

**EFFECTS OF AGROFORESTRY ON HOUSEHOLD FOOD SECURITY AS
PERCEIVED BY RURAL WOMEN FARMERS IN IMO STATE, NIGERIA**

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20164992688

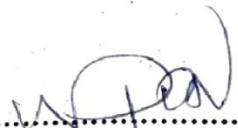
**A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL,
FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI**

**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
AWARD OF MASTER OF SCIENCE (M.Sc) DEGREE IN
AGRICULTURAL EXTENSION.**


DECEMBER, 2019

CERTIFICATION

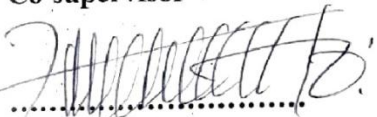
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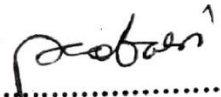
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DEDICATION

This work is dedicated to God Almighty for the grace, wisdom and strength to complete it. Also, to those who tirelessly supported and added value to the study and existing knowledge in Agricultural Extension in Nigeria

ACKNOWLEDGEMENTS

I am particularly privileged to be a project student of Prof. M.T. Ukpongson. I am grateful for the immeasurable time you spent to improve the quality of this work. I will not fail to comment on your erudite disposition to teaching which was most striking to me. I also acknowledge my co-supervisor, Dr. (Mrs.) N.E Ejiogu-Okereke for her contributions.

My appreciation further goes to the Head of Department, Dr. F.C. Anaeto for his kind gesture. My special thanks go to Prof. C.C Asiabaka, Prof A.O. Ani, Prof Edna Matthew Njoku, Prof. F.N Nnadi, Dr. J.O. Ajaero, and Dr. J.U. Chikaire who contributed in giving this research work a purposeful direction and their encouragement and advice.

I appreciate all my lecturers for their suggestions, patience and corrections that added value to this work. I wish to express my gratitude specially to the following lecturers, Dr (Mrs) P.A Anyaoha, Dr. E.I Ogueri, Dr P.A. Onoh, Dr J.A Echetama, Dr. R.N. Nwakwasi, Dr. (Mrs) C.C. Godson Ibeji, Mr F.O. Ugwuoke, Mr. Polycarp Umunakwe, Mr Ogbonna O. Aja for the encouragement in the course of my study.

Finally, I am forever grateful to Almighty God for his grace, divine protection and loving kindness, he has been my source of inspiration. May all praise and honor be to you lord.

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ABSTRACT

The study was designed to analyze the effects of agroforestry on household food security status as perceived by rural women farmers in Imo state Nigeria. The specific objectives of the study were to: describe the socioeconomic characteristics in the study area, identify agroforestry practices women farmers are involved in the study area, identify products which women farmers obtain from their agroforestry farms, determine reasons for practicing agroforestry as perceived by women farmers, determine the food security status of rural woman farmers in the study area, ascertain rural women farmers perceived effects of agroforestry on household food security status in the area, identify constraints to agroforestry practices in the study area as perceived by women farmers. Agroforestry farmers in Imo State formed the population for the study, and a sample of 270 rural women farmers were selected through Multi stage sampling techniques. Data for the study were collected using structured and validated questionnaire and analyzed using descriptive and inferential statistical tools such as mean, frequency, score, percentage, Ordinary least square (OLS) and analysis of variance (Anova) were used to analyze the data. The study revealed that rural women had a mean age of 51years. About 77 % were married, with a mean household size of 6 persons. Average farm size and mean monthly income were 1.8 ha and ₦34,426 respectively. About 63.3 % were not members of social organizations and 34.4 % had farming as their major occupation. Majority (79.6%) were particularly involved in the practice of leaving few fruit bearing trees on farm land when clearing. The women were found to have positive food security status. The result also showed that the effect of agroforestry on household food security status of rural women farmers was high with a grand mean of 2.95; rural women farmers considered the following factors, viz: land security, lack of processing machineries, lack of control overland, high cost of farm inputs, unfavorable agricultural policies, lack of incentives, incidence of pest attack, high mortality of tree seedlings and high incidence of bush fire as the major constraints that affect agroforestry practice among rural women farmers. The hypothetical analysis showed that there was a significant relationship between the socio-economic characteristics of the rural women farmers and the perception of rural women farmers about the effect of agroforestry on food security in Imo state; rural women farmers do not differ significantly in their perceived effect of agroforestry on food security status in the three agricultural zones in Imo state. The study recommended that land being used for agroforestry practice should be secured through measures like perimeter fencing, local fencing with woods and bamboos and mobilizing youths to keep constant watch along the boundary lines so as to prevent encroachment as revealed from the study.

Keywords: Agroforestry; households; food security; rural women; farmers; Imo State; Nigeria.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Sustainable agriculture involves the successful management of resources to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources (Kimbi *et al.*, 2005). Agriculture encompasses all human activities geared towards the production of crops (food, cash and forest trees) and animals for food and fiber production for the benefit of man. Agroforestry is a collective name for land-use systems and technologies where woody perennials are deliberately used on the same land management units as agricultural crops and /or animals in some form of spatial arrangement or temporal sequence, currently practiced by over 1.3 million people worldwide emerges as the best placed towards achieving sustainable agriculture and food security (Leakey, 2010). The acceptance of agroforestry as a system of land management is attributed to increasing spread of tropical deforestation and ecological degradation, shortages of fertilizers and re-awakening of scientific interest in the farming systems since it increase species diversity within farming systems, providing for human needs while supporting wildlife, soil microorganisms, rural communities, economic interests, watersheds, clear air, biodiversity and more (Elevitch and Wilkinson, 2003).

Many agroforestry systems in the world integrate various intensities of traditional agricultural practices in combination with modern assessable low-cost technologies and know-how. These subcategories include agro-silviculture (growing trees with crops), agrosilvopasture (growing trees with pasture), agro-horticulture, shifting cultivation and home gardens which manage trees, crops and animals (Seneviratne *et al.*, 2015). The trees used in agroforestry are utilized mainly as fuelwood, and for timber, fodder, shade, windbreak, fruits, shelter, medicine, soil improvement, supports for climber crops, and other ecological services. (Bélair, 2010; Richard, 2013). Agroforestry systems with its promotion of positive ecological interactions between species and management options with limited environmental losses, aim to provide an array of environmental, social and economic benefits to the communities.

Agroforestry systems provide income to the practitioner, improve soil fertility, enhance the local climate conditions, and reduce the anthropogenic pressure on the soil and biodiversity. Most of these benefits, like ecosystem services, are direct benefits while others such as Carbon

sequestration, micro-climate modification, etc. contribute to mitigate global issues such as climate change. Agroforestry can be viewed as one to such societal response, primarily born out of a need to fulfill immediate basic human needs of food, fuel, fodder, shelter, protection etc.

Most countries focus on reforestation and forest protection initiatives to mitigate climate change and these efforts are conflicting with the requirement of expanding the agricultural production to feed the growing population (Mbow *et al.*, 2014). Sustainable intensification of agriculture through agroforestry by integrating trees into intensive agricultural land uses underlies the importance of achieving sustainable agricultural and biodiversity conversational goals simultaneously.

Agroforestry is recognized as a land-use option in which trees provide both products and environmental services for man. In agroforestry systems, the trees, shrubs, animals in combination are grown on different farmlands in the same locality when aggregated can bring about improved wooded situation thereby enhancing environmental protection and considered viable in meeting ever-increasing needs of man (Otegbeye, 2002). According to Mbow (2013), agroforestry is moving food security issues beyond a purely agronomic focus to embrace a more comprehensive view of socio-ecological systems. Agroforestry practices can provide pathways to ecological intensification and contribute significantly to reduce the yield gap. Agroforestry offers a safe and environmentally sound approach to address rural communities' food and fuel needs. Growing trees increase soil fertility, fuel sources, and production of nutritious fruits.

Fortunately, agroforestry farms and landscapes in major part of Africa's rural landscapes, provide income and environmental outcomes and a range of other ecological services. In the Sahel, wood fuel accounts for more than 80% of the region's energy supply, most of these energy needs are satisfied encroaching on the rapidly shrinking forest cover (Mbow, 2013). The adoption of agroforestry can reduce the human impact on forest cover and spare more lands to healthy ecosystems and biodiversity.

Reaching food and nutritional security requires a range of interconnected approaches from increasing the crop yield and soil fertility, bio-fortification of staple foods to cultivating a wide range of plants which provide edible fruits, vegetables, nuts and diversify the diets of the people (Jamnadaas *et al.*, 2013). However, farming communities around the world use more exotic crop varieties and lesser indigenous varieties which are often richer in nutrients, fiber and protein

sources than the conventional staple crops. These indigenous varieties have been harvested from forests by local communities as NTFPs (Non-Timber Forest Products).

Average fruit consumption is often less than the minimum recommended daily intake (400g per person) in most developing countries as they strongly focus on purchasing cheap sources of staple foods to meet their basic energy requirements as the family budgets limits the purchase of more nutritious food products. However, expenditure analysis has indicated the increase of nutritious food purchase with the increase of household income. Hence, agroforestry can help attain both an increase of income and the provision of direct access to edible nutritious products for the households (Bélair, 2010; Jamnadaas *et al.*, 2013).

Also relying on the income received from a single commodity crop leads to food insecurity as the payments will be one-off, delayed or unpredictable (Jamnadaas *et al.*, 2013). On the other hand, agroforestry systems with multiple crops will help to avoid risks of food insecurities as they provide not only variety of tree commodities but also local food trees, vegetables, and even edible fungi and mostly profits gained are superior to monoculture systems (Kumar, 2006; Pushpakumara *et al.*, 2012). Agroforestry can contribute to food availability directly through the production of food from the perennial components, and/or through the enhancement of food production of the annual crop and/or animal/insect components (Jamnadass *et al.*, 2010; Sarvade *et al.*, 2014). More frequently, and alongside the direct provision of edible products, agroforestry can enhance the yields of other food crop components of the system, for instance by including nitrogen-fixing species, e.g *Faidherbia albida*, the legume has increased the harvests of surrounding cereals and groundnut up to 200% in Nigeria (Fadl and El sheikh, 2010).

In the developing world, women play a crucial role in agricultural production particularly with regards to agroforestry practices. It is estimated that in developing countries about 60% to 80% of smallholder farmers are women (Garitty, 2003; 2004). In particular, women in Nigeria offer 80% of the labor force in agricultural including agroforestry activities while contributing about 60% of food production. For example, in northern Nigeria both men and women are involved in agricultural activities (Chagga home garden) particularly in tree planting, but, women (60%) have more tasks in tree management than men (Epaphra, 2001). Eklund (2009) put forward that agroforestry is particularly suited for women, because it is a low cost and low technology system and means a lot of benefits for women whose task in the household is to provide food and water.

Also, Kiptot (2015) argued that women 's involvement in agroforestry is more likely to derive personal benefit from it. Women are mainly involved in activities such as indigenous fruits and vegetable processing and other enterprises that are considered to be women's domain, women are active players in managing trees and other agricultural enterprises i.e. weeding and watering, planting, they do most of the work especially during the initial stages of establishment (Bonifasi, 2004; Namwata *et al.*, 2012).

According to Bakengesa (2001), agroforestry was recognized in the late 1970's as a sustainable land-use system although existing for years as a traditional land use practice. Different indigenous agroforestry systems, such as agrosilviculture and silvopasture have proven to sustain people due to its ability to restore the soil and water resources, as a result, increased crop yield. According to Franzel *et al.* (2002), farmers in western Kenya planted in combination such species as *Sesbania*, *Tephronia*, and *Cajanus*. A study by Kanmegne *et al.* (2007) reported the adoption of agroforestry by farmers in Ghana where home gardens, perennial plantations, shifting cultivation, mixed cropping and animal rearing were the dominant types practiced. According to the report, the farmers had various perceptions about agroforestry such as the provision of fuelwood, improvement of soil fertility and the provision of favorable climate.

1.2 Problem statement

Agroforestry is rapidly becoming a significant resource management system with the potential of most adequately meeting farmers 'basic needs due to its ability of sustainable food supply and income generation through its components diversity. Agroforestry is one of the interventions used to rehabilitate agricultural farmlands (Bakengesa, 2001). This indigenous silvopasture is the only agroforestry system that somehow is known by the majority on its importance in contributing to household income, however, little effort is put to enhance its importance particularly in its potential to alleviate poverty (Kanmegne *et al.*, 2007). It has not been widely given support due to lack of information on how it contributes to the income generation and food security of households.

Already in many parts of the world, including the area of the present study, many farmers practice agroforestry but remain largely unaware of the contribution it makes to their household socio-economic livelihoods, especially with food security and income generation. It is, therefore, the

objective of the present study to determine how agroforestry contributes to food security and income generation among rural farming households.

According to Global forest resources assessment 2010 report by Food and Agriculture Organization (FAO) (2006), Nigeria is classified among the countries with low forest cover of less than 2.3% of the total land area. Food and Agricultural Organization further reported that between 1990 and 2010, Nigeria has lost 47.5% of its forest cover, or around 8,193,000 ha and it is considered as the highest in Africa (FAO, 2013). Considering the rate at which the country has been losing her forest and agricultural land areas, there is a need for maintenance and enhancement of soil fertility for global food security and environmental sustainability. Therefore, the drive towards ensuring food security should be channeled towards developing agricultural practices and systems that will be environmentally friendly and also focus on productivity in the long term rather than immediate production and accruing returns (Bankole, Adekoya & Nwawe, 2012).

Several studies have acknowledged the participation of women in agroforestry. According to Powell (2009), men are engaged in activities ranging from tree planting and felling, considered as male's domain while rural women farmers have access to fodder, fuelwood, fiber, fruit and mulch. Mbow (2003) noted that in southeastern Nigeria among the Igbos, fruits like African mango (*Irvingia gabonensis*), breadfruit (*Treculia africana*) and oil bean tree (*Panthalactra macrophylla*) are processed and planted by women.

Women play active role in collection and processing of *Vitellaria paradoxa* (shea nut) in the parklands of West Africa, (Schreckenber, 2004). Common perceptions of agroforestry in Nigeria included the increase of output on farmland, provision of fodder and fuelwood and preservation of certain plant species. However, some farmers observed the poor understanding of agroforestry due to poor knowledge and inadequacy of extension staff (Adedayo and Olorunka, 2014).

However, despite women's greater role in agriculture, most researchers have not given special emphasis on women's involvement in agroforestry towards food security. Similarly, studies done by Epaphra (2001) and Njuki (2001) concentrated on the roles of women in agroforestry with little attention on the contribution to poverty reduction, particularly in forest adjacent communities. According to (Lulandala, 2004), Agroforestry remains the only resource management option with real and tangible opportunities of breaking the bondages of energy, food insecurity, poverty and poor and imbalanced nutrition of the developing world rural communities.

While several studies have documented the practice of agroforestry in Nigeria, more needs to be done to ascertain farmers' perceptions of it, especially now emphasis is on green agriculture. This is more pertinent in Imo State, Nigeria, where more needs to be done on farmers' perceptions towards agroforestry. It is against this backdrop that the study seeks to provide answers to the following research questions:

1. What are the socioeconomic characteristics of rural women farmers in the study area?
2. What agroforestry practices do rural women farmers in the study area?
3. What are the agroforestry products obtained from agroforestry farms?
4. What are the reasons for practicing agroforestry?
5. What is the food security status of women farmers practice in the study area?
6. What are the perceived effects of agroforestry on food security in the study area?
7. What are the constraints to the practice of agroforestry in the study area as perceived by women farmers?

1.3 Objectives of the study

The broad objective of the study was to analyze the effects of agroforestry on household food security as perceived by rural women farmers in Imo State, Nigeria. The specific objectives were:

1. describe the socioeconomic characteristics of rural women farmers in the study area
2. identify agroforestry practices women farmers are involved in the study area
3. identify products which women farmers obtain from their agroforestry farms.
4. determine reasons for practicing agroforestry as perceived by women farmers.
5. determine the food security status of rural women farmers in the study area.

6. ascertain rural women farmers perceived effects of agroforestry on household food security status in the area.
7. identify constraints to agroforestry practices in the study area as perceived by women farmers.

1.4 Hypotheses

The following hypotheses were tested;

HO₁; There is no significant relationship between the socioeconomic characteristics of women farmers and agroforestry practices in the area

HO₂: There is no significant relationship between socioeconomic characteristics of women farmers and their perceived effects of agroforestry on their food security in the study area.

HO₃: The women farmers do not differ significantly in their perceived effects of agroforestry on their food security status in the three agricultural zones of Imo State.

1.5 Significance of the study

The report of this study will be beneficial to students and researchers as it serves as a source of information on agroforestry practices. It will help them to appreciate agroforestry as one of the ways of solving the issues of deforestation and degradation of agricultural lands and its role in rural development and agriculture. This could trigger the development of appropriate policy encouraging its practice. The findings will help NGOs to better understand the role they could play in agroforestry practices and thus be able to assist extension agents in the task of reaching rural communities and sensitizing them on agroforestry.

To enhance the full potential of rural women farmers in agroforestry practice and participation, there is need to ensure effective provision of training needs of the rural women, as it helps to upgrade their knowledge and skill, and the effectiveness of the training will enhance farmers capacity in addressing issues associated in their daily agroforestry activities. At the end of the

study, the rural women farmers area strength and weakness will be exposed in agroforestry practice, the result of this study will also reveal the source of information to agroforestry daily operations

The findings of the study will serve as a source of information to extension workers on agroforestry practices and spark off request for further researches. Teachers and students will derive valuable information materials for research and teaching. Factors limiting agroforestry practice as well as the strategies for enhancing its practices will be discovered. The study would increase farmers 'awareness level of the benefits of agroforestry as a soil conservation strategy, means of improving livelihood and productivity and a way of conserving their forest resources. The study will equally add to existing knowledge on agroforestry and stimulate further research on the subject.

Finally, the recommendations of this study will enable extension organizations, institutions, facilitators', supervisors, policymakers, stakeholders and agroforestry practitioners determine ways of harnessing enormous benefits derivable for agroforestry.

CHAPTER TWO

LITERATURE REVIEW

The literature review of this study is related to the topic under study. The concept of agroforestry provides the background knowledge on collective name for the land-use system and technology where woody perennials are deliberately used on the same land management unit as agricultural crops and or animals in some form of spatial arrangement or temporal sequence. The study has been reviewed under the following headings;

- 2.1 Concept of agroforestry
- 2.2 Importance of agroforestry
- 2.3 Classifications of agroforestry practices
- 2.4 Structural classification of systems
- 2.5 Agroforestry systems / practices in Nigeria
- 2.6 Women in agroforestry
- 2.7 Rural women households
- 2.8 Concept of food security
- 2.9 Agroforestry for food security
- 2.10 Constraints to adoption of agroforestry practices
- 2.11 Theoretical Framework
- 2.12 Conceptual Framework

2.1 Concept of Agroforestry

According to Dosskey, Bentrup, and Schoeneberger (2011), agroforestry is the integration of trees into agricultural systems to aid the management of the agricultural components. Agroforestry is a collective name for land-use systems and practices in which woody perennials are deliberately combined on the same land management unit with herbaceous crops and/or animals, either in some form of spatial arrangement or temporal sequence. In agroforestry systems, there are both ecological and economic interactions among the different components (Lulandala, 2004; Elevitch and Wilkinson, 2003). Agroforestry practices can be used in croplands where trees or shrubs are interspersed with annual crops, on contour strips and boundaries, where multipurpose trees provide numerous products including poles, fuel, fruits, and fodder. It can be practiced in public or shared land where trees can be grown for wood, fodder, food or cash crops (Bankole, Adekoya, & Nwawe, 2012).

Fagbemi, (2002) see agroforestry as the system of farming which combines agriculture with forestry in a rational approach and maintenance of sustainable production system on the same piece of land, either simultaneously or subsequently. It is a collection of names for all land-use system and technologies in which woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately combined on the same management unit with herbaceous plants (crop or pasture) and or animals, in form of spatial arrangement or temporal sequence (Olujide and Oladele 2011). According to Mbow (2013), agroforestry is moving the food security issue beyond a purely agronomic focus to embrace a more comprehensive view of socio-ecological systems. Agroforestry practices can provide pathways to ecological intensification and contribute significantly to reduce the yield gap.

Agroforestry practices offer practical ways of applying various specialized knowledge and skills to the development of a sustainable production system and it is recognized as a land-use option in which trees provide both products and environmental services. In agroforestry systems, the tree on different farmlands in the same locality when aggregated can bring about improved wooded situation thereby enhancing environmental protection (Otogbeye, 2002). Given the reality of awareness among the farmers of multiple land use management, the need to improve on the existing practices becomes necessary in the face of increasing population and limited nature of land. Rural people have been discovered to have a wealth of indigenous knowledge and have

incorporated trees in the production system in areas where they lived for a very long period (Evans and Alexander, 2004).

Vanlauwe *et al.*, (2010) described agroforestry as a land use system and technology in which wood, perennial trees, shrubs, palms and bamboos share the same farmland with herbaceous crops with or without animals in such a harmonious, ecological and economical interaction among the different components. Stocking *et al.*, (1989) viewed agroforestry as a land management concept where-in woody perennial species are cropped to protect the land on a long-term basis. Many species of trees have been identified as having considerable potentials and farm woodlots, they provide a wide range of possible products. A particularly well-known example is *Leucaena leucocephala* which is frequently grown in lines associated with food crops (alley cropping). It provides fodder and green manure from the leaves and fuel from its branches. It also helps in erosion control in addition to fixing atmospheric nitrogen to the soil.

Agroforestry has been viewed in different ways by different authors, depending on the line of thought of the person concerned. But all definitions have a central theme, which is the deliberate integration of woody perennials and food crops and animals on the same land management unit''. It involves extending the benefit of agroforestry among those who seek a livelihood in the rural areas. Agroforestry is generally practiced to develop a more sustainable form of land use that can improve farm productivity and the welfare of the rural community. According to Nair (1993), there are three attributes which every agroforestry system should possess and they include:

1. Productivity: Almost all agroforestry systems aim to maintain or increase production (of preferred commodity) as well as productivity (of land). Agroforestry can improve productivity in many ways. These include increased output of tree products, improved yields of associated crops, reduction of cropping system inputs and increased labor efficiency.
2. Sustainability: By conserving the production potential of the resource base, mainly through the beneficial effects of woody perennials on soils, agroforestry can achieve and indefinitely maintain conservation and fertility goals.
3. Adoptability: This implies that the practice should be adopted by any community it is introduced into in spite that it is an old practice.

According to the Food and Agricultural Organization (FAO, 2012) report, agroforestry when designed and implemented correctly, combines the best practices of tree growing and agricultural systems resulting in the most sustainable use of land. Its design should therefore, strive to maximize positive interactions between trees and other elements (crops and animals) and minimize negative interactions. Designers should take into account the land and labor available for adding a tree component to existing farming systems and the tree component's impact on other agricultural and off-farm activities of the target population. The risks, benefits, and costs associated with planting and managing the tree component should be considered from the farmers' perspective. In areas where the trees are to be intercropped with food crops, the likely impact of the tree component on crop yields should also be considered. For example, if the trees are to be planted or harvested at the same time as crops, the likelihood of reduced food production and other opportunity costs should be considered.

2.2 Importance of agroforestry

Agroforestry practices contribute a wide range of products and services. Trees under this practice of agroforestry may provide food, shelter, energy, medicine, cash income, raw materials for craft, fodder and forage and resources to meet social obligations (ICRAF 1992). Agroforestry practices of all types provide important direct and indirect benefits not only to the farmers who implement them, but to their communities and the global population as a whole. Some of the benefits are listed below.

2.2.1 Agroforestry as a climate change adaptation strategy

Agroforestry is defined as the integration of trees in agricultural enterprises to drive multiple benefits that include fodder for livestock, tree products both for subsistence and commercial purposes (ICRAF, 2013). According to Sanches (2000); Kwesiga *et al.* (2003), agroforestry systems present multiple benefits which include enrichment of soil quality via the use of fertilizer trees, provision of a microclimate due to tree canopies and generation of forest products such as firewood and other medicinal outputs. A large and growing body of scientific evidence indicates that climate change is a major threat to sustainable development and achieving the Millennium Development Goals (MDGs) (Intergovernmental Panel on Climate Change (IPCC), 2007). Shifting weather regime will have many adverse effects on agriculture, including more frequent

drought, increased fungal outbreaks and insect infestations, reduction in ecosystem integrity and resilience, and a decline in biodiversity. However, agroforestry practices could be used to adapt to, or mitigate, the predicted impacts of climate change on smallholder agriculture (Verchot *et al.*, 2007). The intensification and diversification functions of agroforestry practices can strengthen the socio-economic resilience of rural populations to climate change.

2.2.2 Agroforestry for food and income

According to Obasi (2010), many indigenous people depend on forests for their livelihood, edible and medicinal plants, bush meat, fruits, honey, shelter, firewood and many other goods, as well as for cultural and spiritual values. Agroforestry can also provide economic diversification that improves the financial well-being of families and communities, especially those of small-to-medium resource farmers. Agroforestry provides income generation opportunities (in processing and enterprise development) for rural women. Indigenous fruit trees provide food, nuts and fruit during periods of hunger as well as timber and poles for building, non-timber forestry products for crafts and medicine, fuelwood, charcoal, and fodder and shade for animals and farmworkers from the wild.

2.2.3 Enhancing soil fertility

Agroforestry practices have attracted considerable attention as an attractive and sustainable pathway to improve soil fertility. According to Sanchez (2002), there are four ways through which trees can contribute to the improved nutrient supply -increase nutrient inputs to the soil, enhance internal cycling, decrease nutrient losses from the soil, and provide environmental benefits. It is estimated that on average African soils have been depleted by about 22 kg nitrogen, 2.5 kg phosphorus, and 15 kg potassium per hectare of cultivated land over the past 30 years in 37 African countries – an annual loss equivalent to \$4 billion worth of fertilizers (Sanchez, 2002).

2.2.6 Soil conservation

According to Anitta and Sathya (2012), integrating trees on the fields acts as a natural sump for nutrients from deeper layers of soil, adds bio-fertilizer, conserve moisture and enhance the productivity of the system. It provides surface soil cover and protects the soil from the damaging impact of raindrops. It also lowers surface soil temperature, increases soil moisture infiltration

and retention, improves the physical properties of the soil and stimulates biotic and faunal activities in the soil (Kang & Akinnifesi, 2000). Studies have shown that alley cropping with leguminous trees like (*Leucaena leucocephala*) has been most widely used in the field for producing mulch material for moisture conservation and nutrient recycling. Alley cropping with *Leucaena leucocephala* was effective for erosion control on sloping lands up to 30% (Anitta and Sathya, 2013).

2.2.5 Enhancing water use efficiency

There is evidence that agroforestry has the potential for improving water use efficiency by reducing the unproductive components of the water balance (Alao and Shuaibu, 2011). Examples from run-off, soil evaporation, and drainage show that simultaneous agroforestry practices could double rainwater utilization compared to annual cropping systems, mainly due to temporal complementarities. Agroforestry can also be useful for the utilization of sewage contaminated wastewater from urban systems. Soils under different tree canopies are rich in organic carbon content, moisture availability and nutrient status Srivastava (2013).

2.2.6 Agroforestry for bio-fuel and bio-energy production

Bio-fuels are renewable liquid fuels coming from biological raw materials and have proven to be good substitute for oil in the transportation sector. Bio-fuel is gaining worldwide acceptance as a solution for problems of environmental degradation, energy security, restricting imports, rural employment, and agricultural economy. According to Anitta and Sathya (2013), 70-80% energy in rural areas comes through biomass from trees and shrubs. The promotion of the use of oils could also provide a poverty alleviation option in rural areas.

2.3 Classifications of agroforestry practices

Young (1989) reported that there are hundreds, possibly thousands of agroforestry systems but only 20 distinct practices. These systems, existing in different places, are so complex and diverse that they need to be grouped and classified into different categories to evaluate them and develop some action plans for their improvement. According to Nair (1993), the easiest and most obvious way of classifying agroforestry systems are the spatial and temporal arrangement of components, the importance and role of the components, the production aims or outputs from the system and

the social and economic features. In correspondence to the systems, structure, function (output), socioeconomic nature or ecological (environmental) spread. Thus, agroforestry can be classified according to the following sets of criteria:

1. Structural basis: This refers to the composition of the components, including the spatial arrangement of the woody component, vertical stratification of all the components and temporal arrangement of the different components.
2. Functional basis: This refers to the major function or role of the system, usually furnished by the woody components (these can be protective services e.g. windbreak, shelterbelt, soil conservation etc).
3. Socio-economic basis: This refers to the level of inputs of management (low input, high input) or intensity or scale of management and commercial goals (subsistence, commercial, intermediate).
4. Ecological basis: This refers to the environmental condition and ecological suitability of systems, based on the assumption that certain types of systems can be more appropriate for certain ecological conditions; i.e. there can be separate sets of agroforestry systems for arid and semiarid lands, tropical highlands, lowland humid tropics etc.

These broad classifications of agroforestry are independent and mutually exclusive but are interrelated. While structural and functional basis often relate to the biological nature of the woody components in the system, the socioeconomic and ecological stratification refers to the organization of the systems according to prevailing local conditions (socioeconomic or ecological).

Continuous depletion of the forest reserve base and agricultural land has major effects on the agricultural segments of Nigeria economy (Akpabio, *et al.*, 2008). It causes a decline in the productive capacity of soils, accelerated erosion, destruction of wildlife habitats and loss of plant genetic diversity, climate change, landslides, soil degradation, and unfavorable hydrological changes. With continuous deforestation, the humid forest of Southeastern Nigeria which is richly endowed with many under-utilized and neglected plants (such as *Irvingia wombolu*, *Irvingia gabonensis*, *Pentaclethra macrophylla*, *Piper guineense*, etc.) that have high nutritional, economic and medicinal values for man could become extinct (Nzekwe, Onyekwelu, & Uju, 2008).

Before the Green Revolution, the majority of the subsistence farming anywhere in the world involved mixed species, usually including tree products. In the background of the green revolution, subsistence agroforestry systems have continued and are now supported by the increased need to encompass ecosystem services in addition to food production. This has become very pertinent considering the rising rate of food insecurity and environmental degradation in many parts of Africa. According to Mbow (2013), Africa faces major challenges of food, water and energy security, equity, poverty, and environmental degradation. In the context of the livelihoods delivered by rural Africa to about 70% of its billion people, agroforestry can assist with all of these challenges.

According to Lulandala (2004), agroforestry remains the only land management system that effectively integrates the main dynamic sectors of agriculture, forestry and animal husbandry for ensured better use of limited land, labor and time resources. It facilitates the enhancement and diversification in the land-unit resource products of production systems and further permits interactive resource conservation, improvement and sustainability. It is clear that rural household's food consumption depends on their production, efforts to produce enough are hindered by various factors; unpredictable rainfall being the major among others (even if rainfall is adequate, intensity, distribution and run-off still make it not sufficiently used in agriculture), therefore to overcome this, agroforestry has the ability to ensure conservation and prevention of run-off and conserve moisture for a long period of time (Shalli, 2003). Better life is ensured by agroforestry through its products as food, fruits for nutrition, medicinal use such as *Azadiractica indica* (Neem tree), Lueciana species for cattle feed, trees yield building supplies for houses as well as the source of firewood. Over 80% of energy in tropical Africa comes from fuelwood, the large majority of those who depend on the availability of firewood for cooking being the rural population (Marcoux, 2000). Agroforestry holds great promise for contributing to sustainable land-use systems which can overcome the problem of land degradation and food crisis which is a pressing problem in Nigeria (Kang and Akinnifesi, 2000).

2.4 Structural classification of systems

a. Classification based on the nature of components: This system of classification considers three vital basic sets of elements that are managed by the land user, namely the tree or woody perennial, the herb (Agricultural crops including pasture species), and the animal. In most agroforestry systems, the herbaceous species is also involved, the notable exceptions being apiculture and aquaculture with trees and plantation-crop mixtures of two woody perennials such as coffee and rubber trees, or cacao, and tea under shade trees. Animals are only present in some agroforestry systems.

b. Classification based on the arrangement of components: This system of classification considers the arrangement plant component of agroforestry system, if the system involves plants and animal components, such plant arrangement in multispecies combinations can involve the dimensions of space and time. Spatial arrangements of plants in agroforestry mixtures vary from dense mixed stands (as in-home gardens) to sparsely mixed stands (as in most silvopastoral systems). Moreover, the species can be in zones or strips of varying widths. There can be several scales of such zones varying from microzonal arrangement (such as alternate rows) to macrozonal ones. A common example of the zonal pattern is hedgerow intercropping (alley cropping). An extreme form of zonal planting is the boundary planting of trees on edges of plots and fields for a variety of purposes and outputs. Other extreme forms of macrozonal arrangement include sole cropping systems, the interactive association of different components however can be used as the criterion to decide the limits between macrozonal agroforestry and sole crop system.

The temporal arrangement of plants in agroforestry can also take various forms. An extreme example is the conventional shifting cultivation cycles involving 2 to 4 years of cropping followed by more than 15 years of fallow cycle when a selected woody species or mixture of species is planted or is allowed to regenerate naturally. Similarly, some silvopastoral systems may involve grass keys in rotation with woody species, with the same species of grass remaining on the land for several years during the grass phase. These temporal arrangements of components of agroforestry have been described as coincident, concomitant, overlapping (of which the extreme case is relay cropping), separate, interpolated and so on. CTA (2003).

c. **classification based on the functions of the system:** Production and protection (which are the cornerstone of sustainability) are theoretically, two fundamental attributes of all agroforestry systems. This means agroforestry systems have a productive function yielding one or more products that usually meet basic needs, as well as a service role (i.e. protecting and maintaining the production degree of commercialization). The emphasis on production should not downplay the importance of sustainability. Although production is a very important consideration in agroforestry, it is the sustainability attribute that makes it different from other approaches to land use, thus all agroforestry systems have both productive and protective roles, though varying degrees. Depending on the relative dominance of the particular role, the system can be termed productive or protective.

d. **ecological classification:** this is an arrangement system which include a mixture of various forms of agroforestry (in terms of the nature as well as arrangement of components) and these can be agrisilvicultural, silvopastoral or agrosilvopastroal systems in any of the ecological regions., arrangement of existing systems as well as recommendations of potential agroforestry technologies, for specific agro-ecological zones.

2.5 Agroforestry practices (systems) in Nigeria

a. **Tuangya system:** This system of agroforestry is reported to have originated in Myanmar (Burma) and means hill (Taung) cultivation (ya) (Chiboko, 2002). Originally, it was the local name for shifting cultivation and subsequently used to describe the afforestation method. Essentially, tuangya system involves growing annual agricultural crops along with the forestry species during the early years of establishment of the forestry plantation. In tuangya system of agroforestry, food crops are interpolated with trees in a unit area of land for 1 -2 years. Food crops cease to exist on farm land when the tree crop close canopy. The tuangya system was the main agroforestry method practiced in the forest reserves from 1950 to date.

b. **Home garden:** Home gardening has a long tradition in many tropical countries. Tropical home gardens consist of an assemblage of plants, which may include trees, shrubs, vines, and herbaceous plants, growing in or adjacent to a homestead or home compound. These gardens are planted and maintained by members of the household and their products are intended primarily for household consumption. The gardens also have considerable ornamental value and they provide shade to people and animals. Home garden is used here to refer to an intimate association

of multipurpose trees and shrubs within individual houses, with the whole crop-tree-animal unit being managed by family labor (Fernandes and Nair, 1986). The primary emphasis of home gardens is food production for household consumption whereas plantation-crop combinations usually focus on commercial production of such plantation crops. Plantation crops such as cocoa (*Theobroma cacao*), coconut (*Cocosnucifera*), coffee (*Coffee arabica*) and black pepper (*Piper nigrum*) are often dominant components of the humid tropics. Home gardens exemplify many agroforestry characteristics, i.e. the intimate mix of diversified crops and multipurpose trees fulfills most of the basic needs of the local population while the multistoried configuration and high species diversity of the home gardens help reduce the environmental deterioration commonly associated with monocultural production systems.

Food production is the primary function and role of most, if not all of the home gardens. Another aspect of food production in home gardens is the almost continuous production that occurs throughout the year. The combination of crops with different production cycles and rhythms results in a relatively uninterrupted supply of food products. Depending on the climate and other environmental characteristics, there may be peak and slack seasons for harvesting the various products. Home garden production is practiced primarily for home consumption but any marketable surplus can provide a safeguard against future crop failures and security for the interval between the harvests. According to Nguyen *et al.* (2013), home gardening system of agroforestry affords diversified production, improves the food production level and conserves the soil and indigenous plant species for farm families.

c. **Multistory tree gardens:** This is a system of mixed tree plantations consisting of conventional forest species and other commercial tree crops, especially tree spices, lending a managed mixed forest appearance. As opposed to home gardens, which surround individual houses, these tree gardens are usually away from houses and are typically found on communally-owned lands surrounding villages with dense clusters of houses. The characteristics and conditions of the places where the systems are practiced, various forms of tree garden systems can be found. The most important among these include tree gardens, compound farms (gardens) of southern Nigeria (Okonkwo, 2010).

d. **Alley-cropping (hedgerow intercropping):** This is a technique developed at the International Institute for Tropical Agriculture (IITA) and ICRAF. In this system of agroforestry, arable crops

are grown between hedge-rows of planted shrubs and trees, preferably leguminous species which are periodically pruned to prevent shading of the companion crops and the pruning applied as mulch for the crops. The trees provide nitrogen from atmospheric fixation, recycle nutrients from the depth of soil, suppress weeds and increase organic matter content of the soil. (Epaphra, 2001) noted that alley cropping is most suitable for food production in altisols and other high-base soils in the humid and sub-humid tropics, as it has been accepted in Southern Nigeria and the middle-belt on an experimental basis in the country. The tree species considered are those with deep rooting (Beech *Fagus spp*), ability to coppice (Black Locust, Chestnut, Willow, Elderberry), nitrogen-fixing (Black Locust, Mimosa, Alder, Redbud, Autumn Olive, Kentucky Coffee Tree, Golden Chain Tree, Acacia, Mesquite).

e. **Alley farming:** This is an agroforestry system focusing on livestock production. In alley farming, trees, shrubs and other perennials are planted with arable crops to supplement the woody plants in the rows. The alleys are designed to suit the local environment. Alley farming is designed mainly for sheep and goat grazing. The advantages of alley farming are that crop residues control soil erosion through windbreak. The major disadvantage of the two systems (alley cropping/farming) is the competition of hedgerows with crops for soil water which is often limited in semi-arid tropics (Schreckenber, 2004).

f. **Shelterbelts:** this is an agroforestry system in which food crops are planted between rows of trees planted as shelter. The shelterbelts are modified to suit the farmers. The trees and shrubs are planted in one or more rows at right angles to the prevailing winds. The practice often increases crop yields because of their beneficial effects on soil and microclimate. The effect on animals is to reduce stress from heat and wind around houses, shade and wind protection are often combined with the production of fruit, edible leaves for humans and animals and even fuelwood. The multi-species shelterbelts protect cropland and at the same time check desertification, the tree covers affect the microclimate of its immediate environment through temperature reduction due to tree cover (Schreckenber, 2004). The demerits of the system are that labor involvement is enormous and species used as hedgerow crops are without edible products.

g. **Multi-purpose trees on cropland (tree on farmland or farm forestry):** This is an agroforestry component applied to the Savanna and rain forest ecosystems. It is a practice in which farmers intentionally leave a few trees on farms when clearing the land. The trees

commonly left are those of economic importance to the farmers. The economic trees are replaced by young ones at maturity. There is also deliberate planting of desirable fruit-bearing trees (fruit trees) on farmlands where the density of the natural tree is low (Owusu, 2001). Other terms with forestry endings are community forestry, a form of social forestry which refers to tree planting activities undertaken by a community on communal lands. The system involves people's direct participation in the process, either by growing trees themselves or by processing the tree products locally. It is suited for areas with abundant common lands. Social forestry, on the other hand is considered to be the practice of using trees and/or tree planting specifically to pursue social objectives, usually the betterment of the poor through delivery of the benefits (of trees and/or tree planting) to the local people. Poulton and Poole (2001) observed that all these labels (community, farm and social forestry) directly or indirectly refer to growing and using trees to provide food, fuel, medicines, fodder, building materials and cash income for community benefit.

h. **Aqua-forestry:** This is an agroforestry system that is not popular but widely practiced by traditional farmers in inland watercourses where the farmers have full rights to the land. Aqua-forestry is a practice that links trees with aquaculture (Okonkwo, 2010). Trees are planted around fish ponds to provide fodder for herbivorous fish. The fuel-wood from the trees are used for fish processing while decomposed leaves are used as pond fertilizer. The trees also serve as shelter and shade which create a desirable microclimate for the pond. Aqua forestry is widely practiced in Malawi and Pearl River Delta in China where fruits of guava, avocado, papaya and leaves of *Leucaena* are used to feed herbivorous fishes such as *Tilapia* and *Nilotica* species. (Powell, 2009).

i. **Apiculture (Api -Silviculture):** this is an agroforestry system which involve careful selection of woody species grown for their nectar-producing flowers and pollen valued by bees to boost wax and honey production. They are good nectar-producing flowers species particularly if flowering is staggered, allowing the bees to work as long as there are flowers instead of only working for a few months in the year. This is probably the production with the highest ratio of value of products harvested to plant biomass consumed Schreckenber (2004).

j. **Protein bank:** It is difficult to rely solely on annual plants in production systems that involve animals to supply forage during dry seasons or years of low rainfall. Woody perennials vegetation is judiciously used to help meet this difficulty, not only does it provide green forage when the grass cover has withered but it can be also supplying more protein than grass (Okonkwo, 2010).

2.6 Women in agroforestry

Agroforestry is a common system of production throughout Africa (Zomer *et al.*, 2009). The focus on women and the adoption of agroforestry practices is important for various reasons. At the center of this type of farming system are women farmers who are frequently responsible for managing trees and other agricultural enterprises, they provide labor especially during the initial stages of forestry establishment i.e. planting, weeding and watering. (Kiptot and Franzel 2011). Women provide most of the labor (cutting grass, manure application, feeding animals, milking, fetching water and even selling milk). Secondly, with minimal inputs and a low-cost system which requires diversity of products and services such as timber, fruits, fodder, food and soil fertility improvement, women who cannot afford to adopt high cost of technologies due to their severe cash and credit constraints, are offered opportunities (Wambugu *et al.*, 2001).

Kiptot and Franzel (2011) reported that after the establishment stage of forestry farms, many trees enterprises require relatively little labour e.g. weeding during early growth and if trees are mixed with annual crops then no extra weeding is required. Many trees require no cash inputs or minimal amounts for the purchase of seed or seedlings, if they can be found. Third, women are involved in the decision-making and increasingly assuming leadership role in the absence of men in many households. Gladwin *et al.* (2001) reported that female-households account for 30% of all rural smallholder households in Nigeria while in western Kenya more than half of the households are headed by women. These women are not only actively involved in the production of food through agroforestry but also promote the spread of agroforestry technologies to other farmers through collective action in tree nursery establishment and sharing the knowledge they have on agroforestry in their groups.

In a study on the achievement and impact of a fodder project in the north central Nigeria, Wambugu *et al.* (2001) found that out of 2600 group members involved in establishing fodder shrub nurseries, 60% are women. In western Nigeria, Place *et al.* (2004), found that women used improved fallows and biomass to transfer technologies more than men who more often used fertilizer. Phiri *et al.* (2004) found that in four Zambian villages, 32% of males and 23% of females planted improved fallows. There was considerable variation within villages with one having more females than males planting improved fallows. According to Phiri *et al.* (2004) this

variation could be attributed to the presence of active women groups and participation in Agriculture. These findings according to Kippot (2011) suggest that the use of improved fallows for replenishing soil fertility is gender-neutral; women farmers are as actively involved as well as their male counterparts.

But there are also concerns that as the products become more of a cash crop, the benefits may shift from women to men (Poulton and Poole, 2001). In the Shea growing region of Benin, Schreckenbreg (2004) found out that 90% of women were involved in collecting nuts/fruits of the shea tree. Other tree products that are frequently collected by women and children in west and central Africa are *Parkiabiglobosa*, *Dacryodesedulis*, *Irvingia gobonensis*, and *Ricinodendronheudelotti*. In southern Africa, common species collected by women include *Sclerocaryabirrea*, *UapacaKirkiana*, *Vangueriainfausta*, *Azanzagarkeana*, *Ziziphus Mauritania* and *Strychnols cocculoides*. In eastern Africa *Vitelleri aparadox*, *Tamarindus indica*, *Vitexdoniana* and *Adansoniadigita*.

In Cross State Nigeria, women are often involved in the collection of notable forest products like bush mango (*Irvingia Spp*), *African salad (Gretum spp)*, *bush pepper (piper guineensis)*, *oil bean (pentaclethra macrophylla)*, *wrapping leaf (Thaumatococcus daniellii)* *edible mushrooms (Edeth et al., 2013)*

Other studies that have reported similar reports that women and children being the collectors are for instance Kalaba *et al.* (2009) in Imo state where women normally combine fruit collection with other household chores such as collecting fuelwood and fetching water. Women's household heads normally reserve nuts of the Shea tree for their female relatives. When the nuts are in season, women start collecting Shea fruits from common parklands where competition from other women is stiffer. Collecting is normally done on their way to and from agricultural fields. In a day, women collect head loads of up to 47 kg. When the Shea fruits the common parklands have been exhausted, the women turn to their husbands' fields to collect the Shea fruits. A study of gender and commercialization of *Gnetuma fricanum* in Cameroun by Kanmegne *et al.* (2007) found that women and children are also the main collectors of the leaves which are used as vegetable. They accounted for less than 5% of collectors.

Apart from collecting, women are also involved in processing to add value to fruit tree products. Shea kernels are processed are into local butter. This process is laborious and not a particularly

profitable business. As a result, few women are involved. In some parts of Benin such as Bassila area, women who make butter also make traditional soap from leftover and rancid butter. This soap is sold locally and is said to have healing properties (Schreckenbreg, 2004). In Southern Africa, products that women process from indigenous fruits or nuts include alcoholic and non-alcoholic beverages, confectionaries, additives for other foods, dried whole fruits, oil, and butter. In addition to soil fertility management, fodder production, indigenous fruits and vegetable production and processing, women are involved in the establishment and management of woodlots.

In a study by Chiboko (2002) on the analysis of household-owned woodlots between female-headed and male-headed households in Malawi, she noted that most women (96%) in female-headed households stated that they owned woodlot individually while only 27% of the men said they co-owned with their wives. On the number of trees, female-headed households tended to have half as many trees as male-headed households, reflecting the fact their farms were half as large.

Although, men and women are involved in the management of agroforestry, but literature confirms the fact that women do most of the work, especially at the initial stages of tree establishment. In a study conducted by Epaphra (2001) and well as Gerhardt and Nemarundwe (2006) it was noted that over 60% - 80% of women farmers in Nigeria, are responsible for managing trees species planted on agricultural farms and are also responsible for watering young seedlings.

2.7 Rural women households

The role that women play and their position in meeting the challenges of agroforestry production and agricultural development are quite dominant and prominent. Their relevance and significance, therefore, cannot be overemphasized. Findings from a study financed by the United Nations Development Programme (UNDP) revealed that women make up some 60-80 percent of the agricultural labour force in Nigeria (World Bank, 2003) depending on the region and they produce two-thirds of the food crops. Therefore, the integration of women in agroforestry is essential for the achievement of some goals such as increased food production, fold self-sufficiency and sustained reduction of poverty and malnutrition. Yet, in spite of these, widespread assumption that men and not women make the key farm management decisions has prevailed.

Sadly, female farmers in the country are among the voiceless, especially for influencing agricultural policies.

Rahman (2008) noted that such policies, which are aimed at increasing food security and food production, tend to either underestimate or ignore women 's role in both production and the general decision-making process within the household. Socioeconomic characteristics of the farmers, among other factors, affect their decision-making in agriculture. The various contributions of women to agricultural production in Nigeria have been variously described in the literature but their role in the decision-making process in agriculture has not been widely employed or at best, remains minimal.

According to Rahman (2008), Women shoulder the primary responsibility for food security in Africa yet development agencies have devoted minimal resources to researching the impact of their agricultural policies and new techniques on the wellbeing of Africa's women farmers, Women contribute tremendously to agroforestry output but unfortunately they hardly, until recently, benefited from agricultural incentives and innovation because of economic suppression and social and traditional practices which undermine the constitutional provisions on the equality of men and women. Gender discrimination, rather than ignorance, is the reason for the lack of women participation in agroforestry, agricultural programs and projects.

Regardless of the level of development achieved by the respective economies, women play a pivotal role in agriculture and in rural development in Nigeria. There are serious constraints that militate against the promotion of an effective role for women in development in those societies which were bound by age-old traditions and beliefs. Patriarchal modes and practices motivated by cultures and/or interpretations of religious sanctions and illiteracy hinder women's freedom to opt for various choices to assert greater mobility in social interactions (Mohammed, 2006). Resulting from these situations, women's contribution to agriculture and other sectors in the economy remain concealed and unaccounted for in monitoring economic performance measurement. Consequently, they are generally invisible in plans and programmes.

In rural households, rural women fully involve during the whole day in domestic labour activities like looking after the children, cleaning the house, cooking, washing and other activities (Agha, 2005). Although their participation in agricultural and household activities are very high but the educational facilities and enrollment of female in primary education is hopeless because their

enrollment has stayed roughly the same for the country as a whole, at about 30% (Lloyd *et al.*, 2002). Other than education women's full participation in economic and household activities impeded by cultural and legal constraints, which limits women's participation by women's relative lack of time and mobility due to their workloads and multiple roles (World Bank, 1995). it is crystal clear that women mostly participate in farming (agricultural) as well as household activities and they are the household managers but their work is considered as non-productive, unorganized and un-documented throughout the world.

In rural areas of Imo state, women play a major role in agricultural production, livestock raising and cottage industries and remain busy from dawn to dusk to supply food to men in fields, fetch water, collect fuelwood, and manage livestock. They are equally efficient in seedbed preparation, tilling, sowing, fertilizer application, fodder cutting, weeding, intercultural operations, transplanting, husking, threshing, drying, storing cereals and fodder, selling agricultural commodities and harvesting of all the crops, fruits and vegetables (Shah and Khan, 2004). Women often devote more time to carry out these tasks than men do and their participation is notably higher in food storage and processing. They carry out these tasks in addition to their normal household activities (Shaheed & Mumtaz, 2000).

It is relevant to consider some aspects of the marginalization of the status of women in the world by having a look at the figures which are based on the documents of the United Nations (World Bank, 2016). Some of the findings are:

- a) Unemployment Rate: Male unemployment rate decreased by 11% from 2000 to 2014 while that of women, the unemployment rate increased by 0.5% during the same period.
- b) Women in the Informal Sector: Without legal protection or security, women depend on informal trade for their survival. In Third World countries, a high percentage of food vendors were women: in Nigeria 94%, Thailand 80%, 63% in the Philippines; -
- c) Inequality in Pay: All over the world women earn only two-thirds of men 's pay and earn less than three-quarters of the wages of men doing similar jobs. Women form a third of the world 's official labour force, but are concentrated in the lowest-paid jobs and are more vulnerable to unemployment than men; -

- d) Domestic Work: Women do almost all the world 's domestic work and coupled with their additional work in the productive spheres - this means most women work a double day.
- e) Unpaid domestic work is regarded as women's work. Though it is vital work, it is invisible work, unpaid, undervalued and unrecognized, yet, women's contribution to society in this regard is enormous; -
- f) Agriculture: Women grow about half of the world's food, but own hardly any land, have difficulty in obtaining credit and are overlooked by agricultural advisors and projects. In Africa, three-quarters of the agricultural work is done by women while in Asia, Latin America and the Middle-East, women comprise half of the agricultural labor force; -
- g) Health: Women provide more health care than all health services combined and have been major beneficiaries of a new global shift in priorities towards prevention of disease and promotion of good health; -
- h) Education: Women continue to outnumber men among the world 's illiterates by about 3:2 ratio, but school enrollment boom is closing the education gap between boys and girls; -
- i) Political Affairs: Due to poorer education, lack of confidence and greater workload, women are still under-represented in the decision-making bodies of their countries.

The effects of the long-term cumulative process of discrimination against rural women have been accentuated by underdevelopment. Graphically, while women represent nearly 50% of the world's adult population and one-third of the total labour force, they labour nearly two-thirds of the total working hours but receive only one-tenth of world income and own less than one percent of property. The story of overworked women in the rural areas of the developing and underdeveloped countries of the world is too well known. The type of agricultural activities generally expected of women is highly labor-intensive and the rural women generally do not enjoy the benefits of new technologies. Their wages are generally less because it is assumed that the efficiency of women's labour is poor compared to that of men. Regarding ownership of land, women do not enjoy equal rights, particularly in the developing countries where most of the production, processing, storage and preparation of food is carried out by the women. These

account for 50% of the total labour required for food production. Many of these tasks are performed by children, especially the girls.

2.8 Concept of food security

Food security is defined as the availability of food and one's access to it. A household is considered food secure when its occupants do not live in hunger or fear of starvation. World Food Summit (1996), stated that food security is met when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life. This definition was confirmed, extending its scope by adding that the nutritional dimension is integral to the concept, and specified its components by detailing that the four pillars of food security are availability, access, utilization, and stability must be met.

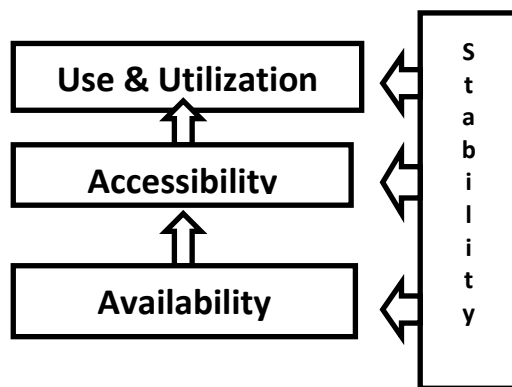


Figure 1: Four pillars of food security.

Source: Adapted from: Weingärtner (2004)

The first pillar of food security is food availability: It represents the existence and supply of sufficient amount of food ready for consumption for all individuals in the household, country and region, through production, distribution, exchange and/or aid. (FAO, 2006). At the household level, food availability refers to the abundance of adequate amounts of food for all household members, either through own production or by purchase. For example, in the Tigray region of Ethiopia, the average household production covers about 38% of the annual food demand (BOFED 2004).

The second pillar of food security is access: This refers to the capabilities of region, locality,

households and/or individuals within a household, to have access to resources, and rights to acquire sufficient amounts and quality of food (Gross *et al.*, 2000; Rivera and Qamar, 2003). At household level, all members of a household to have sufficient food access as well as sufficient amount of food according to their physiological and psychological needs and preferences to meet their daily dietary demand (Weingärtner, 2004; FAO, 2006).

According to (Weingärtner, 2004; Pieters *et al.*, 2013) food accessibility is often influenced by social, economic or cultural factors such as favoritism, gender bias, and education, causing unequal distribution of food among household members. For instance, among rural farm families, females, mainly mothers, get relatively smaller food amounts, fewer meals and/or inferior quality food than male members of the same household (Mengesha and Ayele, 2015).

The third pillar is utilization: This refers to the ability of an individual to use food in a way that all physiological requirements are satisfied. Considering the food quality, it involves the importance of non-food aspects, such as availability of clean water and clean cooking fuel, hygiene and sanitation. The three underpinning elements of this pillar are diet diversity, proper preparation and handling, and absorption efficiency (Weingärtner, 2004; FAO, 2008; Pieters *et al.*, 2013; Pangaribowo *et al.*, 2013).

(i) Diet diversity: This refers to the content of an optimum number of calories and nutrients in the food required by each member of the household. A household 's staple crops may offer sufficient energy, but not contain optimum amounts of essential macro- and micronutrients, making the household members prone to malnutrition. Currently, this is the situation for more than 2 billion people around the world (FAO *et al.*, 2012). Alternatives at household level, the economic, educational, cultural and behavioral measures to promote the inclusion of animal products, fruits and vegetables in home diets, as it has been proven that wealthier and better-educated people have more diversified diets (Hatløy *et al.*, 2000; Ruel, 2002).

(ii) Proper preparation: The presence of nutritious food does not guarantee Food and Nutrition Service. Non-food inputs like clean water and energy are needed to appropriately prepare, consume and assimilate food. At the household level, the access to sufficient clean water and energy as well as their proper usage and handling are crucial factors to guarantee a safer, more palatable and more energy-efficient consumption of food.

(iii) Absorption efficiency: this is also known as nutrient utilization, this centers on an individual's physiological efficiency in absorbing the consumed food, and therefore well-correlated with the health status of the individual that, in case deficient, can impair the person's ability to benefit from the food (Weingärtner, 2004). At the household's level, absorption efficiency depends on the economic, educational and physical characteristics of a household in caring for the health of the family members.

The fourth pillar stability refers to the duration of the three other dimensions to remain stable over a long period of time (FAO, 2009 b). Events like food price hikes, floods, droughts, pest outbreaks, etc., can cause economic or environmental shocks that may lead to an initially food-secure household becoming insecure. Stability comprises two general attributes, namely carrying capacity, referring to the tolerance level of the subject against harming events, and resilience, referring to the capability and time required to recover from those events (Pieters *et al.*, 2013). Accumulation of assets before the shock occurrence such as storing food and saving cash can significantly enhance the carrying capacity and resilience of households during calamities.

2.9 Agroforestry for food security

Agroforestry as evergreen agriculture has enormous potentials to tackle food insecurity, Historical evidence showed that agroforestry has been widely practiced through the ages as a means of achieving agricultural sustainability and slowing the negative effects of agriculture such as soil degradation and desertification and Promoting agroforestry is one option many perceive as a major opportunity to deal with problems related to land-use and CO₂ -induced global warming (EARO 2000, Eyasu 2002). The food security concept is built on three main prongs; availability, affordability, and accessibility Eyasu (2002) to have the right quantity and mix of food at all times. Eyasu (2002) also measure food security stating that there are two attributes which every agroforestry system should possess and they include:

Service functions: These include soil fertility maintenance through erosion control and biological Nitrogen fixation (BNF), watershed protection, maintains ecological stability, conservation of biodiversity and carbon sequestration. Agroforestry has the potential to increase carbon sink capacity thereby contributing to climate change mitigation.

Productive functions: This involves the production of high-value fruits for income and nutrition security, high-quality fodder for livestock, wood for household energy, timber/poles for construction and income generation.

Agroforestry has enormous potentials in helping to address the global food crisis. According to Eyasu (2002) agroforestry science has been engaged in developing technical, institutional and policy innovations that are fundamental to achieving food security in the developing world, especially in Africa. The importance of agroforestry not only for food security, but also as a way of improving rural incomes and nutrition, protecting biodiversity and environmental services, and helping the rural poor to adapt to climate change is now widely recognized. For example, the International Assessment of Agricultural Science and Technology for Development challenged the world with a new vision of multifunctional agriculture. In its report, completed in 2008, it concluded that agroforestry has a central role to play in achieving this vision, particularly in the developing world, also farmers can reverse the trend of declining soil fertility and increase their crop yields substantially with minimal cash inputs. Moreover, it can improve food security significantly as it provides farmers with diversified food sources, additional income and improves resilience to the production systems, thus improving food availability, food accessibility, utilization, and food production sustainability.

Agroforestry systems are increasingly recognized as providing both mitigation and adaptation to climate change impacts in Africa, targeting adaptation benefits to poor smallholder farmers most at risk from climate change (Woodfine, 2009) as well as providing a median of 95 tons ha⁻¹ of potential carbon storage (Albrecht *et al.*, 2003). They can also provide a starting point for addressing land degradation prevalent over much of the sub-Saharan Africa. The insight that trees on farms provide livelihood benefits is not new, and diversity-based approaches to agricultural adaptation to climate variability have been adopted by many farmers (Nguen *et al.*, 2013). In the light of recurring food shortages, projected climate change, and rising prices of fossil fuel-based agricultural inputs, agroforestry has recently experienced a surge in interest from the research and development communities, as a cost-effective means to enhance food security, while at the same time contributing to climate change adaptation and mitigation (Franzel *et al.*, 2014; Lulandala *et al.*, 2004; Herrero 2012). It has also experienced a recent increase in adoption by farmers in many parts of Africa as demonstrated by Garrity *et al.*, (2010).

2.10 Constraints to adoption of Agroforestry practices

i. Lack of advocacy/agricultural policies for agroforestry practices

There is a deficiency in comprehensive and specific policies to encourage the development of agroforestry practices (Powell, 2009). This is because they are integrated into other policies such as the land policy, the forest development policy, the rural development policy, and the poverty alleviation program. Some policies discourage farmers from growing trees or certain tree species on their farms. Consequently, many farmers do not consider it worthwhile to cultivate trees that they cannot cut for sale as timber or other uses, and they associate tree growing with government harassment. Similarly, policies and incentives for agriculture often promote monoculture systems, as in the promotion of oil palm plantations, and the amount of credit supporting this may impact negatively on agroforestry development.

ii. Low Awareness of Agroforestry Practices

As an integrated practice not tied exclusively to any single commodity or conservation interest, agroforestry does not fit neatly within conventional industry boundaries. Therefore, it is not widely recognized or understood among consumers, buyers, regulators, land management professionals and producer groups (Place *et al.*, 2004). The opportunity of agroforestry technologies to provide some medium and long-term benefits to individuals and the public simultaneously is not as yet well communicated to many stakeholders. According to Place *et al.*, (2004), governments have not often been involved in awareness creation for agroforestry practices, most likely due to the problems of agroforestry being neglected or not championed by a single government ministry.

iii. Low Production Knowledge

Although advances have been made through workshops, demonstrations and extension materials, the broader community of producers generally has low to moderate knowledge of agroforestry practices and lack basic information on production techniques, production potential and product standards (Powell, 2009). Special skill and sustained efforts are needed for undertaking the various management aspects of trees, about which many crops or livestock farmers may not be aware of. It is also noted that interaction between components, especially the hypothetical adverse

effects of trees on crops, is an area about which farmers who are not experienced with such systems are very apprehensive, and researchers are not equipped enough to allay such apprehension.

iv. Inadequate Research in Agroforestry

Most research and development efforts are focused on short-term monoculture cropping systems and less effort is placed on the potential for improved varieties in multispecies agroforestry practices. According to FAO (2013), breeding for agroforestry conditions (such as shade tolerance, root morphology, structure phenology) is virtually unexplored. Demand-driven, impact-oriented research institutions are needed to ensure a flow of innovations to rural areas. Yet frequently we find that research agenda are unresponsive to field realities and poorly linked to extension.

v. Unquantified Economics

Data on costs and returns for agroforestry activities are still lacking and are needed as a basis for calculations of internal rate of return, elaboration of credit schemes in support of agroforestry, and projection of large-scale investments. This limits the ability of prospective producers to make informed investment decisions, business plans or obtain insurance, financing or other credit instruments (Powell, 2009).

vi. Poor Market Information and Connections

Kang and Akinnifesi (2000) reported that there is a notable lack of information on marketing of agroforestry products. Lack of access to markets, farm inputs and management skills have been noted as the major constraints to growth of agricultural enterprises. Market information systems have recently been introduced in some countries, but they often do not include tree products. As such, markets for tree products are both less efficient and less developed than for crop and livestock commodities (FAO, 2013). Producers lack knowledge of agroforestry market opportunities and do not possess the general information and resources needed to make and maintain market connections. Food and Agricultural Organization (FAO) (2013) found that the processing and sale of commodities, which is a huge economic incentive for farmers to turn from agroforestry has had major constraints due to lack of markets, and inadequate organizational and management skills. If there is no market for goods produced, farmers may not see past the lack of economic gain in planting these trees.

vii. Labour Shortages/Labour Cost

Labour is an important input in the business of agroforestry. Many agroforestry opportunities require reasonably-priced labour and shortages hinder adopting these practices. According to Kang and Akinnifesi (2000) labour distribution varies between regions, gender, systems and seasons, and constitutes an important socioeconomic factor in the development of agroforestry. Most agroforestry innovations are accompanied by changes in labour demands. The availability of labour is crucial for different tasks in agroforestry, especially seedling production, tree establishment and management. The human capacity, infrastructures and institutional supports for agroforestry are usually not as well developed as for annual crop technologies (Gladwin, *et al.*, 2002).

viii. Lack of key infrastructure

According to Powell (2009) lack of suitable infrastructure to sort, grade, stabilize, and add value through processing to non-timber forest products (NTFPs), other specialty crops and niche production hinder the practice of agroforestry. There are only fragmented efforts to promote agroforestry products, often involving a small group of people in a given community. Aspects of quality control, storage, processing, and certification for agroforestry products are poorly disseminated among rural populations.

ix. Land and Tree Tenure

A land tenure system is the body of rights and duties which regulates the use and control of land. Unsecured or ambiguous land tenure, common in developing countries, results in confusion about land delineation and rights. Rights to trees may be separate from rights to land and both land and tree tenure insecurity may discourage people from introducing or continuing agroforestry practices (FAO, 2013). Constraints associated with tenancy are significant in many developing countries where large numbers of farmers cultivate communal land under traditional tenure arrangements that do not allow them to claim ownership or exclusive use rights to the trees on their fields.

x. Lack of Incentives and other production materials

One of the greatest constraints of some agroforestry technologies is the lack of farmers' access to quality seeds. Lack of seed, seedlings, and other planting material are frequently identified as the

most important constraint to greater adoption of agroforestry. Planting stock and the propagation methods for many species of interest is lacking or not readily available. Seed collection, propagation and multiplication methods are poorly known and farmers often have no other option but to protect or transplant trees which have germinated spontaneously or depend on relatively ineffective public and private sectors (FAO, 2013). Most forest departments in developing countries which have the mandate for all tree seed supply have been neglected. This has serious drawbacks for agroforestry species because resident forestry workers are few in the field and are not highly aware of needs of farmers (Place *et al.*, 2004). Incentives and support for the development and adoption of production and conservation applications for agroforestry are not widely available or are perceived to be overly restrictive. According to Place *et al.* (2004) government agencies most often do not provide incentive to farmers and the result is that without government involvement in providing greater incentives, the level of private investment in agroforestry will be less than socially optimal. Therefore, incentive systems for farmers to produce at societal level benefits need to be established and clarified to farmers (Karl, 2009).

xi. Inadequate extension services

Powell (2009) stated that the lack of full time, dedicated extension staff for agroforestry and other emerging industries was viewed by many as strong challenge to implementing new practices. Agroforestry extension has been problematic in Africa because of the lack of rigorously validated and locally adapted extension messages, the general weakness and limited resources of public extension systems, lack of agroforestry training for extension workers, and the unclear assignment of responsibility for agroforestry among agricultural and forestry extension institutions. Even where extension agents are trained, they often are understaffed and cannot easily meet the time commitments required to fully train farmers on new farming methods like agroforestry.

The transmission of new management practices to frontline extension workers has long been acknowledged as a difficulty, especially in Africa. One of the studies from several countries in Africa have shown that sustainable land management practices such as agroforestry are not sufficiently known by extension agents and much less likely to be disseminated to farmers (Banful, Nkonya and Oboh, 2010). Moreover, some agroforestry practices are knowledge intensive and thus do not diffuse as quickly as other technologies.

xii. Subsidies or support for other land use practices

According to Kabunga *et al.* (2013) fertilizer tree technology was considered impractical or less economically rational to use in Nigeria because nitrogen fertilizers were a cheaper option. There is little argument that fertilizers are needed in agriculture, but by subsidizing them without commensurate support for other soil fertility measures such as agroforestry-based fertilizer trees, governments risk promoting a narrow technological package that is not compatible with long term soil health. Many governments support agriculture in some ways, but agroforestry is not often included as an agricultural enterprise for support (Place *et al.*, 2004). Many governments have now improved market information systems for agricultural commodities but again, tree products are usually neglected.

xiii. Socio- Cultural Factors

The preferences of male and female farmers concerning tree crops often differ, reflecting their respective interests and roles in the farming system. A key lesson from experience is that most small farmers do not wish to grow trees exclusively for wood, but prefer species that serve a variety of other purposes as well, such as providing food, fodder, extracts, shade, or fertilizer or serving as a hedge (Powell, 2009). Traditionally, the pastoralists' life of moving with their herds and focusing on the immediate needs of forage and survival discourages them from planting, protecting, and managing trees and forests or the associated biodiversity thereof. Decision making concerning tree species and techniques to be promoted should take into account farmers' preferences and customary beliefs and practices that might discourage farmers from growing trees or certain tree species.

xiv. Lack of Coordination between Sectors

In many countries, agroforestry is regarded as belonging to all sectors' such as agriculture, forestry, livestock, rural development, environment, energy, health, water and commerce in principle, but in practice, it belongs to none and rarely occupies a special line in a governmental body or has its own policy space (FAO, 2013). It falls between the agriculture, forestry and environment departments, with no institution taking a lead role in the advancement of agroforestry or its integration. Agriculture departments emphasize crop production on agricultural lands; thus agricultural policies directly contribute to excluding trees from farms and the landscape. Some forestry departments do not believe it is possible to grow good quality, widely-

spaced timber on farms and have little interest in non-timber trees or the growing of trees with crops and/or livestock on the same plot of land (FAO, 2013).

xv. Lack of Involvement of Farmers during the Programme Development

Researchers often fail to remember that each farm is site-specific and each farmer is unique. Forgetting this was the first mistake of the agroforestry developers (researchers), as they packaged this system, and promoted it to farmers with a diverse range of circumstances. The result being that many beneficial systems which agroforestry developed were inflexible and unusable by numerous farmers (Powell, 2009). Other researches have shown that in order to ease the process of adoption of innovation, it is pertinent to seek the views of small-scale local agroforestry practitioners in the planning of agroforestry programme.

xvi. Low production due to competition between trees and crops

When there is an interaction between organisms sharing the same pool of resources, there will either be positive interaction (complementarity) or negative interactions (competition) (Kabunga., 2012). Too much shade, competition for nutrients and root space as well as allelopathic interactions may weaken crop yields. Many farmers do not know much about agroforestry to ensure that these negative interactions do not occur and are not willing to put themselves at risk.

xvii. Land Scarcity

A farmer with a small piece of land is generally less likely to plant woody perennials, as this would be taking up space that could be used for harvesting crops. Some agroforestry practices are only advantageous where land is not scarce such as with improved fallows (Anitta *et al.*, 2013). Farmers who do not possess such assets are physically limited and unable to practice this technique. Changing farm practices is also a higher risk for farmers owning limited land

2.11 Theoretical Framework

The study was based on two theories- theory of perceived attributes and the two-step information flow model.

a. Theory of perceived innovation attributes

The theory of perceived attributes as propounded by Rogers and Shoemaker (1974) is premised on the assumption that the adoption of agroforestry practice is influenced by several characteristics associated with the agroforestry technology. Notably, this theory does not share penchant with the five-step innovation adoption process that sees adoption as a function of the five mental steps an individual undertakes before adopting. In the five steps model, awareness or knowledge of the innovation is what is required to arouse the interest of the farmer to start considering adopting the technology. Simply put, awareness is considered the first and crucial step an individual must experience as the individual undergoes the mental process that leads him into adopting or rejecting the technology. The reason being that through the awareness of a technology interest is aroused, and interest, once stirred sets the stage for the individual to compare the pros and cons of adopting such technology.

The discrepant argument of the five-step adoption process model relative to the perceived attributes theory of Rogers (1995) entails that before the attributes of technologies are taken into consideration the individual must have gotten to the stage of evaluation having pass through the stages of awareness and interest. Corroborating this, Nwachukwu (2003) opined that the potentials of any agricultural technology are considered realizable only if they get to the knowledge of those they are intended for. It does not add up in the view of the five-step model as presupposed by the theory of perceived attributes that individuals could take the decision to adopt innovations without been influenced to adopt or reject at one stage or the other. Influence referred here is usually exerted by the inherent components of communication coming from either the sender; the message; the channel; the receiver; or the response.

Thus, the five-step model considers the two-step flow communication model appropriate in facilitating the spread and adoption of agroforestry practices. The two –step flow facilitates the spread of innovation through the communication activities of stakeholders like opinion leaders, individuals, groups, social organizations, contact farmers, etc. Here, farmers' associations is considered a necessary forum that raises the awareness of farmers about an innovation as well as

bring them in contact with new technologies vis-à-vis their interaction, cross fertilization of ideas, participation in the training activities of the organization, etc.

However, the perceived attributes theory considers its argument superior that individual will participate in agroforestry practices if they perceive them relatively better than existing technologies, compatible to their social context, relatively cheaper, triable within the technical capacity of the individual, offer observable results (Mgbada, 2010). As against the submission of the five-step, this theory argues that a farmer's interest to adopt may not be aroused by the farmer's mere awareness of the innovation, rather, the mind-blowing relative advantage or affordability of an innovation may stir the farmer to give the innovation a try. The implication of this theory entails that rather than concentrating efforts in creating awareness about agroforestry practices, greater emphasis should be on what the practices serve to accomplish in the light of existing needs of the farmer. Asiabaka (2002) shared this view of Rogers when he opined that what is necessary is not whether the farmer followed the five-step, but that the farmer is convinced to adopt.

Focus on technology attributes will likely promote the generation of location specific technologies, audience target technologies and thus improve the weaknesses of the five-step model. The former believes that once a farmer becomes aware of an innovation, he is likely to adopt the innovation at the end of the day. This assumption has not always worked as thought. Nwachukwu and Chikwe (2013) regrets that many scientists who premised innovation generation on this assumption often fail to develop a people-oriented technology thereby exacerbating technology rejection/discontinuance. Also, while the five-step considers the level of awareness or information spread of innovation most important in getting the farmer to adopt or continuously adopt, the perceived attribute theory does not solely see adoption of agroforestry as a matter of innovation diffusion. It rather assumes that the attributes of an innovation are capable of marketing the innovation. The case of farmers who go far ahead of extension by travelling to Israel, Brazil, Thailand and other foreign lands to procure seeds, improved animal species, knowledge of new practices, etc., is just an instance buttressing the ability of technology attributes to endear itself to people. It could therefore be deduced from the foregoing that the attributes of agroforestry practices are what should be considered first before any other thing. When the attributes, especially, the relative advantages over others are attractive to the farmer adoption and sustained use of the innovation would be easy. This theory is quite suitable since it seeks to understand that rural women farmers tends participate in agroforestry practices if they perceive the system relatively better than existing technologies, compatible to their social context, relatively cheaper, triable within the technical capacity of the individual, offer observable results.

b The two-step information flow model

This model of information dissemination emphasizes the use of representative leadership (wedges) as a significant factor in information dissemination. It was pioneered by Lazarsfeld, Berelson and later Elihu Katz in 1950s. It is based on the assumption that for the dissemination of agroforestry practices to be more effective, especially among rural women, messages should not flow directly from the source to the receivers. It argues that wedges should be introduced in the form of representative leaders (knowledgeable and respected by the people) who would interpret messages to the final audience. This model finds a place of relevance in the present study as it essentially justifies the need to use contact farmers in disseminating agroforestry practices. Nwachukwu (2003) noted that besides the want of coverage, contact farmers are also used as mediators, especially during the period of legitimizing extension programme. Thus, they are used to communicate to the rural people in a way and manner that earn their trust and confidence. Also, extension agents usually carry out Small Plot Adoption Technique (SPAT) on the farmland of contact farmers, this enables the rural farmers see what extension is bringing as safe and useful technologies that are replicable in their own context (Agabmu, 2011). Notably, critiques of this model consider it difficult and tasking in selecting trusted and respected people to serve as contact farmers. Agabmu (2011) lightened this argument by considering the position of the critiques as lame and flawed. Explaining this, he posited that the problem with the use of contact farmers bothers more on their technical inabilities to carry out extension tasks like method and result demonstrations, rather than their availability. He maintained that State ADPs have enough contact farmers to work with, but do not have enough technically competent contact farmers to perform complementary extension tasks.

The relevance of this model is that it reinforces the assumption that dissemination of agroforestry practices is more effective when they are delivered through the involvement of contact farmers who in turn step down the technologies to other farmers. The effectiveness of this method is based on the assumption that farmers see agroforestry practices they observe in their neighbour's farm as authentic and replicable in their own context. This theory directly agrees to this study as it

affects the flow of agroforestry information towards improvement of productivity among rural women farmers in the state.

2.12 Conceptual Framework

The conceptual framework explains schematically the relationship between the variables dependent and independent in the study; Effects of agroforestry on household food security as perceived by rural women farmers in Imo state Nigeria

The independent variable (A) are Agroforestry practices in the study area which include alley cropping, home garden, shelterbelts, aqua forestry, apiculture, multistorey garden.. The dependent variable (C) was household food security.

The intervening variables (B) were government policies and sociocultural factors. However rural women farmers could be hindered from practicing or from benefiting from these agroforestry practices by a number of factors which include low level of awareness of agroforestry practice, lack of planting materials, inadequate knowledge of agroforestry practice, land tenure system, and high cost of farm inputs as shown in block (D).

The conceptual framework is predicted on the premise that the agroforestry practices, independent variables (A) influences rural women household food security (C). The influence may be facilitated by the intervening variables (B)- government policies and sociocultural factors or otherwise depending on the disposition. Where government policies and sociocultural factors are favorable and disposing, rural women will be motivated to practice agroforestry practices (A) includes include alley cropping, home garden, shelterbelts, aqua forestry, apiculture, multistorey garden etc.

Also, constraints (D), low level awareness of agroforestry practice, lack of planting materials, land tenure system, inadequate knowledge of agroforestry, high cost of farm input, lack of access to land, high cost of farm input etc, could hinder or limit the functionality of the socioeconomic factors and reduce the perceived benefits of participation in agroforestry. On the other hand, when the socioeconomic factors impinge on the perceived household food security and the government policies and sociocultural factors are predisposing and the constraints well managed would result to (Ci). The resultant features will include Increase household food security, increased income, improved soil fertility, conservation of soil moisture to soil for plant growth, increased raw materials for industries etc

When these measures are properly implemented, the practice of agroforestry will be enhanced, resulting to overall improvement in agroforestry and agricultural production in the state and Nigeria at large leading to (C).

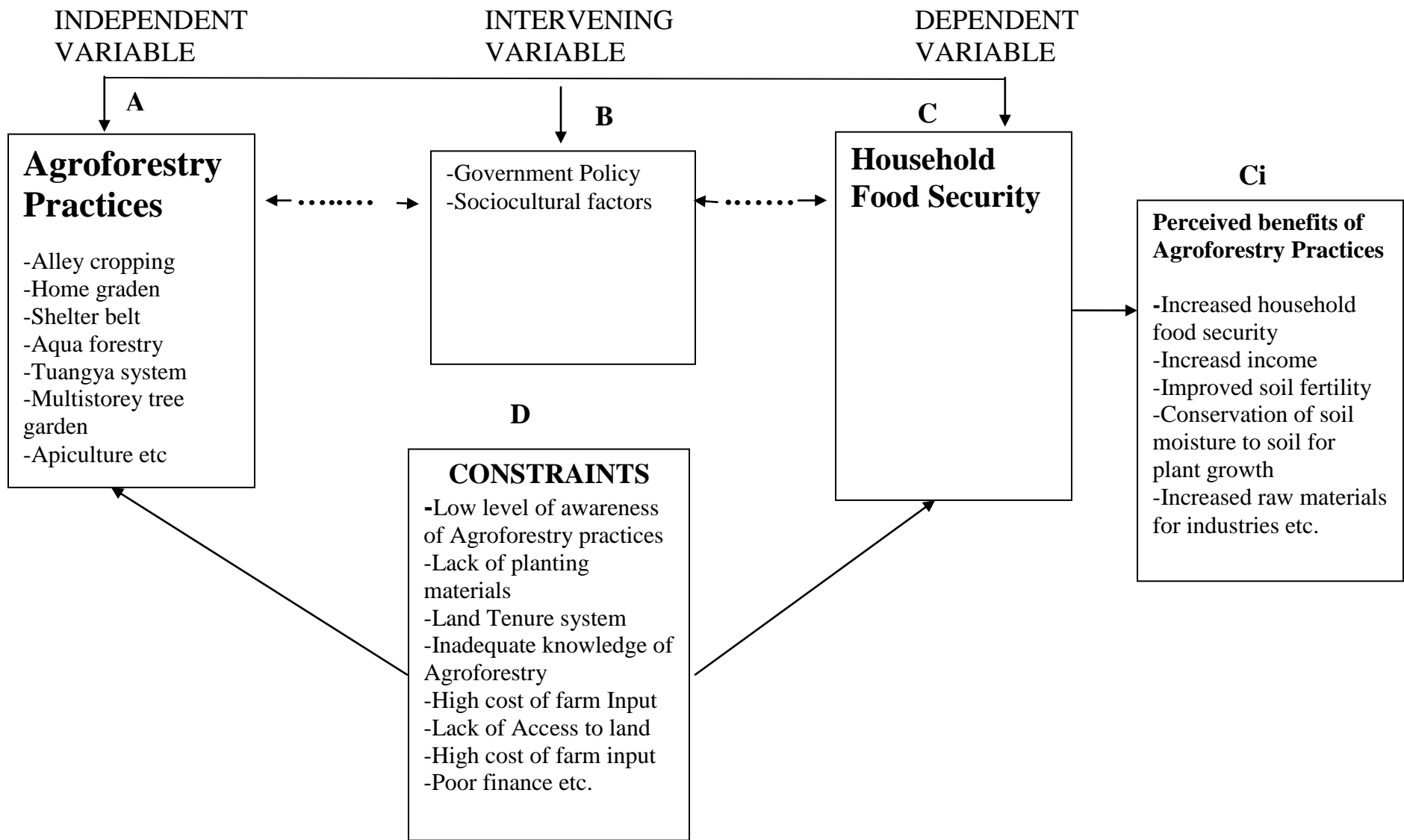


Fig 1: A schematic illustration of the effect of Agroforestry on household food security as perceived by rural woman farmers in Imo State, Nigeria

CHAPTER THREE

METHODOLOGY

3.1 Study area

The study was conducted in Imo State, Nigeria. Imo state was created on February 3, 1976. It is located in the South East zone of Nigeria and it lies between latitude $4^{\circ} 45'N$ and $7^{\circ} 15'N$ and longitude $6^{\circ} 50'E$ and $7^{\circ} 25'E$ with land area of $5,530\text{Km}^2$, and an estimated population of about 4.8 million people and an annual growth rate of 3.35 percent (NPC, 2016).

Imo state has a total number of 27 local government areas, with a high population density which exceeds that of the annual average of 166 persons per kilometer square (www.imostate.gov.ng). The population density of the State varies from 230 persons per kilometer square in Egbema area to about 1400 persons per kilometer square in Mbaise, Mbano, Orlu and Mbaitoli area (Federal republic of Nigeria Gazette, 2017). Moreover, a greater percentage of the population lives in the rural area and they are farmers. Imo state lies within the rainforest zone Nigeria and has a large forest vegetation containing woods and tree crops (both for timber and the like) such as mahogany, iroko, obeche, palm trees, oil bean trees, Gmelina trees, bamboo, rubber tree, fruit trees such as mango, orange, avocado pear etc. and other tree crops that complement farmers income source. Imo state belong to Benin formation of the coastal plain sand which is of tertiary age, deep, porous, fertile and highly leached. Drained by Imo River, Otamiri river, Nworie river, Njaba and Urashi rivers, the annual rainfall of imo state varies from 1,500mm-2,200mm (60-80 inches) with about 20°c (68.0°c) annual temperature and 75 percent annual relative humidity (the humidity reaching 90% in rainy season) (www.imostate.gov.ng).

The major economic activity of the people includes the following: farming, trading, agro processing and other non-agricultural practices. The major crops grown by the people are banana, yam, cocoyam, maize, rice, leafy vegetables, melon, palm oil, etc. The state is also endowed with mineral resources like crude oil, natural gas, lead, zinc, aluminum (www.imostate.gov.ng).

Imo state is divided into three agricultural zones of Owerri, Orlu, and Okigwe. Women constitute the majority of the farmers in the state; this could be as a result of the increasing male out-

migration common in many rural areas (Orisakwe and Agomuo, 2011). They are also largely involved in the population of such animals as local chicken, goats and sheep. (Ani, 2004)

3.2 Sample and Sampling techniques

Multistage sampling technique was used to select respondents of the study. The first stage involved random selection of three Local Government Areas (LGAs) from each of the three agricultural zones in the state to give 9 LGAs namely (Ikeduru, AhiazuMbaise, Mbaitoli, Isu Njaba, Oru East, Oru West, Ehime Mbano, Isiala Mbano, Obowo). In the second stage, three communities were selected randomly from each LGA to give 27 communities (Ugirike, Ihuodimeze, Ngugo, Obohia, Mpam, Oparanadim, Alaenyi Ogwa, Afara, Ifakala, Ekwe, Umundugba, Amandugba, Amagu, Amiri, Ofekata, Eleh, Asoebe, Mgbidi, Umuezeala, Umueze, UmuezeII, Amauzari, Anara, Ibeme, Amuzi Obowo, Achara, Umungwa). Thirdly, one village each was randomly selected to give 27 villages namely (Oba, Amake, Umuahunanya, Afor-Amafor, Umuegwu, Oparanadim-Nwokwo, Ndiuhu, Amakpu, Amafor, Amunike, Umuchoko, Ndiaba, Umuabiaku, Amadaba, Ezeani, Umuezela Ama, Umeleke, Umuiodu, Ekwe, Aguna, Alaude, Ndiuhu, Amagu, Amanze) was used for the study. Finally, ten farmers were randomly selected from each village to give a total sample size of 270 respondents. The sampling frame was a list of communities / villages where agroforestry practice were highly pronounced based on the pilot survey earlier carried out in the study area. The sample frame also includes the list of farmers who were highly involved in agroforestry practice as supplied by key informants namely ADP headquarter Owerri, as well as the Extension officers, Community development officers and Traditional chiefs in the study area. Table 3.1 shows the summary of the sampling procedure.

Table 3.1 Sampling procedure

| Zone | LGA | Communities | Villages | Respondents | Total |
|---------------|------------|--------------------|-----------------|--------------------|--------------|
| Owerri | 3 | 3 | 1 | 10 | 90 |
| Orlu | 3 | 3 | 1 | 10 | 90 |
| Okigwe | 3 | 3 | 1 | 10 | 90 |
| Total | | | | | 270 |

Source: field survey data, 2019

3.3 Method of data collection

Data for the study were obtained mainly from primary sources with supporting information from secondary sources. The primary data were elicited from the farmers using structured questionnaire, complemented with interview schedule. The instrument was designed in such a way as to capture all the objectives of the study.

3.4 Standardization of Research Instrument

In order to minimize errors, the research instruments was pre-tested and the following procedures were adopted to determine reliability and validity of the test item in the data gathering instrument to ensure standardized measuring instrument.

3.4.1 Estimating Validity

Validity was estimated to ensure the research instrument (questionnaire) measured what it was designed to measure. Face validity was employed to determine the extent to which the instrument was perceived adequate covering the concepts it purported to measure by experts or knowledgeable people in the subject area. According to Olowu (2004), face validity is the extent to which the instrument is perceived by experts 'knowledgeable people in the subject area as covering the content and measuring the subject. Content validity in this regard was employed to determine the relevance and suitability and adequacy in scope of the items to be included in the research instrument. Achieving this entailed giving the instrument to expert in the field of Agricultural Extension to ascertain whether the instrument captured all the relevant areas of the concept. The questions were judged for relevance, importance, clarity and adequacy in eliciting the needed information.

3.4.2 Estimating Reliability

Kerlinger (1973) defined reliability as the relative absence of errors of measurement in a measuring instrument or scale. The test-retest method was used. Two copies of the research instrument were administered to 20 women farmers who possess similar characteristics as the respondents of the study but are from a different location outside the study area. After a period of two weeks, the instrument were administered to them again and retrieved. The two sets of responses were correlated using Pearson Product Moment Correlation (PPMC). The correlation coefficients for scales measuring the reasons behind agroforestry, food security status, effects of

agroforestry on food security and constraints militating against agroforestry included $r = 0.79$; 0.81; 0.78; 0.85 expressing high reliability.

3.5 Measurement of variables

Objective one- To describe the socio-economic characteristics of the women farmers the variables measured under this objective included: age, marital status, educational level, household size, income level, membership of social organization, primary occupation.

Age: The farmers indicated their actual ages in figures and chronologically in years.

Marital status: measured as 1= married, 2= single, 3 = widowed, 4 = separated.

Educational attainment: The farmers indicated their level of formal educational attainment as outlined below.

- a) No formal education = 0
- b) Primary school attempted = 1
- c) Primary school completed = 2
- d) Secondary school attempted = 3
- e) Secondary school completed = 4
- f) Tertiary institution attempted = 5
- g) Tertiary institution completed = 6

Household Size: numbers of persons living under the same roof and eaten from the same pot.

Farming experience: number of years they spent in agroforestry practices.

Income level: amount they make per month in naira

Membership of social organization: the farmers indicated whether they were members of social organizations as dummy membership 1, otherwise 0.

Primary occupation: the respondent indicated their primary occupation as follows:

- a) Farming
- b) Civil service
- c) Teaching
- d) Artisan
- e) Food processing
- f) Trading
- g) Menial job

Objective two: identify agroforestry practices which women farmers involved in the study area. The respondent were provided a list of agroforestry practices which they indicated practices prevalent and practiced in their area.

Objective three: identify products which women farmers obtained from their agroforestry farms. The respondents were provided a list of forest products which they indicated products they obtained from their agroforestry farms.

Objective four: determine reasons for practicing agroforestry as perceived by women farmers. The respondents were provided with a list of perceived reasons gained from practicing agroforestry on a four (4) point Likert type scale of Strongly Agree =4, Agree =3, Disagree =2, Strongly Disagree =1

Objective five: determine the food security status of rural women farmers in the study area. This was measured on a four (4) point Likert type rating scale of Strongly Agree =4, Agree =3, Disagree =2, Strongly Disagree =1 in determining the food security status of the respondents

Objective six: ascertain rural women farmers perceived effects of agroforestry on household food security in the area. The respondents indicated their responses on a four (4) point Likert type scale from a list perceived effects of agroforestry on household food security, and their response were measured based on the scale of Strongly Agree =4, Agree =3, Disagree =2, Strongly Disagree =1.

Objective seven: identify constraints to agroforestry practices in the study area as perceived by women farmers. The respondents indicated their agreement on the constraints the face on a (4) point Likert type scale of Strongly Agree =5, Agree =4, Disagree =3, Strongly Disagree =1.

3.6 Method of data analysis

Descriptive and inferential statistical tools were used to analyze data collected for the study. The descriptive statistical tools such as frequency table, percentages and mean were used to analyze the data in objectives one to describe the socioeconomic characteristics.

Objectives two and three were achieved using descriptive statistical tools such as frequency, tables and percentages

Objectives four, were achieved using mean score derived from 4-point Likert-type scale of Strongly agree, Agree, Disagree and Strongly Agree. A discriminating index was obtained by dividing the sum of the value of the rating scales by the number of scales, as follows

$$\frac{S.A+A+D+S.D}{N} = \frac{4+3+2+1}{4} = 2.5$$

2.5 (discriminating index)

Objective five, were achieved using mean score derived from 4-point Likert-type scale of Strongly agree, Agree, Disagree and Strongly Disagree. A discriminating index was obtained by dividing the sum of the value of the rating scales by the number of scales, as follows

$$\frac{S.A+A+D+S.D}{N} = \frac{4+3+2+1}{4} = 2.5$$

Where all items with $\bar{X} \leq 2.5$ were considered as not food secured while item $\bar{X} \geq 2.5$ were considered to be food secured.

2.5 (discriminating index)

Objectives six, were achieved using mean score derived from 4-point Likert-type scale of Strongly agree, Agree, Disagree and Strongly Disagree. A discriminating index was obtained by dividing the sum of the value of the rating scales by the number of scales, as follows

$$\frac{S.A+A+D+S.D}{N} = \frac{4+3+2+1}{4} = 2.5$$

Where all items with $\bar{X} \leq 2.5$ were considered as having —no effect to food security status of rural women household while item $\bar{X} \geq 2.5$ were considered to have effect.

2.5 (discriminating index)

Objective seven, were achieved using mean score derived from 4-point Likert-type scale of Strongly agree, Agree, Disagree and Strongly Agree.

A discriminating index was obtained by dividing the sum of the value of the rating scales by the number of scales, as follows

$$\frac{S.A+A+D+S.D}{N} = \frac{4+3+2+1}{4} = 2.5$$

Where all items with $\bar{X} \leq 2.5$ were not constraints while items with $\bar{X} \geq 2.5$ were considered as constraints.

2.5 (discriminating index)

3.7 Hypotheses

Hypothesis I and II were tested using Ordinary Least Square (OLS) and Hypothesis III were tested using Analysis of Variance (ANOVA).

Hypothesis one: The test of significant relationship between socioeconomic characteristics of women farmers and agroforestry practices in the study area were established using OLS. The implicit function is expressed. Thus:

$$Y = f (X_1, X_2, X_3 \dots X_9, e)$$

Where

1. Y = Number of agroforestry practices undertaken by the women farmers.
2. X_1 = age (years)
3. X_2 = marital status (dummy variables married 1, otherwise 0)
4. X_3 = formal educational attainment
5. X_4 = household size (number of persons who eat from the same pot)
6. X_5 = income level per month (Naira)
7. X_6 = social organization membership (dummy variable member 1, otherwise 0)
8. X_7 = farm size (hectare)
9. X_8 = farming experience (years)
10. X_9 = primary occupation (dummy variable farming 1 otherwise 0)
11. e = error term

Hypothesis two

The significant relationship between socioeconomic characteristics of women farmers and perceived effect of agroforestry on food security in the study area were established using Ordinary Least Square (OLS) multiple regression.

$$Y = f (X_1, X_2, X_3 \dots X_9, e)$$

Where

1. Y = Weighted mean of the perceived effects of agroforestry on household food
2. security of rural women
3. X_1 = age (years)

4. X_2 = marital status (dummy variables married 1, otherwise 0)
5. X_3 = formal educational level (levels of formal education)
6. X_4 = household size (number of persons who eat from the same pot)
7. X_5 = income level per month (Naira)
8. X_6 = social organization membership (dummy variable member 1, otherwise 0)
9. X_7 = farm size (hectare)
10. X_8 = farming experience (years)
11. X_9 = primary occupation (dummy variable farming 1 otherwise 0)
12. = error term.

Hypothesis three: The significant difference in the food security status of rural women in the three agricultural zones of Imo state was analyzed using ANOVA, that is, Analysis of variance, expressed as follows:

$$1. F = \frac{MSSB}{MSSW} = \frac{SSB(n-K)}{SSW(K-1)}$$

$$2. SSB = \sum n_j [\bar{X} - \bar{X}]^2$$

$$3. SSW = \sum_{i=1}^{N_j} \sum_{j=1}^K (X_{ij} - \bar{X}_j)^2$$

Source: Pedhazur (1999)

Where;

1. F = the value from which the statistical mean was judged.
2. SSB = Sum of squared deviations between the mean perception of the women's level of involvement in agroforestry practice and their livelihood in the three agricultural zone.
3. SSW = Sum of squared deviations within the mean perception of women's level of involvement in agroforestry practices and the benefit in their livelihood in the three agricultural zone.
4. \bar{X} = grand mean of the women's involvement in agroforestry in the three agricultural zones
 X_{ij} = nth level of women farmer's involvement in agroforestry from agricultural zone j.
5. n_j = sample size of the respondent from Agricultural zone j
6. n = number of observations from the three agricultural zone k = number of agricultural zones in the state.

CHAPTER FOUR

RESULTS AND DISCUSSION

The results of the study were presented and discussed in this chapter. Based on the following;

- Socio-economic characteristics of the respondents
- Agroforestry Practice engaged in by rural women farmers
- Products obtained from agroforestry practices
- Reasons for practicing agroforestry
- Food security status of rural women farmers
- Perceived effects of agroforestry on household food security
- Constraints of agroforestry
- Hypotheses

4.1 Socioeconomic characteristics of rural women farmers

The socioeconomic variables examined in this study included: age, marital status, years of experience, household size, educational level, farm size, membership of social organization and monthly income

4.1.1 Age of Rural Women

Table 4.1 Distribution of Women according to Age

| Age (yrs) | Frequency | Percentage | Mean |
|--------------|------------|------------|------|
| 21-30 | 13 | 4.8 | |
| 31-40 | 22 | 8.1 | |
| 41-50 | 100 | 37.0 | 51 |
| 51 and above | 135 | 50.0 | |
| Total | 270 | 100 | |

Source: field survey data, 2019

The result shows that majority (50.0 percent) of the rural women were aged 51 years and above with a mean of age 51 years. This implies that the rural women engaged in agroforestry in the area were still in their active and productive age, and as such are expected to show greater zeal and enthusiasm in agroforestry practices in agreement with Onwumere (2008). These features could be valuable and predisposing to agroforestry. More so, the women may have gained so many years of experience which could also be inspirational to agroforestry, thus they may have known what they want and thus go out for it since they are still at their prime or active age.

4.1.2 Marital Status

Table 4.2 Distribution of Women according to Marital Status

| Variable | Frequency | Percentage |
|--------------|------------|------------|
| Single | 15 | 5.6 |
| Married | 208 | 77.0 |
| Separated | 8 | 3.0 |
| Widowed | 39 | 14.4 |
| Total | 270 | 100 |

Source: field survey data, 2019

Majority (77 percent) of the rural women farmers indicated that they were married, 5.6 percent were single, 3.0 percent were separated while 14.4 percent were widowed. This implies that most rural women farmers in Imo state were married, which goes to suggest in line with Ani (2004)

that agricultural production especially at rural areas is dominated by married women. Thus, Marriage could positively influence the rural women ‘s participation in agroforestry as security of couples and progenies requires increased financial inflow to alleviate hardship and ensure meeting up with social and economic needs, with the sole aim of promoting their productivity, meeting up with social and economic needs and bettering their living standard.

4.1.3 Level of education

Table 4.3 Distribution of Women according to level of education

| Level of education | Frequency | Percentage |
|----------------------------|------------------|-------------------|
| No formal education | 18 | 6.6 |
| Primary school attempted | 33 | 12.5 |
| Primary school completed | 42 | 15.5 |
| Secondary school attempted | 24 | 8.8 |
| Secondary school completed | 93 | 34.4 |
| Tertiary school attempted | 27 | 10.0 |
| Tertiary school completed | 33 | 12.2 |
| Total | 270 | 100 |

Source: field survey data, 2019

The result shows that 34.4% percent of the rural women farmers in Imo state completed their secondary education been the highest educational attainment, 15.5 percent had primary education. Also 6.6 percent heard no formal education, 10.0 percent had access to adult education, while 12.2 percent had tertiary education. The result implied that 93.4 percent of the rural women farmers had one level of formal education or the other. Education is a priceless asset. It sharpens reasoning and improve the farmers wisdom in the use of farm resources. This portrays the rural women as literate farmers which is expected to stimulate their involvement in agroforestry practices in conformity with the assertion of Ani (2007) that literacy promotes farmers ‘involvement and productivity in agriculture.

4.1.4 Household size

Table 4.4 Distribution of Women according to Household Size

| Farm Size (ha) | Frequency | Percentage | Mean |
|----------------|------------|------------|----------|
| 1-4 | 67 | 24.8 | |
| 5-8 | 168 | 62.2 | 6 |
| 9-12 | 31 | 11.5 | |
| 13- above | 4 | 1.5 | |
| Total | 270 | 100 | |

Source: field survey data, 2019

The result indicates that majority (62.2 percent) of the rural women farmers had household size of 5-8 persons with a mean household of 6 persons, and this revealed that the rural women farmers maintained a relatively moderate household. This is in consonance with the household population policy of Nigeria, 4 children to household of man and woman. The moderate Household size could be reflective of the economic reality of the present, where couples try to bear the number of children, they could carter for with less stress. Household members could serve as potential source of labour for agricultural and agroforestry operations. This suggests that the women maintain moderate household size in corroboration of Owese *et al.* (2009) that unlike crop farmers most agroforestry farmers have small household size.

4.1.5 Farming Experience

Table 4.5 Distribution of Women according to Farming Experience

| Farming experience | Frequency | Percentage | Mean |
|--------------------|------------|------------|------|
| 1-10 | 54 | 20.0 | |
| 11-12 | 88 | 32.6 | |
| 22-23 | 66 | 24.5 | 23 |
| 33-43 | 40 | 14.8 | |
| 44- above | 22 | 8.1 | |
| Total | 270 | 100 | |

Source: field survey data, 2019

The result shows that majority; (32.6 percent) of the rural women farmers had farming experience of 11-21 years in the practice agroforestry with a mean average experience of 23 years. This was enormous and priceless for farm decision making. By this, it is therefore pertinent to state that rural women farmers had garnered extensive knowledge and skills needed to excel in agroforestry practices according to Ariwaodo and Duru (2009). Participation on agroforestry based on years of experience could open windows of opportunities and expose them to innovations that would improve their productivity.

4.1.6 Monthly Income

Table 4.6 Distribution of Women according to their Income Level

| Income (Naira) | Frequency | Percentage | Mean |
|-----------------------|------------------|-------------------|-----------------|
| Less than 10,000 | 12 | 4.4 | |
| 11000 to 20000 | 32 | 11.9 | |
| 21000 to 30000 | 53 | 19.6 | ₦ 32,426 |
| 31000 to 40000 | 49 | 18.1 | |
| 41000 and above | 124 | 45.9 | |
| Total | 270 | 100 | |

Source: field survey data, 2019

The result reveals that the monthly income of 45.9 percent of the women representing majority was ₦41,000 and above with a mean monthly income of ₦32,426. By this result, the women are earning above the national minimum wage of ₦30,000 and thus confirmed the finding of Ojo *et al.* (2009) that farmers engaged in agroforestry are gainfully employed as they earn like their counterparts in civil service. The income could favor their capacity to gainfully involve in agroforestry practices which will likely help them to improve their productivity.

4.1.7 Rural women’s Membership of Social Organization

Table 4.7 Distribution of Women according to Age

| Membership of Social Organization | Frequency | Percentage |
|-----------------------------------|------------|------------|
| Yes | 99 | 36.7 |
| No | 171 | 63.3 |
| Total | 270 | 100 |

Source: field survey data, 2019

The result shows that majority (63.3 percent) of the rural women farmers in Imo state were not members of any social organization, while 36.7 percent were members of social organization. The membership of social organization by the women is imperative for progress in agricultural production. This is in corroboration of Mbaya (2009) that many farmers are not improving productivity in agroforestry due to their disconnect with forums and platforms such as farms co-operatives, market association, commodity associations for information sharing. This result underlines the importance of encouraging rural women farmers to enlist with rural social organization to explore and exploit the opportunities therein.

4.1.8 Farm Size

Table 4.8 Distribution of Women according to their Farm Size

| Variable | Frequency | Percentage | Mean |
|--------------|------------|------------|------------|
| 0-1 | 131 | 48.5 | |
| 2-3 | 104 | 38.5 | 1.8 |
| 4-5 | 32 | 11.9 | |
| 6-above | 3 | 1.1 | |
| Total | 270 | 100 | |

Source: field survey data, 2019

The result on farm size reveals that majority (48.5 percent) of the rural women farmers had 0-1 hectare of farm land committed to agroforestry, while on the average farm size of women stands at 1.8 hectares. This result portrays the rural women farmers as small-scale farmers who operate at subsistence level as earlier noted by Kareem *et al.* (2009) that agroforestry is yet to receive the

attention of large-scale farmers with large farm lands, and as a result has remained the enterprise largely undertaken by small holder farmers.

4.1.9 Primary Occupation

Table 4.9 Distribution of Women according to Primary Occupation

| Primary occupation | Frequency | Percentage |
|---------------------------|------------------|-------------------|
| Farming | 93 | 34.4 |
| Civil service | 39 | 14.4 |
| Teaching | 20 | 7.4 |
| Artisan | 29 | 10.7 |
| Food processing | 19 | 7.2 |
| Trading | 63 | 23.3 |
| Menial job | 7 | 2.6 |
| Total | 270 | 100 |

Source: field survey data, 2019

The result validated the women as occupational farmers with majority (34.4 percent) of them were found to be occupational farmers, and 23.3 percent of the rural women farmers were traders. Also were 14.4 percent of the rural women farmers for civil service while 10.7 percent, 7.4 percent, 7.2 percent and 2.6 percent of the rural women farmers were artisans, teaching, food processing and menial jobs respectively.

However, the result implies majority of the rural women engaged in agricultural activities more than they did in other occupations. This result is at variance with the pessimism expressed in Nwachukwu (2008) that farmers are increasingly making agriculture their minor occupation as they massively abandon farming for other job sector.

4.2 Agroforestry practices engaged in by rural women farmers

Table 4.10: Distribution of rural women farmers by Agroforestry practices

| Agroforestry practices | *Frequency | Percentage |
|--|------------|------------|
| Cultivation of annual crop among young trees (taungya system) | 145 | 53.7 |
| Growing of trees, shrubs and herbaceous plant around the compound (Home gardens) | 178 | 65.9 |
| Intercropping of food crops and woody species in the same land (Alley cropping) | 144 | 53.3 |
| Planting trees of aesthetic value to demarcate boundaries, control water and erosion, supply of food, fodder and woods | 197 | 73.0 |
| Leaving few fruits bearing trees on the farm when clearing the land (Multipurpose trees on crop land) | 215 | 79.6 |
| Growing trees and vegetable on same land (silvio culture) | 111 | 41.1 |
| Growing trees and keeping pastures/animals on same land (silvio pasture) | 113 | 41.9 |
| Trees in plantation and arable crops (plantation crop combination) | 165 | 61.1 |
| Leaving crops or shrubs in natural fallows in order to improve soil fertility (improve crop fallow) | 198 | 73.3 |
| Using tree/shrubs as fence (live fencing) | 98 | 36.3 |

Source: Field survey data, 2019

*Multiple responses recorded

Result in Table 4.2 shows the distribution of rural women farmers by their Agroforestry practices. It thus indicates that majority (79.6 percent) of the women were particularly involved in the practice of leaving few fruits bearing trees on the farm when clearing the land, that is multipurpose trees on crop land. This was followed by 73.3 percent who practiced the technique of leaving crops or shrubs in natural fallows in order to improve soil fertility (improve crop fallow). Those who adopt the practice of planting trees of aesthetic value to demarcate boundaries, control water and erosion, supply of food, fodder and woods were 73.0 percent while 65.9 percent were into growing of trees, shrubs and herbaceous plant around the compound (Home gardens). Planting trees in plantation and arable crops (plantation crop combination) was practiced by 61.1 percent followed by 53.7 percent who cultivation annual crop among young

trees (taungya system). Others were growing trees and keeping pastures/animals on same land (silvio pasture) 41.9 percent, growing trees and vegetable on same land (silvio culture) 41.1 percent while 36.3 percent were involved in using tree/shrubs as fence (live fencing).

This result aligns with the earlier findings of several studies. For instance, the findings of Gowland-Mwangi and Maina (2013) who found the practice of leaving few fruits bearing trees on the farm when clearing the land common among farmers involved in agroforestry. They explained that the practice is intended to serve the dual purpose of providing sources of income for the farmer as well as providing minimum cover for nursery seedlings and mitigation of evapo-transpiration. Typically, small scale farmers engage in this practice in order to have something to fall back on to in raising funds. For instance, farmers use proceeds from tree crops to procure input materials for their farm as well as pay for farm labour.

On the practice of leaving crops or shrubs in natural fallows in order to improve soil fertility, Ukpe *et al.* (2009) noted that the practice is still common among small scale farmers who leverage on bush fallowing as cheaper alternative to use in place for fertilizers. Small scale farmers are resource-poor farmers who prefer cheaper technologies and practices than expensive practices.

Owese *et al.* (2009) while commenting on the efficacy of planting trees of aesthetic value noted that farmers have through such means succeeded in controlling and preventing erosion, supplying medicine, food, fodder and woods for the markets. They stressed that in addition to serving their primary purpose, several aesthetic trees are rich sources of herbal materials which has become a booming market. Furthermore, Ukpe *et al.*, (2009) added that the reason behind of growing of trees, shrubs and herbaceous plant as well as planting trees in plantation and arable crops is inspired by the revenue potentials of such activities. By earning money through the aforementioned, the farmers are able to meet their other basic needs like payment of healthcare services, clothing, education, social amenities, housing, food, etc.

4.3 Products obtained from agroforestry practices

Table 4.11: Distribution of rural women farmers by Agroforestry products

| Agroforestry products | *Frequency | Percentage |
|-----------------------|------------|------------|
| Grains | 215 | 79.6 |
| Fruits | 218 | 80.7 |
| Fuelwood | 264 | 97.8 |
| Timber | 117 | 43.3 |
| Building poles | 95 | 35.2 |
| Charcoal | 111 | 41.1 |
| Fodder for animal | 133 | 41.9 |
| Meat | 165 | 61.1 |
| Honey | 98 | 36.3 |
| Animal hides/skin | 38 | 14.1 |
| Mushroom | 45 | 16.7 |
| Medicine/herbs | 67 | 24.8 |
| Vegetable | 239 | 88.5 |

Source: Field survey data, 2019

*Multiple responses recorded

From the result above, it could be seen that fuelwood was the major product (97.8 percent) obtained from the practice of agroforestry by the rural women. This was followed by vegetable 88.5 percent. Fruits 80.0 percent were the third most common agroforestry product obtained by the rural women. Others included grains 79.6 percent, meat 61.1 percent, timber 43.3 percent, animal fodder 41.9 percent, charcoal 41.1 percent, and honey 36.3 percent, building poles 35.2 percent, medicine/herbs 24.8 percent, mushroom 16.7 percent and animal hides/skin 14.1 percent.

This result is consistent with the findings of Ukpe *et al.*, (2009) which identified timber, animal fodder, charcoal, honey, building poles, medicine/hers, mushroom among the products generated from agroforestry practices. According to them, it is through proceeds from these products that enable the farmer raise money to meet other needs. Particularly, products like timber, honey and animal hides and skin are worth huge money in the international and cross border markets.

Nwachukwu and Ekwe (2011) in their writings on globalization and rural development considered the aforementioned agroforestry products as pan African exchange products. They explained that through pan African agreements between Nigeria and other African countries it has become cost-effective to move forest products such as timber and animal hides/skin across border into neighbouring African countries where they fetch high market value. This development has encouraged trans-African forest product enterprises, such as mentioned above.

The implication of this result is that rural women are likely to show interest in agroforestry products with higher market value such as listed earlier. Meanwhile, it is also important to note that indiscriminate deforestation and other practices that deplete the environment often become inevitable during forest exploitation. Hence, regulatory agencies of the government and environmental advocates should be involved in enforcing forest conservation laws amongst those who engage in forest exploitation activities.

4.4: Reasons why rural women farmers practice agroforestry

Table 4.12: Distribution of rural women farmers based on reasons why rural women engage in agroforestry practices.

Sample size n = 270

| Reasons | Strongly agree | Agree | Disagree | Strongly disagree | Mean | SD |
|---|----------------|-------|----------|-------------------|------|-----|
| Provision of food | 127 | 51 | 12 | 80 | 2.8* | 0.3 |
| Act as source of income | 146 | 96 | 17 | 11 | 3.4* | 0.4 |
| Source of raw materials | 119 | 116 | 24 | 11 | 3.3* | 0.4 |
| Provision of shelter/shade for man and Livestock | 113 | 105 | 37 | 15 | 3.2* | 0.5 |
| Helps improve soil quality | 94 | 120 | 32 | 24 | 3.1* | 0.5 |
| Source of home nutrition | 74 | 132 | 34 | 30 | 2.9* | 0.5 |
| Acts as wind breaker | 119 | 103 | 26 | 22 | 3.2* | 0.3 |
| Source of fertilizer for agricultural Operation | 101 | 107 | 44 | 18 | 3.1* | 0.3 |
| It enhances sustained economic growth | 73 | 120 | 67 | 10 | 3.0* | 0.4 |
| It is significant to human health | 74 | 141 | 31 | 24 | 3.0* | 0.4 |
| Rural to urban migration is reduced | 65 | 111 | 58 | 24 | 2.7* | 0.4 |
| Everybody has enough to eat | 42 | 33 | 80 | 115 | 2.0 | 0.5 |
| Enough food is locally produced | 62 | 54 | 23 | 131 | 2.2 | 0.3 |
| There is control over what people eat and people are no more at mercy of Others | 56 | 31 | 53 | 130 | 2.0 | 0.3 |

Source: Field survey data, 2019

Table 4.4 above shows the distribution of rural women farmers based on reasons why farmers practice agroforestry using mean discriminating index of 2.5, the result indicated that farmers were inspired to practice agroforestry for the following reasons: agroforestry serves as a source of income ($\bar{X}=3.4$), source of raw material ($\bar{X}=3.4$), shelter for man and livestock ($\bar{X}=3.2$), wind break ($\bar{X}=3.2$), improves soil quality ($\bar{X}=3.1$), sustenance of economic growth ($\bar{X}=3.0$), significant to human health ($\bar{X}=3.0$) and reduction in rural to urban migration ($\bar{X}=2.7$). The standard deviation value of the respondents ranged from 0.3 - 0.5 expressing them as having

homogenous reason for engaging in agroforestry practices. This result reinforces the widely documented importance of agroforestry products particularly in production of finished goods in terms of raw materials, Ariwaodo and Duru (2009) in their work on the conservation and resource utilization of agroforestry products, forestry products are used in seasoning, flavouring of food, production of beverages, medicine, carminatives, stimulants, perfumery, soap, toothpaste, incense, dyes. He further added that if not for limited information on the chemical composition of some agroforestry products which calls for the promotion of better preparation, packaging, storage, and marketing of there would have been greater exploitation of agroforestry resourced.

Ojo *et al.* (2009) further reported that agroforestry forest ensures that hundreds of millions of people in the developing world not go to bed hungry. In fact, he maintained that food security is very much dependent on environmentally responsible and sustainable use of the world 's forest. The edible fruits, seeds and nuts, leaves, tubers and roots, fungi, gum and sap add diversity, flavouring and essential nutrition to diets.

The implication of this result is that agroforestry practices in the study area have the potentials to provide food, income, shelter, improve soil fertility, home nutrition, wind breaker, fertilizer for agricultural operations, sustained economic growth for rural women farmers. The role of women in household farming and marketing is usually at the basic level (primary production) and strongly related to the aforementioned (Ani, 2004).

4.5 Food security status of agroforestry rural women households

Table 4.13: Distribution of rural women farmers by food security status of rural households.

Sample size n = 270

| Indicators | Mean | SD | Decision |
|--|------|-----|-----------|
| Not worried that household food will run out | 2.7* | 0.8 | Agree |
| Food bought always last | 2.6* | 0.9 | Agree |
| Readily afford to eat a balanced food | 2.7* | 0.8 | Agree |
| Adult do not cut meal | 3.0* | 0.7 | Agree |
| Adult never skipped meal | 2.6* | 1.5 | Agree |
| Source of home nutrition | 2.5* | 1.1 | Agree |
| You ate enough always | 2.3 | 1.1 | Dis Agree |
| You were hungry, but had enough to eat | 2.8* | 0.4 | Agree |
| You gained weight because family food was enough | 2.4 | 1.2 | Dis Agree |
| Adult never starved for a whole day | 2.3 | 1.3 | Dis Agree |
| Adult starved for a whole day for or more times in a month | 2.3 | 1.2 | Dis Agree |
| Different kinds of high-cost food were available for children | 2.5* | 1.2 | Agree |
| Fed children balanced meal always | 2.5* | 1.4 | Agree |
| Children ate enough food | 2.5* | 1.3 | Agree |
| Never cut size of children's meal | 2.6* | 1.4 | Agree |
| Children never skipped meal up to three times or more in one month | 2.5* | 0.3 | Agree |
| Children were never hungry | 2.1 | 0.4 | Dis Agree |
| Children never skipped meal | 2.4 | 0.5 | Dis Agree |
| Children always ate for whole day | 2.6* | 1.3 | Agree |

Grand Mean 2.52

Source: Field survey data, 2019

*** No above the discriminating index 2.5 (food secured)**

The result in Table 4.5 revealed that 19 food security status index understudied, the rural women farmers were found to indicate positive status and secured in 13 indicators. These include that they do not cut meal ($\bar{X}=3.0$), they have enough to eat when they are hungry ($\bar{X}=2.8$), readily afford to eat balanced food ($\bar{X}=2.7$), they do not worry that their household food will run out ($\bar{X}=2.7$), the food they buy always last ($\bar{X}=2.6$), their children never go hungry ($\bar{X}=2.6$), their

children always eat for whole day ($\bar{X}=2.6$), they do not skip meal ($\bar{X}=2.5$), they serve as source of home nutrition ($\bar{X}=2.5$), different kinds of high cost food were available for children ($\bar{X}=2.5$), children ate enough food ($\bar{X}=2.5$) and children never skipped meal up to three or more times in one month ($\bar{X}=2.5$).

A grand mean of 2.52 was obtained from the mean score of the table which was above the discriminating index on 2.5. this implies that based on this work, the rural women farmers in the state were foods secured.

The standard deviation value ranged from of 0.3 – 1.5. The standard deviation 0.3, 0.4, 0.5, 0.7, 0.8 and 0.9 indicated that the women were homogeneous in their views regarding the food security status of rural women household. There was harmony in the responses by the women.

However, this implies (S.D = 0.3) there was more consensus in the women's responses concerning the fact that their children never skipped meal upto three or more times in a month.

The other items ranged from 1.1 – 1.5 indicated that the farmers harbored different opinion and were heterogeneous in their views regarding the food security status of rural women households. On the other hand, most of the women did not agree (heterogenous) that adults never skipped meal (S.D = 1.5)

Corroborating this result, Ojo *et al.* (2009) posited that household food security is guaranteed with agroforestry. According to him, during seasonal or emergency periods of food shortage, forest provides food that bridges the gap between sufficiency and famine. Mbaya (2009) noted that for people who cannot afford alternative source of protein depend on bush meat for their protein supply. He also maintained that unlike other sources of protein like beef, chicken, food crops those who eat bush meat obtain it through substance hunting. This probably explains why women indicated having regular food supply for their household. Haunting is cost effective as little or no cost is incurred as well as guaranteed regular food. An instance of this is the demonstration of snail at homestead after it had been caught from the forest. Thus, it is made accessible to the women for use at any time and day. When caught in large quantity same could be exchanged for money with which other needs are addressed by the women, as to how rural women maintain positive nutrition status through agroforestry, Kareem *et al.* (2009) explained that agroforestry enables rural women exploit and manage situation such as ecological

phenomena social needs and economic demands that would compete with their time and resources and in some cases harnessing such for greater food productivity.

For instance, in the area of environmental management through agroforestry practice the rural women are able to improve their soil fertility for greater yield at no cost, regulate their stream flow, prevent silting of rivers and streams. In terms of social benefits, rural women harness forest products to produce goods like fuel-wood, building post, folders and forage materials for making agricultural implements. All these can serve for household consumption and commercial purposes. Also, the attention of interventionists ' organizations towards reducing poverty through agroforestry is another reason promoting the potential of agroforestry for food security. Many of these programme according to kareem *et al.*, (2009) have provided technical assistance to rural women thereby helping in the spread of agroforestry practice, especially on current tread and development in agroforestry. Today snail farming, tree cropping, herbal medicine, lumbering activities have become common practice in the study area and with improved technique.

Furthermore, putting into perspective the submissions of Nnadi and Anaeto (2013) that poverty is predominant in rural area and rural women and youths being the worst hit. This assertion however is at variance with the result of this study as it portrays rural women in the study area as maintaining positive food security status. In fact, as against the submission of Nnadi and Anaeto (2013) the present finding suggests.

4.6 Effects of agroforestry on household food security status of rural women households

Table 4.14: Distribution of rural women farmers by effects of agroforestry on household food security status of rural women households

Sample size n = 270

| Perceived effects | Strongly | Agree | Disagree | Strongly | Mean | SD |
|--|----------|-------|----------|----------|------|-----|
| | agree | | | disagree | | |
| Supply of adequate fruits and vegetable | 98 | 99 | 36 | 37 | 3.0* | 0.5 |
| Provision of supplementary food items | 52 | 143 | 43 | 32 | 2.8* | 0.3 |
| Source of cash for purchase of food | 85 | 94 | 59 | 34 | 2.9* | 0.4 |
| Provision of vegetable rich in calcium | 139 | 83 | 23 | 25 | 3.2* | 0.5 |
| Provision of fuel for cooking | 113 | 107 | 31 | 19 | 3.1* | 0.6 |
| Supply of fodder for domestic animals | 76 | 118 | 49 | 27 | 2.9* | 0.7 |
| Provision of medicinal plants for family use | 85 | 127 | 33 | 25 | 3.0* | 0.3 |
| Medicinal plants for treating animal Disease | 89 | 90 | 62 | 29 | 2.9* | 0.5 |
| Reduced environmental damages by heavy wind | 85 | 110 | 50 | 25 | 2.9* | 0.7 |
| Improved micro-climate conditions during climate extremes. | 76 | 125 | 29 | 26 | 2.8* | 0.8 |

Source: Field survey data, 2019

$\bar{X} \leq 2.5$ (no effect) $\bar{X} \geq 2.5$ (had effect).

Table 4.6 shows the distribution of rural women farmers by the effects of agroforestry on food security status of rural women in Imo state. Based on 2.5 discrimination index established from a point likert type scale, the result indicated that agroforestry affected the rural women in all the ten-food security effect indicator used in this study. Precisely, agroforestry provided vegetable rich in calcium ($\bar{X}=3.2$), fuel wood for cooking ($\bar{X}=3.1$), adequate edible fruit and vegetable ($\bar{X}=3.0$) medicinal plants for family use ($\bar{X}=3.0$), medicinal plants for treating animal diseases ($\bar{X}=2.9$) reduction in environmental damages by heavy wind ($\bar{X}=2.9$) cash for purchase of food ($\bar{X}=2.9$), fodder for domestic animals ($\bar{X}=2.9$) and improved micro-climate conditions during climate extremes ($\bar{X}=2.8$). A grand mean of 2.95 was obtained from the mean score which revealed that agroforestry had strong effect on household food security status of rural women farmers.

These findings align strongly with the earlier finding of Kareem *et al* (2009), That agroforestry fulfils the benefits of food security vis-à-vis the provision of food self-sufficiency employment generation, reduction of poverty, boosting research and extension services effective utilization of land and water, development of agricultural system, Gowland-Mwangi and Maina (2013) while underscoring the potential of agroforestry resources in attaining food security noted that through agroforestry it is possible to reverse loss of environmental resources such as forest, shrubs, trees and vegetation that provide alternative source of food and income for farmers. He added that African government through comprehensive Africa agriculture development programme (AADP) are leveraging on the potential of agroforestry to tackle under nutrition, rising food prices, inefficient food supply chain, depletion of natural resources, rural-urban migration economic instability and other food security challenges. Also, at this time when the menace of climate change is increasing devastating farms and undermines farmers 'productivity. The role of agroforestry in providing alternative for mitigation and adaptation to the effects of climate change cannot be over stressed. A warm climate is likely to increase incidence and geographic spread of insects and fungal disease, induce frequent droughts that result in increased rainfall to the point of slowing down the spread of drying of the maturing seeds, decrease in seed germination and potentially increase aflatoxin levels in the seeds during storage (Gowland Gwanji and Maina, 2003).

Fortunately, farmers are able to mitigate or adequately adapt these consequences through agroforestry practice like shelter belt establishment, alley cropping, bush fallowing, cover

cropping and organic farming. In fact, the economic and social effects of agroforestry were further summarized by Ukpe *et al.* (2009) to include feeding the nation, creation of tourism and foreign exchange, sales of live, dressed carcass and other animal products. The report also affirmed that wildlife resources are used as edible products (food and medicine) non-edible product (tropies) and sport hunting (tourism)

The standard deviation (SD) value which ranged from 0.3 – 0.8 indicated that the farmers agreed on some items that measured the effects of agroforestry practices on rural women households.

4.7 Constraints to agroforestry practices for food security of rural women households

Table 4.15: Distribution of rural women farmers by constraints to agroforestry practices towards food security of rural women households.

Sample size n = 270

| Perceived Constraints | Strongly Agree | | Disagree Strongly | | Mean | SD |
|--|----------------|----------|-------------------|----------|------|-----|
| | Agree | Disagree | Strongly Disagree | Disagree | | |
| Land Security | 82 | 129 | 41 | 7 | 3.2* | 0.2 |
| Lack of control over land | 78 | 134 | 37 | 10 | 3.0* | 0.6 |
| Long gestation period to reap the benefits of Agroforestry | 50 | 51 | 48 | 9 | 2.4 | 0.7 |
| High cost of Farm inputs | 80 | 133 | 37 | 9 | 2.9* | 0.5 |
| Lack of production materials | 67 | 100 | 81 | 9 | 2.7* | 0.6 |
| Unfavorable agricultural policies | 84 | 119 | 44 | 11 | 2.9* | 0.7 |
| Lack of incentives | 86 | 116 | 44 | 13 | 2.9* | 0.6 |
| Poor and inadequate extension service | 53 | 103 | 88 | 13 | 2.6* | 0.7 |
| Lack of interest by farmers | 64 | 93 | 82 | 19 | 2.7* | 0.5 |
| Incidence of pest attacks | 80 | 118 | 49 | 12 | 2.9* | 0.8 |
| Theft | 63 | 96 | 82 | 16 | 2.7* | 0.8 |
| Poor marketing information and system | 71 | 97 | 81 | 8 | 2.8* | 1.3 |
| Lack of processing machineries | 109 | 103 | 39 | 8 | 3.1* | 1.4 |
| Low awareness of agroforestry practice | 58 | 100 | 77 | 24 | 2.6* | 0.3 |
| High mortality of tree seedling | 55 | 95 | 83 | 26 | 2.6* | 0.4 |
| High cost of establishment | 73 | 121 | 54 | 12 | 2.9* | 0.5 |
| Lack of labour | 55 | 95 | 84 | 25 | 2.6* | 0.6 |
| High incidence of bush fire | 73 | 121 | 54 | 12 | 2.9* | 0.2 |
| Poor financial base | 72 | 99 | 58 | 31 | 2.7* | 0.7 |
| Poor government policy support | 65 | 127 | 49 | 15 | 2.7* | 0.9 |

Source: Field survey data, 2019

The result in Table 4.7 shows the distribution of rural women farmers with respect to constraints that affects effectiveness in agroforestry. The reveals that all the items investigated were indicated by farmers as constraints to agroforestry practice in the study area. The constraints were further ranked in order of decreasing severity. The ranking revealed that land security was the major constraint to agroforestry practice in the area (1st) with a mean score of 3.2, this was followed by lack of processing machineries (2nd). While lack of control over land was rated third. High cost of farm inputs, lack of production materials, unfavorable agriculture policies, lack of incentives, high cost of establishment of agroforestry and high incidence of bush fire were ranked fourth. Poor

marketing information and systems occupied the 11th position while theft, poor financial base, poor government policy support and incidence of pest attacks ranked 12th. Others include lack of labor, high mortality of tree seedling and inadequate extension service which ranked 16th, while the least rated constraint was long gestation period to reap benefits of agroforestry.

This results strongly confirms the earlier findings of Ukpe *et al.*, (2009) which found land security as a major challenge to agroforestry. He noted that the rapid degradation of the rural environment has led to dwindling supplies of agroforestry resources ultimately leading to dwindling income. Where land is not cyclic, unemployment and secured agroforestry resources become vulnerable to unlawful activities like setting of fire in forest, land encroachment, human population poaching, climate changes, among others (Ukpe *et al.*, 2009).

On the problem of lack of processing machines, Apu (2010) noted that most machines for harnessing forest resources are capital intensive and beyond the reach of rural women farmers. this is manifest in wood processing which is completely dominated by wealthy merchants who process forest woods into industrial logs and ship to foreign markets. Some of the referred expensive machineries include limbering machines, wood shaping machine, wood priming machine, crane and trucks for transporting wood products.

In terms of land control, rural women are usually restrained by several cultural norms and traditions to control the ownership and use of lands (Ani, 2004). This practice limits the productivity of rural women in agroforestry, and consequently subjugate them to poverty. Further in his comments on other problems that limit women participation in agricultural production such as agroforestry, he noted that issues like high cost of input, high cost of production materials, poor government policy, high cost of establishing agroforestry are common placed. It is in this light that Nwachukwu (2008) recommended effective agricultural subsidy regime to be implemented by government at all levels, ranging from Federal to local government levels. Through input subsidy farmers can afford improved technologies hitherto beyond their reach. The efficacy of this approach is witnessed in the mechanism of the Growth Enhancement

Support Scheme (GESS) of the previous government in which input such as quality fertilizer, seeds and cuttings were supplied to farmers at affordable prices (Federal Ministry of Agriculture and Rural Development (FMARD), 2011). These measures are implemented through the

framework of government policies as in the case of which GESS was encapsulated in the Agricultural Transformation Agenda (ATA) policy of the Federal government. Through effective policy pertinent issues such as mentioned earlier undermining agricultural production are identified and effectively addressed.

Similarly, the challenge of poor marketing information, theft, pests and disease attack, lack of labour, high mortality and inadequate extension services have remained policy making matters (FMARD, 2011). The report asserted that with a well formulated policy tailored to help farmers meet their information needs such as through funding TV/radio farmer programmes, provision of pests control centers across different locations, increased agroforestry development activities to generate new jobs, implementation of value chain extension service delivery.

The grand mean was 2.79. This was above the discriminating index of 2.5. This implies that the rural women farmers in the state experienced the above listed constraints as deterring factors towards the attainment of household food security.

The standard deviation value of the farmers perception ranged from 0.2 – 1.4. The standard deviation score of high cost of farm inputs (0.5), lack of interest by farmers (0.5), high cost of establishment (0.5), lack of control over land (0.6), lack of production materials (0.6), lack of incentives (0.6), lack of labour (0.6), long gestation period to reap the benefits of agroforestry (0.7), poor and inadequate extension service (0.7), poor financial base (0.7), incidence of pest (0.8), theft (0.8), poor government policy (0.9) were in unity. There was harmony in the response by the women. The other items were not in unity in the responses by the women, indicating that the farmers harbored different opinions regarding what constrained agroforestry practices towards attaining food security of rural women households.

4.8 Hypothesis of the study

4.8.1 Hypothesis 1: There is no significant relationship between socioeconomic characteristics of rural women farmers and agroforestry practices in the study area

Table 4.16: Regression analysis of Multiple Regression Analysis of the Relationship between socioeconomic characteristics and agroforestry practices in the study area.

| Variables | Functional Forms | | | | n=270 |
|---|-----------------------|----------------------|----------------------|----------------------|-------|
| | Linear | Semi-Log | Double-Log | Exponential | |
| Age (X ₁) | 16.1064 (3.2748)** | 1.0829 (1.0589) | 0.0583 (1.4254) | 0.0095 (3.0645)** | |
| M/Status (X ₂) | -18.0339 (-1.0281) | -2.5041 (-1.1705) | -0.0859 (-1.2048) | -0.0065 (2.1206)* | |
| Education (X ₃) | -11.0351 (-1.1169) | -5.8826 (-1.2206) | -0.0883 (-1.2367) | 0.0062 (-2.1379)* | |
| H/H Size (X ₄) | 17.5913 (1.0999) | 3.9143 (1.2871) | 0.0717 (3.4306)** | 0.0094 (2.4103)* | |
| Farming Exp. (X ₅) | 17.2219 (2.6388)** | 1.5597 (2.2241)* | 0.0794 (2.5367)** | 0.0081 (2.8929)** | |
| Income (X ₆) | 15.2065 (1.0841) | 2.5703 (1.2349) | 0.0665 (3.0505)** | 0.0087 (3.1071)** | |
| Social org. membership (X ₇) | 4.2233 (2.5690) | 7.8883 (0.9471) | 0.0057 (2.0061)* | 0.0003 (6.5931)** | |
| Farm Size (X ₈) | 0.0013 (2.0999)* | 0.0053 (3.4551)** | 0.0717 (2.6399)** | 0.0094 (2.9113)** | |
| Occupation (X ₉) | 12.7773 (1.1819) | 11.3443 (0.5871) | 7.3333 (0.1106) | 10.6660 (1.2153) | |
| Constant | 88.4126 | 245.5107 | 188.5517 | 139.0922 | |
| R ² | 0.4908 | 0.4029 | 0.6945 | 0.7842 | |
| F-value | 10.8704 | 7.5733 | 25.4396 | 41.4721 | |

* = Significant at 5% probability level

** = Significant at 1% probability level Figures in parenthesis are t-ratio.

Decision Rule:

Significant at 5% when t-ratio $\geq 1.96 < 2.57$

Significant at 1% when t-ratio ≥ 2.57

Tables 4.8 presents the results of the multiple regression analysis on the socioeconomic characteristics of rural women farmers influencing agroforestry practices in the study area. The analysis was subjected to four functional forms of Linear, Semi-log, Double-log, and Exponential forms of the regression model. From the results, the exponential function was chosen as the lead equation having fulfilled the conditions of having the highest number of significant variables (eight), the value of coefficient of multiple determination (R^2) and F-value. Precisely, the exponential function produced an R^2 of 0.7842, F-value of 47.8951 which were significant at 1% level of probability, indicating that the exponential function gave a good fit to the data. Therefore, the results of the exponential function were used for discussion.

The regression analysis result shows that the coefficient of age 3.0645 was positive and is statistically significant at 1%, meaning that agroforestry practice increased with age. This is an indication that the older the agroforestry farmers get, the more mature they are to handle the intricacies of agroforestry practices. This could be attributed to the increased years of experience and encounter with reality. The study of Amselem *et al.*, (2010) found out a positive significant relationship between age of farmers and farming experience.

The marital status ($X_2 = 2.1206$) has a positive coefficient and it is statistically significant at 5%, implying that as a female farmer moves from being single to being married, she tends to show greater interest in the practice of agroforestry and try as much as possible to exploit to the fullest all achievable benefits, hence they perceive they perceive the benefit more. This study of Ogumefun and Achika, (2015) also established a positive relationship between marriage and the need for improvement in productivity.

The coefficient of education ($X_3 = -2.1379$) was negative and is statistically significant at 5%, implying that the higher the level of education attainment, the lower the practice of agroforestry.

Household size ($X_4 = 2.4103$) had a positive coefficient which is statistically significant at 5% indicating that increase in the number of household size increases the practice of agroforestry. The coefficient of experience ($X_5 = 2.8929$) was positive and is statistically significant at 1% thereby

indicating that the more experience an agroforestry farmer has, the more agroforestry practices he engages in.

The coefficient of income ($X_6 = 3.1071$) was positive and statistically significant at 1%, indicating that as the income of agroforestry women farmers increases, the more they are motivated to practice agroforestry. This statement is in agreement with the finding of Aninembabazi and Mugisha (2014).

The coefficient of social organization membership ($X_7=6.5931$) was positive and statistically significant at 1%, indicating that the more social organizations the farmer joins the more the farmer practices agroforestry.

The coefficient of farm size (X_8) was positive and statistically significant at 1%, indicating that increase in farm size results in increase in the practice agroforestry. Therefore, it is concluded that the socio-economic attributes influencing rural women practice of agroforestry in the area include age, household size, education level, agribusiness experience, income, membership of social organization and farm size. This result confirmed the findings of Ojo *et al.* (2009) which suggested that campaigns to promote agroforestry in Nigeria must be taken into cognizance personality related attributes of the farmers. Such as the income, food supply, education level.

Based on this, the null hypothesis was rejected, implying that there is a significant relationship between the socio-economic characteristics of rural women farmers and agroforestry practices in Imo state.

4.8.2 Hypothesis 2: There is no significant relationship between socioeconomic characteristics of rural women farmers and perceived effect agroforestry on food security in the study area

Table 4.17: Estimated linear relationship between socioeconomic characteristics of rural women farmers and the perceived effect of agroforestry on food security in the study area

| Variables | Coefficient | t-ratio | P-value | n=270 |
|---|--------------------|----------------|----------------|--------------|
| Age (X₁) | 0.578 | 7.224** | 0.000 | |
| Marital status (X₂) | 1.612 | 0.231 | 5.203 | |
| Education (X₃) | 0.310 | 8.532** | 0.010 | |
| Household size (X₄) | 0.111 | 1.222 | 9.104 | |
| Experience(X₅) | 0.324 | 6.320** | 0.000 | |
| Income(X₆) | 1.337 | 8.774** | 0.002 | |
| Social organization membership (X₇) | 0.310 | 8.532** | 0.010 | |
| Farm size(X₈) | 0.111 | 6.222** | 0.004 | |
| Occupation (X₉) | 0.324 | 1.320 | 6.560 | |
| Constant | 5.223 | 3.654 | 6.666** | |
| R² | 0.732 | | | |

Source: SPSS computation of field survey, data (2019)

Note: ** indicates significant at 1% level of probability

Table 4.9 is linear relationship between socioeconomic characteristics of rural women farmers and the perceived effect of agroforestry on food security in the study area. The result of the analysis gave an R² - value of 0.732, implying that age, education, experience, income, social organization membership and farm size explained 73.2 % of the variations in the agroforestry practices in the study area. The result of the linear regression analysis revealed that age (t = 7.224), education (t = 8.532), experience (t = 6.320), income (t = 8.774), Social organization membership (t = 8.532) and farm size (t = 6.222) were statistically significant at 1% probability level, and this implied that the significant socioeconomic characteristics of rural women farmers which include age, education, experience, income, social organization membership and farm size have significant effects on the perception of rural women farmers about the effect of agroforestry on food security in the study area. These results aligned with the assertions of authors. For instance, Onwumere (2008) noted that the younger the farmer the more enthusiasm the women show towards agroforestry practices. Marriage may also prompt farmers' involvement in the practices according to the result. The result also suggests that the higher the educational attainment of the farmers the

more the farmer explores new agroforestry practices. Similarly, farmers with high experience may be more favorably disposed towards undertaking new agroforestry practices. Farmers with high income earnings may be more inclined to try-out new agroforestry practices more than resource poor farmers. Also, through social organization membership the farmers get opportunities to update their knowledge and skills for greater productivity.

Therefore, the null hypothesis which states that there is no significant relationship between socioeconomic characteristics of rural women farmers and their perceived effect of agroforestry on food security in the study area is rejected and the alternative hypothesis is accepted

4.8.3 Hypothesis 3: Rural women farmers do not differ significant in the perceived effects of agroforestry on the food security status of rural women in Owerri, Orlu and Okigwe zones of Imo State

Table 4.18: Analysis of Variance (ANOVA) on the perceived effects of agroforestry on the food security status of rural women in the 3 agricultural zones of Imo State (Owerri, Orlu and Okigwe)

| | Sum of Squares | DF | Mean Square | F-cal | F-tab | Sig | P<0.05) | n=270 | Decision |
|-----------------------|----------------|-----|-------------|-------|-------|---------------------|---------|-------|------------------------------------|
| Between groups | 12.112 | 251 | 1.336 | 1.122 | 1.880 | 0.120 ^{ns} | - | | Null hypothesis is accepted |
| Within Groups | 56.150 | 18 | 1.211 | | | | | | |
| Total | 68.262 | 269 | 2.547 | | | | | | |

Source: SPSS analysis of field survey data, 2019
ns = Not significant

Table 4.10 presents the Analysis of Variance (ANOVA) on the perceived effects of agroforestry on the food security of rural women in the 3 agricultural zones of Owerri, Orlu and Okigwe of Imo State. The analysis indicated that there is no significant difference on the perceived effects of agroforestry on the food security of rural women farmers in Owerri, Orlu and Okigwe zones of Imo State having produced an F-value of 1.122 which is less than F-tabulated of 1.880 and a significant value (Sig.) of 0.120 which exceeded P-value of 0.05). Hence, the null hypothesis which states that rural women do not differ in the perceived effects of agroforestry on the food security of women in the 3 agricultural zones of Owerri, Orlu and Okigwe of Imo State is therefore accepted. This implies that the opinion of the women can be viewed as reliable information on the effects of agroforestry on food security status of rural women in agriculture as well as be used for policy making. This result collaborates the findings opinion of Owese *et al.* (2009) that farmers involved in agroforestry largely share similar food security and poverty status when measured on the scale of income, basic needs and capability. In terms of income criterion, the annual income generation of the women was slightly above the poverty line of \$1.9 per day adsorbing them of being regarded as poor farmers. this strongly suggests that agroforestry has the potential to lift people out of poverty. In the area of basic need criterion Ani (2004) noted that rural women farmers do not have access to adequate healthcare, housing, education, safe drinking water, and sanitation. This is sequel to the development gap between rural and urban areas. In fact, rural dwellers are described as the other Nigerians in Obasi (2010), while the rural location is seen as being unattractive to live in due to the absence of basic

infrastructural facilities that make life worth living. Implicitly, the income level of the rural women notwithstanding location of the women is what keeps them lacking basic needs of life. Against this backdrop, Owese *et al.* (2009) opined that it is not always true that increase income translates into improved access to means of satisfying basics human needs.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

The study analyzed effects of agroforestry on household food security as perceived by rural women farmers in Imo state, Nigeria. In Nigeria, rural women are involved in both farming and non farming activities, contributing to the domestic and socioeconomic life of the societies by supporting their households and communities in improving rural household and overall well-being. The specific objectives were to: identify agroforestry practices women farmers are involved in the study area; products which women farmers obtain from their agroforestry farms; reasons for practicing agroforestry as perceived by women farmers; food security status of rural woman farmer in the study area; rural women farmers perceived effects of agroforestry on household food security in the area. The study hypotheses investigated the relationship between farmers' socioeconomic characteristics and women farmers' agroforestry practices in the area; the socioeconomic characteristics of women farmers and perceived effect of agroforestry on food security in the study area as well as investigated significant difference in the perceived effects of agroforestry on food security status of rural women farmers in the three agricultural zones of Imo State.

Data for the study were obtained from 270 farmers using structured questionnaire, selected through a multi-stage sampling technique. Descriptive and inferential statistical tools such as frequency score, percentages, mean, Ordinary Least Square (OLS) multiple regression model, Linear regression and Analysis of variance were used.

The result shows that the average of the rural women was 51 years, with completed secondary school (33.3%) and mean household of 6 persons. The farmers were experienced with mean experience of 23 years and mean monthly income of N32,426. The mean farm size of the farmers was 1.8 hectares expressing them as small-scale farmers. Majority (79.6%) of the women were particularly involved in the practice of leaving few fruits bearing trees on the farm when clearing the land, that is multipurpose trees on crop land.

Farmers were inspired to practice agroforestry for the following reasons: agroforestry serves as a source of income, some of raw material, shelter for man and livestock, wind break, improves soil

quality, substance of economic growth, significant to human health and reduction in rural to urban migration.

The women were found to have positive food security status in the area of not cutting meal (3.0), having enough to eat when they are hungry (2.8), not worrying that their household food will run out (2.7), the food they buy always last (2.6) their children never go hungry (2.6), their children always eat for whole day (2.6), they do not skip meal (2.5), they serve as source of home nutrition (2.5), different kinds of high cost food were available for children (2.5), children ate enough food (2.5) and children never skipped meal up to three or more times in one month (2.5).

In terms of perceived effects of agroforestry on household food security, the result indicated that, agroforestry provided vegetable rich in calcium (3.2), fuel wood for cooking (3.1), adequate edible fruit and vegetable (3.0) medicinal plants for family use (3.0), medicinal plants for treating animal diseases (2.9) reduction in environmental damages by heavy wind (2.9) cash for purchase of food (2.9), fodder for domestic animals (2.9) and improved micro-climate conditions during climate extremes (2.8). The ranking revealed that land security was the major constraint to agroforestry practice in the area (1st).

With an $R^2 = 0.7842$, the regression result revealed that the socioeconomic attributes influencing rural women practice of agroforestry in the area include age, household size, education level, agribusiness experience, income, membership of social organization and farm size, while the Anova result (F-value = 1.122; Sig. = 0.120 at P-value of 0.05) indicated that the women did not differ in the perceived effects of agroforestry on the food security of women in the 3 agricultural zones of Owerri, Orlu and Okigwe of Imo State.

5.2 Conclusion

The study concludes that the rural women are small scale farmers who have positive attributes that could support their involvement in agroforestry practices. Majority of the women were particularly involved in the practice of leaving few fruits bearing trees on the farm when clearing the land. The farmers were inspired to practice agroforestry because agroforestry serves as a source of income, provides some of raw material, shelter for man and livestock. With a Grand mean 2.52 above the discriminating index, the women were found to have positive food security status in the area as the do not cut meal, having enough to eat when they are hungry, not

worrying that their household food will run out, the food they buy always last their children never go hungry, their children always eat for whole day, they do not skip meal The practice of agroforestry provided vegetable rich in calcium, fuel wood for cooking, adequate edible fruit and vegetable, medicinal plants for family use, medicinal plants for treating animal diseases, reduction in environmental damages by heavy wind. The major constraint to agroforestry practice in the area was lack of land security. Age, household size, education level, experience, income, membership of social organization and farm size influence rural women practice of agroforestry. The women did not differ in the perceived effects of agroforestry on the food security of women in the 3 agricultural zones of Owerri, Orlu and Okigwe of Imo State.

5.3 Recommendations

Based on the findings of the study, the following recommendations were made:

1. Women should be more vigilant in securing / protecting their land boundaries by mobilizing youths to keep constant watch along the boundary lines so as to prevent encroachment
2. There should be advocacies by intervention agencies (including extension services) towards designing machines that are compactible for women which they could use for processing agroforestry products.
3. Control and ownership of land by women around the study area should be improved by reviewing land tenure policies that traditionally constrain from owning land, such as through co-operative land leasing.
4. Inputs for agroforestry production should be subsidized by the government and intervention agencies to make them affordable by the rural women such as by extending schemes like GESS, Anchor borrowers' scheme and other programmes.
5. Agricultural Policies and laws geared towards promoting agroforestry production activities among women should be enacted by policy makers for favourable and smooth participation of women as to ensure profit.

6. Women in agroforestry production need to be encouraged and giving incentives to promote continuous production for the development of agricultural sector.

5.4 Contribution to Knowledge

The research contributes to knowledge and information firstly by providing vital information's on agroforestry to rural women farmers as a profitable and viable venture capable of meeting rural women farmers immediate needs (food, income and shelter).

It will help rural women farmers to understand and appreciate agroforestry as one of the ways of solving the problem of deforestation, land degradation and rising decline of soil fertility through integration of nitrogen, phosphorus and potassium fixing species of plant and trees during establishment stage of agroforestry farms.

The study identified land security as a limiting factor faced by rural women farmer in their agroforestry engagement, through agroforestry such problem could be managed through perimeter fencing, local fencing with woods and bamboos. They study further contributes to the intellectual development of intervention agencies, and agricultural extension staffs. Etc.

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APPENDIX

FEDERAL UNIVERSITY OF TECHNOLOGY OWERRI

DEPARTMENT OF AGRICULTURAL EXTENSION

Questionnaire: Effects of Agroforestry on household food security as perceived by rural women farmers in Imo State Nigeria.

Dear Sir/Madam,

I am a Master of Science student of Federal University of Technology Owerri undertaking a research work on the topic above.

The study is strictly for academic purpose, you are kindly requested to respond to the questions accordingly.

Thanks for your cooperation

Nwozuzu Sunday Obioha

Note: Please Tick Appropriately

Section A: Socio-economic characteristics

1. Name: _____
2. How old are you _____
3. Sex: (1) Male (2) Female
- Marital status
- 4.(a) Single (b) Married (c) Separated/divorced
- (d) Widowed
5. Level of education
- a. No formal education
 - b. Primary School attempted
 - c. Primary School completed
 - d. Secondary School attempted
 - e. Secondary School completed
 - f. Tertiary School attempted
 - g. Tertiary School completed
6. What is your household size persons _____
7. How long have you been in the business of farming Years? _____
8. What is your monthly income? # _____
9. Do you belong to any Social organization? Yes No
10. What is your farm size (In hectare) _____
11. What is your primary occupation
- a. Civil servant
 - b. Farming
 - c. Teaching
 - d. Artisan
 - e. Food processing _____
 - f. Trading _____
 - g. Menia jobs

Others(please specify)..... _____

SECTION B: AGROFORESTRY PRACTICES ENGAGED IN BY THE FARMERS IN YOUR AREA?

12. Which of the following under listed practice(s) do you practice in your area

| S/n | Agroforestry practices | Practiced | Not Practiced |
|-----|---|-----------|---------------|
| 1 | Cultivation of annual crop among young trees (Taungya system) | | |
| 2 | Growing of trees, shrubs and herbaceous plant around the compound (Home gardens) | | |
| 3 | Intercropping of food crops and woody species in the same land (Alley cropping) | | |
| 4 | Planting trees of aesthetic value to demarcate boundaries, control water and erosion, supply of food, fodder and fuel woods | | |
| 5 | Leaving few fruits bearing trees on the farm when clearing the land (Multipurpose trees on crop land) | | |
| 6 | Growing trees and vegetables on the same land (Silvio culture) | | |
| 7 | Growing trees and keeping pasture/animals on the same land (Silvi pasture) | | |
| 8 | Trees in plantation and arable crops (Plantation crop combination) | | |
| 9 | Leaving trees or shrubs in natural fallows in order to improve soil fertility (Improved tree fallow) | | |
| 10 | Using tree/shrubs as fence (live fencing) | | |

Others (please specify)

SECTION C: WHICH OF THE FOLLOWING FOREST PRODUCTS DO YOU OBTAIN FROM YOUR AGROFORESTRY FARMS?

Please Tick Appropriately as applicable to you

- a. Crops
- b. Fruits
- c. Firewood
- d. Timber

- e. Building poles
 - f. Charcoal
 - g. Fodder for animals
 - h. Meat
 - i. Honey
 - j. Animal hides / skin
 - k. Mushroom
 - l. Medicines / herbs
- Others (please specify)

SECTION D: WHAT ARE YOUR REASONS PRACTICING AGROFORESTRY? Please tick as applicable to you.

| S/N | REASONS | Strongly Agree | Agree | Disagree | Strongly Disagree |
|-----|--|----------------|-------|----------|-------------------|
| a. | Provision of food | | | | |
| b. | Act as source of income | | | | |
| c. | Source of Raw materials | | | | |
| d. | Provision of Shelter/shade for man and livestock | | | | |
| e. | Helps improve soil quality | | | | |
| e. | Source of home nutrition | | | | |
| g. | Acts as Wind breaker | | | | |
| h. | Source of fertilizer for agricultural operations | | | | |
| i. | It enhances sustained economic growth | | | | |
| j. | It is significant to human health | | | | |
| k. | Rural to urban migration is reduced | | | | |
| l. | Everybody has enough food to eat | | | | |
| m. | Enough food is locally produced | | | | |
| n. | There is control over what people eat and | | | | |

| | | | | | |
|----|---|--|--|--|--|
| o. | people are no more at the mercy of others | | | | |
|----|---|--|--|--|--|

Others: specify

SECTION E: FOOD SECURITY STATUS OF AGROFORESTRY RURAL WOMEN HOUSEHOLDS

Please tick as applicable to you.

| S/n | Indicators | Strongly Agree | Agree | Disagree | Disagree | Strongly |
|-----|---|----------------|-------|----------|----------|----------|
| a) | Not worried that household food will run out | | | | | |
| b) | Food bought always last | | | | | |
| c) | Readily afford to eat a balanced food | | | | | |
| d) | Adults do not cut meal | | | | | |
| e) | Adult never skipped meal | | | | | |
| f) | Source of home nutrition | | | | | |
| g) | You ate enough always | | | | | |
| h) | You were hungry, but had enough to eat | | | | | |
| i) | You gained weight because family food was enough | | | | | |
| j) | Adult never starved for a whole day | | | | | |
| k) | Adults starved for a whole day for or more times in a month | | | | | |
| l) | Different kinds of high-cost food were available for children | | | | | |
| m) | Fed children balanced meal always | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

| n) | Children ate enough food | | | | |
|--|--|----------------|-------|----------|-------------------|
| o) | Never cut size of children's meal | | | | |
| p) | Children never skipped meal up to three times or more in one month | | | | |
| q) | Children were never hungry | | | | |
| r) | Children never skipped meal | | | | |
| s) | Children always ate for whole day | | | | |
| SECTION E: WHICH OF THE FOLLOWING ARE PERCEIVED EFFECTS OF | | | | | |
| AGROFORESTRY ON FOOD SECURITY AS OBSERVED BY YOU? Please tick (v) as applicable | | | | | |
| to you. | | | | | |
| S/n | Perceived effects | Strongly Agree | Agree | Disagree | Strongly Disagree |
| a. | Provision of adequate edible fruit and vegetables | | | | |
| b. | Provision of supplementary food items | | | | |
| c. | Provision of cash for purchase of food | | | | |
| d. | Provision of vegetables rich in calcium | | | | |
| e. | Provision of fuel for cooking | | | | |
| f. | Provision of fodder for domestic animals | | | | |
| g. | Provision of medicinal plants for family use | | | | |
| h. | Provision of medicinal plants for treating animal diseases | | | | |
| i. | Reduced environmental damages by heavy wind | | | | |
| j. | Improved micro-climate conditions during | | | | |

| | | | | | |
|--|-------------------|--|--|--|--|
| | climate extremes. | | | | |
|--|-------------------|--|--|--|--|

SECTION F: CONSTRAINTS TO AGROFORESTRY PRACTICE IN THE STUDY AREA.

Which of the following do you perceive as constraints to agroforestry practice in your area?

| S/N | Perceived Constraints | Strongly Agree | Agree | Disagree | Strongly Disagree |
|-----|--|----------------|-------|----------|-------------------|
| 1 | Land Security | | | | |
| 2 | Lack of control over land | | | | |
| 3 | Long gestation period to reap the benefits of Agroforestry | | | | |
| 4 | High cost of farm inputs | | | | |
| 5 | Lack of production materials | | | | |
| 6 | Unfavorable agricultural policies | | | | |
| 7 | Lack of Incentives | | | | |
| 8 | Poor and Inadequate extension service | | | | |
| 9 | Lack of Interest by farmers | | | | |
| 10 | Incidence of pest attacks | | | | |
| 11 | Theft | | | | |
| 12 | Poor marketing information and systems | | | | |
| 13 | Lack of processing machineries | | | | |
| 14 | Low awareness of agroforestry practice | | | | |
| 15 | High mortality of tree seedling | | | | |
| 16 | High cost of establishment | | | | |
| 17 | Lack of labour | | | | |
| 18 | High incidence of bush fire | | | | |
| 19 | Poor financial base | | | | |
| 20 | Poor government policy support | | | | |