers to ways of preserving soils is being attain optimum fertility of the soil. They use organics, mulching, and contouring if the slopes are steep. In addition, the use of sandbags is introduced to avoid soil erosion during flooding. The importance of these methods and strategies are consistent with the view described by Giller et al. (2009). Proper land preparation through appropriate soil conservation and enhancement practices ensures high crop productivity. In recent years, indigenous soil conservation methods have diminished due to the use of fertilizers, pesticides, and incompatible technologies, which are largely responsible for soil degradation (Garutsa and Nekhwevha, 2016).

4.4 Conclusion

Relative to the inventory of 46 IFVs (from 19 families), *Ageratum conyzoides*, *Citrus aurantiifolia*, *Talinum fruticosum*, *Amaranthus hybridus*, *Vernonia adoensis* var. *adoensis* and *Vernonia amygdalina* were regarded as the most popular among the participants in the study area. In addition, *Elaeis guineensis* had the most diverse uses with applications as food, medicine and fuel (energy-source). Currently, many people still rely on these plants for their sustainable livelihoods and survival. Asteraceae and Malvaceae were the dominant families while the leaves and fruits were the most utilised plant parts. This study revealed the patterns of consumption of IFVs among the population especially for food sustenance and health benefits. Thus, promoting these indigenous/naturalised plant species is a viable means of exploring the rich biodiversity which has the potential to expand the existing food pool. This will contribute to food sufficiency among local communities. However, the nutritional and phytochemical content of these identified IFVs needs to be explored as essential evidence to enhance their acceptable. It is also important to assess the storage aspect of the IFVs given their short shelf-life, especially during the peak harvest period.

CHAPTER 5: IMPROVING RURAL LIVELIHOOD THROUGH THE CULTIVATION OF INDIGENOUS FRUITS AND VEGETABLES: EVIDENCE FROM ONDO STATE, NIGERIA

5.1 Introduction

In developing countries, nearly 3.2 billion people live in rural areas, with many depending on agriculture food systems for their livelihoods (Dengerink et al., 2021; Knickel et al., 2018; Mustafa et al., 2021). Relative to other sectors, the agriculture and food sectors are unique in their scale of employment and reliance on the small and medium enterprises (Bouazza, 2015). Food systems are therefore critical for addressing poverty and equitably distributing economic opportunities (Bongaarts, 2021; Garbero et al., 2021; Ruben et al., 2021). Food shortage and the high prevalence of poverty in many developing countries indicates the need to expand food production and sustainable livelihood among rural communities in particular, where more vulnerable populations, poor livelihoods and food insecurity is aggravated (Gonçalves et al., 2021; Ribeiro et al., 2017). This situation challenges the achievement of 'zero hunger', the United Nations (UN) Sustainable Development Goals (SDG) number 2 target by 2030 (Gonçalves et al., 2021; Imathiu, 2021). Therefore, exploring the potential of indigenous plants as valuable sources of food and to encourage socio-economic prosperity and improved livelihood cannot be over emphasized (Awodoyin et al., 2015; Omotayo et al., 2020).

The cultivation of indigenous plants, especially fruit and vegetables, has been described as an important social and economic unit of rural households, from which a diverse and stable supply of economic products and benefits are derived (Maroyi, 2009). Indigenous fruit and vegetables can improve the nutritional status, health, socio- economic, food security and livelihood outcomes of households. In addition, some indigenous plants and their products are sold in local and regional markets, thus improving the financial status and livelihoods of households. The sale of the cultivated indigenous fruit and vegetables and their products by rural households and small-scale farmers has been identified as a potential means of poverty alleviation (Kehlenbeck et al., 2013; Maroyi, 2009; Shumsky et al., 2014).

In Nigeria, improving and expanding the agricultural food production to meet the increasing food need of the growing population is important. There is a need for intensified effort to cultivate indigenous plants to ensure food availability and adequate reserves to accommodate the food requirements in rural communities for improved livelihood, economic development

and agricultural expansion (Nnadi et al., 2013). Cultivated indigenous plants and agricultural fields provide rural families with income, nutritious vegetables and animal feed, which helps communities to achieve self-sufficiency (Leakey et al., 2005; Maroyi, 2009; Wood et al., 2013). The rural poor remain "strugglers/hustlers" that undertake various enterprises through which they cobble together a livelihood. Researchers are aware of the insights of local people who are acknowledged within their own communities as experts on indigenous plants (Awoyemi et al., 2012; Cunningham, 2014). The inherent limitations (acceptability, availability of inputs, land tenure problems, maturity period) that affect many indigenous plant cultivation systems has resulted in their production remaining viable yet active in rural communities (Bassey and Ikpi, 2011; Maroyi, 2009).

In most parts of Nigeria, the diverse indigenous fruit and vegetables, their cultivations and profitability are not adequately documented (Awoyemi et al., 2012; Bassey and Ikpi, 2011). The cultivation of indigenous plants involves elaborate social, technological and economic mechanisms to safeguard the plant resources. We analyzed the profitability of indigenous plant cultivation, the factors influencing the decision of farmers to cultivate them on their lands, and their impact on the livelihoods of selected communal areas in Ondo State, Nigeria. The study further analyzed the socio-economic aspects of the rural farmers, and evaluated their ecological stability, impact, productivity and sustainability.

5.2 Materials and Methods

5.2.1 Study area

The study was conducted in Akure South local government area of Ondo State located in South-west Nigeria **(Figure 2.2)**. Akure is the capital of Ondo state, has a population of 665,524 and an area of 332 km^2(Afolabi et al., 2019), major occupation being farming. It consists of 11 wards with approximately 320 communities, some being mainly rural. It is about 900 km south-west of Abuja and 311 km North of Lagos State. The climate of Akure is both hot and humid, usually caused by rain-bearing southwest monsoon winds from the ocean and dry northwest winds from the Sahara Desert. The rainy season is from April to October, with approximately 1524 mm of rainfall a year, while the dry season lasts from December to February, the seasons influencing the crops that are grown or their maturation process. Akure lies about 7°25" North in equator and 75°19" east of the Meridian. It is about 900 km south-west of Abuja and 311 km North of Lagos State. Akure South is one of the 18 local governments of Ondo State,

Nigeria **(Figure 2.2).** The state lies between latitude 5° 45′ and 8° 15′ North, longitude 4° 45′ and 6° East. The climate of Akure is both hot and humid, usually caused by rain-bearing southwest monsoon winds from the ocean and dry northwest winds from the Sahara Desert.

Temperatures ranges between 28 to 31 °C with mean annual relative humidity of 80% and 250 m/ 1135 ft above sea level (Ajibefun, 2011). The two major rivers are River Owena and River Ala. The study area is characterized by flat or gentle steep. It is a humid forest zone. The major types of rocks found in Akure are granite and charmonite. The major occupation of the people is farming. The native language of the people of Akure land is 'Yoruba'. The people of Akure are very friendly and welcome other tribes, across the land are other ethnic groups including Ibo, Hausa and Fulani (Ajibefun, 2011). Akure is an agricultural trade centre for cassava, corn (maize), bananas, rice, palm oil and kernels, okra, rubber, coffee as well as various indigenous fruit and vegetables. Although cocoa is by far the most important local commercial crop, cotton, teak and palm produce are also cultivated for export.

5.2.2 The data sampling methods and sample size

The study targeted small-holder farming households with experience in indigenous fruit and vegetables production, with both random and purposive sampling techniques being applied. The study was conducted in randomly selected 40 out of the 320 communities in Akure South. The selection of the communities was based on the availability of indigenous plants in their natural habitat, its rural nature and farming culture. The total sample size was 400 participants (10 farming households from each of the 40 community), these farmers were indigenous cultivating farmers and those that are non indigenous cultivating farmers. Purposive sampling was used to identify suitable family's to obtain data from those who were considered to be the most knowledgeable in the field of interest or most experienced and successful (Guest, 2014). A structured questionnaire developed based on the objectives of the study, with face-to-face interviews being conducted in the native language (Yoruba).

5.2.3 Research instrument, validity, and reliability

An inventory of 16 indigenous fruit and 30 vegetables recognized as important and popular in Nigeria was generated, which was used as a checklist against which to identify those used by

the 40 communities **(Table 5.1)**. Prior to data collection, the voucher specimens for the selected indigenous fruits and vegetables were prepared and deposited at the herbarium of the Forestry Research Institute of Nigeria (FRIN), Ibadan, Oyo state, Nigeria.

A well-structured questionnaire was administered alongside with a photo album of the selected indigenous plants for ease of identification. The questionnaire was divided into three sections: A-collecting demographic characteristics; B-documented their indigenous knowledge and practices on the indigenous fruit and vegetables, while C-established how the indigenous fruit and vegetables were produced and enhanced their livelihood (Human, natural, social, financial and physical capital). The questions related to data about the local indigenous plant names, uses, commonly eaten, production, harvesting, sales, income generated and livelihood benefit

Table 5.1 Scientific names and families of the selected indigenous fruits and vegetables. The names were verified using the Plant List (http://www.theplantlist.org/).

s Fruits

hical Name	Family	*Vernacular name	Commonly utiliz parts
carpus communis (Parkinson ex F.A. Zorn) erg	Moraceae	Breadfruit (E), Berefuutu (Y)	Fruit, leaves, ste and roots
ia sapida K.D. Koenig	Sapindaceae	Ackee (E), Ishin (Y)	Fruit, bark, seed
s aurantifolia L.	Rutaceae	Lime (E), Oronbo were (Y)	Fruit
s aurantium L.	Rutaceae	Orange (E), Ganinganin (Y)	Fruit, bark and s
s nucifera L.	Arecaceae	Coconut (E), Agbon (Y)	Fruit and seed
sophyllum albidum G. Don	Sapotaceae	Africa star apple(E), Agbalumo (Y)	Fruit, bark and r
um guineense Willd	Leguminosae	Black velvet tamarind (E), Awin (Y)	Fruit
s guineensis Jacq	Asteraceae	Oil palm (E), Eyin (Y)	Fruit, seed and o
gia gabonensis (Aubry-Lecomte ex O'Rorke)	Irvingiaceae	Bush mango (E), Oro (Y)	Fruit, bark, seed
gia wombolu Vermoesen	Irvingiaceae	Bitter bush mango (E), Oro (Y)	Fruit and bark
ia biglobosa (Jacq.) G. Don	Leguminosae	Locust beans (E), Iru (Y)	Fruit and seeds
enetia conophora Müll.Arg.	Euphorbiaceae	Walnut (E), Awusa (Y)	Fruit, seed and r
num indicum L.	Solanaceae	African eggplant (E), Ajegun Were(Y)	Fruit
num aethiopicum Jacq.	Solanaceae	Garden egg (E), Igba (Y)	Fruit
dias mombin L.	Anacardiaceae	Hog plum (E), Iyeye (Y)	Fruit
broma cacao L.	Malvaceae	Cocoa (E), Koko (Y)	Fruit, bark, seed

s Vegetables

hical Name	Family	Vernacular Name	Plant Parts

atum conyzoides Hieron.	Asteraceae	Billy goat weed (E), Imiesu (Y)	Fruit, leaves, see root
ranthus hybridus Vell	Amaranthaceae	Africa spinach (E), Tete (Y)	Leaves and stem
ranthus spinosus L	Amaranthaceae	Spiny amaranthus (E), Teteelegun (Y)	Fruit, leaves and
ranthus viridis All	Amaranthaceae	Green amaranth (E), Teteabalaye (Y)	Leaves and stem
ographis paniculate (Burm.f.) Nees	Acanthaceae	King of bitter (E), Mejemeje (Y)	Leaves, stems ar
lla alba L.	Basellaceae	Malabarspinach (E), Amunututu (Y)	Leaves and stem
havia diffusa L.	Nyctaginaceae	Hog weed (E), Eemo/Olowojeja (Y)	Leaves and stem
*phyllum pinnatum (*Lam.) Oken	Crassulaceae	Miracle leave (E), Abamoda (Y)	Leaves and roots
a pentandra (L.) Gaertn.	Malvaceae	Baobao (E), Eegungun (Y)	Leaves and seed
molaena odorata L.	Asteraceae	Siam weed (E), Akintola (Y)	Leaves and roots
oscolus aconitifolius (Mill.) I.M. Johnst.	Euphorbiaceae	Chaya (E), Iyanapaja (Y)	Leaves and stem
socephalum rubens (Juss. ex Jacq.) S'more	Asteraceae	Coriander (E), Ebolo (Y)	Leaves, stem and
sia argentea L.	Amaranthaceae	Lagos spinach (E), Shokoyokoto (Y)	Leaves and stem
odendrum volubile P. Beauv.	Lamiaceae	White butter fly (E), Dagba(eweata) (Y)	Leaves and roots
horus olitorius f. grandifolius De Wild.	Malvaceae	Jute leaves (E), Ewedu (Y)	Leaves and roots
ta prostrata Lour.	Asteraceae	False daisy (E), Abikole (Y)	Leaves and stem
ypium barbadense L.	Malvaceae	Cotton seed (E), Owu (Y)	Fruit and seed
cus asper Hook.f.	Malvaceae	Hibiscus (E), Isapa (Y)	Leaves, seed and
aea taraxacifolia (Willd.) Amin ex C. ey	Asteraceae	Wild lettuce (E), Yanrin (Y)	Leaves and stem
hot utilissima Pohl	Euphorbiaceae	Cassava leaves (E), Ege (Y)	Leaves
na pruriens (L.) DC.	Leguminosae	Mucuna leaves (E), Esisi/Iwerepe (Y)	Leaves and root
um gratissimum L.	Lamiaceae	Scent leaves (E), Efirin (Y)	Leaves, seeds an
acuta Burm.f.	Malvaceae	Wire weed (E), Iseketu (Y)	Leaves, stem and
num erianthum D. Don	Solanaceae	Big eggplant (E), EwuroIjebu (Y)	Leaves, stem and
num macrocarpon Pav. ex Dunal	Solanaceae	Africa eggplant (E), Igbagba (Y)	Leaves, stem, ba

um nigrum Acerbi ex Dunal	Solanaceae	Black nightshade (E), Efoodu (Y)	Leaves, stem, an plant
*cio biafra*e Oliv. & Hiern	Asteraceae	Bologi (E), Woorowo (Y)	Leaves and stem
um triangulare Jacq.) Willd.	Talinaceae	Waterleaf (E), Gbure (Y)	Leaves and stem
onia adoensis var. adoensis	Asteraceae	Bitter leaf (E), Ewuroodo (Y)	Leaves, stem an plant
onia amygdalina Del.	Asteraceae	Bitter leaf (E), Ewuro (Y)	Leaves and stem

*Vernacular name, E = English, Y= Yoruba

5.2.4 Econometric model specification

Descriptive, inferential statistics and gross margin analysis were used in data analysis with the aid of STATA and SPSS software. Descriptive instruments, such as Tables, percentages, graph and frequency distribution were used to explain the socio-economic characteristics of the participants, while probit regression and propensity score matching analysis were employed for testing the hypothesis. The gross margin analysis was carried out to measure the profitability of indigenous plants production. According to (Omotayo and Oladejo, 2016), the gross margin is measured as Total Revenue (TR) less Total Variable Cost (TVC). The net return (Profit) was calculated by subtracting the Fixed Cost (FC) from Gross Margin (GM). Mathematically: TC = TFC + TVC

$$GM = TR - TVC \quad \ldots\ldots (1)$$

$$NR/PROFIT = GM - TFC \quad \ldots\ldots (2)$$

Where, GM = Gross Margin; TR = Total Revenue; NR = Net Return; TFC = Total Fixed Cost and TVC = Total Variable Cost. TC= Total Cost

5.2.4.1 Probit regression analysis of factors influencing the participant's decision to utilize their lands for indigenous fruit and vegetable cultivation

A probit regression model was fitted to assess the determinants of rural household's decision to utilize their land for indigenous fruits and vegetables. The model is the standard method for estimating binary category dependent variable and due to the dichotomous nature of the dependent variable, which is the dummy form of whether the participants decide to utilize their land for the cultivation of indigenous fruits and vegetables or not. Probit regression is a mathematical modelling approach that can be used to describe the relationship of several independent variables to a dichotomous dependent variable, also called a probit model, being used to model dichotomous or binary outcome variables (Olagunju et al., 2021).

In the probit model, the inverse standard normal distribution of the probability is modelled as a linear combination of the predictors. The probit model constrains the estimated probabilities to be between 0 and 1, and relaxes the constraint that the effect of independent variables is constant across different predicted values of the dependent variable (Ogunniyi et al., 2018; Ogunniyi et al., 2021). The probit model assumes an S-shaped response curve, such that in

each tail of the curve, the dependent variable responds slowly to changes in the independent variables, while towards the middle of the curve, i.e., towards the point where Pr (Yi = 1) is closest to 0.5, the dependent variable responds more swiftly to changes in the independent variables. The probit model assumes that while we only observe the values of 0 and 1 for the variable Y, there is a latent, unobserved continuous variable that determines the value of Y. We assume that Y can be specified as follows:

$Yj = \alpha + \beta j \sum_{i=1}^{n} Ij \quad + uj$'…… (3)

$P_i = \alpha_o + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \alpha_8 X_8 + \alpha_9 X_9 + \alpha_n X_n + \ldots + e_{i\ldots\ldots}$ (4)

Where Y_j is the binary dependent variable indicating the participants' decision to cultivate indigenous fruit and vegetables on their lands. Dummy variable: 1 is if yes and 0 if otherwise; α and β $_a$re the parameters of the estimates; n = number variables; μ_j= Error term; I_j = the independent variables are as stated in **Table 5.2**. Thus, the null hypothesis indicates that there is no significant relationship between the socio-economic characteristics and decision of households to cultivate indigenous fruits and vegetables on their land.

Table 5.2: Variables influencing the decision of participants to cultivate indigenous fruits and vegetables on their lands

Variables	Description and measurement units
Age	Age of the participant, in completed years
Marital status	Marital status of the participant? (1=married, 0=otherwise)
Educational status	Years of formal schooling? (In completed years)
Other occupation	Other occupation of the participant apart from farming? (1=yes, 0=no)
Ethnicity	Ethnic group of the participant? (1= Yoruba,0= otherwise)
Household size	Number of household members? (Head count)
Years of experience	Experience in farming? (Number of years)
Storage techniques	Storage method of the product? (1= basket,0=otherwise)
Nutritional benefits	Nutritional advantages of indigenous plants? (1=yes, 0=no)
Drought resistant benefits	Drought resistant advantages of indigenous plants? (1=yes, 0=no)
Low input requirement benefits	Low input advantages of indigenous plant? (1=yes, 0=no)
Pest and disease benefits	Pest and diseases resistant advantages of indigenous plants? (1=yes, 0=no)

Variables	Description and measurement units
Financial return	Total value of revenue from indigenous plant production in Naira (Continuous)
Membership of cooperative society	Participant's cooperative membership? (1=yes, 0=no)
Customer access to farm	Can potential buyers have access to the farm? (1=yes, 0=no)
State of infrastructure	Is the farm land having necessary infrastructure? (1= yes, 0=no)
Financial gain	Is indigenous plant cultivation profitable? (1=yes, 0=no)
Transportation cost	Total value of transportation during production in Naira (Continuous)
Labour cost	Total labour production in Naira (Continuous)
Established market	Is there market for the indigenous plants produced? (1=yes, 0=no)
Road availability	Is there accessible road leading to the farm? (1= yes, 0=no)
Access to government subsidies	Do you have access to government subsidies? (1= yes, 0=no)

5.2.4.2 Principal component analysis of the livelihood asset index generation

In this study, Principal Components Analysis (PCA) was used to compute composite indices of the household's livelihood generation from the sustainable livelihood questions **(Table 5.3)**. This approach helps capture the different dimensions of the household's livelihood assets in a composite manner, bearing in mind the likely correlation that could exist among some variables. To allow for equal weighting across the measures of livelihood, five questions from each of the sustainable livelihood indicators were selected. The selection of the indicator was guided by insights drawn from the livelihood asset literatures as well as availability of data (Kaza et al., 2018; Rada et al., 2014). All the major dimensions of sustainable livelihood have been represented by at least four indicators. A livelihood asset variable (PCA-based livelihood index) was generated. The variables selected for constructing the livelihood index were the five sustainable livelihood categories coded as 1 if yes and 0 otherwise, the categories being human capital, natural capital, social capital, financial assets and physical capital assets, which was computed as follows:

$$\text{Livelihood index} = \emptyset_{\mathrm{i}} + \beta_{\mathrm{i}} \sum_{n=1}^{C} N_{\mathrm{ir}} + z_{\mathrm{v}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (5)$$

Where livelihood index is the composite waste index,$\emptyset_i$, β_i represents those parameters to be estimated. However, N_{ir} represents the vector of variables and z_v the error term. The study then used the index generated by the PCA as the outcome variable in the propensity score matching model employed for the impact of indigenous fruit and vegetable cultivation on their livelihoods using propensity score matching.

5.2.4.3 Impact of cultivating indigenous fruits and vegetables on their livelihoods using propensity score matching

The concept of propensity score matching (PSM) was first introduced by Rosenbaum and Rubin,(Rosenbaum and Rubin, 1983). As a program evaluation technique, PSM compares the outcomes of program participants with 'equivalent' non-participants (Rufai et al., 2021). As the two groups are comparable, based on the observed characteristics, except for program participation, the differences in the outcomes are assumed to be attributed to the program. The estimated propensity score, for subject $e(x_i)$, $(i = 1,\ldots, N)$ is the conditional probability of being assigned to a particular treatment, given a vector of observed covariates x_i (Rosenbaum and Rubin, 1983):

$e(x_i) = \Pr(z_i = 1 \mid x_i)$ …… (6)

and

$\Pr(Z_i, \ldots., X_1, \ldots X_n) = \sum_{i=1}^{N} e\{X_i\}^{zi}\{1 - e\{X\}^{1-zi}$ …… (7)

Were

z_i= 1 for treatment

z_i= 0 for control

x_i= the vector of observed covariates for the i^{th} subject.

The propensity score is a probability, ranging in values from 0 to 1, with matching used in a randomized experiment comparing two groups, ideally scoring each participant as 0.50. This is because each participant would be randomly assigned to either the treatment or the control group, with a 50% probability. In this study, PSM was used to evaluate the impact of cultivating indigenous fruit and vegetables on the livelihood of the households and enables the calculation of the mean effect of their cultivation on the participants. If Y_1 denotes the potential outcome conditional on indigenous fruit and vegetable cultivation and Y_0 the potential

outcome conditional on non-cultivation of indigenous fruits and vegetables, the impact of program is given by:

$$\Delta = Y_1 - Y_0 \quad \text{.....(8)}$$

5.2.4.4 Estimating the impact (Average Treatment Effect on the Treated)

The matched sample was used to compute the Average Treatment Effect for the treated (impact). It is estimated as follows:

ATT= E (Δ | D=1, **X**) = E ($Y_1 - Y_0$| D = 1, **X**) ……. (9)

= E (Y_1 | D = 1, **X**) - E (Y_0 | D = 1, …….....(10)

Where D = 1 denotes indigenous fruits and vegetables cultivating household (treatment) and **X** is a set of conditioning variables on which the subjects were matched. Equation 8 would have been easy to estimate except for the equation E (Y_0 | D = 1, X). This is the mean of the counterfactual and denotes what the outcome would have been among participants had they not participated in the treatment, with PSM providing a way of estimating this equation.

ATT= E [Y_1 | D = 1, P(X)] = E [Y_0 | D = 0, P(X)] ……. (11)

Equation 10 is applicable to single programs where the treatment variable is categorical with only two mutually exclusive categories, although the equation is easily generalized to multiple programs (Imbens and Hirano, 2004; Lechner, 1999, 2001). The ATE, i.e., the average effect of the treatment for an individual drawn at random from the overall population at random, is:

$$ATE = \frac{N_1}{N} \times ATT + \frac{N_0}{N} \times ATU \quad \text{……. (12)}$$

Where N_1 is the number in the treatment group and N_0 the number in the control group. The above equation shows the relationship between ATT (average treatment on the treated), ATE (average treatment effect on an individual) and ATU (average treatment on the untreated). The null form of the set hypothesis was that there is no significant relationship between the impact of cultivating indigenous fruit and vegetable and the livelihood of households in the study area.

Table 5.3: Dummy variable used to generate composite livelihood asset indices

Households' livelihood assets	Description	Mean	S. D
Human capital			
Do you have vocational training in indigenous fruits and vegetables?	Dummy	0.73	0.4405
Technical training on how to cultivate indigenous fruits and vegetables?	Dummy	0.55	0.4981
Marketing skill on indigenous fruits and vegetables?	Dummy	0.535	0.4993
Do you have innovative product(s) from indigenous fruits and vegetables?	Dummy	0.441	0.4971
Do you have access to government agent for on job training or follow-ups?	Dummy	0.303	0.4599
Natural capital			
Do you have access to land?	Dummy	0.317	0.4661
Do you utilise the land for indigenous fruits and vegetables?	Dummy	0.308	0.4620
Do you have access to water?	Dummy	0.358	0.4798
Do you have or own livestock?	Dummy	0.421	0.4943
Social capital			
Networking with another indigenous fruit and vegetable seller?	Dummy	0.458	0.4989
Networking with government relevant ministry?	Dummy	0.754	0.4309
Do you network with international organizations or another farmer cooperative?	Dummy	0.510	0.5005
Do you network with professional membership and organization such as the National Fadama Development Project (NFDP), Agricultural Development Programme (ADP)?	Dummy	0.487	0.5005
Are you part of any trade unions?	Dummy	0.352	0.4835
Do you network with village or community committee?	Dummy	0.234	0.5601
Financial capital			
Access to banks and cooperative?	Dummy	0.425	0.4949
Personal savings?	Dummy	0.225	0.4181
Access to Government subsidies or grants?	Dummy	0.692	0.4620
Access to money from relatives?	Dummy	0.525	0.500
Networking with financial institutions?	Dummy	0.340	0.474
Physical capital			
Is there an established market for indigenous fruits and vegetables?	Dummy	0.448	0.4978
Are roads accessible?	Dummy	0.795	0.4042
Telephone infrastructure?	Dummy	0.817	0.3871

Households' livelihood assets	Description	Mean	S. D
Access to private vehicle or other means of transportation?	Dummy	0.320	0.4671
Ease of access to customers?	Dummy	0.317	0.4660

5.2.5 Ethical Approval

The ethical clearance (certificate no: NWU-01771–20-A9) for the research was approved and designated as a minimal risk by the Faculty of Natural and Agricultural Sciences Research Ethics Committee (FNASREC), North-West University, South Africa. The rule of voluntary participation and withdrawal of the participant at any given time was observed. Furthermore, the principle of privacy, autonomy, dignity, and respect was observed all through the survey administration.

5.3 Results and discussion

5.3.1 Socioeconomic characteristics versus land utilization status of the participants

Table 5.4 represents the descriptive results of the variables used in the probit regression model. The dependent variable is the total farm revenue of the indigenous fruit and vegetables, measured in Naira (Nigerian Currency:1USD = ₦450, during the survey Period September - November 2021). About 69.25% of the participants cultivate indigenous fruits and vegetables on their lands. The average total revenue (₦72,345.53) made from farming was significantly higher among those who cultivated indigenous fruits and vegetables than the participants who did not (₦55, 888.99). This translates into 29.40% increase in the average total farm revenue by those who cultivates indigenous fruits and vegetables relative to participants who do not.

The participants' demographic characteristics shows that 60.50% of the farmers were male while 39.50% were females, showing that there were more men farming than women in the study area. This is in line with the traditional knowledge that male is often more involved in agriculture that the female counterparts. This also corroborates with the findings from several studies that males were more likely to cultivate indigenous plants than females (Dadjo et al., 2020; Nkonki-Mandleni and Omotayo, 2020; Omotayo et al., 2020).

The average age of the participant was 50.25 years with 41.80% of the participants within the age category of 48-57 years. This is in line with Omotayo (2016), who suggested that the age bracket is the economically active age and as such will respond positively to livelihood intervention aimed at improving the productive capacity of the rural households. Furthermore, the marital status of the participants shows that 86% were married while singles, divorced and widow(ers) comprised 4.30% each. This is a good indicator of the possibility of improved

livelihood because the family members of the married participants have the probability of assisting in the cultivation of the indigenous fruits and vegetables. Hence, the lower production cost and higher revenue for better livelihood among the indigenous plant farmers in the study area. Furthermore, the availability of family labour reduces labor constraints faced during the peak of the farming season, which if properly managed leads to increase in indigenous plant production in the study area.

In terms of the educational attainment of the participants **(Figure 5.2)**, secondary/high school education was the most (42.00%) dominant level. This shows a considerably low level of education among the participants, educational attainment has been confirmed as a viable contributor to productivity of farmers as this could assist the farmers in understanding of the dynamics of the farming enterprise (Daud et al., 2018; Olagunju et al., 2021; Omotayo, 2016; Wu, 1977; Zakaria, 2017). Educational attainments could also help the participant to stand a good chance embracing innovation in cultivating in indigenous fruit and vegetable in the study area.

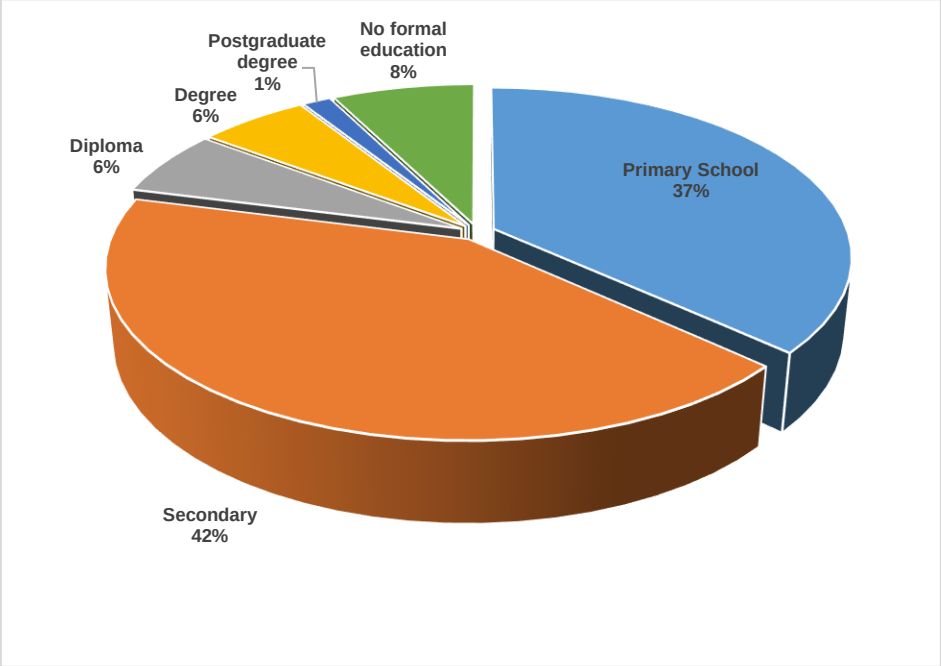


Figure 5.2 Educational attainment of the participants in the study area, (n=400)

An average household size of 6 was observed in the study, with 56% of the families having 6-10 members. As agricultural production activities are labour intensive, large households can provide farm labour at little or no direct cost (Omotayo, 2016; Omotayo and Oladejo, 2016). The participants were mainly of Yoruba tribe (88.30%) due to the location of the study area.

This is line with (Ajibefun, 2011), who indicated that the native language of the people of the Akure land, Ondo state is 'Yoruba'. Their cultural dominance and land ownership will result in their cultivating the indigenous fruit and vegetable of their choice, without being mindful of restrictive lease or rental conditions The average years' experience of the participants in indigenous fruit and vegetable cultivation was 19.16 years. This indicates that most families have been farming for a long time, and the accumulated years of experience will help them to plant, accommodate climate change adaptation strategies, have good seasonal knowledge, and be familiar with pest and disease control, agronomic and technical problems in farming, *Ceteris peri bus* (Omotayo and Oladejo, 2016).

Table 5.4 Socioeconomics characteristics disaggregated by land utilization status of the participants

Variable	Pooled (n=400)		Indigenous plants farmers (n=277)		Non-indigenous plant farmers (
e variable	Mean	S. D	Mean	S. D	Mean
m revenue	64,117.3	50130.93	72345.53	58743.86	55888.99
od index	3.42e-09	2.107	-0.84990	1.42101	1.9018
nomics variables					
	0.395	0.4894	0.3935	0.48941	0.39837
	50.25	9.582	50.1264	9.0835	50.528
tatus	1.07	0.513	1.0974	0.51908	1.016
nal Status	1.15	1.405	1.0722	1.41748	1.3414
on	1.65	3.35	1.8014	3.7783	1.333
	0.175	0.55	0.18050	0.53492	0.1626
ld size	6.075	2.258	5.9097	2.1099	6.447
Experience	19.16	10.619	18.144	10.106	21.447
echniques	0.36	0.481	0.36101	0.48116	0.3577
al benefits	3.278	0.698	3.3357	0.64767	3.1463
resistant benefits	2.71	1.046	2.7039	1.0763	2.7235
ut requirement benefits	2.669	1.148	2.9205	0.9673	2.0983
disease benefits	2.817	0.949	2.78339	.94217	2.8943
return	0.105	0.307	0.06859	0.25321	.18699
ship of cooperative society	0.305	0.461	0.27797	0.44881	.36585
r access to farm	0.163	0.369	0.10507	0.30720	.29268
nfrastructure	1.492	0.592	1.4693	0.58665	1.5447
gain	0.237	0.443	0.2346	0.44942	0.2439
tation cost	1628.82	2881.0	1437.688	2256.516	2057.7
ost	1021	9049.40	10476.53	9236.447	9632.52

Variable	Pooled (n=400)		Indigenous plants farmers (n=277)		Non-indigenous plant farmers	
ed market	0.34	0.4743	0.20577	0.40499	0.64227	0
ilability	0.52	0.5002	0.45126	0.49851	0.67479	0
o government subsidies	0.692	0.462	0.649819	0.47788	0.78861	0

5.3.2 Land utilization and total farm revenue of the participants

The variables and their descriptive statistics, including mean and standard deviations, are presented in **(Table 5.4)**, and includes the disaggregated indigenous and non-indigenous farmer's statistics. The data reveals obvious difference across of the variables between the two groups, and that the indigenous fruit and vegetables farmers (69.25%) possibly invested less on production inputs, including labour, pest and diseases management, compared to the non-indigenous farmers, thereby generating more revenue than their counterparts. **(Figure 5.3)** shows the farmers Kernel density distributions of total revenue as being disaggregated by their land utilization status. Cox (2004) provides a detailed description on kernel density. The natural log (ln) of the average total revenue made from farming was significantly higher among those who cultivate indigenous fruit and vegetables than the participants who do not. Observable differences are noted between the two groups, which corroborates the literatures that cultivating indigenous fruit and vegetables contributes to the income and livelihood of people in rural areas (Omotayo et al., 2020) . However, this study demonstrates this further because the previous evidence does not adjust for bias from unobservable factors. Furthermore, this difference in the two groups of farmers may indicate unobservable factors that can affect production risks differently, such as justifying the basis for the choice of the propensity score matching model for the analyses.

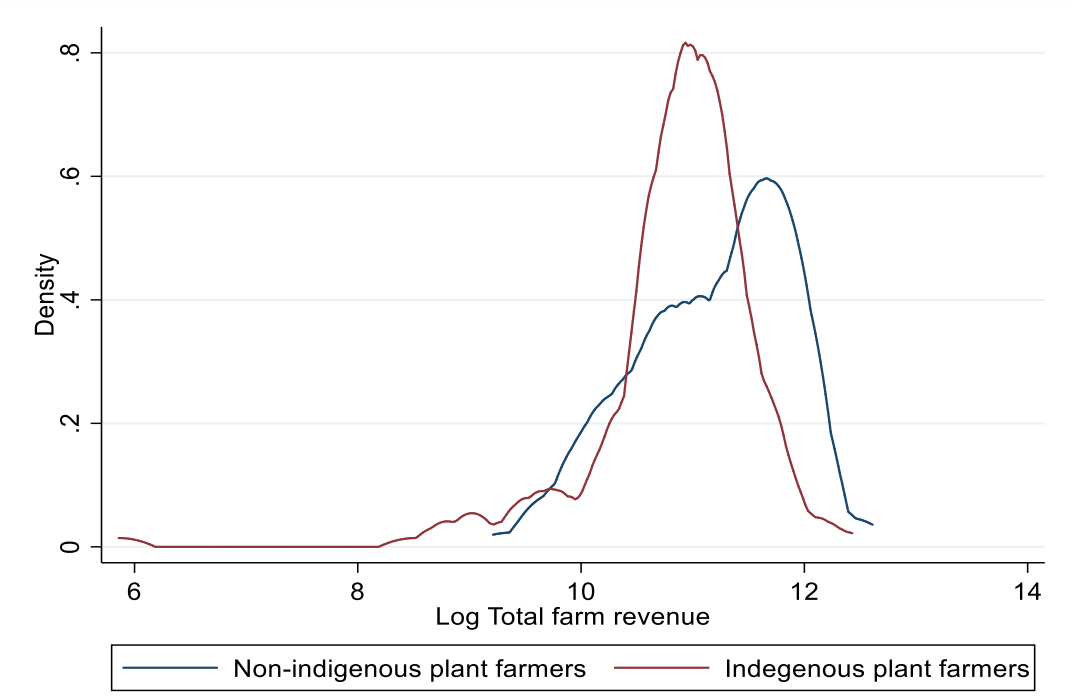


Figure 5.3 Kernel density distributions of total revenue disaggregated by land utilization

5.3.3 Gross margin analysis result

Gross margin is the difference between the Total Revenue (TR) and the Total Variable Cost (TVC). It is a useful planning tool in situations where fixed capital is a negligible portion of the indigenous fruit and vegetable enterprise.

Therefore, GM =TR-TVC = ₦64,117.3– ₦35,379.50 = ₦28, 737.8/Ha

GM = ₦28, 737.8/Ha

In addition,

Net Return/Profit = GM – TFC = ₦28, 737.8 –₦9,550 = ₦19,187.8 /Ha

The profitability analysis of the indigenous fruit and vegetable revealed that the Gross Margin of the rural farmers in Akure South local government area of Ondo State, Nigeria, is ₦28, 737.8/Ha, the profitability being ₦19,187.8 /Ha. These figures indicate that indigenous fruit and vegetables cultivation is profitable and supports the literature in this regard (Burkhart and Jacobson, 2009; Halli et al., 2016; Mvungi et al., 2020; Ojiewo et al., 2013). However, the profitability level remains small, probably due to lack of adequate recognition of the importance of indigenous fruit and vegetables by consumers, unlike their counterparts who use exotic products. In addition, the low profitability rate could be due to the productivity level of the varieties that are available, which are mainly indigenous, with plant breeding and scientific improvement possibly helping to improve their yield/Ha, productivity and profitability, which will transfer into a better livelihood of the rural farmers (Grenz and Sauerborn, 2007; Saxena et al., 2018).

5.3.4 Factors influencing the participant's decision to utilize their lands for indigenous fruit and vegetable cultivation

Studies on factors influencing the decisions of farmers to cultivate indigenous plants remain relatively scarce in Nigeria, specifically fruit and vegetables cultivation **(Table 5.5)**. The average marginal effects were estimated and reported to ensure the results are better interpreted (Greene, 2003). The measures of goodness of fit for the model, such as the Wald chi^2, Pseudo R^2, were calculated. According to the diagnostics measures utilized in the study, the model is regarded as a good fit. The utilized variables were subjected to a multicollinearity test, which was conducted with a variance inflation factor (VIF) of 1.47, which indicates that there was an absence of serious multicollinearity in the analysis. Given that many variables that captured the

socio-economic and participant's decision to utilize their land to cultivate indigenous products had different level of statistical significance, the null hypothesis was rejected.

In this study, the marital status of the participants was negative and significant ($p<0.1$) which indicates that this status decreases their probability of deciding to cultivate indigenous fruit and vegetables. The coefficient of their educational attainment was positive and significant ($p<0.05$). *Ceteris peri bus*, households with higher levels of education had a 0.037 probability of cultivating indigenous fruit and vegetables in the study area. Education facilitates the ability to explore and acquire new information, such as new plant cultivations, access to market, input prices as well as cost and returns (Schreinemachers et al., 2016). Their education status may influence their decision to use their land to cultivate indigenous fruit and vegetables in the study area.

The probability of another occupation (civil servants, traders, apprentice) for the participants was negative and significant ($p<0.01$). This implies that having other occupations in the selected rural areas decreased the possibility of the farmers deciding to cultivate indigenous fruit and vegetables significantly. This might be due to time constraints and the time demand of farming, making it difficult to have another occupation. In addition, poor awareness on the lucrativeness of the enterprise could also deter or reduce their decision to cultivate indigenous plant varieties. This conformed to the findings of Omotayo et al. (2020) that there is need for awareness on the nutritional and economic advantages of many indigenous plants. The coefficient on knowledge of the nutritional benefits of indigenous fruit and vegetables among the participants was significant ($p<0.01$) and positive. Knowledge on their benefits has the probability of increasing the decision to utilize their land for cultivating indigenous products.

Another important factor that influences the decision to use their land to cultivate indigenous fruit and vegetables is the knowledge of the associated low input requirement. Farmers that have this knowledge are more likely to use their land for its cultivation. This is expected, given that many rural smallholder farmers often need to minimize their cost of production in order to obtain higher farm revenue and profit. Knowledge about the low-level of pests and diseases associated with indigenous fruit and vegetables was significant ($p<0.1$) and was found to influence their decision to grow such crops. A unit increase in the knowledge of these rural farmers are more likely to marginally result in 0.0711 increase in probability of farmers

deciding to cultivate them. In terms of the knowledge of the financial returns from the cultivation of indigenous fruits and vegetables, a positive and significant ($p<0.01$) value was recorded. The knowledge can increase their probability of using their land for its cultivation. This further translates into the fact that a unit increase in the participant's knowledge of financial return from cultivating indigenous fruits and vegetables led to 0.2843 increase in the probability of using their farmland for such cultivation. Additionally, the variable representing customer access to the farm and the state of infrastructure were positive and significantly ($p<0.01$ and $p<0.05$ respectively) influence the decision to cultivate indigenous fruits and vegetables. This suggests that farmers with better knowledge about access of customers to farm and the importance of good infrastructure being more likely to influence farmland use for cultivating indigenous fruits and vegetables. The purpose of these two variables is to enhance the production and marketing of the plants, as described in literature (Aubert et al., 2012; Doss, 2006).

The coefficients of the financial gains from cultivating indigenous fruits and vegetables, as well as transportation cost were positive and significant ($p<0.1$ and $p<0.05$ respectively). This implies that knowledge about the financial gains and transportation cost from cultivating indigenous fruit and vegetables has the probability of influencing their decision to use their land for cultivating indigenous plants or not. This is expected, as adequate knowledge is essential before investing in any business venture, this knowledge will guide the farmers in order to achieve their goal of making profit. The results marginally indicate that a unit increase in the financial gains of farmers from cultivating indigenous fruits and vegetables, as well as the transportation costs, will increase the probability of utilizing their farmland for cultivating indigenous fruits and vegetables in the study area. This aligns with the apriori expectation, as adequate knowledge of the possible financial gain and cost implications will aid the decision on delving into such business adventures.

Furthermore, the labour cost of producing indigenous fruits and vegetables was negative and significant ($p<0.05$). In the study area, a reduction in the labour cost of production increased the probability of the farmers' deciding to utilize their land to cultivate indigenous fruit and vegetables. This corroborates the apriori knowledge, as it is rational to decide in favour of their cultivating when the labour cost is lower, as this will increase the probability of higher profit

from the enterprise, hence a better livelihood for the farmer (Fox and Sohnesen, 2012; Kuivanen et al., 2016; Paudel Khatiwada et al., 2017).

In addition, the variable representing the farmers knowledge about established market for the indigenous fruit and vegetables was positive and significant ($p<0.01$). This implied that the more knowledgeable the farmer about the presence of a market for their produce, the higher will be their probability of deciding to utilize their farmland for its cultivation. This is expected, as knowledge of market availability is key to production of agri-produce, especially in the case of perishable produce, such as fruit and vegetables (Gardas et al., 2019; Shukla and Jharkharia, 2013). Finally, the coefficients of access to government subsidies by participants was positively significant ($p<0.1$). An increased in the farmers access to government subsidies has the probability of enhancing their decision to cultivate indigenous fruits and vegetables in the study area. This is expected, as access to government subsidies/support to access viable seeds, chemicals and fertilizers could encourage the farmers to use their land to cultivate indigenous fruit and vegetables area. This will translate into better income and improved livelihood among the rural farmers (Muimba-Kankolongo, 2018).

Table 5:5 Probit regression result of the factors influencing the decision to utilize lands for indigenous plant's cultivation

Variable	Coefficient	Robust Std. Error	t	P>|t|	Tolerance	Marginal Effect	Robust Std. Error
Age	-0.0048	0.0115	-0.42	0.676	0.4679	-0.00152	0.0036
Marital status	-0.3690	0.1891	-1.95	0.051*	0.8802	-0.1173	0.0596
Educational status	0.1165	0.0577	2.02	0.044**	0.9051	0.03704	0.0184
Occupation	-0.0687	0.0227	-3.03	0.002 ***	0.9236	-0.0218	0.0072
Ethnicity	-0.2022	0.1576	-1.28	0.200	0.8152	-0.0643	0.0502
Household size	-0.0463	0.0455	-1.02	0.310	0.6707	-0.0147	0.0144
Years of experience	0.0152	0.0114	1.34	0.182	0.4234	0.0048	0.0036
Storage techniques	0.2004	0.1971	1.02	0.309	0.7193	0.06487	0.0648
Nutritional benefits	0.2833	0.1388	-2.04	0.041**	0.7912	-0.09009	0.0439
Drought resistant benefits	0.1346	0.0974	1.38	0.167	0.5699	0.0428	0.0310

Variable	Coefficient	Robust Std. Error	t	P>|t|	Tolerance	Marginal Effect	Robust Std. Error
Low input requirement benefits	0.3619	0.0818	4.43	0.000***	0.6575	0.1150	0.0257
Reduced pest and disease benefits	0.2236	0.1192	1.88	0.061*	0.6035	0.0711	0.0372
Financial return	0.7789	0.2575	3.02	0.002***	0.7878	0.2843	0.0996
Membership of cooperative society	-0.0970	0.2009	-0.48	0.629	0.6561	-0.0304	0.0623
Customer access to farm	1.0724	0.2457	4.36	0.000***	0.6524	0.3910	0.091
State of infrastructure	0.3652	0.1519	2.40	0.016**	0.7749	0.1161	0.0476
Financial gain	0.4319	0.2426	1.78	0.075*	0.6971	0.1373	0.0768
Transportation cost	0.0000	0.0000	2.05	0.041**	0.6304	0.0000	0.0000
Labour cost	-0.0000	0.0000	-2.07	0.038**	0.6178	-7.15e-06	0.0000
Established market	0.8331	0.1743	4.78	0.000***	0.7326	0.2811	0.0593
Road availability	0.2654	0.1798	1.48	0.140	0.7248	0.08395	0.0562
Access to government subsidies	0.3235	0.1885	1.72	0.086*	0.7946	0.0983	0.0539
Constant	-0.4081	0.8100	-0.50	0.614			
Number of observations	400						
Wald chi^2 (22)	136.91						
Prob > chi2	0.0000						
Pseudo R^2	0.3301						
Log pseudolikelihood	-164.064						
Mean Variance Inflation Factor (VIF)	1.47						

Note: *** p<0.01, ** p<0.05, * p<0.1

5.3.5 Impact of indigenous fruit and vegetable cultivation on farmer's livelihood outcome

The estimated average impact of cultivating indigenous fruit and vegetables on livelihood outcomes (livelihood and average farm revenue) of households was denoted by the Average Treatment Effect for the treated (impact) ATE, with the impact parameter suggesting that cultivating indigenous fruit and vegetables will increase farmer livelihood and farm revenue by 2.265 and 17604.85, respectively. Levels of 120.70% and 24.30% increase in livelihood outcomes were recorded as a result of cultivating indigenous fruit and vegetables for livelihood and farm revenue, respectively **(Table 5.6, Figure 5.4)**. Therefore, the null hypothesis was rejected as the result is congruence with the descriptive findings of this research, that the farming households that cultivate indigenous fruits and vegetables have better average farm revenue and livelihoods than those who do not. This corroborates the literature that the cultivation of indigenous plants contributes to livelihood improvement of households (Kehlenbeck et al., 2013; Muhanji et al., 2011; Tanimonure et al., 2021).

Table 5.6 Propensity score matching results of the impact of indigenous fruit and vegetable cultivation on household's livelihood outcomes

Outcome variables	Sample	Treated	Controls	Difference	T-stat
Livelihood	Unmatched	1.89110243	-.849916718	2.74101915	14.87
	ATT	1.87670221	-.388338309	2.26504052	6.12
Average farm revenue	Unmatched	72717.2131	35931.8182	36785.3949	7.14
	ATT	72574.3802	54969.527	17604.8531	1.68

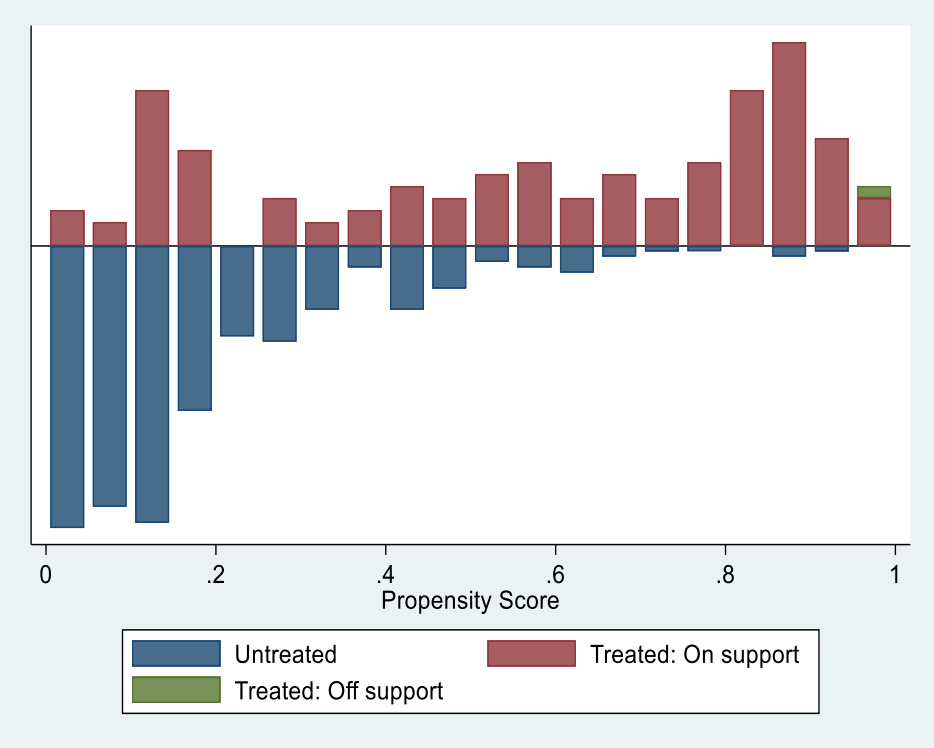


Figure 5.4 Density of the propensity scores and common support for indigenous fruit and vegetable farmers and non-indigenous fruit and vegetable farmers.

5.4 The study limitations

The study relied solely on the information from 400 selected rural indigenous and non-indigenous fruits and vegetables cultivating households in Akure South local government and not the entire local governments in the state. In addition, out of the 320 communities in Akure South local government area, 40 were selected, which cannot be taken as a general representation of the knowledge of the impact of indigenous fruit and vegetables on household livelihood in Ondo state and Nigeria as a whole. The current study focused on farmers and knowledge holders in the selected communities and not the entire populace.

5.5 Conclusions and recommendations

Based on the observed farming practices in the study area, the cultivation of indigenous fruit and vegetables should be encouraged to improve the livelihoods and rural development of farming households in Nigeria. Policies that seek to promote the livelihood of smallholder farming households need to recognize and support the cultivation of indigenous fruit and vegetables rather than the natural imposed, narrowly framed, rural economic growth narrative that can potentially erode the indigenous fruit and vegetables food complementarities. The findings emphasized the role of educational attainment, government subsidies, knowledge of

the nutritional benefits of the indigenous fruit and vegetables as key determinants for farmers to decide whether to cultivate them. Kernel distribution revealed that the natural log (ln) of the average total revenue made from farming was significantly higher among those who cultivate indigenous fruits and vegetables than the participants who do not. In addition, the study affirmed that cultivating indigenous fruit and vegetable has the potential to increase livelihood and farm revenue by 2.265 and 17604.85, respectively. Likewise, livelihood and farm revenue generated levels of 120.70% and 24.30% increase respectively.

The conditions necessary for enabling poor households to explore the benefits of cultivating indigenous fruit and vegetables needs to be encouraged and prioritized in the rural communities of Nigeria. Policies that tend to prioritize intensified and commercialized cultivation of indigenous fruit and vegetables as complementarities for the livelihood of farming households should be encouraged. If farming households are to be supported in improving their livelihood, sufficient land for cultivation should be given priority in rural development and agricultural policies. Policy interventions targeted towards strengthening the biotechnological advancement of indigenous fruit and vegetables remain pertinent. This will contribute toward novel strategies for producing suitable indigenous plant genotypes that are capable of resisting drought, high temperature, submergence and salinity stresses, thereby improving their cultivation and production. Furthermore, there is need for policies that are directed towards enhanced awareness programmes, improved access to affordable financing options, and the provision of incentives for the cultivation of indigenous fruit and vegetables.

CHAPTER 6: GENERAL CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

Indigenous fruits and vegetables have played a major role in Nigeria in terms of food security, poverty and hunger alleviation because in many of the local communities where these plants are found, the indigenous people make use of them as their staple food, medicinal plants and means of livelihood, hence they play a major role in eradicating food insecurity. The surveys of socio-economic group in various parts of Nigeria showed that indigenous vegetables and fruits create opportunities for employment and serve as income generation for the rural population.

6.2 Research highlights

The current study reports the use of forty-six (46) selected indigenous fruits and vegetables (IFV) species (16 indigenous fruits and 30 indigenous vegetables) in the food pattern and for consumption in 40 selected communities in Akure South LGA of Ondo state. The most widely used IFV in the study area belong to 19 families, the most popular of which are Asteraceae (9) and Malvaceae (7). In the study area, many people still rely on the plants that grow around them for their sustainable dietary supplements and health needs. The result from the present study reveals that the most popular IFV used by the participants according to their UV were *Ageratum conyzoides* Hieron (0.9), *Citrus aurantifolia* (Christm) swingle (0.9), *Amaranthus hybridus* Vell. (0.9), *Artocarpus communis* (Parkinson ex F.A. Zorn) Fosberg (0.8), *Elaeis guineensis* Jacq (0.8), *Corchorus olitorius* f. *grandifolius* De Wild. (0.8), *Crassocephalum rubens* (Juss. ex Jacq.) S'more (0.8) *Talinum triangulare* (Jacq.) Willd (0.9), *Vernonia adoensis* var. *adoensis* (0.9) and *Vernonia amygdalina* Delilee (0.9).

They are well recognized and known by the respondents for their diverse uses, most especially *A. Conyzoides* even though is a common weed found everywhere its value is inestimable due to its diverse uses in treating different ailments, highly medicinal so also, is *C. aurantifolia* an indigenous fruit, a medicinal plant that cure many ailments. In addition, the indigenous fruits and vegetables served as food (53%), medicine (46%) and fuel (1%) as the reported used in the study area. Indigenous fruits and vegetables are regarded as neglected plant species and are under-studied. Some of the indigenous plants that have has been used locally as blood tonic to boost blood and increase immunity include Malabar spinach, bologi, coriander, mucuna leaf and waterleaf when consumed. Findings also show that jute leaves when consumed has been used several times to aid childbirth delivery while walnut eaten raw is an antidote for curing snake bite.

In addition, the impact of indigenous fruit and vegetable cultivation on the livelihood of the participants was assessed. The study revealed that cultivating indigenous fruit and vegetable was profitable (₦19,187.8/USD 42.60/Ha). Farmers that cultivate indigenous fruit and vegetables (n= 277) made additional 29.40% average total farm revenue than those (n=123) who did not. The cultivation of indigenous fruits and vegetables in the selected rural communities is important in the improvement of the livelihoods of households. Hence, the use of land for IFV cultivation cannot be overemphasized.

The current study reveals that the local communities recognized and identified with the potentials that are locked up in IFV which support the work of other researchers (Omotayo et al., 2020; Schreckenberg et al., 2006; Shai et al., 2020). This study enables us to appreciate the importance of IFVs and reveals the patterns of their consumption by the population in this region. The potentials of IFVs are well acknowledged for food sustenance and health benefits. Hence, promoting these plant species is paramount to the conservation of agro-biodiversity, and this will contribute to the improvement of food sufficiency in this community in Ondo State.

6.3 Recommendations

The findings from this present study revealed that the 40 local communities selected in Akure South Local Government Area in Ondo state, Nigeria are aware of the potentials that are found in indigenous fruits and vegetables. Ranging from food sustenance to health and to livelihood. Majority of these indigenous plants are edible and medicinal in nature, available, cheap AND found everywhere in the local communities. The recommendations are as follows:

1. There should be proper awareness of the benefits of these indigenous fruits and vegetables among the local communities to enhance their acceptance over exotic ones.
2. It is highly recommended that awareness campaigns about the health benefits, job opportunities for local communities must be included in the national development plan and agricultural policy by the ministry of agriculture. This will serve as encouragement to the local farmers and enlighten urban dwellers of the benefits of consuming IFVs rather than (or along with) exotic species.
3. It is also recommended that Ministry of Agriculture should organize workshops and seminars for the farmers in the locality as a mean of exploring how the potentials in indigenous fruits and vegetables can be used to enhance their livelihoodsand the possibilities of value addition.

4. In addition, more research should be carried out on the storage aspect of the indigenous fruits and vegetables. They are seasonal crops, and a lot of wastage are always recorded when they are in season. Good storage techniques would make them available all through the year.
5. Future research needs to explore the nutritional analysis of the indigenous fruits and vegetables especially that endemic to the study area.
6. It is highly recommended that governments should give more recognition to indigenous fruits and vegetables farmers by giving them support in terms of financial assistance such as loans, grants, subsidies and access to land.

6.4 Limitations of the study

The limitation of the research was that only Akure South local government Area population was used among the 18 LGAs in Ondo State. Also, out of 320 communities in Akure South, only 40 communities were selected, and this cannot be taken as general representation of the knowledge of the impact of IFV in Akure and Ondo state in Nigeria. Most of the knowledge holders wanted to be paid for the duration of the interviewed while some decided not to participate seeing the researcher as a threat or rival that wants to steal their knowledge from them and so deprive them of their means of livelihood. In addition, some indicated that the questions were too deep, and they were not willing to talk about the topic. These were great obstacles because they were potential knowledge experts with great experience in indigenous knowledge practices in IFV. The focus of the study was restricted to the farmers and the knowledgeable holders in the community, which may have resulted in the exclusion of other members of the community with another valuable knowledge.

REFERENCES

Abah, J., Mashebe, P., Denuga, D.D., 2015. Prospect of Integrating African Indigenous Knowledge Systems into the Teaching of Sciences in Africa. American Journal of Educational Research 3(6), 668-673.

Abdoulaye, T., Abass, A., Maziya-Dixon, B., Tarawali, G., Okechukwu, R., Rusike, J., Alene, A., Manyong, V.M., Ayedun, B., 2014. Awareness and adoption of improved cassava varieties and processing technologies in Nigeria. Journal of Development and Agricultural Economics 6, 67-75.

Abioye, A., Zaid, Y., Egberongbe, H.S., 2011. Documenting and disseminating agricultural indigenous knowledge for sustainable food security: The efforts of agricultural research libraries in Nigeria.

Absolon, K., Herbert, E., 1997. Community action as a practice of freedom: A First Nations perspective. Community organizing, Canadian experiences, 205-227.

Achigan-Dako, E.G., N'Danikou, S., Assogba-Komlan, F., Ambrose-Oji, B., Ahanchede, A., Pasquini, M.W., 2011. Diversity, Geographical, and Consumption Patterns of Traditional Vegetables in Sociolinguistic Communities in Benin: Implications for Domestication and Utilization1. Economic Botany 65(2), 129.

Adebawo, O., Salau, B., Ezima, E., Oyefuga, O., Ajani, E., Idowu, G., Famodu, A., Osilesi, O., 2006. Fruits and vegetables moderate lipid cardiovascular risk factor in hypertensive patients. Lipids Health Dis 5, 14-14.

Adebooye, O.C., Ogbe, F.M.D., Bamidele, J.F., , 2003. Ethnobotany of indigenous leaf vegetables of Southwest Nigeria. . Delpinoa 45, 295-299.

Adebooye, O.C., Olanike, F.D., Adeolu, B.A., Oyedele, D.J., Oluwagbenga, A.T., 2014. Nigerian women reap benefits from indigenous vegetables, Stories of change. Canada, WRENmedia.

Adebooye, O.C., Opabode, J.T., 2004. Status of conservation of the indigenous leaf vegetables and fruits of Africa

African Journal of Biotechnology 3(12), 700-705.

Adegbilero-Iwari, I., Subair, R.E., Oguntoyinbo, O., 2021. Indigenous Knowledge for Curative Purposes: A Review of Medicinal Plants Used In Ekiti State Nigeria. Annals of the Romanian Society for Cell Biology, 4633-4642.

Adeniran, M.A., Falemu, F.A., 2017. Plants used as anti-anaemic and haematinic agents among indigenes of ijero local government area, Ekiti state, Nigeria. Journal of Environmental Issues and Agriculture in Developing Countries, 9(1), 10.

Adesina, S., Gbile, Z., 1984. Steroidal constituents of Solanum scabrum subsp. nigericum. Fitoterapia.

Adjatin, A., Dansi, A., Badoussi, E., Loko, Y.L., Dansi, M., Azokpota, P., Gbaguidi, F., Ahissou, H., Akoègninou, A., Akpagana, K., Sanni, A., 2013. Phytochemical screening and toxicity studies of Crassocephalum rubens (Juss. ex Jacq.) S. Moore and Crassocephalum crepidioides (Benth.) S. Moore consumed as vegetable in Benin. International Journal of Current Microbiology and Applied Sciences 2(8), 1-3.

Afolabi, O.J., Akinneye, J.O., Igiekhume, A.M., 2019. Identification, abundance, and diversity of mosquitoes in Akure South Local Government Area, Ondo State, Nigeria. The Journal of Basic and Applied Zoology 80(1), 1-7.

Aina, L.O., 1991. Directions of the information professions in africa as reflected in the literature. International Library Review 23(4), 365-380.

Ajao, A.A.-n., Mukaila, Y.O., Sabiu, S., 2021. Wandering through Southwestern Nigeria: An Inventory of Yoruba Useful Angiosperm Plants. Heliyon, e08668.

Ajao, A.A., Mukaila, Y.O., Sabiu, S., 2022. Wandering through southwestern Nigeria: An inventory of Yoruba useful angiosperm plants. Heliyon 8(1), e08668.

Ajao, A.A., Ojo, M.O., Oladipo, O.T., Yusuf, A.A., Mukaila, Y.O., Ajao, A.A., 2018. Clerodendrum volubile P. Beauv (Lamiaceae), an underutilized indigenous vegetable of utmost nutritive and pharmacological importance. Beni-Seuf University. Journal Applied Science 7(4), 606–611.

Ajesh, T., Naseef, S.A., Kumuthakalavalli, R., 2012. Ethnobotanical documentation of wild edible fruits used by Muthuvan tribes of Idukki, Kerala-India. International Journal of Pharma and Bio-Sciences 3, 479-487.

Ajibefun, I., 2011. Akure City Profile" (PDF). International Water Management Institute.

Akerele, D., Momoh, S., Aromolaran, A., Oguntona, C., Shittu, A., 2013. Food insecurity and coping strategies in South-West Nigeria. Food Security 5.

Akhtar, S., Shah, S.W.A., Rafiq, M., Khan, A., 2016. Research design and statistical methods in Pakistan Journal of Medical Sciences (PJMS). Pakistan Journal of Medical Sciences 32, 151.

Akinnifesi, F., Ajayi, O.O., Sileshi, G., Kadzere, I., Akinnifesi, A.I., 2007. Domesticating and Commercializing Indigenous Fruit and Nut Tree Crops for Food Security and Income Generation in Sub-Saharan Africa, in: Haq, N. (Ed.) Proceedings 5th International Symposium on New Crops and Uses: their role in a rapidly changing world. Centre for Underutilized Crops, University of Southampton, United Kingdom, p. 32.

Akinola, R., Pereira, L.M., Mabhaudhi, T., de Bruin, F.-M., Rusch, L., 2020. A Review of Indigenous Food Crops in Africa and the Implications for more Sustainable and Healthy Food Systems. Sustainability. 12, 3493.

Alagba, R., Ofor, M., Okoli, N., Ibeawuchi, I.I., Obiefuna, J.C., 2015. Fruit and vegetable crop production in Nigeria: The gains, challenges and the way forward. Journal of Biology, Agriculture and Healthcare 5, 194-208.

Anderson, W., Taylor, C., McDermid, S., Ilboudo-Nébié, E., Seager, R., Schlenker, W., Cottier, F., de Sherbinin, A., Mendeloff, D., Markey, K., 2021. Violent conflict exacerbated drought-related food insecurity between 2009 and 2019 in sub-Saharan Africa. Nature Food 2(8), 603-615.

Ariwaodo, J.O., Chukwuma, E.C., Adeniji, K.A., 2012. Some medicinal plant species of Asamagbe stream bank vegetation, Forestry Research Institute of Nigeria, Ibadan. Ethnobotany Research and Applications 10, 541-549.

Asaah, E.K., Tchoundjeu, Z., Atangana, A.R., 2003. Cultivation and conservation status of Irvingia wombolu in humid lowland forest of Cameroon

Journal of Food, Agriculture & Environment 1 (3&4), 251-256.

Asante, M.K., 1988. Afrocentricity. Africa World Press Trenton, NJ, Trenton.

Asogwa I.S., Okoye J.I., Oni, K., 2017. Promotion of indigenous food preservation and processing knowledge and the challenge of food security in Africa. Journal of food security 5(3), 75-87.

Ateba, C.N., Kaya, H.O., Pitso, F.S., Ferim, V., 2012. Batswana indigenous knowledge of medicinal and food plant uses for sustainable community livelihood. In: Smit JA & Masoga MA (eds.) African Indigenous Knowledge Systems and Sustainable Development: Challenges and Prospects. People's Publishers, Durban, South Africa,. 68-86.

Aubert, B.A., Schroeder, A., Grimaudo, J., 2012. IT as enabler of sustainable farming: An empirical analysis of farmers' adoption decision of precision agriculture technology. Decision support systems 54(1), 510-520.

Awodoyin, R.O., Olubode, O.S., Ogbu, J.U., Balogun, R.B., Nwawuisi, J.U., Orji, K.O., 2015. Indigenous fruit trees of tropical Africa: status, opportunity for development and biodiversity management. Agricultural Sciences. 6, 31.

Aworh, O.C., 2014. Lesser-known Nigerian fruits and vegetables: Post-harvest handling, utilization and nutritional value. Ibadan University Press.

Aworh, O.C., 2015. Promoting food security and enhancing Nigeria's small farmers' income through value-added processing of lesser-known and under-utilized indigenous fruits and vegetables. Food Research International 76, 986-991.

Awoyemi, O., Abdulkarim, I., Ewa, E., Aduloju, A., 2012. Ethnobotanical assessment of herbal plants in South-Western Nigeria. Academic research international 2(3), 50.

Awoyinka, A.F., Abegunde, V.O., Adewusi, S.R., 1995. Nutrient content of young cassava leaves and assessment of their acceptance as a green vegetable in Nigeria. Plant Foods Human Nutrition 47(1), 21-28.

Ayanlade, A., Radeny, M., 2020. COVID-19 and food security in Sub-Saharan Africa: implications of lockdown during agricultural planting seasons. npj Science of Food 4(1), 13.

Ayanwale, A.B., Amusan, C.A., Adeyemo, V.A., Oyedele, D.J., 2016. Analysis of household demand for underutilized indigenous vegetables. International journal of vegetable science. 22, 570-577.

Ayoola, S., Peluola, C., Senjobi, C., Lawal, I., Ande, O., Salami, B., 2010. Performance of Cochorus olitorius as influenced by soil type and organic manure amendments in Yewa North Local Government Area, Ogun State. African Journal of Biotechnology 9.

Baloyi, L., Makobe-Rabothata, M., 2014. The African conception of death: A cultural implication.

Bassey, C., Ikpi, L., 2011. Perception of utilitarian values of agrobiodiversity by rural farmers in Akwa Ibom State, Nigeria. African Journal of Agricultural Research 6(32), 6622-6634.

Bello, O.M., Ogbesejana, A., Tijjani, A., 2018. Lipoxygenase (Lox) Inhibitory Activity of Leaves of *Ceiba Pentandra (*L.) Gaertn: A Neglected Vegetable from Nigeria. FUDMA Journal of Sciences 2, 79-82.

Bennett, B., 2006. Natural Products: The New Engine for African Trade Growth: Consultancy to Further Develop the Trade Component of the Natural Resources Enterprise Programme (NATPRO). Regional Trade Facilitation Programme, Windhoek, Namibia.

Besong, E.E., Balogun, M.E., Djobissie, S.F.A., Obu, D.C., Obimma, J.N., 2016. Medicinal and economic value of Dialium guineense. African Journal of Biomedical Research 19, 163-170.

Bhan, M.K., Dhar, A.K., Khan, S., Lattoo, S.K., Gupta, K.K., Choudhary, D.K., 2006. Screening and optimization of Andrographis paniculata (Burm.f.) Nees for total andrographolide content, yield and its components. Scientia Horticulturae 107(4), 386-391.

Bhaskara, R.D., 1997. World Food Summit. Discovery Publishing House.

Bikam, P., 2015. Food preservation challenges in rural areas of developing countries. A case study of Ha-Makuya rural community in Limpopo Province, South Africa. International journal series in multidisciplinary research 1(3), 31-45.

Bless, C., Higson-Smith, C., Kagee, A., 2006. Fundamentals of social research methods: An African perspective. Juta and Company Ltd.

Bohm, B.A., Stuessy, T.F., 2001. Flavonoids of the sunflower family *(Asteraceae)*. Springer Science & Business Media, Berlin/Heidelberg, Germany.

Bongaarts, J., 2021. FAO, IFAD, UNICEF, WFP and WHO The State of Food Security and Nutrition in the World 2020. Transforming food systems for affordable healthy diets FAO, 2020, 320 p. Wiley Online Library.

Bouazza, A.B., 2015. Small and medium enterprises as an effective sector for economic development and employment creation in Algeria. International Journal of Economics, commerce and management 3(2), 1-16.

Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qualitative Research in Psychology 3, 77-101.

Bricki, N., Green, J., 2007. A guide to using qualitative research methodology.

Briones, A.E., . 2015. The impact of culture, religion and traditional knowledge on food and nutrition security in developing countries., Food Secure Working Paper Series. pp. p. 1e81,.

Buettner, T., 2015. Urban estimates and projections at the United Nations: The strengths, weaknesses, and underpinnings of the world urbanization prospects. Spatial Demography 3, 91-108.

Burkhart, E.P., Jacobson, M.G., 2009. Transitioning from wild collection to forest cultivation of indigenous medicinal forest plants in eastern North America is constrained by lack of profitability. Agroforestry systems 76(2), 437-453.

Bvenura, C., Afolayan, A.J., 2015. The role of wild vegetables in household food security in South Africa: A review. Food Research International 76, 1001-1011.

Bvenura, C., Sivakumar, D., 2017. The role of wild fruits and vegetables in delivering a balanced and healthy diet. Food Research International 99.

Camp, W., 2001. Formulating and Evaluating Theoretical Frameworks for Career and Technical Education Research. Journal of Vocational Education Research 26, 4-25.

Chakravarty, S., Bhutia, K., Suresh, C., Shukla, G., Pala, N., 2016. A review on diversity, conservation and nutrition of wild edible fruits. Journal of Applied and Natural Science 8, 2346-2353.

Chambers, R., Conway, G., 1992. Sustainable rural livelihoods: practical concepts for the 21st century. Institute of Development Studies (UK).

Chawane, M., 2016. The development of afrocentricity: A historical survey. Yesterday and Today. 16, 78-99.

Chilisa, B., 2012. Indigenous research methodologies. Los Angeles: SAGE publications.

Chivandi, E., Mukonowenzou, N., Nyakudya, T., Erlwanger, K.H., 2015. Potential of indigenous fruit-bearing trees to curb malnutrition, improve household food security, income and community health in Sub-Saharan Africa: A review. Food Research International 76, 980-985.

Chivenge, P., Mabhaudhi, T., Modi, A.T., Mafongoya, P., 2015. The potential role of neglected and underutilised crop species as future crops under water scarce conditions in Sub-Saharan Africa. International Journal of Environmental Research and Public Health 12, 5685-5711.

Conway, G.R., Barbier, E.B., 2013. After the green revolution: sustainable agriculture for development. Routledge, United Kingdom.

Cox, N.J., 2004. Speaking stata: Graphing distributions. The Stata Journal 4(1), 66-88.

Crane, P., Ge, S., Hong, D.-Y., Huang, H.-W., Jiao, G.-L., Knapp, S., Kress, W., Mooney, H., Raven, P., Wen, J., Wu, W.-H., Yang, H.-M., Zhu, W.-H., Zhu, Y.-X., 2017. The Shenzhen Declaration on Plant Sciences-Uniting plant sciences and society to build a green, sustainable Earth.

Crane, P.R., Ge, S., Hong, D.-Y., Huang, H.-W., Jiao, G.-L., Knapp, S., Kress, W.J., Mooney, H., Raven, P.H., Wen, J., Wu, W.-H., Yang, H.-M., Zhu, W.-H., Zhu, Y.-X., Committee, S.D.D., 2019. The Shenzhen declaration on plant sciences—Uniting plant sciences and society to build a green, sustainable Earth. Plants, People, Planet 1(1), 59-61.

Creswell, J.W., 2013. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications.

Crush, J., Frayne, B., 2010. The invisible crisis: Urban food security in Southern Africa.

Cunningham, A.B., 2014. Applied ethnobotany: people, wild plant use and conservation. Routledge.

Dadjo, C., Nyende, A.B., Salako, K.V., Hounkpevi, A., Assogbadjo, A.E., 2020. Socio–economic factors determining conservation and cultivation of Garcinia kola Heckel—a medicinal plant extinct in the wild in Benin. Economic Botany 74, 115-125.

Dansi, A., Adjatin, A., Adoukonou-Sagbadja, H., Faladé, V., Yedomonhan, H., Odou, D., Dossou, B., 2008. Traditional leafy vegetables and their use in the Benin Republic. Genetic Resources and Crop Evolution 55(8), 1239-1256.

Dastile, N.P., 2013. Beyond Euro-Western dominance: An African-centred decolonial paradigm. Africanus. 43(2), 93-104.

Daud, A.S., Awoyemi, T., Omotoso, A.B., Omotayo, A.O., 2018. Human capital and income diversification among crop farmers in rural Oyo State, Nigeria. Journal of Agribusiness and Rural Development 49(3), 251-260.

De Beer, J.J.J., Van Wyk, B.E., 2011. An ethnobotanical survey of the Agter–Hantam, Northern Cape Province, South Africa. South African Journal of Botany 77(3), 741-754.

De Vynck, J.C., Van Wyk, B.E., Cowling, R.M., 2016. Indigenous edible plant use by contemporary Khoe-San descendants of South Africa's Cape South Coast. South African Journal of Botany 102(Supplement C), 60-69.

Dejene, T., Agamy, M., Agúndez, D., Martín-Pinto, P., 2020. Ethnobotanical Survey of Wild Edible Fruit Tree Species in Lowland Areas of Ethiopia. Forests 11, 177.

Della, A., Paraskeva-Hadjichambi, D., Hadjichambis, A.C., 2006. An ethnobotanical survey of wild edible plants of Paphos and Larnaca countryside of Cyprus. Journal of Ethnobiology and Ethnomedicine 2, 34.

Deng, J., Xiang, Y., Hao, W., Feng, Y., Yang, G., Ren, G., Han, X., 2014. Research on the Food Security Condition and Food Supply Capacity of Egypt. The Scientific World Journal 2014, 405924.

Dengerink, J., Dirks, F., Likoko, E., Guijt, J., 2021. One size doesn't fit all: regional differences in priorities for food system transformation. Food Security, 1-12.

Deshmukh, S.A., Gaikwad., D.K., 2014. A review of the taxonomy, ethnobotany, phytochemistry and pharmacology of Basella alba (Basellaceae). Journal of Applied Pharmaceutical Science 4(01), 153-165.

DeWalt, B.R., 1994. Using Indigenous Knowledge to Improve Agriculture and Natural Resource Management. Human Organization 53(2), 123-131.

Doss, C.R., 2006. Analyzing technology adoption using microstudies: limitations, challenges, and opportunities for improvement. Agricultural economics 34(3), 207-219.

Eilu, G., Oriekot, J., Tushabe, H., 2007. Conservation of indigenous plants outside protected areas in Tororo District, eastern Uganda. African Journal of Ecology 45, 73-78.

Ekeke, E.C., 2011. African traditional religion: A conceptual and philosophical analysis. Lumina. 22(2), 1-18.

Ekesa, B., Walingo, M.K., Onyango, M., 2009. Accesibility to and consumption of indigenous vegetables and fruits by rural households in Matungu division, western Kenya. African Journal of Food, Agriculture, Nutrition and Development 9.

Ekpa, E., Folake, O.M., Adeoye, R., 2016. Effect of processing methods and time on the Vitamin C contents of some leafy vegetables sold in Lokoja, Nigeria. Journal of Science 5(1), 472-482.

Ele, I.E., Omini, G.E., Adinya, B.I., 2013. Assessing the extent of commercialization of smallholding farming households in Cross River State, Nigeria. Journal of Agriculture and Veterinary Science 4, 49-55.

Erinoso, S., Aworinde, D., 2018. Current outlook and future promise of ethnobotany in Nigeria: A review and personal observation. African Journal of Plant Science 12(4), 73-80.

Erinoso, S.M., Aworinde, D.O., Teniola, O.A., Ojo, S.O., 2020. Ethnobotany of *Elaeis guineensis* Jacq. and its importance in the household economy of the Ikale and Ilaje of Ondo State, Nigeria. Ethnobotany Research and Applications 20, 1-16.

Eyong, C.T., 2007. Indigenous Knowledge and Sustainable Development in Africa: Case Study on Central Africa, pp. 121-139.

Ezeomah, B., Farag, K., 2016. Effects of development on indigenous dietary pattern: A Nigerian case study. Appetite 107, 59-68.

FAO, 1995. Fruit and vegetable processing. FAO agricultural services bulletin No. 119.

(Rome).

FAO/WFP, 2014. The State of Food Insecurity in the World 2014, Strengthening the enabling environment for food security and nutrition Food and Agriculture Organization of the United Nations, Rome.

Feng, L., Zhai, Y.-Y., Xu, J., Yao, W.-F., Cao, Y.-D., Cheng, F.-F., Bao, B.-H., Zhang, L., 2019. A review on traditional uses, phytochemistry and pharmacology of Eclipta prostrata (L.) L. Journal of Ethnopharmacology 245, 112109.

Forum, A.C.P., 2019. For Lack of Will: Child hunger in Africa. African Child Policy Forum (ACPF), Addis Ababa

Forum., G., 2013. Indigenous methods of food preparation: What is their impact on food security and nutrition?

Fox, L., Sohnesen, T.P., 2012. Household enterprises in Sub-Saharan Africa: Why they matter for growth, jobs, and livelihoods. World Bank Policy Research Working Paper(6184).

Garbero, A., Resce, G., Carneiro, B., 2021. Spatial dynamics across food systems transformation in IFAD investments: a machine learning approach. Food Security 13(5), 1125-1143.

Gardas, B.B., Raut, R.D., Cheikhrouhou, N., Narkhede, B.E., 2019. A hybrid decision support system for analyzing challenges of the agricultural supply chain. Sustainable Production and Consumption 18, 19-32.

Garutsa, T.C., Nekhwevha, F.H., 2016. Labour-burdened women utilising their marginalised indigenous knowledge in food production processes: The case of Khambashe rural households, Eastern Cape, South Africa. South African Review of Sociology 47, 106-120.

Gbadamosi, I.T., Oloyede, A.A., 2014. The mineral, proximate and phytochemical components of ten Nigerian medicinal plants used in the management of arthritis. African Journal of Pharmaceutical Pharmacology 8(2014), 638-643.

Giller, K.E., Witter, E., Corbeels, M., Tittonell, P., 2009. Conservation agriculture and smallholder farming in Africa: the heretics' view. Field Crops Research 114, 23-34.

Golafshani, N., 2003. Understanding reliability and validity in qualitative research. The qualitative report 8(4), 597-606.

Gonçalves, C.d.B.Q., Schlindwein, M.M., Martinelli, G.d.C., 2021. Agroforestry systems: a systematic review focusing on traditional indigenous practices, food and nutrition security, economic viability, and the role of women. Sustainability 13(20), 11397.

Greene, W.H., 2003. Econometric analysis. Pearson Education India, India.

Grenz, J.H., Sauerborn, J., 2007. The potential of organic agriculture to contribute to sustainable crop production and food security in Sub-Saharan Africa. J Agric Rural Dev Trop Subtrop 89, 50-84.

Guest, G., 2014. Sampling and selecting participants in field research. Handbook of methods in cultural anthropology, 215-249.

Guest, G., MacQueen, K.M., Namey, E.E., 2011. Applied thematic analysis. Sage publications, London

Guntarik, O., Daley, L., 2017. Indigenous creative practice research: between convention and creativity. New Writing. 14, 409-422.

Gürbüz, N., Uluişik, S., Frary, A., Doğanlar, S., 2018. Health benefits and bioactive compounds of eggplant. Journal of Food chemistry 268, 602-610.

Halli, S.B., Swamy, K., Sankanur, M., Yewale, A., 2016. Fruit-based agroforestry systems for food security and higher profitability. International Journal of Farm Sciences 6(2), 302-311.

Hart, M.A., 2010. Indigenous worldviews, knowledge, and research: The development of an indigenous research paradigm. Journal of indigenous voices in social work 1(1), 1-16.

Holbrook, J.C., 2009. African cosmology. In cosmology across cultures. 409, 138-144.

Howard, L.R., Prior, R.L., Liyanage, R., Lay, J.O., 2012. Processing and storage effect on berry polyphenols: challenges and implications for bioactive properties. J Agric Food Chem 60(27), 6678-6693.

Huang, C.-W., McDonald, R.I., Seto, K.C., 2018. The importance of land governance for biodiversity conservation in an era of global urban expansion. Landscape and Urban Planning 173, 44-50.

Ijeh, I.I., Ejike, C.E.C.C., 2011. Current perspectives on the medicinal potentials of Vernonia amygdalina Del.

. Journal of Medicinal Plants Research 5(7), 1051-1061.

Iloh, C., Tierney, W., 2014. Using ethnography to understand twenty-first century college life. Human Affairs 24.

Imathiu, S., 2021. Neglected and underutilized cultivated crops with respect to indigenous African leafy vegetables for food and nutrition security. Journal of Food Security 9(3), 115-125.

Imbens, G., Hirano, K., 2004. The Propensity Score with Continuous Treatments.

Innih, S.O., Omage, S.O., Omage, K., 2020. Hematinic effects of Spondias mombin and its protective role against the spleenotoxic effect of phenylhydrazine. Clinical Phytoscience 6(1), 30.

Isaiah, E., 2011. Horn of Africa: Poor Attention to Forecasts to Blame for Famine in Somalia. Inter Press Service,. 201.

Jessica Fanzo., Danny Hunter., Teresa Borelli., Mattei., F., 2013. Diversifying Food And Diets Using Agricultural Biodiversity To improve Nutrition And Health.

Jideani, A.I., Silungwe, H., Takalani, T., Omolola, A.O., Udeh, H.O., Anyasi, T.A., 2021. Antioxidant-rich natural fruit and vegetable products and human health. International Journal of Food Properties 24, 41-67.

Jones, R.A., 2020. Disease pandemics and major epidemics arising from new encounters between indigenous viruses and introduced crops. Viruses 12, 1388.

Joshi, S.K., Ballabh, B., Negi, P.S., Dwivedi, S.K., 2018. Diversity, Distribution, Use Pattern and Evaluation of Wild Edible Plants of Uttarakhand, India. Defence Life Science Journal 3(2), 126-135.

Jyotsna, A., Saonere, S., 2011. An overview of Citrus aurantium used in treatment of various diseases. African journal of plant science Vol.5(7), 390-395.

Kadiri, O., Olawoye, B., 2015. Underutilized indigenous vegetable (UIV) in Nigeria: a rich source of nutrients and antioxidants - a review. Annotated Food Science Technology 16(2), 236-247.

Kahane, R., Hodgkin, T., Jaenicke, H., Hoogendoorn, C., Hermann, M., Hughes, J.D.A., Padulosi, S., Looney, N., , , 2013. Agrobiodiversity for food security, health and income. Agronomy for Sustainable Development 33, 671-693.

Kamwendo, G., Kamwendo, J., 2014. Indigenous knowledge-systems and food security: some examples from Malawi. Journal of Human Ecology 48(1), 97-101.

Kanu, I.A., 2013. The dimensions of African cosmology. Filosofia Theoretica. Journal of philosophy and religion 2(2), 533-554.

Kavitha, C., Thangamani, C., 2014. Amazing bean "Mucuna pruriens": A comprehensive review. Journal of Medicinal Plants Research 8(2), 138-143.

Kaza, S., Yao, L., Bhada-Tata, P., Van Woerden, F., 2018. What a waste 2.0: a global snapshot of solid waste management to 2050. World Bank Publications.

Kehlenbeck, K., Asaah, E., Jamnadass, R., 2013. Diversity of indigenous fruit trees and their contribution to nutrition and livelihoods in sub-Saharan Africa: examples from Kenya and Cameroon. Diversifying food and diets: Using agricultural biodiversity to improve nutrition and health, 257-269.

Kermali, S., Anishetty, N., Cooper, H., 1997. Promoting development and commercialization of underutilized crops and species in the fao global plan of action. ICUC, Southampton, UK.

Knickel, K., Redman, M., Darnhofer, I., Ashkenazy, A., Chebach, T.C., Šūmane, S., Tisenkopfs, T., Zemeckis, R., Atkociuniene, V., Rivera, M., 2018. Between aspirations and reality: Making farming, food systems and rural areas more resilient, sustainable and equitable. Journal of Rural Studies 59, 197-210.

Kock, K.T., 2017. Documentation of indigenous knowledge of food processing and preservation among VaTsonga women in New Forest village Mpumalanga Province. Mafikeng: North West University. (Mini Dissertation- Honours).

.

Kothari, C.R., 2004. Research Methodology: Methods and Techniques, (Second Edition), New Age International Publishers.

Kovach, M., 2010. Conversation method in Indigenous research. An interdisciplinary journal honouring the voices, perspectives and knowledge is of first peoples through research, critical analyses, stories, standpoints and media reviews 5(1), 40-48.

Kuivanen, K., Alvarez, S., Michalscheck, M., Adjei-Nsiah, S., Descheemaeker, K., Mellon-Bedi, S., Groot, J.C., 2016. Characterising the diversity of smallholder farming systems and their constraints and opportunities for innovation: A case study from the Northern Region, Ghana. NJAS-Wageningen Journal of Life Sciences 78, 153-166.

Kunkel, G., 1984. Plants for Human Consumption: An Annotated Checklist of the Edible Phanerogams and Ferns. Koeltz Scientific Books.

Lavallée, L.F., 2009. Practical Application of an Indigenous Research Framework and Two Qualitative Indigenous Research Methods: Sharing Circles and Anishnaabe Symbol-Based Reflection. International Journal of Qualitative Methods 8(1), 21-40.

Lawal, I.O., Olufade, I.I., Rafiu, B.O., Aremu, A.O., 2020. Ethnobotanical survey of plants used for treating cough associated with respiratory conditions in Ede South local government area of Osun State, Nigeria. Plants 9, 647.

Leakey, R.R., Tchoundjeu, Z., Schreckenberg, K., Shackleton, S.E., Shackleton, C.M., 2005. Agroforestry tree products (AFTPs): targeting poverty reduction and enhanced livelihoods. International Journal of Agricultural Sustainability 3(1), 1-23.

Lechner, M., 1999. Earnings and employment effects of continuous gff-the-job training in east germany after unification. Journal of Business & Economic Statistics 17(1), 74-90.

Lechner, M., 2001. Identification and estimation of causal effects of multiple treatments under the conditional independence assumption, Econometric evaluation of labour market policies. Springer, pp. 43-58.

Lester, F.K., 2005. On the theoretical, conceptual, and philosophical foundations for research in mathematics education. Journal of Zdm. 37, 457-467.

Lienou, L.L., Telefo, P.B., Njimou, J.R., Nangue, C., Bayala, B.R., Goka, S.C., Biapa, P., Yemele, M.D., Donfack, N.J., Mbemya, J.T., Tagne, S.R., Rodrigues, A.P.R., 2015. Effect of the aqueous extract of Senecio biafrae (Oliv. & Hiern) J. Moore on some fertility parameters in immature female rat. Journal of Ethnopharmacology 161, 156-162.

Lindsay, G., 2013. The benefits of combined (mixed) methods research. Social Work and Social Sciences Review 16(2), 76-87.

Lombo, S., 2017. Analysis of consumption patterns and their effects on social cohesion from a Zulu cosmology perspective. Durban: University of Technology. (Thesis-PhD).

Luse, A., Mennecke, B.E., Townsend, A.M., 2012. Selecting a research topic: A framework for doctoral students. International Journal of Doctoral Studies 7, 143.

Mabhaudhi, T., Chibarabada, T.P., Chimonyo, V.G.P., Murugani, V.G., Pereira, L.M., Sobratee, N., Govender, L., Slotow, R., Modi, A.T., 2019. Mainstreaming Underutilized Indigenous and Traditional Crops into Food Systems: A South African Perspective. Sustainability 11(1), 172.

Magwede, K., Van Wyk, B.E., Van Wyk, A.E., 2019. An inventory of Vhavenḓa useful plants. South African Journal of Botany 122, 57-89.

Manlosa, A.O., Hanspach, J., Schultner, J., Dorresteijn, I., Fischer, J., 2019. Livelihood strategies, capital assets, and food security in rural Southwest Ethiopia. Food Security 11, 167-181.

Maroyi, A., 2009. Traditional homegardens and rural livelihoods in Nhema, Zimbabwe: a sustainable agroforestry system. International Journal of Sustainable Development & World Ecology 16(1), 1-8.

Maroyi, A., 2011. The gathering and consumption of wild edible plants in Nhema communal area, Midlands Province, Zimbabwe. Ecology Food Nutrition 50(6), 506-525.

Maroyi, A., 2017. Diversity of use and local knowledge of wild and cultivated plants in the Eastern Cape province, South Africa. Journal of Ethnobiology and Ethnomedicine 13, 43.

Mashile, S.P., Tshisikhawe, M.P., Masevhe, N.A., 2019. Indigenous fruit plants species of the Mapulana of Ehlanzeni district in Mpumalanga province, South Africa. South African Journal of Botany 122, 180-183.

Matos, R.A., Adams, M., Sabaté, J., 2021. The Consumption of Ultra-Processed Foods and Non-communicable Diseases in Latin America. Frontiers in Nutrition 8, 110.

Maundu, P., Achigan-Dako, E., Morimoto, Y., 2009. Biodiversity of African vegetables.

Maxwell, J.A., 2012. Qualitative research design: An interactive approach. Sage publications.

Mayes, S., Massawe, F., Alderson, P., Roberts, J., Azam-Ali, S., Hermann, M., 2012. The potential for underutilized crops to improve security of food production. Journal of Experimental Botany 63, 1075-1079.

Mazonde, I.N., 2001. Culture and education in the development of Africa. Gaborone. .

Mbavai, J., 2013. An assessment of the effectiveness of the Sudan Savanna Taskforce project in adoption and diffusion of improved cowpea varieties in selected communities in Musawa Local Government Area of Katsina State. unpublished thesis submitted to the Department of Adult Education and Community Services, Faculty of Education, Bayero University Kano.

Mbhenyane, X.G., 2017. Indigenous foods and their contribution to nutrient requirements. South African Journal of Clinical Nutrition 30, 5-7.

Mbiti, J.S., 2015. Introduction to African religion. Waveland Press.

McGranahan, C., 2018. Ethnography. The International Encyclopedia of Anthropology, 1-5.

Md. Sanower Hossain., Zannat Urbi., Abubakar Sule, K.M., Rahman., H., 2014. "Andrographis paniculata (Burm. f.) Wall. ex Nees: A Review of Ethnobotany, Phytochemistry, and Pharmacology". The Scientific World Journal 2014, 28.

Mendez, M.A., Monteiro, C.A., Popkin, B.M., 2005. Overweight exceeds underweight among women in most developing countries. Am J Clin Nutr 81(3), 714-721.

Michael Buenor Adinortey, Justice Kwabena Sarfo, Jeffery Kwarteng, Cynthia Ayefoumi Adinortey, William Ekloh, Lydia Enyonam Kuatsienu, Alexander Kwadwo Nyarko, 2018. The Ethnopharmacological and Nutraceutical Relevance of Launaea taraxacifolia (Willd.) Amin ex C. Jeffrey",. Evidence-Based Complementary and Alternative Medicine 2018, 13.

Mishra, R., Tripathi, A.D., Singh, R.B., Tomar, R.S., Wilson, D.W., Smail, M.M., 2022. Estimates of functional food and nutraceutical availability in the world, with reference to food peroxidation and food safety. Functional Foods and Nutraceuticals in Metabolic and Non-Communicable Diseases, 23-42.

Mkabela, Q., 2005. Using the Afrocentric method in researching indigenous African culture. The qualitative report. 10(1), 178-189.

Molobela, L., 2017. Exploring black rural Bushbuckridge women's constructions and perceptions of the practise of abortion, Psychology. University of South Africa.Pretoria.

Moyo, M., Amoo, S.O., Aremu, A.O., Gruz, J., Šubrtová, M., Jarošová, M., Tarkowski, P., Doležal, K., 2018. Determination of mineral constituents, phytochemicals and antioxidant qualities of *Cleome gynandra*, compared to *Brassica oleracea* and *Beta vulgaris*. Frontiers in Chemistry 5(128), doi:10.3389/fchem.2017.00128.

Mozirandi, W., Tagwireyi, D., Mukanganyama, S., 2019. Evaluation of antimicrobial activity of chondrillasterol isolated from Vernonia adoensis (Asteraceae). BMC Complementary and Alternative Medicine 19(1), 249.

Mudhara, M., Ndwandwe, S., 2014. Contribution of indigenous knowledge practices to household food security: a case study of rural households in KwaZulu-Natal. Indilinga African Journal of Indigenous Knowledge Systems 13, 271-282.

Muhanji, G., Roothaert, R.L., Webo, C., Stanley, M., 2011. African indigenous vegetable enterprises and market access for small-scale farmers in East Africa. International Journal of Agricultural Sustainability 9(1), 194-202.

Muimba-Kankolongo, A., 2018. Food Crop Production by Smallholder Farmers in Southern Africa: Challenges and Opportunities for Improvement. Academic Press.

Mustafa, M.A., Mabhaudhi, T., Avvari, M.V., Massawe, F., 2021. Transition toward sustainable food systems: A holistic pathway toward sustainable development, Food Security and Nutrition. Elsevier, pp. 33-56.

Mvungi, H., Laizer, A., Lukumay, P.J., Ochieng, J., Ngoteya, G., Dinssa, F., Simon, J.E., Govindasamy, R., Ndinya, C., Odendo, M., 2020. Profitability Analysis of Traditional African Vegetable Seeds Production in Kenya. Journal of Medicinally Active Plants 9(4), 281-288.

Nader, L., 2011. Ethnography as theory. HAU: Journal of ethnographic theory 1(1), 211-219.

Nakhauka, E.B., 2009. Agricultural biodiversity for food and nutrient security: The Kenyan perspective', International Journal of Biodiversity and Conservation,. 1, 208-214.

Nana, F.W., Hilou, A., Millogo, J.F., Nacoulma, O.G., 2012. Phytochemical Composition, Antioxidant and Xanthine Oxidase Inhibitory Activities of Amaranthus cruentus L. and Amaranthus hybridus L. Extracts. Pharmaceuticals 5(6), 613-628.

Ndwandwe, S., 2013. The contribution of indigenous knowledge practices to household food production and food security: A case of Okhahlamba local municipality, South Africa. Pietermaritzburg: University of Kwa-Zulu Natal

Ngadze, R., Linnemann, A., Nyanga, L., Fogliano, V., Verkerk, R., 2016. Local processing and nutritional composition of indigenous fruits: The case of monkey orange (Strychnos spp.) from Southern Africa. Food Reviews International 33.

Ngondi, J.L., Oben, J.E., Minka, S.R., 2005. The effect of Irvingia gabonensis seeds on body weight and blood lipids of obese subjects in Cameroon. Lipids Health Dis 4(1), 12.

Ngugi, I.K., Gitau, R., Nyoro, J., 2007. Access to high value markets by smallholder farmers of African indigenous vegetables in Kenya. IIED, London.

Nkambule, S.J., Moodley, I., Kuupiel, D., Mashamba-Thompson, T.P., 2021. Association between food insecurity and key metabolic risk factors for diet-sensitive non-communicable diseases in sub-Saharan Africa: a systematic review and meta-analysis. Scientific Reports 11(1), 5178.

Nkonki-Mandleni, B., Omotayo, A.O., 2020. Exploring the Living Conditions at Ezakheleni Informal Settlement, Durban Metropolis of Kwazulu-Natal, South Africa with an Upscaling Motive. Int. J 76(11).

Nnadi, F., Chikaire, J., Ezudike, K., 2013. Assessment of indigenous knowledge practices for sustainable agriculture and food security in Idemili South Local Government Area of Anambra State, Nigeria. Journal of Resources Development and Management 1.

Obata, O.O., Aigbokan, E.I., 2012. Ethnobotanical practices among the people of Oka-Akoko, Nigeria. Plant Archive 12(2), 627-638.

Oboh, G., 2005. Effect of blanching on the antioxidant property of some tropical green leafy vegetables. LWT - Food Science and Technology. 38(5), 513-517.

Ogbu, J.U., Umeokechukwu, C.E., 2014. “Aspects of Fruit Biology of Three Wild Edible Monkey Kola Species Fruits (Cola spp: Malvaceae)”. Annual Research & Review in Biology 4, 2007-2014.

Ogle, B.M., Grivetti, L.E., 1985. Legacy of the chameleon: Edible wild plants in the kingdom of Swaziland, Southern Africa. A cultural, ecological, nutritional study. Part I - Introduction, objectives, methods, Swazi culture, landscape and diet. Ecology of Food and Nutrition 16(3), 193-208.

Ogunniyi, A., Omonona, B., Abioye, O., Olagunju, K., 2018. Impact of irrigation technology use on crop yield, crop income and household food security in Nigeria: A treatment effect approach.

Ogunniyi, A.I., Omotoso, S.O., Salman, K.K., Omotayo, A.O., Olagunju, K.O., Aremu, A.O., 2021. Socio-economic Drivers of Food Security among Rural Households in Nigeria: Evidence from Smallholder Maize Farmers. Social Indicators Research, 1-17.

Ogunrayi, O.A., Akinseye, F.M., Goldberg, V., Bernhofer, C., 2016. Descriptive analysis of rainfall and temperature trends over Akure, Nigeria. Journal of Geography and Regional Planning 9, 195-202.

Oikpefan, E.O., Ayinde, B.A., Mudassir, A., Farooq, A.D., 2019. Comparative In Vitro Assessment of the Methanol Extracts of the Leaf, Stem, and Root Barks of Cnidoscolus aconitifolius on Lung and Breast Cancer Cell Lines. Turk J Pharm Sci 16(4), 375-379.

Ojiewo, C., Tenkouano, A., Hughes, J., Keatinge, J., 2013. Diversifying diets: using indigenous vegetables to improve profitability, nutrition and health in Africa. Diversifying food and diets: Using agricultural biodiversity to improve nutrition and health’, Earthscan, 291-302.

Okonji, C., Awolu, O., 2021. Factors influencing adoption of improved technology among maize farmers in Ekiti State Nigeria. Agrosearch 20, 102-112.

Okoye, J., Oni, K., 2017. Promotion of indigenous food preservation and processing knowledge and the challenge of food security in Africa. . Journal of Food Security 5, 75-87.

Okunlola, G.O., Jimoh, M.A., Olatunji, O.A., Olowolaju, E.D., 2017. Comparative study of the phytochemical contents of Cochorus olitorius and Amaranthus hybridus at different stages of growth. Annales of West University of Timisoara. Series of Biology. 20, 43.

Oladele, I.O., 2011. Contribution of Indigenous Vegetables and Fruits to Poverty Alleviation in Oyo State, Nigeria

Journal of Human Ecology 34.

Olagunju, K.O., Ogunniyi, A.I., Oyetunde-Usman, Z., Omotayo, A.O., Awotide, B.A., 2021. Does agricultural cooperative membership impact technical efficiency of maize production in Nigeria: An analysis correcting for biases from observed and unobserved attributes. PloS one 16(1), e0245426.

Olivia, N.U., Goodness, U.C., Obinna, O.M., 2021. Phytochemical profiling and GC-MS analysis of aqueous methanol fraction of Hibiscus asper leaves. Future Journal of Pharmaceutical Sciences 7(1), 59.

Olowo, S.F., Omotayo, A.O., Lawal, I.O., Aremu, A.O., 2022. Improving rural livelihood through the cultivation of indigenous fruits and vegetables: Evidence from Ondo State, Nigeria. Agriculture 12(3), 372.

Omara-Achong, T., Edwin-Wosu, N., Edu, E., Nkang, A., 2012. Survey of indigenous vegetables species in parts of Ogoja and Calabar, Cross River State, Nigeria. European Journal of Experimental Biology 2, 1289-1301.

Omotayo, A.O., 2016. Farming households' environment, nutrition and health interplay in Southwest, Nigeria. International Journal of Scientific Research in Agricultural Sciences 3(3), 84-98.

Omotayo, A.O., Aremu, A.O., 2020. Underutilized African indigenous fruit trees and food–nutrition security: Opportunities, challenges, and prospects. Food and Energy Security. e220, 1-6.

Omotayo, A.O., Ndhlovu, P.T., Tshwene, S.C., Aremu, A.O., 2020. Utilization pattern of indigenous and naturalized plants among some selected rural households of North West Province, South Africa. Plants 9, 953.

Omotayo, A.O., Oladejo, A.J., 2016. Profitability of cassava-based production systems. Journal of Human Ecology 56(1-2), 196-203.

Osanloo, A., Grant, C., 2016. Understanding, selecting, and integrating a theoretical framework in dissertation research: Creating the blueprint for your "house". Administrative Issues Journal: Connecting Education, Practice, Research Journal Of Agriculture And Biological Sciences 4, 7.

Oseni, K., Olawoye, B., 2015. Underutilized indigenous vegetable (UIV) in Nigeria: a rich source of nutrient and antioxidants-a review. Annals Food Science and Technology 16, 236-247.

Paton, D., 2012. Walking in two Worlds. Independent Education 42, 8-10.

Paudel Khatiwada, S., Deng, W., Paudel, B., Khatiwada, J.R., Zhang, J., Su, Y., 2017. Household livelihood strategies and implication for poverty reduction in rural areas of central Nepal. Sustainability 9(4), 612.

Payne, M.E., Steck, S.E., George, R.R., Steffens, D.C., 2012. Fruit, vegetable, and antioxidant intakes are lower in older adults with depression. J Acad Nutr Diet 112(12), 2022-2027.

Phillip, D., Nkonya, E., Pender, J., Oni, O.A., 2009. Constraints to increasing agricultural productivity in Nigeria: A review. International Food Policy Research Insititute.

Pitso, F.S., Lebese, M.R., 2014. Traditional Uses of Wild Edible Plants in Arid Areas of South Africa. Journal of Human Ecology. 48, 23-31.

Priya, K.S., Arumugam, G., Rathinam, B., Wells, A., Babu, M., 2004. Celosia argentea Linn. leaf extract improves wound healing in a rat burn wound model. Wound Repair Regen 12(6), 618-625.

Rada, E.C., Ragazzi, M., Ionescu, G., Merler, G., Moedinger, F., Raboni, M., Torretta, V., 2014. Municipal Solid Waste treatment by integrated solutions: Energy and environmental balances. Energy Procedia 50, 1037-1044.

Ribeiro, H., Jaime, P.C., Ventura, D., 2017. Alimentação e sustentabilidade. Estudos avançados 31, 185-198.

Rickman, J., Barrett, D., Bruhn, C., 2007. Nutritional comparison of fresh, frozen and canned fruits and vegetables. Part 1. Vitamins C and B and phenolic compounds. Journal of the Science of Food and Agriculture 87, 930-944.

Roberts, J.G., 1982. Productivity Growth, Inflation, and Unemployment. Brookings, Cambridge.

Rolnik, A., Olas, B., 2021. The Plants of the Asteraceae Family as Agents in the Protection of Human Health. International Journal of Molecular Sciences 22, 3009.

Rosenbaum, P.R., Rubin, D.B., 1983. The central role of the propensity score in observational studies for causal effects. Biometrika 70(1), 41-55.

Ruben, R., Cavatassi, R., Lipper, L., Smaling, E., Winters, P., 2021. Towards food systems transformation—five paradigm shifts for healthy, inclusive and sustainable food systems. Food Security, 1-8.

Rufai, A.M., Ogunniyi, A.I., Salman, K.K., Salawu, M.B., Omotayo, A.O., 2021. Rural Transformation and Labor Market Outcomes among Rural Youths in Nigeria. Sustainability 13(24), 13794.

Saxena, K., Sharma, D., Vales, M., 2018. Development and commercialization of CMS pigeonpea hybrids. Plant Breed. Rev 41, 103-167.

Schreckenberg, K., Awono, A., Degrande, A., Mbosso, C., Ndoye, O., Tchoundjeu, Z., 2006. Domesticating indigenous fruit trees as a contribution to poverty reduction. Forests, Trees Livelihoods 16, 35-51.

Schreinemachers, P., Wu, M.-h., Uddin, M.N., Ahmad, S., Hanson, P., 2016. Farmer training in off-season vegetables: Effects on income and pesticide use in Bangladesh. Food Policy 61, 132-140.

Senanayake, S.G.J.N., 2006. Indigenous knowledge as a key to sustainable development. Journal of Agricultural Sciences 2.

Shackleton, C.M., Dzerefos, C.M., Shackleton, S.E., Mathabela, F.R., 2000. The use of and trade in indigenous edible fruits in the Bushbuckridge savanna region, South Africa. Ecology of Food and Nutrition. 39, 225-245.

Shai, K.N., 2019. Ethno-botanical investigation of wild fruits among the Mapulana people in Mpumalanga Province, North-west University. Dissertation-Masters

South Africa.

Shai, K.N., Ncama, K., Ndhlovu, P.T., Struwig, M., Aremu, A.O., 2020. An exploratory study on the diverse uses and benefits of locally-sourced fruit species in three villages of Mpumalanga Province, South Africa. 9, 1581.

Sharma, I.P., Kanta, C., Dwivedi, T., Rani, R., 2020. Indigenous agricultural practices: A supreme key to maintaining biodiversity. Microbiological Advancements for Higher Altitude Agro-Ecosystems & Sustainability. Springer, 91-112.

Shomkegh, S.A., Mbakwe, R., Dagba, B.I., 2013. Ethnobotanical survey of edible wild plants in Tiv communities of Benue State, Nigeria. Journal of Natural Science Research 3, 2224-3186.

Shukla, M., Jharkharia, S., 2013. Agri-fresh produce supply chain management: a state-of-the-art literature review. International Journal of Operations & Production Management.

Shumsky, S.A., Hickey, G.M., Pelletier, B., Johns, T., 2014. Understanding the contribution of wild edible plants to rural social-ecological resilience in semi-arid Kenya. Ecology and Society 19(4).

Silalahim, M., 2021. Bioactivity and uses of Cnidoscolus aconitifolius (Mill.) I.M. Johnst World Journal of Biology Pharmacy and Health Sciences 07(03), 57-64.

Slavin, J.L., Lloyd, B., 2012. Health benefits of fruits and vegetables. Adv Nutr 3(4), 506-516.

Soladoye, M.O., Adetayo, M.O., Chukwuma, E.C., Amusa, N., 2010. Ethnobotanical survey of plants used in the treatment of hemorrhoids in South-Western Nigeria, Annonated Biology Respondent. , 1-115.

Soladoye, M.O., Chukwuma, E.C., Owa, F.P., 2012. An avalanche of plant species for the traditional cure of diabetes mellitus in south-western Nigeria. Journal of Natural Product and Plant Resources 2(1), 60-72.

Stadlmayr, B., Charrondière, U.R., Eisenwagen, S., Jamnadass, R., Kehlenbeck, K., 2013. Nutrient composition of selected indigenous fruits from sub-Saharan Africa. Journal of the Science of Food and Agriculture 93(11), 2627-2636.

Stats SA, 2015. Living conditions of households in South Africa, in: Lehohla, P. (Ed.) An analysis of household expenditure and income data using the LCS 2014/2015. Statistics South Africa, Pretoria, South Africa, pp. 1-232.

Suara, K., Chukwuemeka, A., Okubanjo, O., Cecilia., I., 2016. Neutraceutical and antibacterial properties of methanol extract of Plukenetia conophora [Müll.-Arg. family Euphorbiaceae] leaves and physical properties of its cream formulations

Nigerian Journal of Pharmaceutical and Applied Science Research 5(1), 91-98.

Šūmane, S., Kunda, I., Knickel, K., Strauss, A., Tisenkopfs, T., des Ios Rios, I., Rivera, M., Chebach, T., Ashkenazy, A., 2018. Local and farmers' knowledge matters! How integrating informal and formal knowledge enhances sustainable and resilient agriculture. Journal of Rural Studies 59, 232-241.

Taiwo, K.A., Irefin, I.A., Ilori, M.O., 1997. Integration of modern technologies in traditional food processing in Nigeria. Food reviews international. 13(4), 611-621.

Tanimonure, V.A., Naziri, D., Codjoe, S.N.A., Ayanwale, A.B., 2021. Underutilised indigenous vegetables for household dietary diversity in Southwest Nigeria. Agriculture 11(11), 1064.

Tardío, J., Pardo-de-Santayana, M., 2008. Cultural Importance Indices: A comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). Economic Botany 62(1), 24-39.

Tashakkori, A., Teddlie, C., 2003. The past and future of mixed methods research: From data triangulation to mixed model designs. Handbook of mixed methods in social and behavioral research, 671-701.

Thomas, E., Vandebroek, I., Sanca, S., Van Damme, P., 2009. Cultural significance of medicinal plant families and species among Quechua farmers in Apillapampa, Bolivia. Journal of Ethnopharmacology 122(1), 60-67.

Toyang, N.J., Verpoorte, R., 2013. A review of the medicinal potentials of plants of the genus Vernonia (Asteraceae). Journal of Ethnopharmacology 146(3), 681-723.

Tumwet, T.N., Kang'ethe, E.K., Kogi-Makau, W., Mwangi, A.M., 2014. Diversity and immune boosting claims of some African indigenous leafy vegetables in western Kenya. African Journal of Food, Agriculture, Nutrition Development and change. 14, 8529-8544.

Udefi, A., 2012. Philosophy, mythology and an African cosmological system. Ibadan journal of humanistic studies. 22(1), 58-64.

Ugbogu, O.C., Emmanuel, O., Agi, G.O., Ibe, C., Ekweogu, C.N., Ude, V.C., Uche, M.E., Nnanna, R.O., Ugbogu, E.A., 2021. A review on the traditional uses, phytochemistry, and pharmacological activities of clove basil (Ocimum gratissimum L.). Heliyon 7(11), e08404.

United Nations, 2019. Millennium Development Goals. United Nations Department of Public Information

Van den Heever, E., Venter, S.L., 2006. Nutritional and medicinal properties of Cleome gynandra. In: International Conference on Indigenous Vegetables and Legumes. Prospectus for Fighting Poverty, Hunger and Malnutrition. 752, pp. 127-130.

Van der Hoeven, M., Osei, J., Greeff, M., Kruger, A., Faber, M., Smuts, C.M., 2013. Indigenous and traditional plants: South African parents' knowledge, perceptions and uses and their children's sensory acceptance. Journal of Ethnobiology and Ethnomedicine 9, 1-12.

Van Rensburg, W.S.J., Van Averbeke, W., Slabbert, R., Faber, M., Van Jaarsveld, P., Van Heerden, I., Wenhold, F., Oelofse, A., 2007. African leafy vegetables in South Africa. Water SA 33, 317-326.

Van Wyk, B.-E., 2015. A review of commercially important African medicinal plants. Journal of Ethnopharmacology 176, 118-134.

Vinceti, B., van Vliet, N., Keding, G., Stadlmayr, B., Van Damme, P., Carsan, S., Sunderland, T., Njenga, M., Gyau, A., Cerutti, P., 2015. Understanding the roles of forests and tree-based systems in food provision. Journal of Forests and Food 2, 1-209.

Viriri, A., Mungwini, P., 2010. African cosmology and the duality of Western hegemony: The search for an African identity. The journal of pan African studies 3(6), 27-42.

Warren, D.M., 1991. The role of indigenous knowledge in facilitating the agricultural extension process. In: international workshop on agricultural knowledge systems and the role of extension,. pp. 21-24.

Welcome, A.K., Van Wyk, B.-E., 2020. Spatial patterns, availability and cultural preferences for edible plants in southern Africa. Journal of Biogeography 47(3), 584-599.

Welcome, A.K., Van Wyk, B.E., 2019. An inventory and analysis of the food plants of southern Africa. South African Journal of Botany 122, 136-179.

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L.J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J.A., De Vries, W., Majele Sibanda, L., Afshin, A., Chaudhary, A., Herrero, M., Agustina, R., Branca, F., Lartey, A., Fan, S., Crona, B., Fox, E., Bignet, V., Troell, M., Lindahl, T., Singh, S., Cornell, S.E., Srinath Reddy, K., Narain, S., Nishtar, S., Murray, C.J.L., 2019. Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. Lancet 393(10170), 447-492.

Wood, A.P., Dixon, A., McCartney, M.P., 2013. Wetland management and sustainable livelihoods in Africa. Routledge/Earthscan from Routledge.

Wu, C.C., 1977. Education in farm production: The case of Taiwan. American Journal of Agricultural Economics 59(4), 699-709.

Zakaria, H., 2017. The drivers of women farmers' participation in cash crop production: the case of women smallholder farmers in Northern Ghana. The Journal of Agricultural Education and Extension 23(2), 141-158.

Zimba, N., Wren, S., Stucki, A., 2005. Three major tree nut oils of southern central Africa: Their uses and future as commercial base oils. International Journal of Aromatherapy 15, 177-182.

Zohrabi, M., 2013. Mixed method research: Instruments, validity, reliability and reporting findings. Academy Publisher, Finland.

APPENDICES

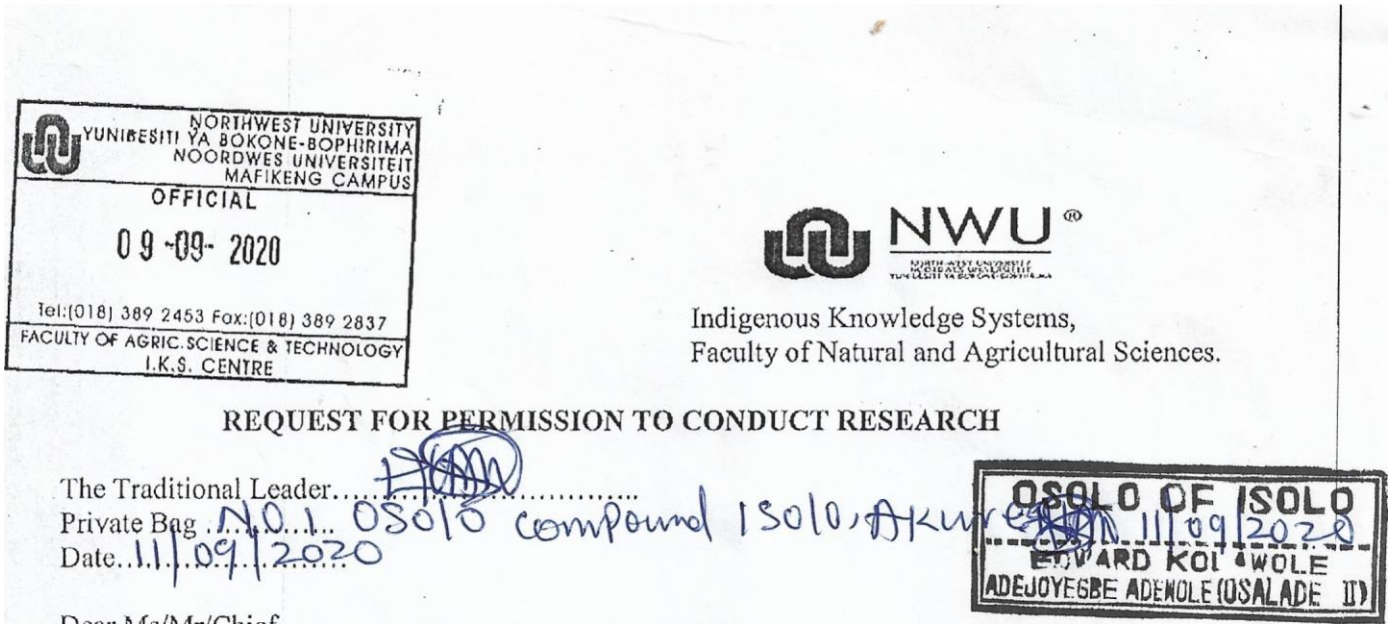
Appendix 1 – Ethic clearance

ETHICS APPROVAL LETTER OF STUDY Based on approval by the Faculty of Natural and Agricultural Sciences Ethics Committee (FNASREC), the Faculty of Natural and Agricultural Sciences Ethics Committee hereby approves your study as indicated below. This implies that the North-West University Senate Committee for Research Ethics (NWU-SCRE) grants its permission that, provided the special conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below. Study title: Utilisation pattern and economic potential of indigenous fruits and vegetables among rural communities in Akure, Nigeria. Study Leader/Supervisor: Dr AO Aremu Student: SF Olowo Ethics number: N W U - 0 1 7 7 1 - 2 0 - A 9 Institution Study Number Year Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation Application type: Single Risk Category: Minimal Commencement date: 01/11/2020 Expiry date: 01/02/2022 Approval of the study is initially provided for a year, after which continuation of the study is dependent on receipt and review of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation. Special in process conditions of the research for approval (if applicable): • The following documentation are archived by FNASREC and should be complete and kept up to date: ◦ Research proposal ◦ Signed approval from the scientific committee indicating the proposed risk category • All researchers involved in the study should submit signed NWU code of conduct statements annually. • All researchers of low-risk studies should submit proof of relevant ethics training every two years. • All researchers that take part in activities that pose a safety and security threat to the researchers, or the environment should submit a risk assessment form annually. • All research involving human interaction should follow best ethical practise and keep documents as proof. This includes informed consent, questionnaires, incorporation of risk-benefit, and responsible data management. • Any research at governmental or private institutions, permission must still be obtained from relevant authorities and provided to the FNASREC. Ethics approval is required BEFORE approval can be obtained from these authorities. File

reference: 9.1.5.4.2 Page 1 of 2 General conditions: While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply: • The study leader/supervisor (principle investigator)/researcher must report in the prescribed format to the FNASREC: ◦ annually (or as otherwise requested) on the monitoring of the study, whereby a letter of continuation will be provided, and upon completion of the study; and ◦ without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study. • The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the study, the study leader/researcher must apply for approval of these amendments at the FNASREC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited. • Annually several studies may be randomly selected for an external audit. • The date of approval indicates the first date that the study may be started. • In the interest of ethical responsibility, the NWU-SCRE and FNASREC reserves the right to: ◦ request access to any information or data at any time during the course or after completion of the study; ◦ to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process; ◦ withdraw or postpone approval if: ∗ any unethical principles or practices of the study are revealed or suspected; ∗ it becomes apparent that any relevant information was withheld from the FNASREC or that information has been false or misrepresented; ∗ submission of the annual (or otherwise stipulated) monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and / or ∗ new institutional rules, national legislation or international conventions deem it. • FNAS-REC can be contacted for further information or any report templates via Roelof.Burger@nwu.ac.za 018 299 4269 The FNASREC would like to remain at your service as scientist and researcher and wishes you well with your study. Please do not hesitate to contact the FNASREC or the NWU-SCRE for any further enquiries or requests for assistance. Yours sincerely, Prof Roel of Burger Chairperson Faculty of Natural and Agricultural Sciences Ethics Committee (FNASREC) File reference: 9.1.5.4.2

Appendix 2 – Permission letter from the tribal authority

UJ



NORTHWEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES UNIVERSITEIT
MAFIKENG CAMPUS
OFFICIAL
09 -09- 2020
Tel:(018) 389 2453 Fax:(018) 389 2837
FACULTY OF AGRIC. SCIENCE & TECHNOLOGY
I.K.S. CENTRE

NWU®

Indigenous Knowledge Systems,
Faculty of Natural and Agricultural Sciences.

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

The Traditional Leader.....
Private Bag ...N.O.1.. OSOLO compound ISOLO, Akure
Date..11.09.2020

OSOLO OF ISOLO
11/09/2020
EDWARD KOLAWOLE
ADEJOYEGBE ADEWOLE (OSALADE II)

Dear Ms/Mr/Chief.....

I am writing to request permission to access and conduct my research project at your area in 20/2021. I am currently registered for Masters of Indigenous Knowledge Systems (MIKS) at the North-West University, South Africa. My research is entitled "Exploring the potential of indigenous fruits and vegetables for nutritional, health and livelihood among communities in Akure, Ondo state, Nigeria". The aim of- the study is to explore how indigenous fruit and vegetables contribute to the nutritional and health benefits as well as livelihood among communities in Akure. I would like to approach community members who are knowledgeable on the subject matter and willing to participants in the-study. Interested participants will be provided with the scope of the study, seek clarity and will be expected to provide a signed consent form if they are happy to participate.

If approval is granted, participants will complete the survey in a designated location in your village. However, some participants may choose to complete the survey at their hotnes.
The survey results will be pooled for the dissertation for the award of my MIKS degree. Furthermore, the results of this study will remain confidential and anonymous. Should this study be published, only pooled results will be documented. I will also be happy to provide the findings to the communities as part of my contribution and giving back for their time, no costs will be incurred by either your village or the individual participants. Your approval to conduct this study will be greatly appreciated, I will be happy to answer any questions or concerns that you may have at that time. You may contact me at olowosimi12@gmail.com/+234 806 012 0126. Prof Oladapo A. Aremu will be supervising the research and is also available to answer any questions regarding the study. His details are:
+27 18 389 2573.

If you agree, kindly sign below. Alternatively, kindly provide a signed letter of permission on your letterhead acknowledging your consent and permission for me to conduct this

survey/study at your area.

Yours Sincerely,

Students' Signature /Date

11/09/2020

SimiloluwaFeliciaOlowo(Researcher)

Signature/Stamp/ Date

Chief

Appendix 3 – Consent form

Utilization and economic pattern of indigenous fruits and vegetables among selected communities in Ondo state, Nigeria

My name is Similoluwa Felicia Olowo with student number 34340734, I am a student at the North West University, doing research on utilization and economic pattern of indigenous fruits and vegetables in 40 selected communities in Akure, Ondo state. I am fully responsible for the information that I will be given thus will assure you that the information given to me will not be used for profit nor sold or given to other entities, it will be for internal use only.

If you have any other concerns about your rights as a research participant that have not been answered by me, you can kindly contact my supervisors Prof. A.O. Aremu (0813892573/Oladapo.Aremu@nwu.ac.za or Dr. A.O. Omotayo (0611649252/Abiodun.Omotayo@nwu.ac.za) at North west University. Mmabatho, South Africa.

Consent

Your signature or thumb print below indicates that you have decided to volunteer as research participant for this study, and that you have read and understood the information provided above. You will be given a signed and dated copy of this form to keep, along with any other printed materials deemed necessary by the study investigators.

Participant's name: Signature of the participant: Date:

Researcher's signature Date

Appendix 4 – Semi-Questionnaire

Indigenous Knowledge Systems
Faculty of Natural and Agricultural Sciences

SEMI-STRUCTURED QUESTIONNAIRE

The questions are strictly for the purpose of research. All information obtained will be treatedwith great confidentiality. Please, answer each question honestly and accurately as your participation in this exercise is crucial to the success of community development. Thanks for your anticipated cooperation.

Please Fill and Tick (✓) in the appropriate place where necessary.

SECTION A

PROJECT TITLE: Utilisation pattern and economic potential of indigenous fruits and vegetables among rural communities in Akure, Nigeria

DATE OF COLLECTION: …….

LOCATION OF DATA COLLECTION: ……

PARTICIPANTS SOCIO ECONOMIC PROFILE

1. GENDER

Male	Female

2. AGE……

3. MARITAL STATUS

Single	Married	Divorced	Widow

4. EDUCATIONAL LEVEL
(a) Primary [] (b) Secondary [] (c) Diploma [] (d) Degree [] (e) PGD [] (f) None

5. RELIGON

Christianity	Islamic	Traditionalists	Other

6. OCCUPATION

Civil servant	Farming	Self employed	Entrepreneur

(7). Ethnic groups (a) Yoruba [ ] (b) Ibo [ ] (c) Hausa [ ] (d) Ijan [ ] (e) Others_____
(8) (a). Household size_____(b). Number of working member (s) _____
(9) Number(s) of years of experience…….

SECTION B

WHAT DO YOU UNDERSTAND BY INDIGENOUS FRUIT AND VEGETABLE?

OBJECTIVE 1. What are the indigenous fruits and vegetables in the study area?

1. Kindly describe in detail what you know about the indigenous fruits and vegetables.

……

2. Tick the types of indigenous fruits and vegetables found in your community and complete the table

S/N	Botanical name	Vernacular name	Local name	Plant part	Local uses	Method of preparation	How often do you eat this	Seasonal availability ARY, BRS, DRS, DS	Medi Contr to the peopl State usefuln
	Fruits								
1	*Artocarpus communis*	Breadfruit (E) Berefuutu (Y)							
2	*Blighia sapida*	Ackee (E) Ishin (Y)							
3	*Citrus aurantifolia*	Lime (E) Oronbo wewe (Y)							
4	*Citrus aurantium*	Orange (E) Ganinganin (Y)							
5	*Cocos nucifera*	Coconut (E) Agbon (Y)							
6	*Crysophyllum albidum*	Africa Star Apple(E) Agbalumo (Y)							
7	*Dalium guineese*	Black Velvet Tamarind (E) Awin (Y)							
8	*Elaeis guineensis*	Oil Palm (E) Eyin (Y)							
9	*Irvingia gabonensis*	Bush Mango (E) Oro (Y)							
10	*Irvingia wombolu*	Bitter Bush Mango (E) Oro (Y)							
11	*Parkia biglobosa*	Locust beans (E) Iru (Y)							
12	*Plukenetia conophora*	Walnut (E) Awusa (Y)							

13	*Solanum indicum*	African Eggplant (E) Ajegun Were (Y)							
14	*Solanum aethiopicum*	Garden Egg (E) Igba (Y)							
15	*Spondias mombin*	Hog Plum (E) Iyeye (Y)							
16	*Theobroma cacao*	Cocoa (E) Koko (Y)							
	Other fruits in the community								
	Vegetables								
1	*Ageratum conyzoides*	Billy Goat Weed (E) Imi esu (Y)							
2	*Amaranthus hybridus*	Africa Spinach (E) Tete (Y)							
3	*Amaranthus spinosus*	Spiny Amaranthus (E) Tete elegun (Y)							
4	*Amaranthus viridis*	Green Amaranth (E) Tete abalaye (Y)							
5	*Androgra hic paniculate*	King of Bitter (E) Mejemeje (Y)							
6	*Basella alba*	Malabar spinach (E) Amunututu (Y)							
7.	*Boerhavia diffusa*	Hog weed (E) Eemo / Olowojeja (Y)							
8	*Bryophyllum pinnatum*	Miracle leave (E)							

		Abamoda (Y)							
9	*Ceiba pentandra*	Baobao (E) Eegungun (Y)							
10	*Chromalaena odorata*	Siam weed (E) Akintola (Y)							
11	*Cnidoscolus aconitifolius*	Chaya (E) Iyana paja (Y)							
12	*Crassocephalum rubens*	Coriander (E) Ebolo (Y)							
13	*Celosia argentea*	Lagos spinach (E) Shokoyokoto (Y)							
14	*Clerodendrum volubile*	White butterfly (E) Dagba (ewe ata) (Y)							
15	*Corchorus olitorus*	Jute leaves (E) Ewedu (Y)							
16	*Eclipta prostrata*	False daisy (E) Abikole (Y)							
17	*Gossypium barbadense*	Cotton seed (E) Owu (Y)							
18	*Hibiscus asper*	Hibiscus (E) Isapa (Y)							
19	*Launaea taraxacifolia*	Wild lettuce (E) Yanrin (Y)							
20	*Manihot utilissima*	Cassava leaves (E) Ege (Y)							
21	*Mucuna pruriens*	Mucuna leaves (E) Esisi / Iwerepe (Y)							
22	*Occimum grattisimum*	Scent leaves (E) Efirin (Y)							
23	*Sida acuta*	Wire weed (E) Iseketu (Y)							
24	*Solanum erianthum*	Big eggplant (E) Ewuro							

		Ijebu (Y)							
25	*Solanum macrocarpon*	Africa eggplant (E) Igbagba (Y)							
26.	*Solanum nigrum*	Black nightshade (E) Efo odu (Y)							
27.	*Senecio biafrae*	Bologi (E) Woorowo (Y)							
28	*Talinum triangulare*	Water leaf (E) Gbure (Y)							
29.	*Vermonia adoensis*	Bitter leaf (E) Ewuro odo (Y)							
30	*Vermonia amygdalina*	Bitter leaf (E) Ewuro (Y)							
	Other vegetables in the community								

ARY: All round the year; BRS: Before rainy season; DRS: During rainy season; DS: Dry season

SECTION C

OBJECTIVE 2. What are the common practices and knowledge associated with the uses of indigenous fruits and vegetables in the community?

1. What is the source of your knowledge on indigenous fruit and vegetable (a)Parents [] (b)Peers [] (c) community members [] (d) sellers [] (e) Others []
2. Is there any community practice for sharing knowledge on indigenous fruit and vegetable withyour culture? Yes [] or No []
3. If yes, how do they transfer the knowledge? ……
4. What are the indigenous methods used in your community to process and preserve indigenous fruits and vegetables?.....
5. Does your culture influence the utilisation of indigenous fruits and vegetables? Yes [] No []
6. If yes, kindly explain…….……
7. Are there any storage techniques you employ locally to preserve the indigenous fruits and vegetables for future use? Yes [] No []
8. If yes mention them…….
9. Are there indigenous fruits and vegetables you know that are no longer available in your area?
   a) Yes (b) No.
10. If yes, which ones? ……..
11. What are the benefits of cultivating these indigenous fruits and vegetables

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
Nutritious					
Drought resistant					
Pest and diseases resistant					
Low input requirement					
Others					

SECTION D

Objective 3. How can indigenous fruits and vegetables contribute to the livelihood of the community members?

1. How do you value indigenous fruits and vegetables? (a) superior [] (b) Inferior []
2. Do you plant any indigenous fruits and vegetables at your backyard or farm? (a) Yes (b) No
3. Do indigenous foods have economic value? (a) Yes (b) No.
4. Where do you often harvest, sell, or buy your indigenous fruits and vegetables from the (a) market?
   (a) local farmer (c) Others (Specify)
5. Is the financial return from indigenous plants playing any role in sustaining your family? (a) Yes (b) No
6. How does indigenous fruits and vegetables contribute to your household's food security (a) Moneyprovision (b) Food provision (c) other welfare (d) Other's ways……
7. Is there market(s) for indigenous food crops vegetables, fruits? (a)Yes (b) No
8. How often is the market accessible to the community?

…….

9. Do you participate in commercialization of indigenous fruit and vegetables? [Yes] or [No]
10. Households' consumption expenditure per month ₦…….?
11. What much is your average households' expenses per month ₦……?
12. Sales and cultivation of indigenous plants as major occupation. [Yes] or [No]
13. Present production scale ..... Large/small
14. Kindly indicate your average income level per month ₦ _____
15. Are you a member of any cooperative society, financial aid, or credit? (a) Yes [] (b) No []
16. Ease of access to customers? [Yes] or [No]
17. Do you have a phone or cell phone? [Yes] or [No]
18. What is the state of infrastructure (road, water, electricity) in your township (a) Good (b) Bad (c)Fair?
19. When you buy, do you make financial gains when the customers pay you for your services**?** [Yes] or [No]
20. Did you produce enough revenue for your family last year?_____
21. How much money do you realize from selling of these indigenous plants per month?

No	**Response (Naira)**	**Tick**
1	(Less than ₦1000)	
2	(₦1001- 2000)	
3	(₦2001- 3000)	
4	(₦3001- 4000)	
5	(₦4001-5000)	
6	>₦5000	

22. Households' willingness to pay for indigenous fruit and vegetables

S/N	Indigenous fruit and vegetable		Gender		Cost of implication	
	Botanical name	Vernacular name	M	F	Willing to pay price per Kg in (₦)	Market price per Kg in (₦)
	Fruits					
1	*Artocarpus communis*	Breadfruit (E) Berefuutu (Y)				
2	*Blighia sapida*	Ackee (E) Ishin (Y)				
3	*Citrus aurantifolia*	Lime (E) Oronbo wewe (Y)				
4	*Citrus aurantium*	Orange (E) Ganinganin (Y)				
5	*Cocos nucifera*	Coconut (E) Agbon (Y)				
6	*Crysophyllum albidum*	Africa Star Apple(E) Agbalumo (Y)				
7	*Dalium guineese*	Black Velvet Tamarind (E) Awin (Y)				
8	*Elaeis guineensis*	Oil Palm (E) Eyin (Y)				
9	*Irvingia gabonensis*	Bush Mango (E) Oro (Y)				
10	*Irvingia wombolu*	Bitter Bush Mango (E) Oro (Y)				
11	*Parkia biglobosa*	Locust beans (E) Iru (Y)				
12	*Plukenetia conophora*	Walnut (E) Awusa (Y)				
13	*Solanum indicum*	Lime (E) Ajegun Were (Y}				
14	*Solanum aethiopicum*	Garden Egg (E) Igba (Y)				
15	*Spondias mombin*	Hog Plum (E) Iyeye (Y)				
16	*Theobroma cacao*	Cocoa (E) Koko (Y)				
	Vegetables					
1	*Ageratum conyzoides*	Billy Goat Weed (E) Imi esu (Y)				
2	*Amaranthus hybridus*	Africa Spinach (E) Tete (Y)				
3	*Amaranthus spinosus*	Spiny Amaranthus (E) Tete elegun				

		(Y)				
4	*Amaranthus viridis*	Green Amaranth (E) Tete abalaye (Y)				
5	*Andrographic paniculate*	King of Bitter (E) Mejemeje (Y)				
6	*Basella alba*	Malabar spinach (E) Amunututu (Y)				
7.	*Boerhavia diffusa*	Hog weed (E) Eemo / Olowojeja (Y)				
8	*Bryophyllum pinnatum*	Miracle leaf (E) Abamoda (Y)				
9	*Ceiba pentandra*	Baobao (E) Eegungun (Y)				
10	*Chromalaena odorata*	Siam weed (E) Akintola (Y)				
11	*Cnidoscolus aconitifolius*	Chaya (E) Iyana paja (Y)				
12	*Crassocephalum rubens*	Coriander (E) Ebolo (Y)				
13	*Celosia argentea*	Lagos spinach (E) Shokoyokoto (Y)				
14	*Clerodendrum volubile*	White butterfly (E) Dagba (ewe ata) (Y)				
15	*Corchorus olitorus*	Jute leaves (E) Ewedu (Y)				
16	*Eclipta prostrata*	False daisy (E) Abikole (Y)				
17	*Gossypium barbadense*	Cotton seed (E) Owu (Y)				
18	*Hibiscus asper*	Hibiscus (E) Isapa (Y)				
19	*Launaea taraxacifolia*	Wild lettuce (E) Yanrin (Y)				
20	*Manihot utilissima*	Cassava leaves (E) Ege (Y)				
21	*Mucuna pruriens*	Mucuna leaves (E) Esisi / Iwerepe (Y)				
22	*Occimum grattisimum*	Scent leaves (E) Efirin (Y)				
23	*Sida acuta*	Wireweed (E) Iseketu (Y)				
24	*Solanum erianthum*	Big Eggplant (E) Ewuro Ijebu (Y)				
25	*Solanum macrocarpon*	Africa Eggplant (E) Igbagba (Y)				
26.	*Solanum nigrum*	Black nightshade (E) Efo odu (Y)				
27.	*Senecio biafrae*	Bologi (E) Woorowo (Y)				
28	*Talinum triangulare*	Water leaf (E) Gbure (Y)				
29.	*Vermonia adoensis*	Bitter leaf (E) Ewuro odo (Y)				
30	*Vermonia amygdalina*	Bitter leaf (E) Ewuro (Y)				

23. Contribution of indigenous fruits and vegetables to the livelihood (indicate the level of impact by marking X)

Households Livelihood Assets	**Yes**	**No**
Human capital		
1. Do you have vocational training in using indigenous fruits and vegetables?		
2. Technical training on how to use indigenous fruits and vegetables?		
3. Marketing skill on indigenous fruits and vegetables?		
4. Do you have packaging skill of indigenous fruits and vegetables?		
5. Do you have invention and creative thinking indigenous fruits and vegetables?		
6. Ability to sell indigenous fruits and vegetables?		
7. Do you have gross income from indigenous fruits and vegetables?		
8. Do you keep record of indigenous fruits and vegetables?		
9. Do you attend financial management training?		
10. Do you attend training on price determination on indigenous fruits and vegetables?		
11. Access to government agent for on job training or follow ups?		
Natural capital		
1.Do you have access to land?		
2.Do you utilise the land for indigenous fruits and vegetables?		
3.Do you have access to water?		

4.Do you have or own livestock?		
Social capital		
1. Networking with financial institutions?		
2. Networking with another indigenous fruit and vegetable seller?		
3. Networking with government relevant ministry?		
4. Do you network with international organizations or another farmer cooperative?		
5. Do you network with professional membership and organization such as FADAMA, ADP?		
6. Are you part of any trade unions?		
7. Do you network with village or community committee?		
Financial capital		
1. Access to banks and cooperative?		
2.Personal savings?		
3.Access to Government subsidies or grants?		
4.Relatives?		
Physical capital		
1. Is there an established market for indigenous fruits and vegetables?		
2. Are roads accessible?		
3. Electricity availability?		
4. Do you have or have access to storage facilities?		
5. Is there the any processing facilities around your communities?		
6. Packaging infrastructure?		
7. Telephone infrastructure?		
8. Access to private vehicle or other means of transpo		
9. Ease of access to customers?		
10. ls the information about the market information and products sufficiently available?		

(24) How much is your monthly cost on the following:

(a) Transportation distribution of the indigenous fruits and vegetables ₦.....

(b) Land preparation to the time of harvesting the indigenous fruits and vegetables ₦.....

(c) Packaging processes ₦ .....

(d) Land rent or lease for indigenous fruits and vegetables? ₦.....

(e) Transportation to point of sale (if applicable)? ₦.....

(f) Labour including family self & labour ₦.....

(g) Miscellaneous. ₦.....

(25) What was your Total cost (TC) ₦.....

(26) What was your total income from last month on trading indigenous fruit and vegetables ₦.....

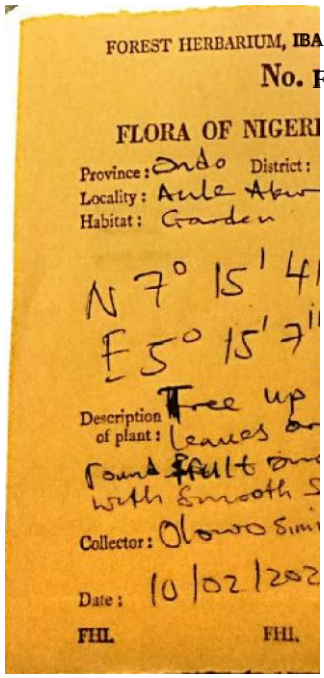
(27) How much do you make from other activities last month (if applicable) ₦.....

(28) Total revenue (TR) from indigenous fruits and vegetables and other activities. ₦.....

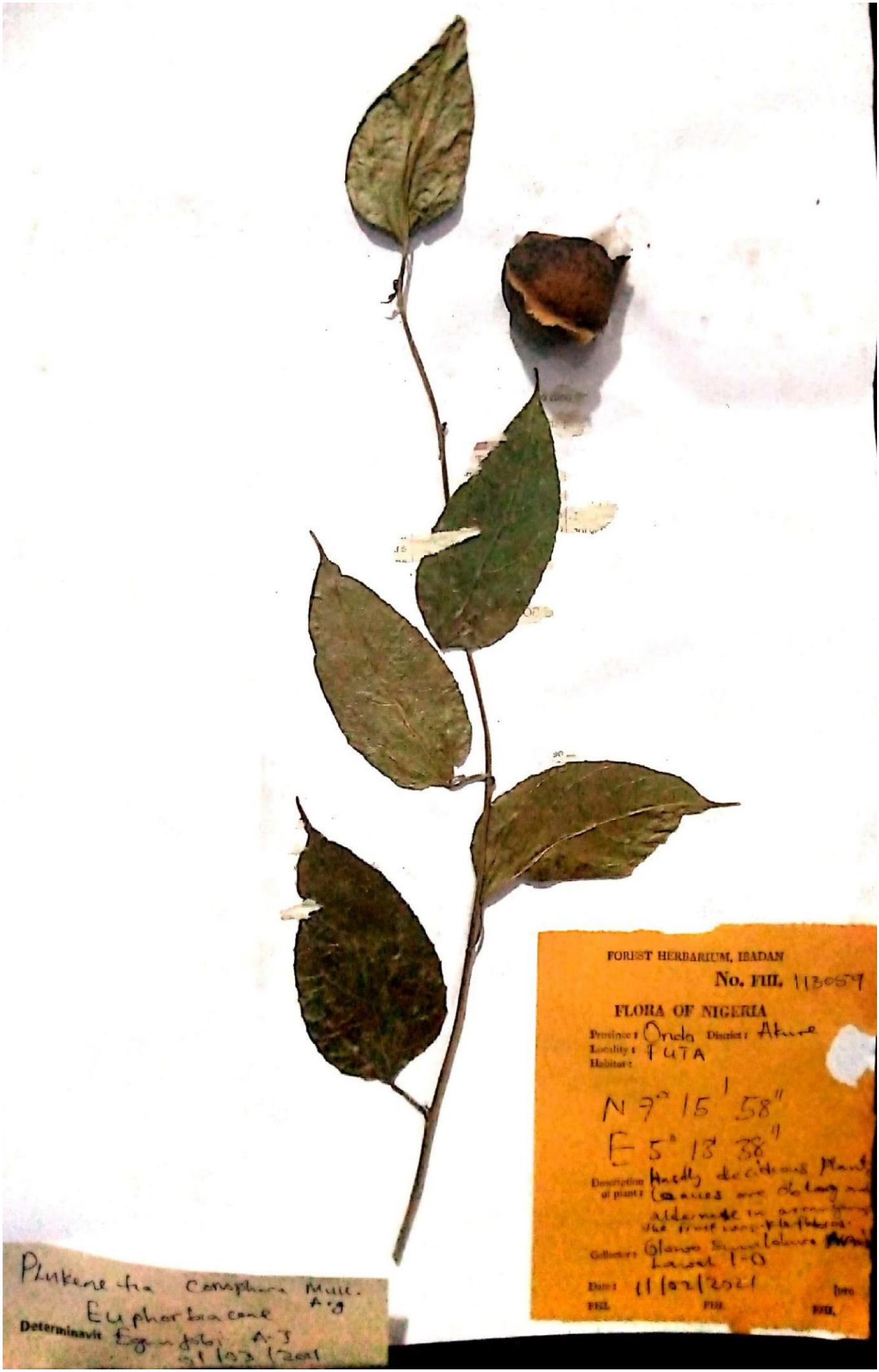
(29) Did you generate enough revenue for your family last year? [Yes] or [No]

(30) How much is your household's food expenditure? ₦.……

Appendix 5 – Confirmation and identification of plants used for the study


FOREST HERBARIUM, IBADAN
No. FUL 113053
FLORA OF NIGERI
Province: Ondo District:
Locality: Arule Abu
Habitat: Garden
N 7° 15' 4
E 5° 15' 7
Description of plant: Tree up
leaves
found
with smooth
Collector: Olowo Simi
Date: 10/02/202
FHI. FHI.

Determinavi




FOREST HERBARIUM, IBADAN
No. FHI. 113047
FLORA OF NIGERIA
Province: Ondo District: Akure
Locality: Shagari Village Akure
Habitat: farmland
N 7° 17' 27"
E 5° 9' 21"
Description of plant: An tall tree up to 20m high, leaves at the upper end of tree with apical crown
Date: 16/02/2021
(PTO
FHI.
FHI.
FHI
Cocos nucifera L.
Aracea
Determinavit Egunjobi A-J
01/03/2021

FOREST HERBARIUM, IBADAN

No. FHI. 113051

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: Ante Akure ondo state

Habitat: farm land

N7° 15' 41"

E5° 15' 7" E

Description of plant: A small tree up to 5m high, a branched thorny, leaves are small with narrowly winged petioles fruit found

Collector: [illegible]

Date: 10/02/2021

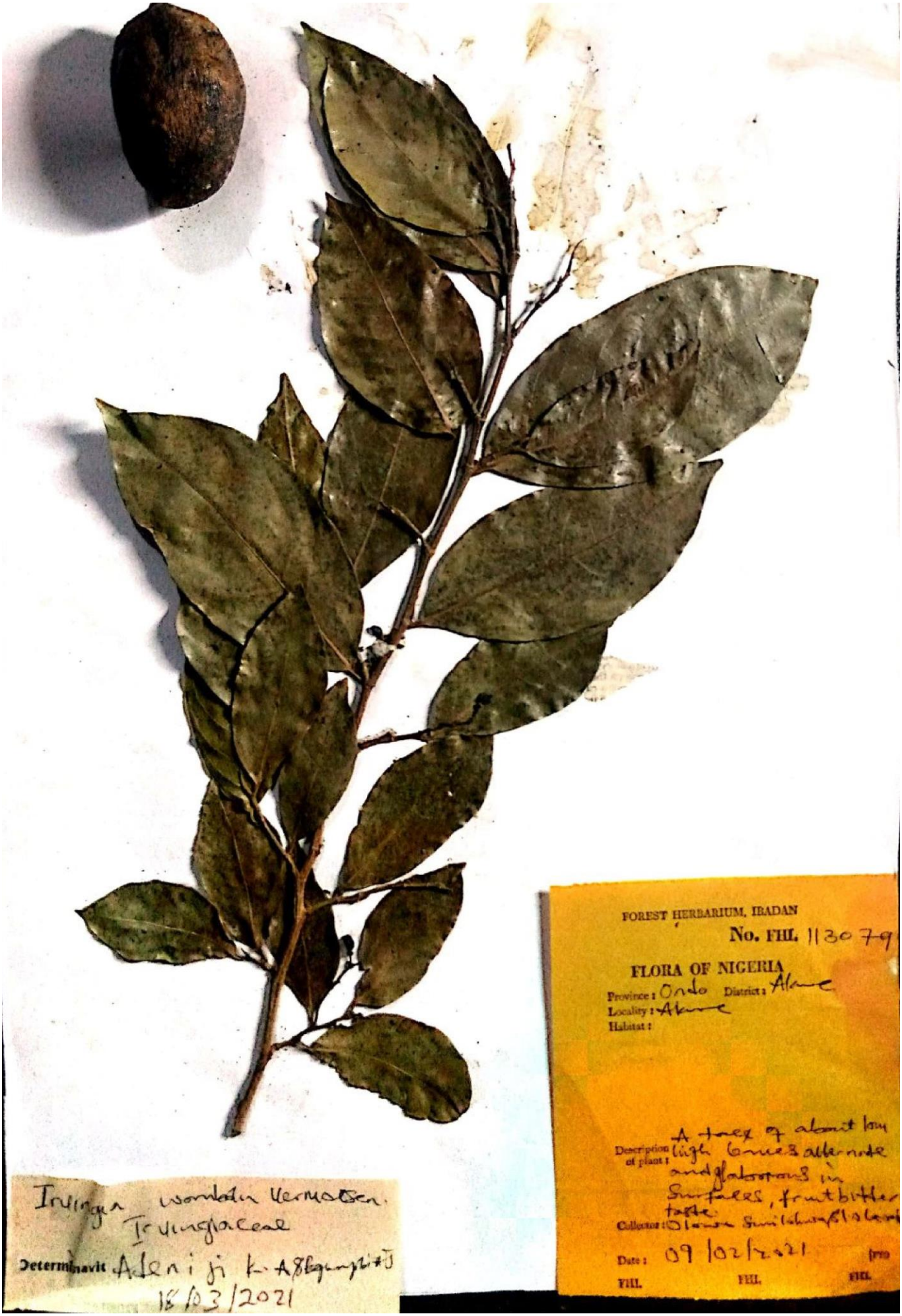
[PTO

FHI. FHI. FHI.

Citrus aurantifolia (Christm.) Swing

Rutaceae

Determinavit Egunjobi A.J 01/03/2021



FOREST HERBARIUM, IBADAN

No. FHI. 113079

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: Akure

Habitat:

Description of plant: A tree of about 10m high. Leaves alternate and glabrous in surfaces, fruit bitter taste.

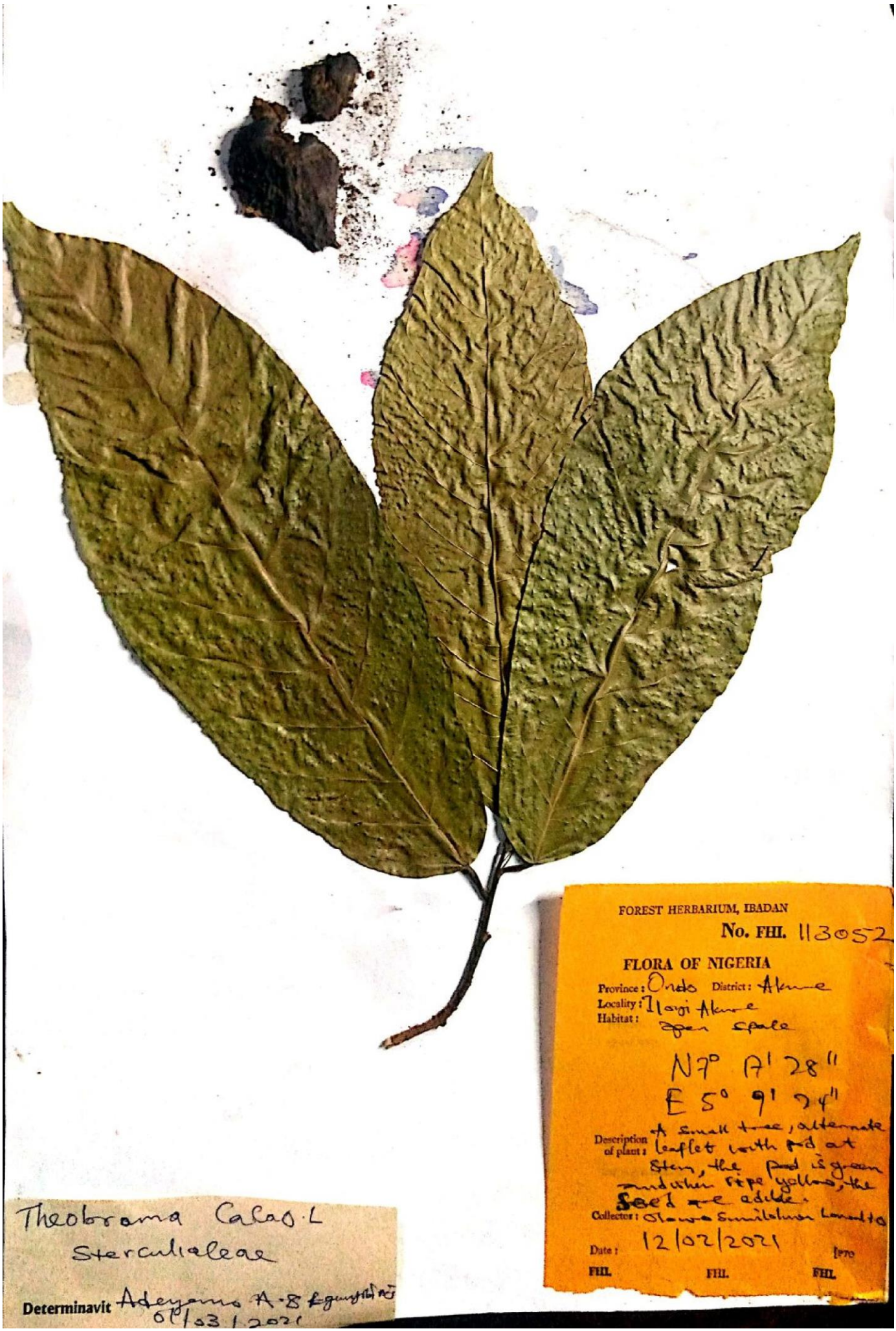
Collector: Olawoye Sunday & Olaniyi

Date: 09/02/2021

FHI. FHI. FHI.

Irvingia wombolu Vermoesen.
Irvingiaceae

Determinavit Aleniji K. A. 18/03/2021



FOREST HERBARIUM, IBADAN

No. FHI. 113052

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: Ilaji Akure

Habitat: open space

N7° A' 28"

E 5° 9' 24"

Description of plant: A small tree, alternate leaflet with red at stem, the pod is green and when ripe yellow, the seed are edible.

Collector: Olawoye Sunitalum Lawal to

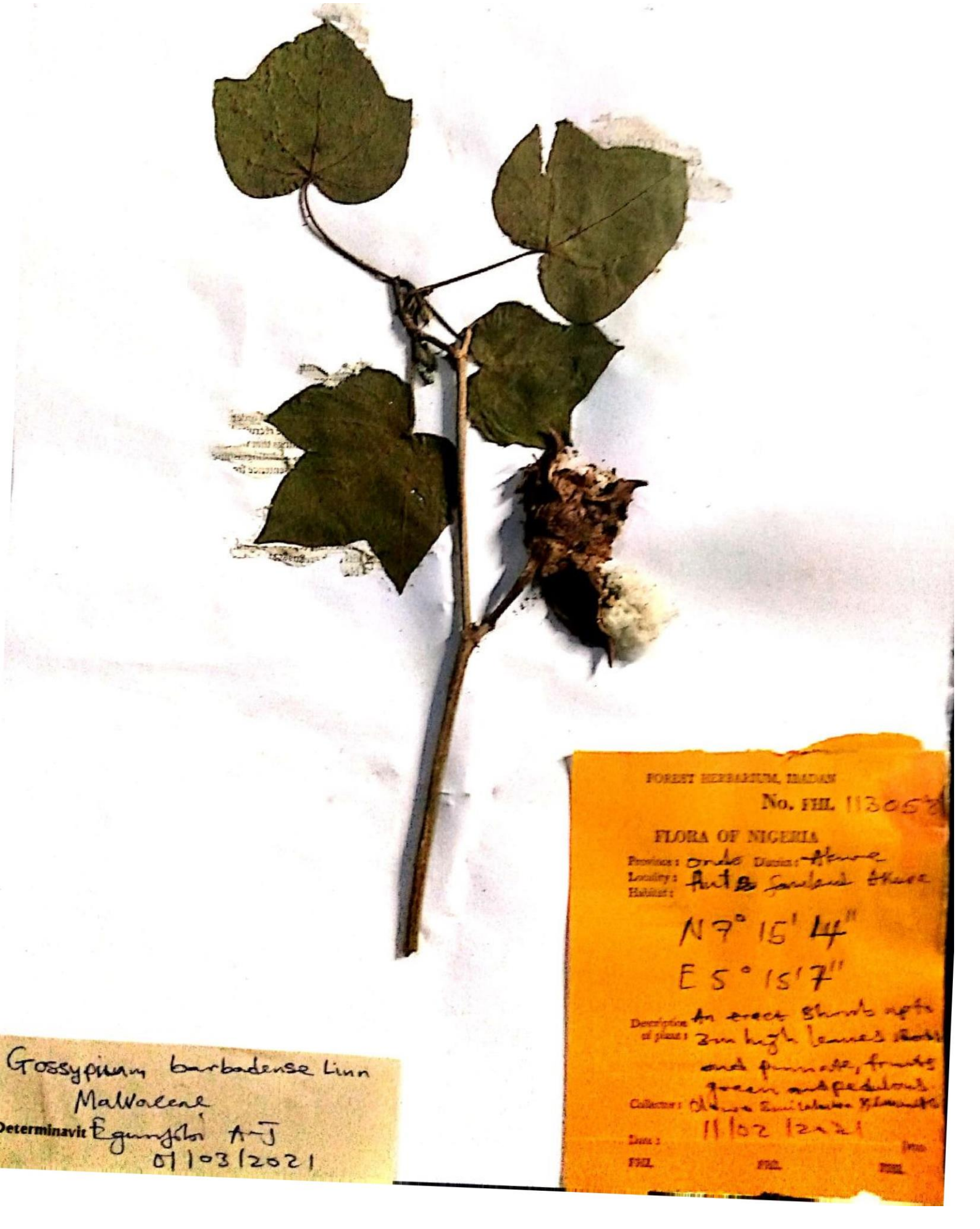
Date: 12/02/2021

FHI. FHI. FHI.

Theobroma Cacao L

Sterculiaceae

Determinavit Adeyemo A.S & Egunyomi A. 01/03/2021



FOREST HERBARIUM, IBADAN

No. FHI 113057

FLORA OF NIGERIA

Province: Ondo Division: Akure

Locality: Art B Sanlen Akure

Habitat:

N 7° 15' 44"

E 5° 15' 7"

Description of plant: An erect shrub upto 3m high leaves ovate and pinnate, fruits green and pedulous

Collector: Akure Envirolution Nigeria Ltd

Date: 11/02/2021

FHI FHI FHI

Gossypium barbadense Linn

Malvaceae

Determinavit Egunjobi A.J

01/03/2021

FOREST HERBARIUM, IBADAN

No. FHI. 113056

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: FUTA Akure

Habitat:

E 5° 9' 24"

N 7° 17' 29"

Description of plant: An erect shrub up to 0.5 m high, the leaves are alternate, elliptic broadly ovate, fruit fleshy-berry green

Collector: Olaniran Mikhail & Ismaila

Date: 09/02/2021

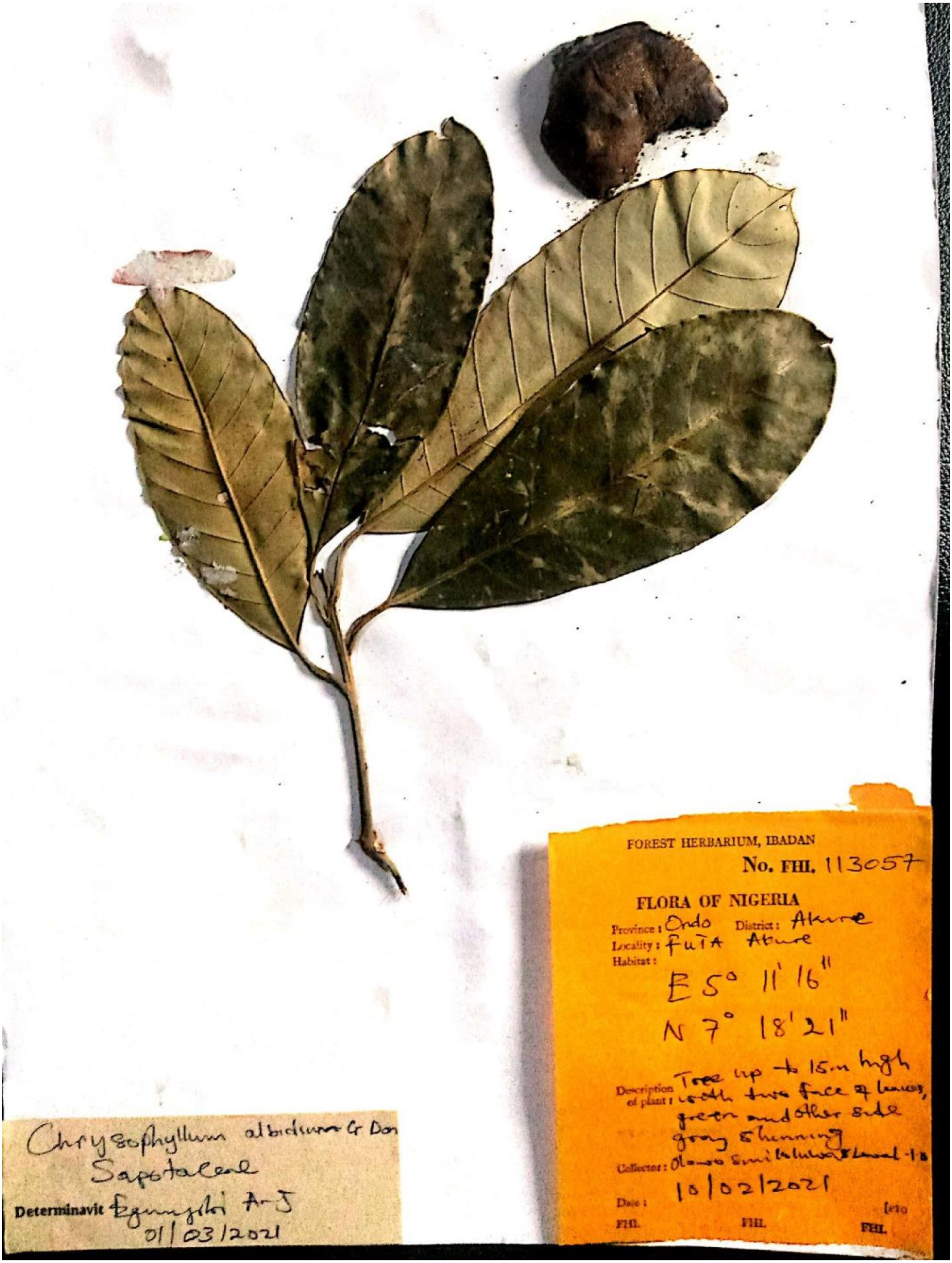
FHI. FHI. FHI.

Solanum Macrocarpum Linn

Solanaceae

Determinavit Egunjobi A. J

01/03/2021



FOREST HERBARIUM, IBADAN

No. FHI. 113057

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: FUTA Akure

Habitat:

E 5° 11' 16"

N 7° 18' 21"

Description of plant: Tree up to 15m high with two face of leaves, green and other side grey & shinning

Collector: Olawoye Emi Oluwa & Level-18

Date: 10/02/2021

FHI. FHI. FHI.

Chrysophyllum albidum G Don

Sapotaceae

Determinavit Egunyekoi A-J

01/03/2021

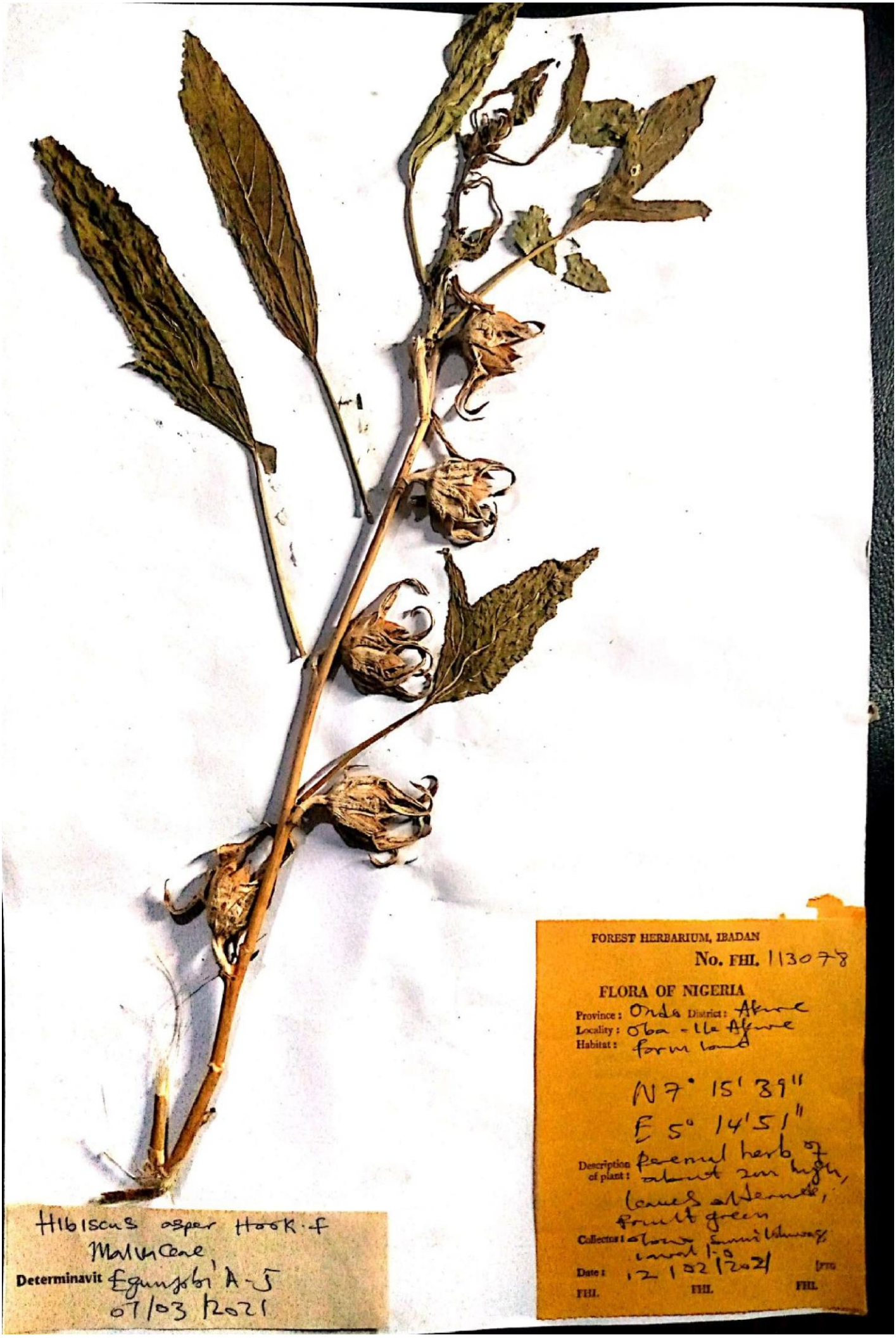
Solanum indicum Linn
Solanaceae
Determinavit Egunyobi A.J
01/03/2021

FOREST HERBARIUM, IBADAN
No. FHI. 113048
FLORA OF NIGERIA
Province: Ondo District: Akure
Locality: Ajale Akure
Habitat: farm land

N 7° 15'41"
E 5° 15'7"

Description of plant: An herbacious plant that grows up 0.3m 1.5m, leaves ovate and acute, fruit red and yellow when ripe.
Collector: Olowo Emiloluwa S. et al 1-6
Date: 10/02/2021

FHI. FHI. FHI.



FOREST HERBARIUM, IBADAN

No. FHI. 113078

FLORA OF NIGERIA

Province: Onda District: Akure

Locality: Oba - Ile Akure

Habitat: farm land

N7° 15' 39"

E 5° 14' 51"

Description of plant: perennial herb of about 2m high, leaves alternate, fruit green

Collector: Olowe Samuel Olumuyiwa and I.O.

Date: 12/02/2021

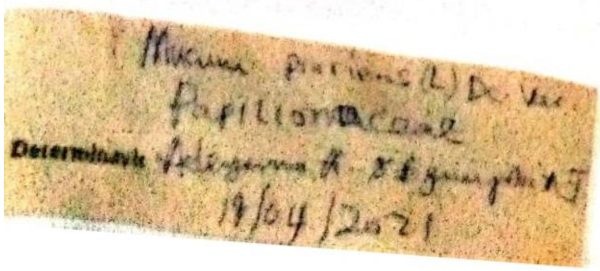
FHI. FHI. FHI.

Hibiscus asper Hook.f

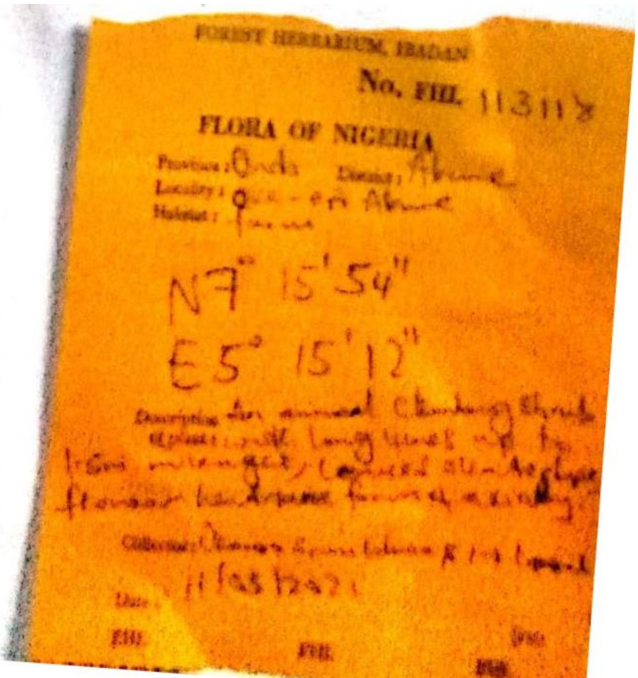
Malvaceae

Determinavit Egunjobi A.J

07/03/2021



Mucuna pruriens (L.) Dc. Var.
Papilionaceae
Determinavit: [illegible]
19/04/2021



FOREST HERBARIUM, IBADAN

No. FHI. 113118

FLORA OF NIGERIA

Province: Ondo District: Akure
Locality: Oba-ile Akure
Habitat: Farm

N7° 15' 54"
E5° 15' 12"

Description: An annual climbing shrub of plant [illegible]

Collector: [illegible]

11/03/2021

Date:

FHI FHI FHI

FOREST HERBARIUM, IBADAN

No. FHI. 113118

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: Oba-Ile Akure

Habitat: farm land

N 7° 15' 39"

E 5° 14' 51"

Description of plant: A woody climber - light sepals persistent

Collector: O.L. OWO Similolwa 81-slash-

Date: 16/03/2021

FHI. FHI.

Clerodendrum volubile Beauv

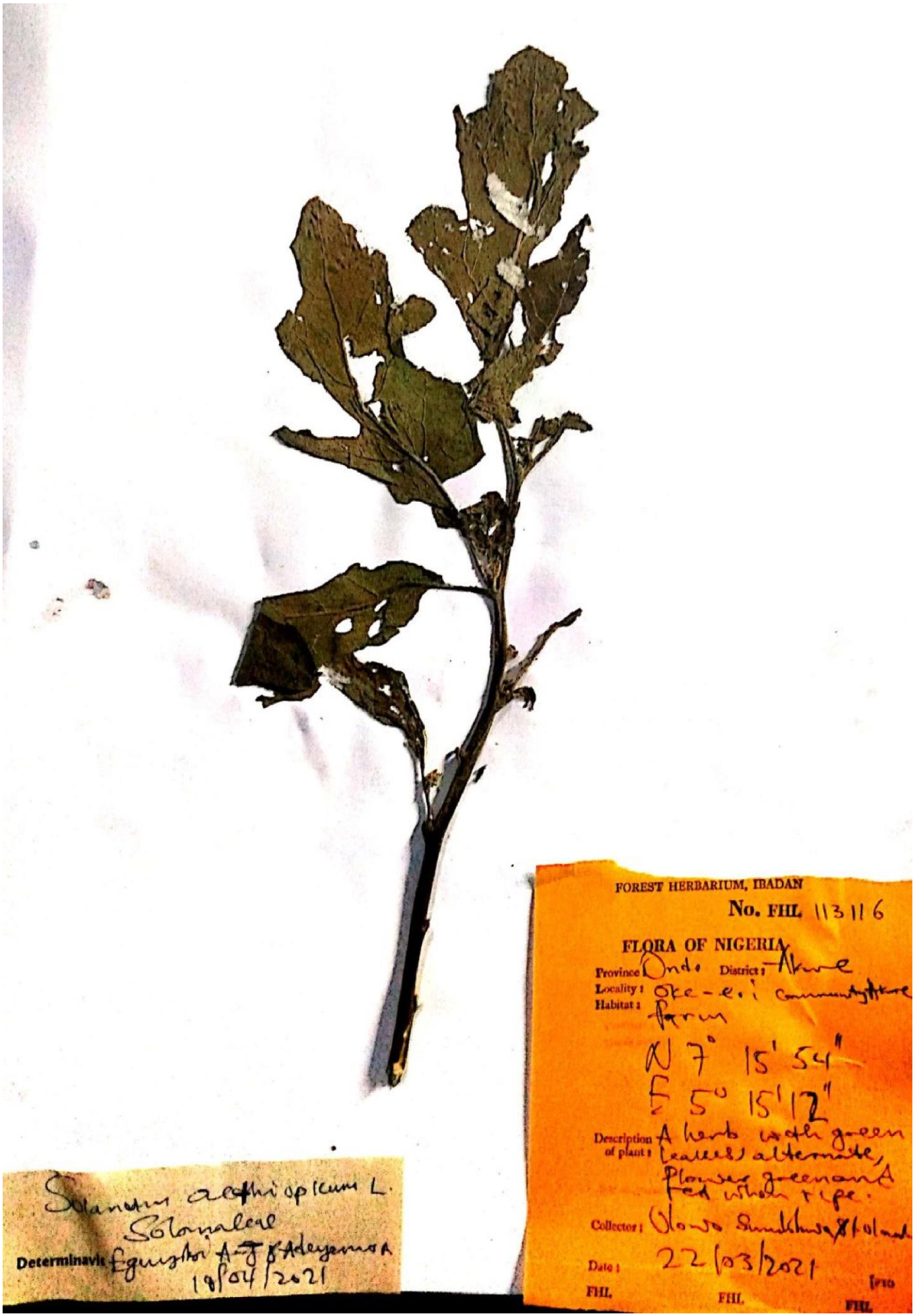
Verbenaceae

Determinavit Egunjobi A.J & Abayomi A

19/04/2021

Senecio biafrae Oliv.-Hiern
Asteraceae
Determinavit Egunjobi A.J & Adeyanju A.A 19/04/2021

FOREST HERBARIUM, IBADAN
No. FHI. 113117
FLORA OF NIGERIA
Province: Ondo District: Akure
Locality: Aule Akure
Habitat: farmland
N7° 15' 41"
E5° 15' 7"
Description of plant: Succulent herb, stems to be Climbing use as vegetable
Collector: Olaniyi Samuel Oluwaseun & I-o Lawal
Date: 12/02/2021
FHI. FHI. FHI.



FOREST HERBARIUM, IBADAN

No. FHI. 113115

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: Ilara Akure

Habitat: open space

N 7° 18' 21"

E 5° 11' 16"

Description of plant: Erect glabrous herb with small round fruit.

Collector: Idowu Sunkanmi & Ayodeji

Date: 21/03/2021

FHI. FHI. [PTO FHI.

Solanum nigrum L

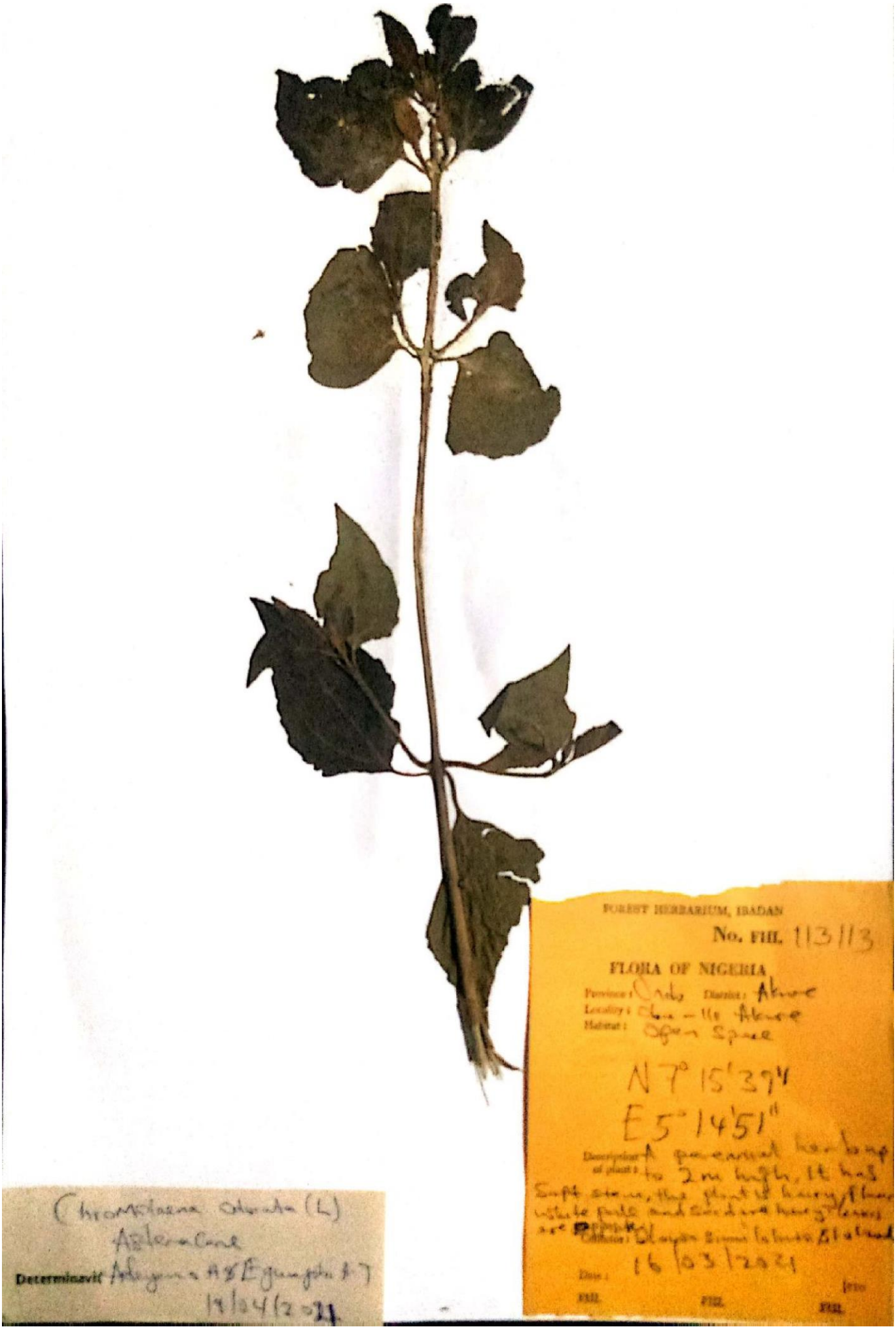
Solanaceae

Determinavit Egunjobi A.J & Adejumo A.

19/04/2021

Sida acuta
Malvaceae
Determinavit Adeyemi A S Egunyomi A J
19/04/2021

FOREST HERBARIUM, IBADAN
No. FHI. 113114
FLORA OF NIGERIA
Province: Ondo District: Akure
Locality: Ilora - Akure
Habitat: Open Space
N 7° 18' 21"
E 5° 11' 16"
Description of plant: An erect herb with much branched with a woody tap root, leaves are alternate flower Butter Cup Shape Fruit is a Capsule.
Collector: Akinbo Simisola & 1-0 Level
Date: 21/03/2021
FHI. FHI. FHI.



FOREST HERBARIUM, IBADAN

No. FHI. 113113

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: Oke-Ilu Akure

Habitat: Open Space

N 7° 15' 39"

E 5° 14' 51"

Description of plant: A perennial herb up to 2m high, it has 5 upt stems, the plant is hairy, the ...

Collector: Olayemi Samuel Olatunde & Others

Date: 16/03/2021

FHI. FHI. FHI.

Chromolaena odorata (L)

Asteraceae

Determinavit Adeyemi A.S.E Gungula A.T

19/04/2021

FOREST HERBARIUM, IBADAN

No. FHI. 113112

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: Aule Akure

Habitat: Open Space

N 7° 15' 14"

E 5° 15' 17"

Description of plant: An annual herb up to 1m high with hairy stem, ovate leaf and hairy petiole, flower white.

Collector: Ohaeri Amaka & Folayan

Date: 16/03/2021

FHI. FHI. FHI.

-Ageratum conyzoides L.

Asteraceae

Determinavit Egunyomi A-J & Akeyemi A

19/4/2021

FOREST HERBARIUM, IBADAN

No. FHI. 113176

FLORA OF NIGERIA

Province: Ondo District: Akure
Locality: Shagari Village Akure
Habitat:

GPS N 7°17'27"
E 5°9'21"

Description of plant: A prostrate herb stem pink flower pinkish fruit green

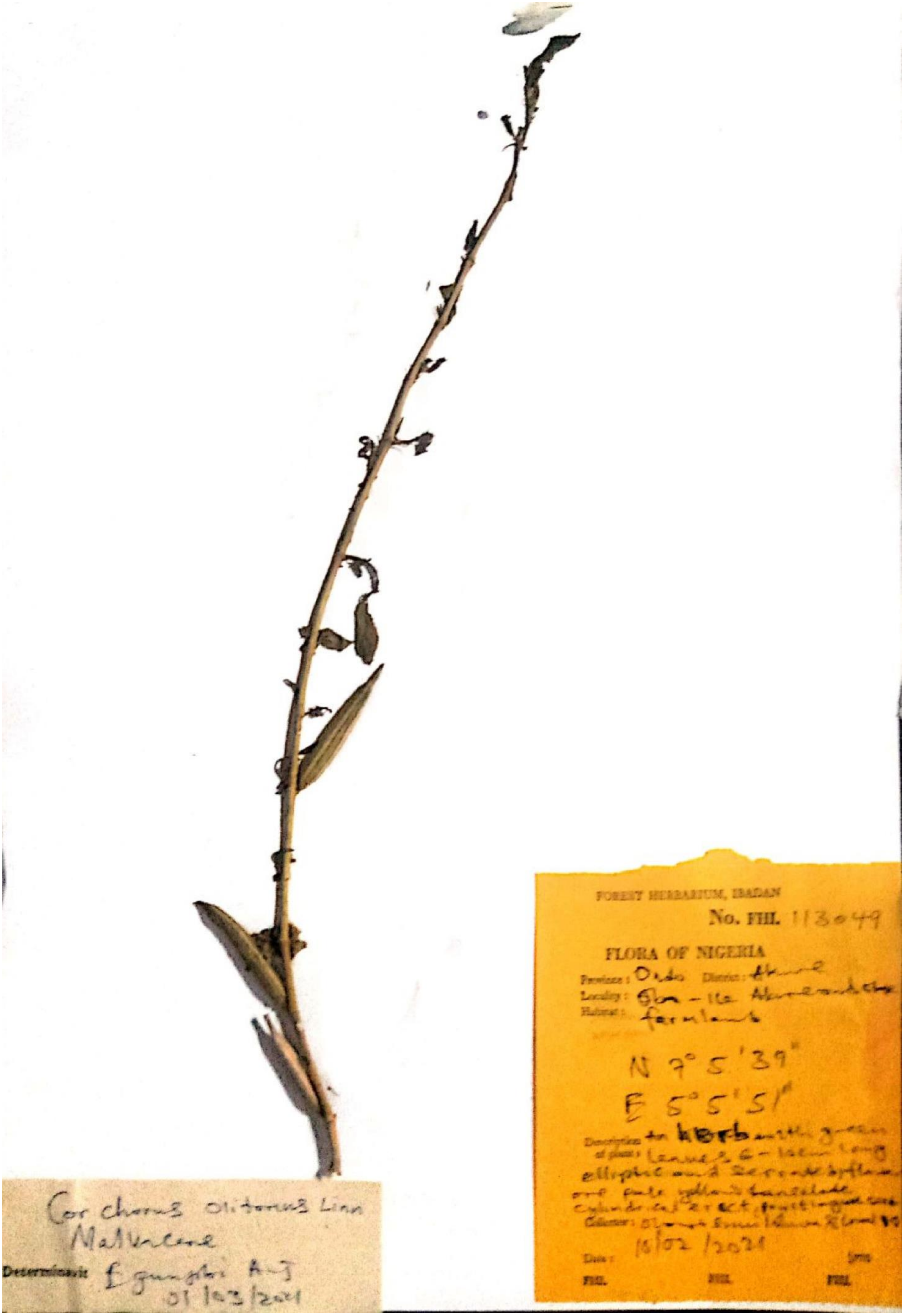
Collector: Olowokudejo & Lowo

Date: 14/05/2021

FHI. FHI. FHI.

Boerhavia diffusa Linn
Nyctaginaceae

Determinavit Egunjobi A.J & Adegoke A
14/05/2021



FOREST HERBARIUM, IBADAN

No. FHI. 113065

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: Oba - Ile Akure

Habitat: farm Land.

N 7 15' 39"

E 5° 14' 51"

Description of plant: A Small Shrub up 1-5m high with a Mass flower

Collector: Olowo Sunitoluwa & I.O Lawal

Date: 09/02/2021

[PTO

FHI. FHI. FHI.

Vernonia amygdalina Del.

Asteraceae

Determinavit Egunyobi A-J & Adeyemo A

08/03/2021

Bryophyllum pinnatum L
Crassulaceae

Determinavit F Gbemisola & J S Adeyemi 19/04/22

FOREST HERBARIUM, IBADAN

No. FHI. 113122

FLORA OF NIGERIA

Province: Ondo District: Alu
Locality: Edu-eka Community Akure
Habitat: Garden

N 7° 15' 58"
E 5° 13' 38"

Description of plant:

Collector: Olowo Emilohun & I-Oluwadare

Date: 11/02/2022

[PTO

FHI. FHI. FHI.

FOREST HERBARIUM, IBADAN

No. FHI. 113123

FLORA OF NIGERIA

Province: Ondo District: Akure
Locality: Akure
Habitat:

N 7° 15' 41"
E 5° 15' 7"

Description of plant: An erect shrub fully glaborous of the base of the stem and leaves surface, flower white.

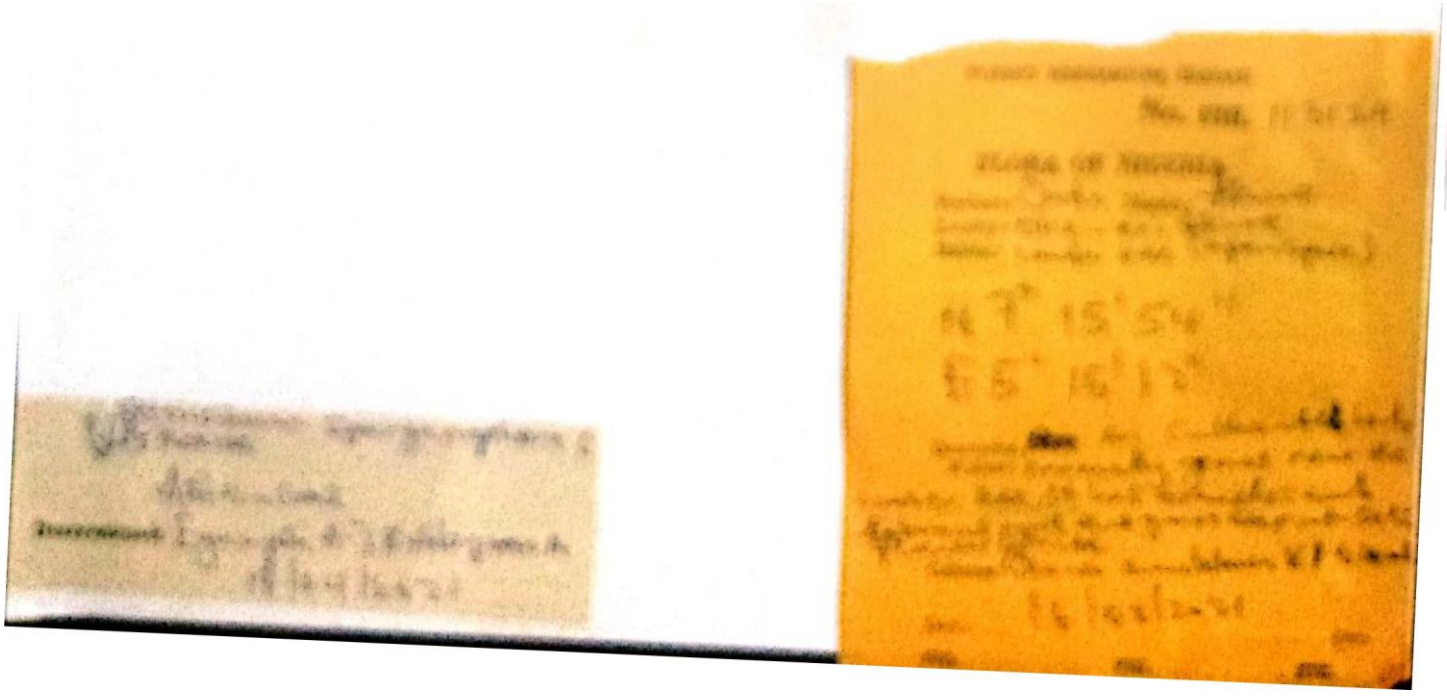
Collector: Olaoso Sijuwade Ibukun & I. O. Lawal

Date: 12/02/2021

FHI. FHI. FHI. [PTO]

Cnidoscolus aconitifolius (Mill.) Johnston
Euphorbiacea

Determinavit Egunjobi A. J. & Adeyemo A
19/02/2021



FOREST HERBARIUM, IBADAN

No. FHI. 113128

FLORA OF NIGERIA

Province: Ondo District: Akure
Locality: Oba-Ile Akure
Habitat: open space

N 7°15'39"
E 5°14'51"

Description of plant:

Collector: Olowo Similoluwa & I.O. Lawal

Date: 22/03/2021 [PTO

FHI. FHI. FHI.

Eclipta prostrata - L
Asteraceae
Determinavit Adeyemi O.A. & Egunyobi A.J
22/04/2021

FOREST HERBARIUM, IBADAN

No. FHI. 113127

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: Oba-Ile Akure

Habitat: Farm land

N 7° 15' 31"

E 5° 14' 51"

Description of plant: Herb with Succulent Stem leaves alternate and divided flower head deep-red

Collector: Olowo Samuel & Co Lawal

Date: 16/03/2021

[PTO

FHI. FHI. FHI.

Crassocephalum rubens (Jacq) S Moore

Asteraceae

Determinavit Adeyemo & Egunjobi AJ

22/04/2021

FOREST HERBARIUM, IBADAN

No. FHI. 113080

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: Ilaje (Akure

Habitat: Garden

N 7° 18' 21"

E 5° 11' 16"

Description of plant: [illegible]

Collector: [illegible]

Date: 30/02/2021

FHI. FHI. FHI.

Basella alba L.

Basellaceae

Determinavit: [illegible]

18/03/2021

Scanned with CamScanner

FOREST HERBARIUM, IBADAN

No. FHI. 113111

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: Shagari Village

Habitat: open space

N 7° 17' 29"

E5° 9' 21"

Description of plant: An erect perennial herb up to 60 cm high with smooth and green with leaves, flowers pink

Collector: Olowo Amitolan & Olowo

Date: 01/02/2021

FHI. FHI. FHI.

Talinum triangulare (Jacq.) Willd

Portulacaceae

Determinavit Bgungbi A-J 14/04/2021

Scanned with CamScanner

Celosia argentea L.
Amaranthaceae
Determinavit Adegoke N.S & Egunjobi J.J
09/03/2021

FOREST HERBARIUM, IBADAN
No. FHI. 113072
FLORA OF NIGERIA
Province: Ondo District: Akure
Locality: Akure
Habitat: open space
N 7° 17' 27"
E 5° 9' 21"
Description of plant: A woody herb with greenish succulent stem leaves lanceolate, inflorescence white-pink
Collector: Olowokudejo & Olowokudejo
Date: 10/02/2021
FHI. FHI. FHI

FOREST HERBARIUM, IBADAN

No. FHI. 113071

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: Akure (Ilere)

Habitat: Open Space

N 7° 18' 21''

E 5° 11' 16''

Description of plant: A tree up to 15m high bole dark brown and rough, fruit green in bunch leaves green and glabrous

Collector: Ilawo Similoluwa & Oluwole

Date: 30/11/2021

[PTO

FHI. FHI. FHI.

Spondias mombin Linn

Anacardiaceae

Determinavit Ezungbi A.J & Alagma A.

09/03/2021

FORREST HERBARIUM, IBADAN

No. FHI. 113073

FLORA OF NIGERIA

Province: Ondo District: Akure
Locality: Ilere
Habitat: open Space

N 7° 18' 21"

E 5° 11' 18"

Description of plant: A herb up to 40cm high with alternate arrangement leaves and flower cream.

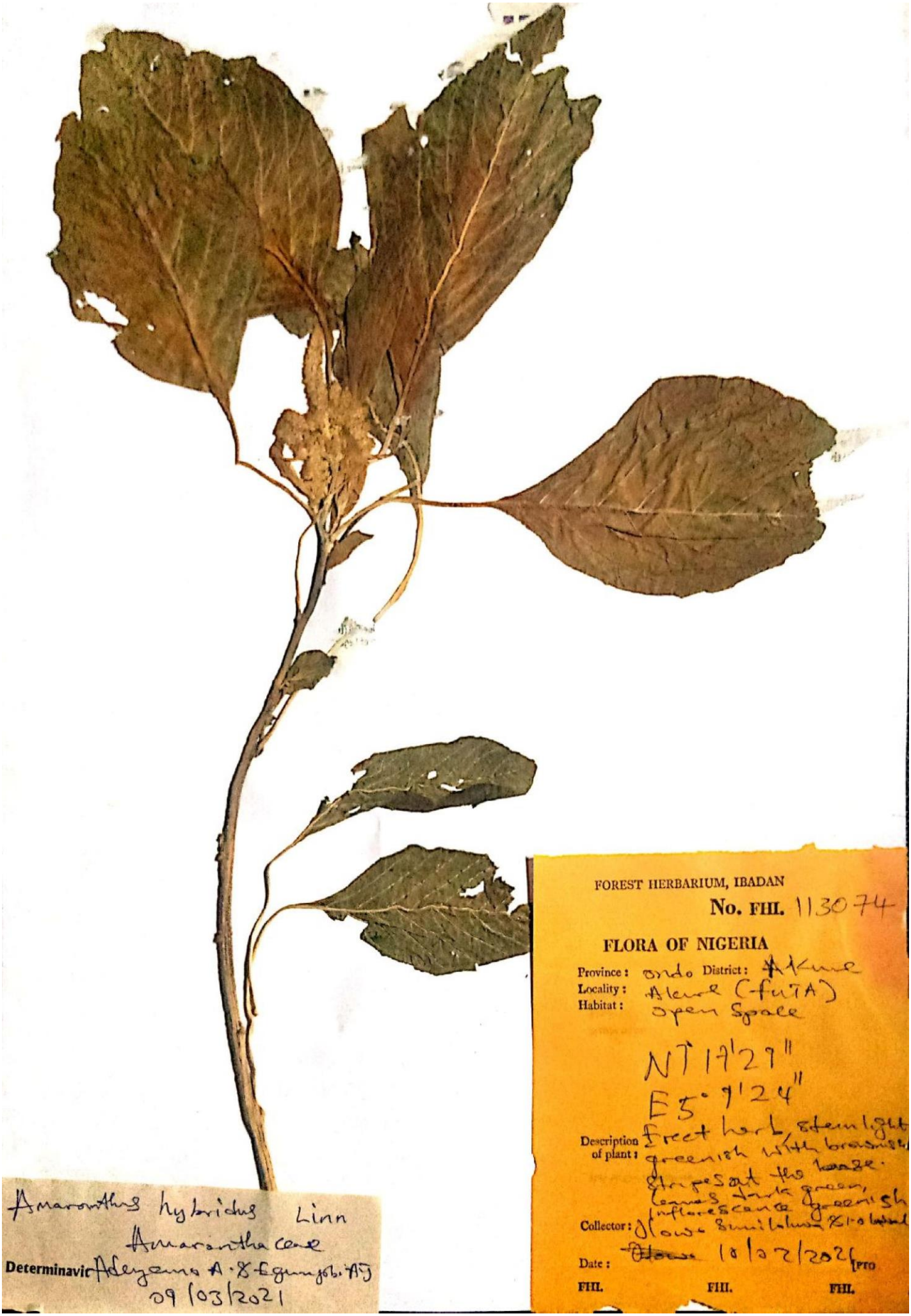
Collector: Olanrewaju Oluwafemi O Lawal

Date: 10/02/2021

[PTO

FHI.

Amaranthus virides Linn
Amaranthaceae
Determinavit Adeyemi A. Ogunjobi A.J
04/03/2021



Amaranthus hybridus Linn
Amaranthaceae
Determinavit Adeyemo A. & Egunyomi A. 09/03/2021

FOREST HERBARIUM, IBADAN
No. FHI. 113074

FLORA OF NIGERIA

Province: Ondo District: Akure
Locality: Akure (FUTA)
Habitat: open Space

N7°17'29"
E5°9'24"

Description of plant: Erect herb, stem light green with brownish streaks at the base. Leaves dark green, leaves dark greenish inflorescence greenish flower similar to stem

Collector: [illegible]

Date: 10/02/2021 [illegible]

FHI. FHI. FHI.

FOREST HERBARIUM, IBADAN

No. FHI. 113075

FLORA OF NIGERIA

Province: Ondo State: Akure
Locality: Ilara ondo Akure
Habitat: Open space

N 7° 18' 21"
E 5° 11' 16"

Description of plant: A tree about ... high leaves are ... leaflets 5–6 ... flowers white
Collector: Olorunfemi ...
Date: 12/03/2021

FHI. FHI. FHI.

Ceiba pentandra Gaertn.
Bombacaceae
Determined by: Adeyemi A. & Egunjobi AS
08/03/2021

FOREST HERBARIUM, IBADAN

No. FHI. 113070

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: Akure

Habitat: Open space

N7°17'27"

E5°9'24"

Description of plant: ± small tree up to 3m high; stem hairy fruit green with white flower

Collector: Okwuosa Emilokwu & Iolan

Date: 10/02/2021

[PTO

FHI. FHI. FHI.

Solanum erianthum D. Don

Solanaceae

Determinavit Egunjobi A. J & Adeyanju A.

08/03/2021

Manihot utilissima
Euphorbiaceae
Determinavit [illegible]
08/03/2021

FOREST HERBARIUM, IBADAN

No. FHI. 113068

FLORA OF NIGERIA

Province: Ondo District: [illegible]
Locality: [illegible]
Habitat: [illegible]

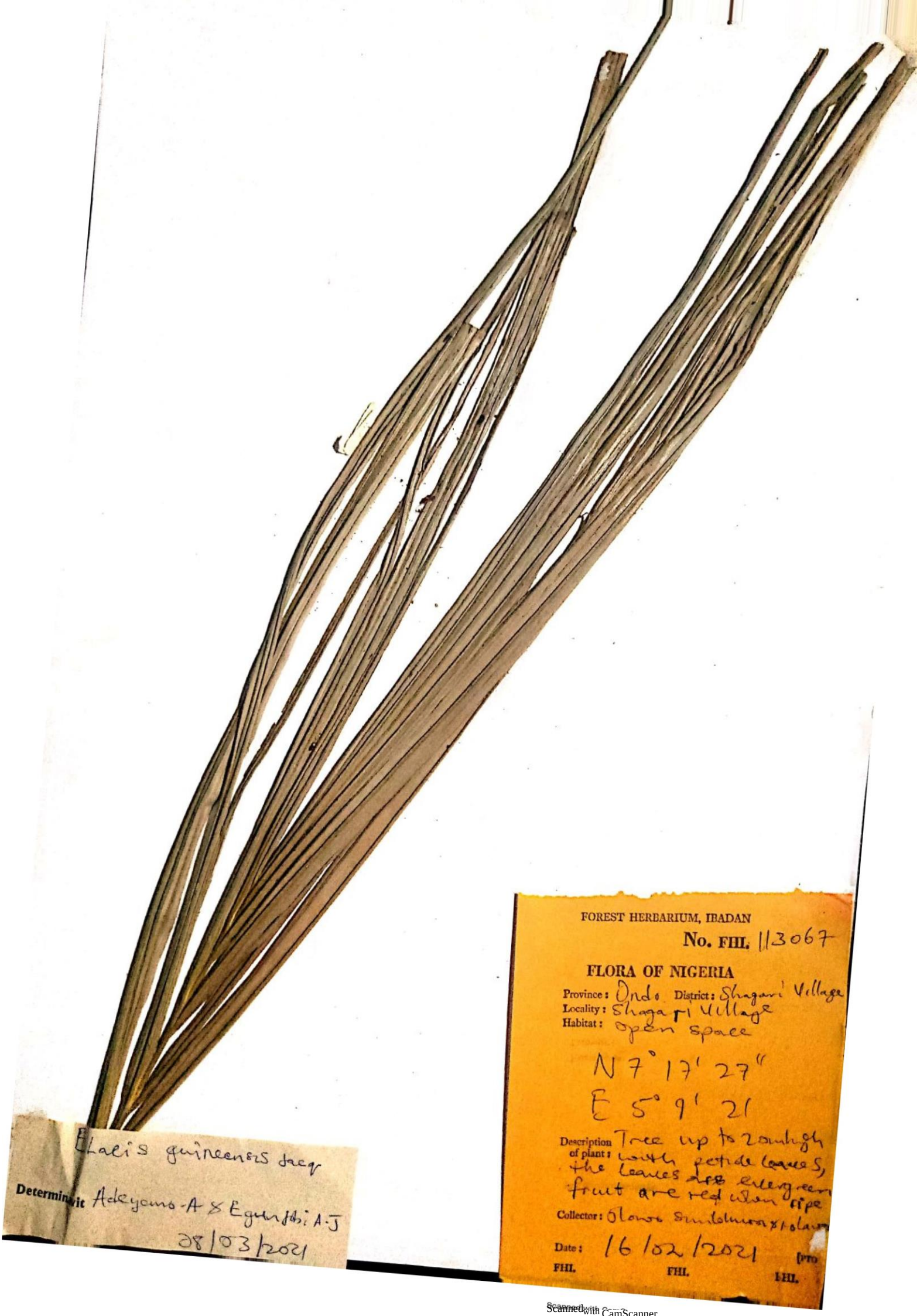
N7° 15' 58"
E 5 13' 38"

Description of plant: [illegible]

Collector: [illegible]

Date: 11/02/2021

FHI. FHI. FHI.



Elaeis guineensis Jacq

Determinavit Adeyemo-A & Egunjobi A.J

28/03/2021

FOREST HERBARIUM, IBADAN

No. FHI. 113067

FLORA OF NIGERIA

Province: Ondo District: Shagari Village

Locality: Shagari Village

Habitat: open space

N 7° 17' 27"

E 5° 9' 21

Description of plant: Tree up to 20m high with petiole leaves, the leaves are evergreen fruit are red when ripe

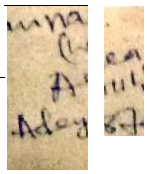
Collector: Olowo Simbolmwa & Olaw

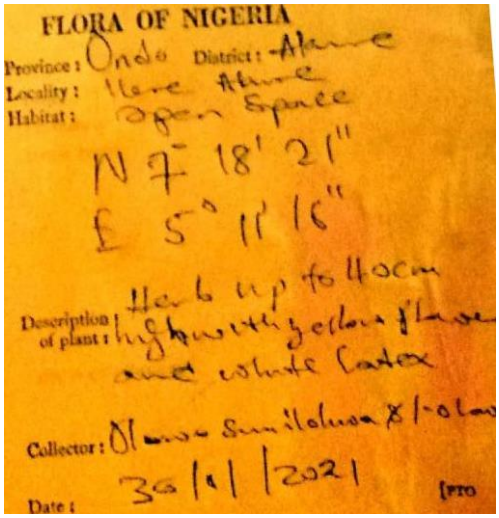
Date: 16/02/2021

FHI. FHI. FHI.

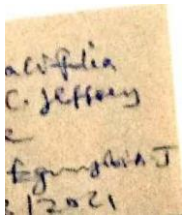
Determ

VORVST





Fill. rilL



Scanned with CamScanner

ia Sapida koenig
Sapindaceae
Egunjobi A.J
01/03/2021

FOREST HERBARIUM, IBADAN

No. FHI. 113060

FLORA OF NIGERIA

Province: Ondo District: Akure

Locality: FUTA

Habitat: Open space

E 5° 9' 24"

N 7° 7' 29"

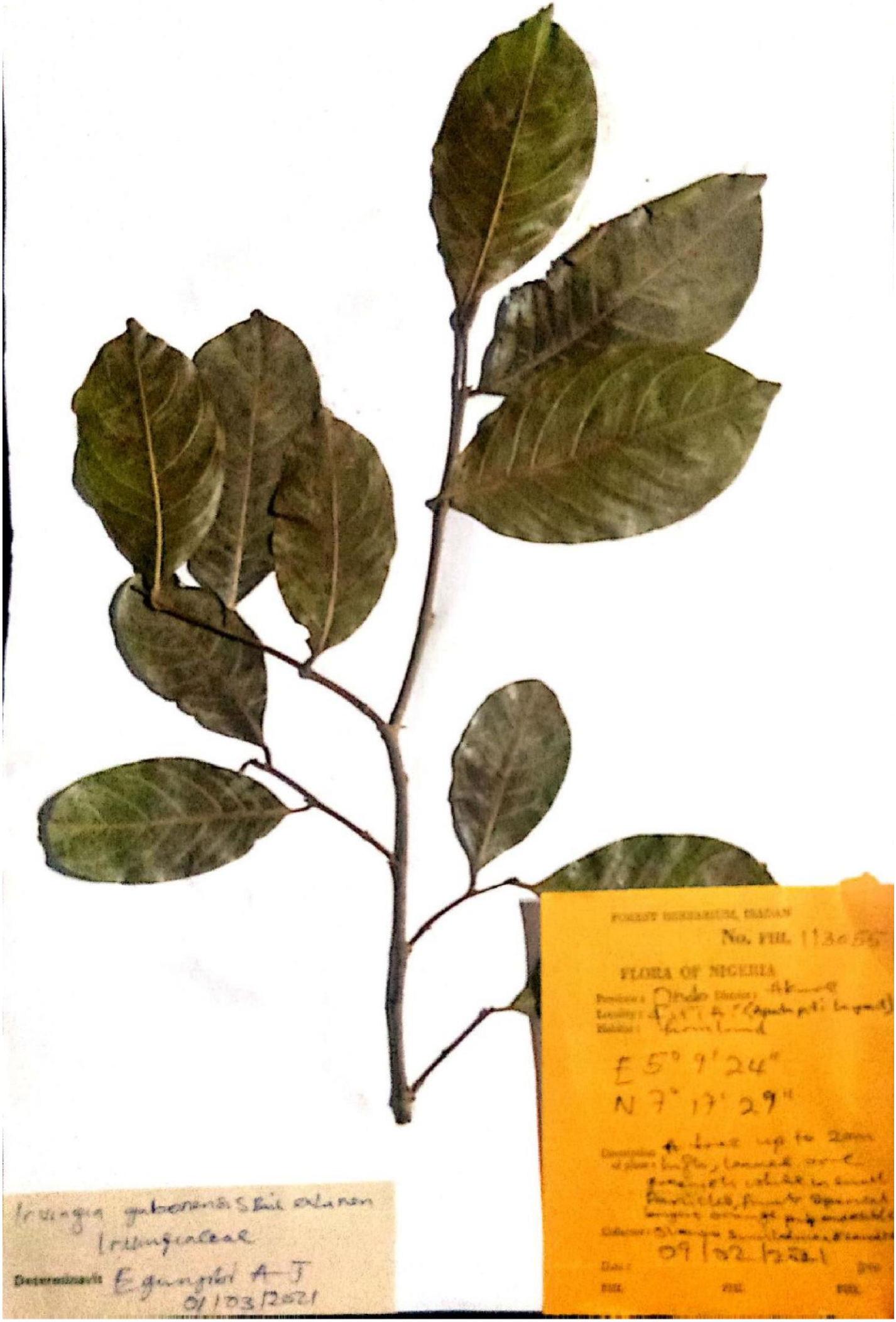
Description of plant: A tree up to 7m high, bearing a spreading crown with opposite leaflet.

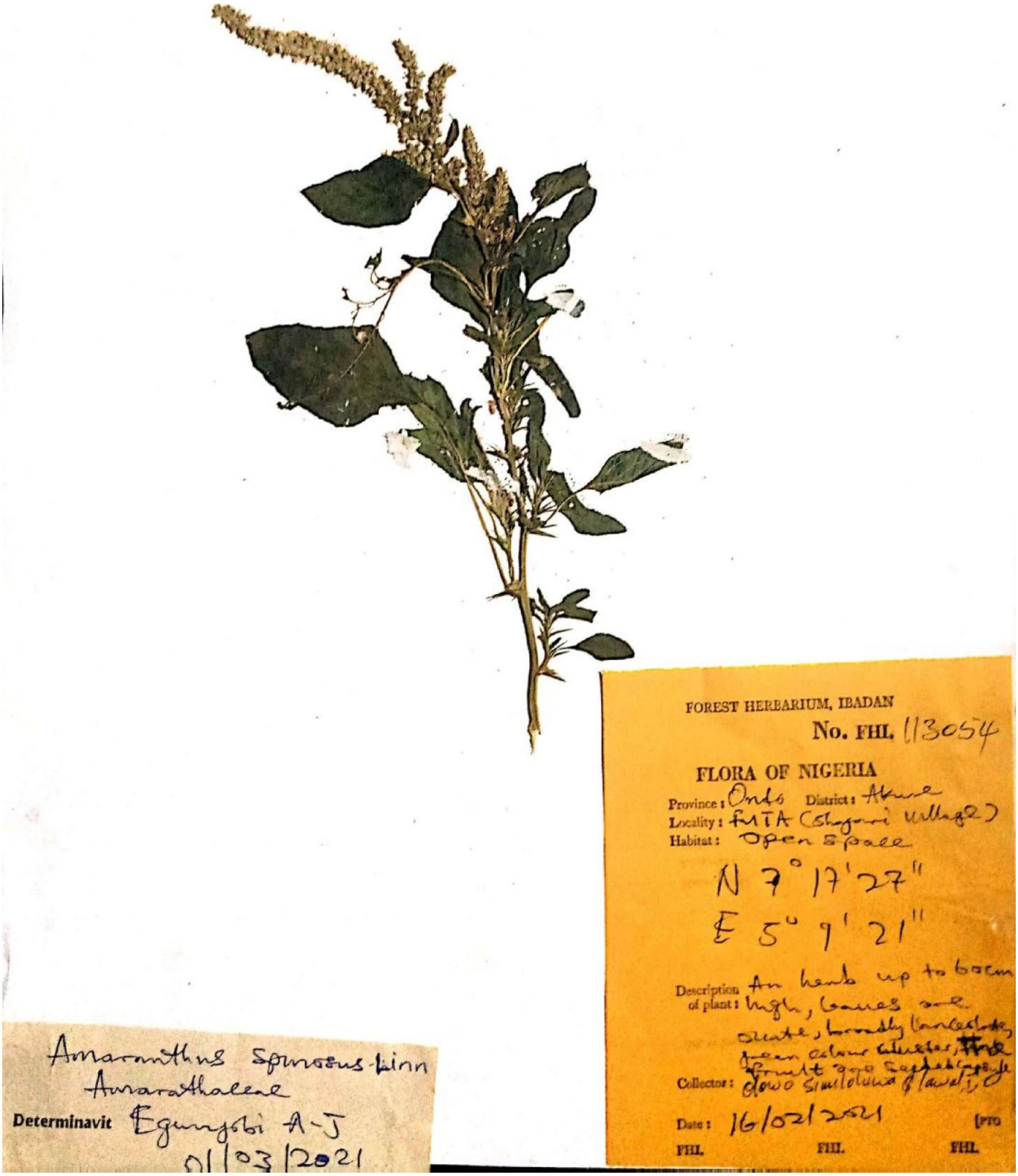
Collector: Olayera Similoluwa 8

Date: 09/02/2021

FHI.

FHI.




FOREST HERBARIUM, IBADAN
No. FHI. 113054
FLORA OF NIGERIA
Province: Ondo District: Akure
Locality: FUTA (Obanla village)
Habitat: Open space
N 7° 17' 27"
E 5° 9' 21"
Description of plant: An herb up to 60cm high, leaves are ovate, broadly lanceolate, green colour clusters, fruit are sachet capsule
Collector: Olowo Simiolumi & Lawal, O
Date: 16/02/2021
[PTO
FHI. FHI. FHI.
Amaranthus spinosus Linn
Amaranthaceae
Determinavit Egunjobi A-J
01/03/2021

FOREST HERBARIUM, IBADAN

No. FHI. 113050

FLORA OF NIGERIA

Province: Ondo District: Akure
Locality: Ilere Akure ondo state
Habitat: farmland

N 7° 8' 21"
E 5° 11' 16"

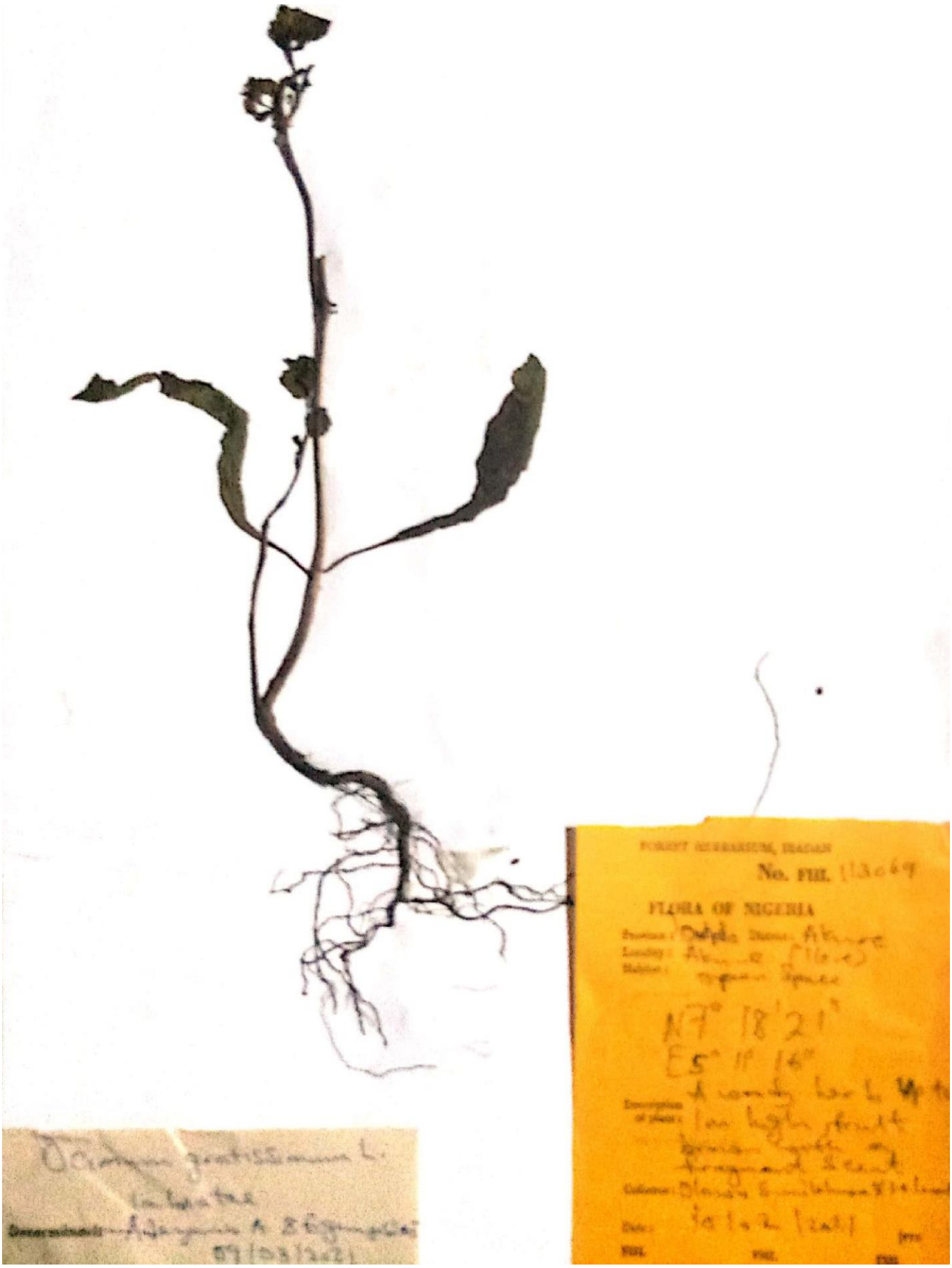
Description of plant: A small tree up to 4m high, leaflet alternate with thorn, flower white colour with big rough fruit surface, and edible.

Collector: Olowo Simisola Lawal

Date: 13/02/2021

FHI. FHI. FHI.

Citrus aurantium Linn
Rutaceae
Determinavit Egunjobi
01/03/2021


FOREST HERBARIUM, IBADAN
No. FHI. 113069
FLORA OF NIGERIA
N7° 18' 21"
E5° 11' 16"

FOREST HERBARIUM, IBADAN

No. FHI. 113121

FLORA OF NIGERIA

Province: Ondo District: Akure
Locality: Oke – eri Akure
Habitat: farm land

N 7° 15' 54"
E 5° 15' 12"

Description of plant: An erect woody herbs

Collector: Olowo Sunibalatal 8/ Olaniy

Date: 16/08/2021 [PTO

FHI. FHI. FHI.

Andrographis paniculata (Burm.f) Wees
Acanthaceae

Determinavit Egunyobi A-J & Adeyemi A.
19/04/2021

rol\1i$T

No. rill. (1 3 1
no or NIGERIA
Diatrict C.

tIAtGtat

Appendix 6 – Photo album of the indigenous fruits and vegetables used for the study

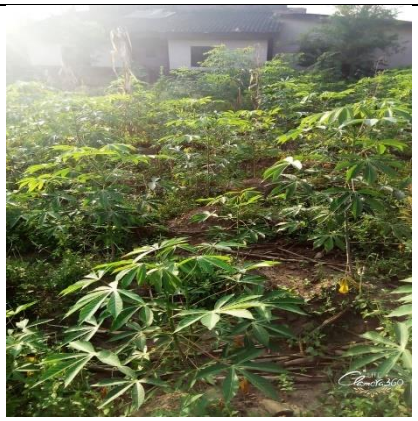
	Botanical Name	**PHOTO ALBUM**		
	Indigenous Vegetables			
1.	**Scientific Name:** *Ageratum conyzoides* Local Name: Imi esu Common Name: Billy Goat Weed			
2.	**Scientific Name:** *Amaranthus hybridus* Local Name: Tete Common Name: African Spinach			
3.	**Scientific Name:** *Amaranthus spinosus* Local Name: Tete elegun Common Name: Spiny Amaranth/ Pigweed			

4.	**Scientific Name:** *Amaranthus viridis* Local Name: Tete abalaye Common Name: Green amaranth			
5.	**Scientific Name:** *Andrographis paniculata* Local Name: Mejemeje Common Name: King of Bitter			
6.	**Scientific Name:** *Basella alba* Local Name: Amunututu Common Name: Malabar spinach			
7.	**Scientific name** *Boerhavia diffusa* Local name: Eemo / Olowojeja (Y) Common name: Hogweed			

8	**Scientific Name:** *Bryophyllum pinnatum* Local Name: Abamoda Common Name: Life Plant / Miracle Leaf			
9.	**Scientific Name:** *Celosia argentea* Local Name: Shokoyoto Common Name: Lagos Spinach			
10	**Scientific name:** *Ceiba pentrandra* Local name: Eegungun (Y) Common name: Life plant / Miracle leaf (E)			
11	**Scientific Name:** *Chromalaena odorata* Local Name: Akintola Common Name: Siam weed			

.				
12.	**Scientific Name:** *Clerodendrum volubile* Local Name: Dagba Common Name: White butterfly			
13.	**Scientific Name:** *Cnidoscolus aconitifolius* Local Name: Iyana paja Common Name: Chya / Tree Spinach			
14.	**Scientific Name:** *Corchorus olitorus* Local Name: Ewedu Common Name: Jute leaves			
15.	**Scientific Name:** *Crassocephalum rubens* Local Name: Ebolo Common Name:			

	Coriander			
16	**Scientific name:** *Eclipta prostrata* Local name: Abikole / Arojoko (Y) Common name: False daisy / Eclipta (E)			
17	**Scientific name:** *Gossypium barbadense* Local name: Owu (Y) Common name: Cotton seed (E)			
18.	**Scientific Name:** *Hibiscus asper* Local Name: Isapa Common Name: Hibiscus			

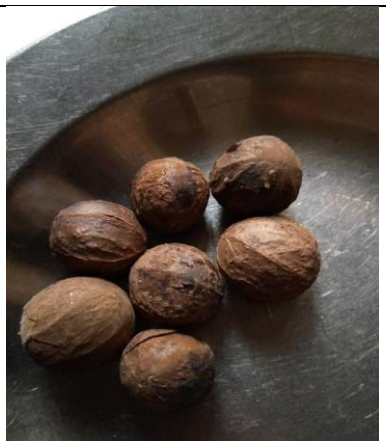
19.	**Scientific Name:** *Launaea taraxacifolia* Local Name: Yarin Common Name: Wild lettuce			
20.	**Scientific Name:** *Manihot utilissma* Local Name: Ewe ege Common Name: Cassava Leaves			
21.	**Scientific Name:** *Mucuna pruriens* Local Names: Iwerepe Common Name: Mucuna Leaves			
22.	**Scientific Name:** *Occimum grattisimum* Local Name: Efirin Common Name: Scent Leaves			

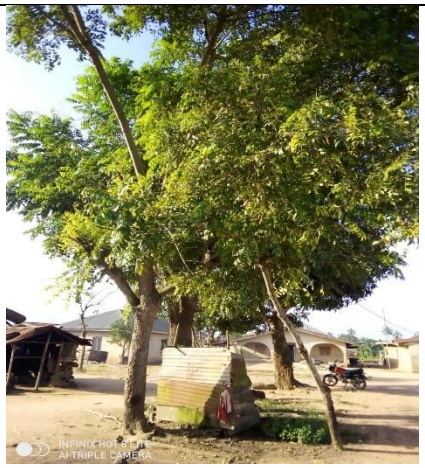
23.	**Scientific Name:** *Senecio biafrae* Local Name: Woorowo Common Name: Bologi			
24.	**Scientific Name:** *Sida acuta* Local Name: Iseketu Common Name: Wire Seed			
25.	**Scientific Name:** *Solanium nigrum* Local Name: Efo odu Common Name: Black Nightshade			
26.	**Scientific Name:** *Solanum macrocarpon* Local Name: Igbagba Common Name: African Egg Plant			

27.	**Scientific Name:** *Talinum triangulare* Local Name: Gbure Common Name: Water Leaf			
28.	**Scientific Name:** *Vermonia adoensis* Local Name: Ewuro odo Common Name: Bitter leaf			
29.	**Scientific Name:** *Vermonia amygdalina* Local Name: Ewuro Common Name: Bitter leaf			

	Botanical Name	PHOTO ALBUM		
	Indigenous Fruits			
1	**Scientific Name:** *Artocarpus communis* Local Name: Berefuutu Common Name: Breadfruit			
2	**Scientific Name:** *Blighia sapida* Local Name: Ishin Common Name: Ack*ee*			
3	**Scientific Name:** *Citrus aurantifolia* Local Name: Oronbo wewe Common Naem: Lime			

4	**Scientific Name:** *Citrus aurantium* Local Name: Ganinganin Common Name: Orange			
5	**Scientific Name:** *Cocos nucifera* Local Name: Agbon Common Name: Cocunut			
6	**Scientific Name:** *Crysophyllum albidum* Local Name: Agbalumo Common Name: African Star Apple			
7	**Scientific Name:** *Dalium guineensis* Local Name: Awin Common Name: Black Velvet Tamarind			

8	**Scientific Name:** *Elaeis guineense* Local Name: Eyin Common Name: Oil palm			
9	**Scientific Name:** *Irvingia gabonensis* Local Name: Oro Common Name: Bush Mango			
10	**Scientific Name:** *Parkia biglobosa* Local Name: Iru Common Name: Locust Beans			
11	**Scientific Name:** *Plukenetia conophora* Local Name: Awusa Common Name: Walnut			

12	**Scientific Name:** *Spondias mombin* Local Name: Iyeye Common Name: Hog Plum			
13	**Scientific Name:** *Theobroma cacao* Local Name: Koko Common Name: Cocoa			
14	**Scientific Name:** *Solanum aethiopicum* Local Name: Ajegun Common Name: Garden Egg			
15	**Scientific Name** *Solanum indicum* Local Name: Ijegun were Common Name: African egg plant