PERCEIVED HEALTH BENEFITS AND UTILIZATION OF MORINGA TREE PRODUCTS (*Moringa oleifera*) AMONG RURAL HOUSEHOLDS OF NASARAWA STATE, NIGERIA

The study assessed the perceived health benefits and utilization of Moringa tree products *Moringa oleifera* among rural households of Nasarawa State, Nigeria. The study described the socio-economic characteristics of the rural households; determine the extent of utilization of *Moringa oleifera* by the respondents; examine the perceived health benefits of *Moringa oleifera* utilization; determine the factors influencing the extent of utilization of *Moringa oleifera* and examine the constraints associated with *Moringa* oleifera utilization in the study area. Multi-stage sampling technique was used to select 244 respondents on which structured questionnaire was employed to obtain primary data. Data collected were analysed with descriptive Statistics as well as attitudinal measuring scale such as Likert rating scale. The results revealed that most (60.7%) of the respondents were within the age range of 31 – 60 years with a mean age of 40 years, while majority (84.0%) of the respondents acquired one form of formal education or the other (primary, secondary and tertiary) with a mean of 13 years of formal schooling. More so, majority (99.2%) of the respondents utilized Moringa leaves, followed by Moringa Fruits/Seeds (89.8%), Moringa roots (87.7%) and Moringa barks (64.3%). In terms of extent of utilization, Moringa leaves ($\overline{X}$ = 2.84), Moringa fruits/seeds ($\overline{X}$ = 2.07) and Moringa roots ($\overline{X}$ = 2.05) recorded the highest extent of utilization among the Moringa tree products in the study area. On the perceived health benefits of Moringa oliofera tree products, the respondents agreed to all the health benefits of Moringa tree products that it is effective in the treatment of High Blood Pressure ($\overline{X}$ = 4.23) ranked 1st. The result of Logit regression estimate revealed Pseudo R^2 of 0.4189 and Chi–squared statistic of 141.01 statistically significant at $p<0.01$ probability level implying goodness of fit of the overall model. Variables such as marital status (2.05, $p<0.05$), household size (2.04, $p<0.05$), education (2.83, $p<0.01$), farming experience (1.82, $p<0.1$), cooperative membership (1.83 $p<0.1$), access to credit (3.23, $p<0.01$), moringa products (6.48, $p<0.01$), purpose of utilization (2.79, $p<0.01$) and perceived health benefits (2.17, $p<0.05$) were found to influence extent of *Moringa oleifera* tree products utilization. The major constraints indicated by the respondents were inadequate finance to purchase Moringa ($\bar{X}$ = 2.70), poor access to credit facilities ($\bar{X}$ = 2.61) and inadequate extension services ($\bar{X}$ = 2.32) ranked 1st, 2nd and 3rd, respectively. The study concluded that the respondents had positive perception about health benefits of *Moringa oliofera* tree products, while the leaves, fruits/seeds and roots are the most utilized tree products. It was therefore recommended that adequate awareness should be created through extension agency on the need to utilize *Moringa oliofera* tree products.

INTRODUCTION

1.1 Background of the Study`

Moringa Tree, also known as Horseradish tree, drumstick tree and ben oil tree is a widely cultivated species of the tropical flowering plant family Moringaceae containing thirteen diverse species (Shahzad *et al.,* 2013) and grows quickly in many types of environments. *Moringa oleifera* is a perennial softwood tree with timber of low quality, but for centuries, has been advocated for traditional medicinal and industrial uses (Eze *et al.,* 2012). It is considered as one of the World's most useful trees, as almost every part of the Moringa tree can be used for food, medication and industrial purposes (Abdullahi, 2011). Also *Moringa oleifera* has the potential to improve nutrition; boost food security; foster rural development; support sustainable land use and improve the health status (Stevens *et al., 2*013).

Moringa oleifera has the potential to significantly add to rural household income and improve quality of life in Nigeria (Adikuru *et al.,* 2011). It serves as a source of income to number of people as several people have started nurseries to grow *Moringa oleifera* in large quantities in order to diversified to generate income, reduce poverty and improve the health of people. According to (Chopade *et al.,* 2012), *Moringa oleifera* plantation can help provide a more diversified farm economy and also potentially stimulate the rural economy as a whole, encouraging the development of more stable commodities. *Moringa oleifera* leaf is not only a promising source of income and employment, but also an outstanding, nutritionally rich vegetable for families and businesses (Seewu *et al.,* 2010).

The perceived Health benefit of *Moringa oleifera* is limitless and a strong antioxidant effective against prostrate and skin cancers. *Moringa oleifera* is an anti-tumour and anti-ageing substance. It is also used as a blood cleanser and blood builder in wound healing and boosts the immune system (Mehta *et al.,* 2011) as well as modulates in anemia, high blood pressure, diabetes, blood cholesterol thyroid, liver and kidney problems. The tree products have strong anti-inflammatory properties ameliorating rheumatism, arthritis as well as effective against digestive disorders, diarrhea, ulcer or gastritis.

As a medicinal plant, *Moringa oleifera* tree products acts as cardiac and circulatory stimulants, possess antitumor, antipyretic, antiepileptic, anti-inflammatory, anti-ulcer, anti-spasmodic, diuretic, anti-hypertensive, cholesterol lowering, anti-oxidant, ant-diabetic, hepatic-protective and inhibitor against bacteria and fungi (Leone *et al.,* 2015). *Moringa oleifera* is very effective for treating arthritis, rheumatism and joint pain. It can also control other severe diseases such as epilepsy, migraine and other headaches. Its detoxification properties make it suitable to treat scorpion and snake bites it has also claimed to boost immune systems (Olugbemi *et al.,* 2010). Its leaves are full of medicinal properties including antiseptic, rheumatism treatment, venomous bites, and other. In traditional medicine, the leaves are used to treat ailments including malaria, typhoid fever, parasitic diseases, arthritis, swellings, cuts, diseases of the skin, genito-urinary ailments, hypertension and diabetes (Leone *et al.,* 2015).

Moringa oleifera is perceived to be an anti-bacterium, anti-microbial and anti-viral agent against urinary tract infection, typhoid, syphilis, dental carries and toothaches, fungus, common cold, HIV, worms, and trypanosomes. The tree products are also a good detoxifying agent against snake and scorpion bites (Popoola and Obembe, 2013). *Moringa oleifera* is also

perceived to prevents the growth of cysts, tumors and glands. It curbs other health complications such as diabetes, anemia and high blood pressure. liver, kidney, stomach and thyroid problems. Leone *et al.* (2015) posited that in traditional medicine, the Moringa leaves are used to treat ailments such as malaria, typhoid fever, parasitic diseases, arthritis, swellings, cuts, diseases of the skin, genito-urinary ailments, hypertension and diabetes. *Moringa oleifera* is also used to enhance lactation and boost the immune system (to treat HIV/AIDS related symptoms), as well as cardiac stimulants and contraceptive remedy (Popoola and Obembe, 2013). Therefore, for treatment of various ailments, one can directly consume either raw and dried leaves, or the extract of an aqueous infusion (Leone *et al.*, 2015).

According Prod *et al.* (2012), perceived health benefits of *Moringa oleifera* includes control severe diseases such as epilepsy, migraine and headaches. It is especially promising as a food source in the tropics because of the substantial or numerous health benefits realized by consumption of *Moringa oleifera* in situation where starvation is imminent (Sanford *et al.*, 2011). *Moringa oleifera* is the cheapest and credible alternative to not only providing good nutrition, but also to cure and prevent a lot of diseases (Paliwal *et al.,* 2011). Actually, the great interest in *Moringa oleifera* is related to its multipurpose uses and its ability to guarantee a good yield, where other crops cannot, in countries where people are mostly at risk of suffering from nutritional deficiencies (Leone *et al.,* 2015).

Moringa oleifera is perceived to be medicinal plant with high nutritional value in terms of high protein, vitamins, beta-carotene and amino acids, hence could be useful as a food supplement for both human and animals (Hashim *et al.,* 2013). The plant has been found to be rich is vitamins, minerals and edible oil called Ben oil (Ofoh *et al.,* 2011). Phyto-chemical

analysis have also shown that its leaves are particularly rich in potassium, calcium, phosphorous, iron, vitamins A and B, essential amino acids as well as such known antioxidants such as B-carotene, vitamin C and flavonoids (Amaglo *et al.,* 2010). The leaf powder is rich in proteins and micronutrients such as vitamins, minerals and all essential amino acids and for centuries, these nutritional and therapeutic properties have been utilized in the traditional treatment of several health disorders in various cultures (Animashaun *et al.,* 2013; Azeez *et al.,* 2013).

Utilizing Moringa Tree has been of many uses to human race ranging from consumption to domestic usage, animal forage, plant manure, bio pesticides and as ornamental plants. The tree also produces viscose resin that is used in the textile industry. The leaf biomass was used as mulch and as organic fertilizer. Usage of Moringa seed for household water purification produced substitute for imported flocculants, thus reducing expenditure by rural household. Moringa seed oil as biodiesel feed source has been proved, and oil could be used as pure biodiesel or petro-diesel mixture on engine (Da Silva *et al.,* 2010). Moringa oil has also excellent characteristics, making it a highly valued ingredient in a variety of applications, ranging from vegetable food oil to use in cosmetic products and other industrial applications such as lubricant for fine machinery.

The key uses of Moringa include human nutrition (leaves, seeds, flowers), alley cropping (biomass production for biodiesel and fertilizing), animal forage (leaves and treated seedpod-cake), biogas (from leaves), domestic cleaning agent (crushed leaves), blue dye (wood), fencing (living trees), fertilizer (seed-cake), foliar nutrient (juice expressed from the leaves), green manure (from leaves) (Adebayo *et al.,* 2011; Popoola and Obembe, 2013). The species is also mainly used as gum (from tree trunks), honey and sugar cane juice-clarifier (powdered

seeds), honey (flower nectar), medicine (all plant parts), ornamental plantings, bio-pesticide (soil incorporation of leaves to prevent seedling damping off), pulp (wood), rope (bark), tannin for tanning hides (bark and gum), water purification (powdered seeds) (Adebayo *et al.,* 2011; Leone *et al.,* 2015).

1.2 Statement of the Research Problem

Over the years Nigeria government have taken many steps to ensure adequate food, improved health status and income of her citizen, but yet there is inadequate knowledge about the medicinal, nutritional and economic benefits of moringa tree products. There have been limited efforts in utilizing this valuable multipurpose tree species in many places in Nigeria including the study area. Little or no efforts have been made to unearth the prevailing potentials health benefits of *Moringa oleifera* among rural households.

Despite the potential health benefits, *Moringa oleifera* has not enjoyed the full patronage expected from the vast populace in Nigeria especially in rural areas. *Moringa oleifera* is still not well exploited and hence considered as underutilized. However, number of factors could be responsible for poor perception of the people in relation to utilization which include lack of technical knowledge, poor entrepreneurial skills and meager access to communication technologies that could help farmers, extension workers and others to share information. The above scenario underlines the need for this study to provide answer to the following research questions:

i. what are the socio-economic characteristics of the rural households in the study area?

ii. what are the extent of utilization of *Moringa oleifera* by the respondents?

iii. what are the perceived health benefits of *Moringa oleifera* utilization among the rural households?

iv.what are the factors influencing extent of utilization of *Moringa oleifera*?

v. what are the constraints associated with utilization of *Moringa oleifera* in the study area?

1.3 Aim and Objectives of the Study

The aim of the study was to examine the perceived health benefits and utilization of Moringa tree products *(Moringa oleifera)* among rural households of Nassarawa State, Nigeria.

The specific objectives were to:

i. describes the socio-economic characteristics of the rural households in the study area;

ii. determine the extent of utilization of *Moringa oleifera* by the respondents;

iii. examine the perceived health benefits of *Moringa oleifera* utilization;

iv. determine the factors influencing the extent of utilization of *Moringa oleifera*, and

v. examine the constraints associated with *Moringa* oleifera utilization in the study area.

1.4 Hypotheses of the Study

The following null hypotheses were tested in this study:

H_O1: There is no significant relationship between some selected socio-economic characteristics of rural households (age, gender, education, experience etc.) and extent of utilization of *Moringa oleifera* in the study area.

H_O2: There is no significant relationship between the perceived health benefits and extent of utilization of *Moringa oleifera* in the study area.

1.5 Justification of the Study

There has been a clamour for the cultivation and utilization of lesser known plant species like *Moringa oleifera* in Nigeria. A number of studies have been carried out on the origin, morphology and chemistry of *Moringa oleifera,* but little or no efforts have been made to unearth the health benefits of the plant. The enormorsity of the benefits of this specie is a

reason to look into the awareness of the specie locally and to find out the knowledge base of local people on it. The study findings will not only give a picture of the health benefits, but will also help in policy recommendation for mass propagation so that the species sustainably used.

Moringa oleifera on a global scale can be a basis for sustainable and predictable global progress and development. Therefore, there is need to make people aware of the beneficial role played by *Moringa oleifera* in order to enjoy the full benefit attached to its use. Medicinal plants in medicine known as phytomedicine are still trustworthy and widely applied as one of the alternative way in medicinal field due to its affordable cost (Abalaka *et al*., 2009). Therefore, there high cost and competition of conventional medicines can be reduced through the use of non- conventional medicine like which is less expensive and toxic.

Despite the importance of medicinal plants, *Moringa oleifera* inclusive, the trade is highly intricate, unorganized and diverse. These could be attributed to the fact that most medicinal plants materials are sold unprocessed, the harvesting of the plant are basically by untrained people and nomadic, inappropriate storing of medicinal plants (Ume *et al.,* 2016), Although, *Moringa oleifera* tree is widespread throughout the tropics, it is commonly found around farms and fences in many compounds, thus making information emanating from plant very scarce.

Therefore, the result of socio-economic characteristics of the rural household will provide insight on factors that could influence the use of *Moringa oleifera* and enable policy makers to come up with appropriate policies that will improve *Moringa oleifera* utilization. It is believed that this research of this nature will provide information to Agricultural Development programme (ADPs) on the on rural households socio-economic and their extent

of utilization of *Moringa oleifera*. More so, the findings are also expected to be useful to the federal Ministry of Agriculture and Rural Development and researchers in term of policy formulation and design of programme that will better the life of rural households especially on utilization of products. The study findings will not only give a picture of the health benefits, but will also help in policy recommendation for mass propagation so that the specie can be sustainably used.

This information will act as basis for supporting the small scale farming communities in their quest to secure better livelihoods. This study is also of importance because the involvement of farmers in the value chain of Moringa plant is critical to optimizing the plant potentials especially when the needed information is available at their disposal.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Socio-economic characteristics of the Rural Farming households

Economic importance of *Moringa oleifera*, from the socio-economic point of view, medicine is an important commodity in our life, often considered as life-saving item. About 90% of

the total medicines come from plant kingdom (Rahman, 2003). Moringa leaf is not only a promising source of income and employment, but also an outstanding, nutritionally rich vegetable for families and businesses (Seewu *et al.,* 2010). Some of the most common and most important reasons are the need for food; medicinal use; income generation and the diversity of other uses. Producing Moringa leaves is also a means of generating agricultural income, developing the food processing industry and founding new businesses.

Moringa oleifera leaf powder in food has the potential to decrease malnutrition, especially in children and can possibly contribute towards eradicating food and nutrition insecurity because of its agricultural characteristics of being drought resistant and in full leaf during the dry season (Mishra *et al.,* 2012). It has a great potential to serve as a high-value food crop, medicinal products, as well as fodder for animals, especially in developing countries (Shahzad *et al.,* 2013). Therefore, *Moringa oleifera* is a relatively good source of vitamins, minerals and essential amino acids and could be considered as a good alternative to be used to help alleviate micronutrient malnutrition at household as well as national level. It serve as a source of income to the rural inhabitants and therefore it is increasingly becoming an important source of livelihood for a number of people as several people have started nurseries to grow moringa in large quantities for sale within and outside the country (Azeez *et al.,* 2013).

Moringa oleifera is one of the most useful tropical trees. Its relative ease of propagation through sexual and asexual means, low demand for soil nutrients and water after being planted makes its production and management easy. It is considered as one of the World's most useful trees, as almost every part of the Moringa tree can be used for food, medication and industrial purposes (Khalafalla *et al.,* 2010). The socio-economic value of biological

diversity resides also in the indirect uses, such as the ecological services e.g. improvement of the quality of water and air, the supply of nitrogen through nitrogen rich biomass, the formation of soils and socio-cultural uses e.g. religious and cultural functions, recreational and aesthetic uses e.g. tourism. These pharmacological properties position Moringa seed oil as a key ingredient in the manufacturing of soaps, lotions and pharmaceutical ointments. Actually, the value chain for Moringa product, if properly developed, offers considerable investment opportunities, and potential job creation, foreign exchange earnings and export diversification (Animashaun *et al.,* 2013).

In Nasarawa State, Moringa oleifera has the potential to be adopted as food and medicine for humans as well as a ruminant fodder, in addition to plant production, is a strategy employed to raise farm income and reduce the food insecurity experienced by rural households due to the decline in agricultural sector (Fakayode *et al.,* 2009).

2.2 Overview of the *Moringa oleifera* production

Moringa oleifera is the most extensively cultivated tree species of the genus Moringa that belongs to the family Moringaceae. It is a highly valued plant, distributed in different parts of tropics and sub-tropics around the world (Anwar *et al.,* 2007). The *Moringa oleifera*, approximately 10 m tall. Its branches are drooping. The leaves are composed by 4-6 couples of leaflets plus the terminal one, the lower leaflets are divided again in sub-composed leaves. Each leaflet is oval, about 2 cm long and 1.5 large. The pods are triangular and ribbed, 25-40 cm long. Each pod contains 20-30 seeds. Seeds are winged, bright brown. It can be planted in sandy soil; it tolerates poor soil, including coastal areas (Mori *et al.,* 2009).

The tree can be planted in medium density plantations for intensive cropping, it can be used for short windbreaks and green fences in large or little farms, and they are commonly planted

in home gardens. The tree can be kept short in alley cropping plantation, cutting each year at 0.5 -1 m height in order to get seasonal re-sprouts up to 2-3 m high. A possible new use for the developing areas of tropics and sub-tropics can be oil production by micro-mills directly managed by groups of small producers in rural villages. The plant is propagated by seeding and cuttings. Seeds should be buried about 2cm. Cuttings can be 0.5-2 m long. The plant starts bearing pods 6–8 months after planting, but regular bearing begins after the second year. Tree podding is good for several years. It does not tolerate freeze or frost. *Moringa oleifera* is a sun- and heat-loving plant. Seeds are planted an inch below the surface and can be germinated year-round in well-draining soil (Muri *et al.,* 2009). It is also widely cultivated, especially in dry tropical areas of the Middle East and Africa (Nouman *et al.,* 2013).

Though, the Moringa tree is widespread throughout the tropics, around farms and compounds and often used as fence especially in Northern Nigeria. *Moringa oleifera* is a miracle tree that has been cultivated for a long period of years and it is now found throughout the tropics. It is grown commercially around the world as food, drink and medicine (Abdullahi., 2011).Its timber is of low quality, but it is an important tree in various parts of the world (Omotesho *et al.,* 2013). It is a fast-growing, drought tolerant tree now widely cultivated in tropical and subtropical areas of Africa, Latin America, Southern and South-Eastern Asia.

2.2.1 Physiology of the *Moringa oleifera* plant

The Moringa tree is a deciduous slender tree with branches of light to dark green droopy leaves. The flowers are creamy-white and are mildly fragrant. Pods from the tree are long and triangular, containing approximately 20 seeds per pod. Each seed is covered in three paper-like wings which serve as a propeller. Flowers, pods and seeds are produced throughout the year. The tree begins to flower after being planted for approximately 8 to 12

months. Flowering continues throughout the year. Moringa branches are soft and can easily be bent. The branches can been used to make fences or trees can been grown around the perimeter of a house/shack as a form of "live fencing" (Price, 2007). Fresh young leaves are eaten in a similar manner to spinach (Mehta *et al.,* 2010). The roots from young Moringa trees can be harvested and substituted for horse radish, hence one of the alternative names for *Moringa oleifera*. The bark covering the root must first be removed before being eaten. Consumption of the root should be limited as excess can be harmful (Price, 2007).

2.2.2 Production of the *Moringa oleifera* plant

The growing condition most suited to *Moringa oleifera* is in hot, semi-arid tropics. The tree is drought tolerant; however, excessively windy conditions may result in the tree drying out. It is interesting to note that this plant can also grow in regions where the soil is not very fertile and is even capable of being grown in garden space at home. *Moringa oleifera* grows well in sandy soil with a slightly acidic pH of 6.2 to 7.0 and has a height ranging from 5-12 m with a straight trunk 10 - 30 cm thick (Hussain *et al.,* 2014). The recommended amount of rainfall is 10-60 inches per year and the most preferred altitudes range from 600 m to 1200 m (Broin and Saint, 2010).

The tree can withstand light frost; should there be extreme frost, a mature tree may die but the tree is capable of re-growing Moringa trees can survive in most soil types but the tree prefers loam or well drained sandy soil (Price, 2007). Moringa trees grow rapidly and can reach up to 4 m per year, with a maximum height of between 6-15 m once fully grown. Periodical pruning encourages new growth with an abundance of leaves that are easily accessible for harvesting (Price *et al.,* 2007). Another reason that can make *Moringa oleifera* to be called a "miracle tree" besides its nutritive value could be that even during the dry

season, the tree still has full leaves, when food sources are exhausted especially in tropical areas (Mishra *et al.,* 2012).

Propagation of *Moringa oleifera* can easily be done from seed or via cuttings. Germination of the seeds usually occurs within 1-2 weeks. Shaded conditions yield the best germination rates. Cuttings can successfully be grown to produce healthy trees. The recommended length is 45-100 cm of a healthy stem. The preferred method of propagation is by seeds or seedlings as cuttings tend to have a shorter root system which may affect the anchoring ability of the tree in windy conditions (Broin and Saint, 2010).

2.2.3 Harvesting and drying of the *Moringa oleifera* leaves

Moringa leaves, both mature and young, can be dried to make Moringa leaf powder. But the drying conditions of leaves are very important for safety of the final product. Before the leaves are dried, healthy; disease free; fungi free leaves with a dark green colour must be manually selected. The washing process of Moringa leaves is in four stages where the leaves are first washed in clean water, then soaked in 1% saline solution ($NaCl_2$) for 5 minutes, thereafter the leaves are dipped in 70% ethanol and finally rinsed with distilled water (Mishra *et al.,* 2012). The leaves must be dried, they can either be shade dried, sun dried or oven dried but the type of drying method is important for nutrient preservation.

A study by (Mehta, 2010) showed that shade drying retained more nutrients in comparison to sun drying and oven drying. When the leaves are shade dried, it is important that they are dried in a sterile, well ventilated room and covered with nets e.g. mosquito nets. For uniform drying the leaves should be turned over, and the personnel responsible for this should have personal protective equipment e.g. sterile gloves to prevent contamination of the leaves (Mishra *et al.,* 2012). Then the leaves can be grinded, to make Moringa leaf powder. A further

stage of drying at 50°C for 30 minutes is required after grinding because the powder is highly hydroscopic. The Moringa leaf powder can be stored for 6 months at 24°C in airtight or vacuum sealed containers, preferably away from light and humid surroundings (Mishra *et al.,* 2012).

2.3 Perceived Health Benefits of *Moringa oleifera*

Moringa oleifera has the potential to improve nutrition; boost food security and improve the health status (Healing potential), therefore *Moringa oleifera* to improve human health used and assist in combating malnutrition especially for developing countries (Shiriki *et al.,* 2015).In many parts of the world, every part of the Moringa tree has been used effectively against various ailments (Ozumba., 2011). *Moringa oleifera* is the cheapest and credible alternative to not only providing good nutrition, but also to cure and prevent a lot of diseases (Paliwal *et al.,* 2011). A wide variety of nutritional and medicinal virtues have been attributed to its roots, bark, leaves, flowers, fruits and seeds (Kumar *et al.,* 2010). Each part of the Moringa tree (fruits, seeds, leaves, flowers, bark and roots) is associated with the presence of at least one, or in most number of benefits (Zaku *et al.,* 2015).These parts have used for the treatment of inflammation and infectious human diseases like cardiac circulatory tonic and antiseptic (Wadhwa, 2013).

Moringa oleifera has a lot of medicinal uses. It is a healing plant used for the treatment of many ailments and troubles (Damilola *et al.,* 2011). All parts of *Moringa oleifera* are useful and help to maintain mental alertness and healthy skin; boost energy levels; improve mental clarity and focus and promote sound sleep (Institute of Charted Chemist of Nigeria (ICCN), 2013). It is strong antioxidant properties guard against skin cancer and prostrate growth. It curbs other health complications such as diabetes, anemia and high blood pressure. Liver,

kidney, stomach and thyroid problems can also be prevented by taking this medicine. The anti-inflammatory properties of *Moringa oleifera* reduce different body pains.

It is very effective for treating arthritis, rheumatism and joint pain. It can also control other severe diseases such as epilepsy, migraine and other headaches. Its detoxification properties make it suitable to treat scorpion and snake bites it has also claimed to boost immune systems (Olugbemi *et al.,* 2010). Its leaves are full of medicinal properties including antiseptic, rheumatism treatment, venomous bites, and other. In traditional medicine, the leaves are used to treat ailments including malaria, typhoid fever, parasitic diseases, arthritis, swellings, cuts, diseases of the skin, genito-urinary ailments, hypertension and diabetes (Leone *et al.,* 2015). Moringa leaves are applied to sores and skin infection and they are also prescribed to cure anemia. The leaves are also used for skin treatments to cure cuts, scrapes, sores, rashes and signs of aging. It is also used to help with anxiety and sleeplessness. Moringa leave is a strong antioxidant, effective against prostrate and skin cancers, an anti-tumor and an anti-aging substance. Moringa leaves provide immunity against HIV and AIDS and manage fibroid, while preventing other diseases.

Moringa leave is a strong antioxidant, effective against prostrate and skin cancers, an anti-tumor and an anti-aging substance. The flower also prevents cough, asthma, muscle diseases and enlargement of spleen. It is eaten raw; pods act as a de-wormer and treat liver and spleen problems as well as pains of the joint. The seeds are used for their antibiotic and anti-inflammatory properties to treat arthritis, rheumatism, gouts, cramps, sexually transmitted disease, boils and epilepsy (Ajala *et al.,* 2012).

It is completely biodegradable and will help the rural poor who suffer from a lot of water borne disease such as cholera, dysentery and typhoid in purification of their water and saved

them from getting ill (Omotesho *et al.*,2013).The roots is use to prevent tuberculosis glands in the neck, to destroy tumors, ulcer and earaches (Adeyemi *et al.,* 2012). The gum of *Moringa oleifera* is used to treat fevers, dysentery and asthma. The gum is used for dental decay. The stem and bark removes all kinds of pain. It is anthelmintic and useful to cure eye disease, it has also been used in treatment and prevention of detoxification and cancer as well as other ailments.

Moringa oleifera is perceived to be medicinal plant with high nutritional value in terms of high protein, vitamins, beta-carotene and amino acids, hence could be useful as a food supplement for both human and animals (Hashim *et al.*, 2013). The plant has been found to be rich is vitamins, minerals and edible oil called Ben oil (Ofoh *et al.*, 2011). Together, the edible parts of the tree contain high amounts of the 8 "essential amino acids" that your body does not produce but must be replenished daily. *Moringa oleifera* has several uses. As plant-based minerals, beta-carotene and trace elements (Anjorin *et al.*, 2010).

Moringa leaves contain four times more vitamin A than the same quantity of carrots; four times the calcium in a cup of milk; more iron than 100 g of spinach; seven times the vitamin C in 100 g of oranges and three times the potassium in 100 g of bananas. The protein quality of Moringa leaves also rivals that of milk and eggs (Fahey, 2005). Leaves are the most nutritious and have a higher health benefiting potential than other organs of the plant (Lako *et al.*, 2007). It is believed that this miracle tree has more Vitamin A than carrots, more Vitamin C than oranges, more calcium than milk and more iron than spinach (Azeez *et al.*, 2013).The leaves are a rich source of minerals, amino acids and proteins, and vitamins, including vitamin A precursors, especially beta-carotene, and various phenolics and alkaloids.

Moringa oleifera has long been considered a panacea for improving the nutrition of poor communities in the tropics and sub tropics (Agbogidi and Ilondu, 2012). Phyto-chemical analyses have shown that its leaves are particularly rich in potassium, calcium, phosphorous, iron, vitamins A and D, essential amino acids, as well as such known antioxidants such as β-carotene, vitamin C, and flavonoids (Amaglo *et al.,* 2010). Moringa leaves contain high levels of vitamin C, calcium and potassium, as well as protein (Zaku *et al.,* 2015). Malnourished children who take M. oleifera as a nutritional source or multivitamin improve their weight and overall health (Farinola *et al.,* 2012). The plant has been found to be rich is vitamins, minerals and edible oil called Ben oil (Ofoh *et al.,* 2011).

According to Kasolo *et al*. (2010) and Stevens *et al.* (2013), the leaves of Moringa are particularly rich in potassium, calcium, phosphorous, iron, vitamins A and D, essential amino acids, as well as some known antioxidants such as β-carotene, vitamin C, and flavonoids. Tree has been canvassed recently to be an indigenous source of highly digestible protein, Ca, Fe, Vitamin C and carotenoids suitable for utilization in many of the developing world and it can be used to combat malnutrition because it is a readily available and promising food source.

2.4 Utilization of *Moringa oleifera*

Moringa tree is a versatile tree useful not only for human beings but also for animals and also in various industrial applications. It has been found useful in nutrition, soil control, water purification, industrial use, livestock, fisheries, cattle feed and also for treating various types of illnesses in human and livestock (Mojisola *et al.,* 2014). Moringa Tree has been of many uses to human race ranging from consumption to domestic usage. Its edible properties and evidence of its role in human health and nutrition made it a tree that is long consumed by

man. Utilizing Moringa Tree has been of many uses to human race ranging from consumption to domestic usage, animal forage, plant manure, bio-pesticides and as ornamental plants. The tree also produces viscose resin that is used in the textile industry. The leaf biomass was used as mulch and as organic fertilizer.

Usage of Moringa seed for household water purification produced substitute for imported flocculants, thus reducing expenditure by rural household. Moringa leaves are added to food preparations as integrators of the diet (Leone *et al.,* 2015). Moringa leaves are eaten as salad, vegetable soup for human nutrition. Seeds are roasted and eaten like groundnut (Popoola and Obembe, 2013). *Moringa oleifera* is also used and valorized through food fortification. For instance, in Nigeria, it is used to fortify food formulations of corn, soy and peanut (Shiriki *et al.,* 2015). Its leaves, flowers and fresh pods can be used as vegetables, while other parts are used as livestock feed (Anjorin *et al.,* 2010).

Moringa seeds contain ben oil (40%) that produced from this tree contains very nutritious and is non-drying resists rancidity, have been utilized for cooking, lubrication, perfume industry and cosmetic products (Adeyemi *et al.,* 2012).It may also be used as forage for livestock, a micronutrient liquid (Stevens *et al.,* 2013). Burying Moringa leaves into the soil before planting serve as a natural pesticide. Crush leaves of *Moringa oleifera* can be used to clean cooking utensils. Moringa seed kernels contain oil that is valued for culinary and cosmetic use (Adedokum *et al.,* 2010). The bark of M. oleifera can be beaten into a fiber that can be used to make rope, mats; the wood produces a blue dye (Adeyemi *et al.,* 2012). Moringa provides wind protection and shade. All parts of Moringa tree are edible and consumed by humans. The Sub-Saharan African region is well endowed with wild and

domesticated food plants that have several beneficial properties, including good nutritional and medicinal properties (Mahajan, 2007).

The key uses of Moringa include alley cropping (biomass production), animal forage (leaves and treated seed-cake), biogas (from leaves), domestic cleaning agent (crushed leaves), blue dye (wood), fencing (living trees), fertilizer (seed-cake), foliar nutrient (juice extracted from the leaves), green manure (from leaves), gum (from tree trunks), honey and sugar cane juice-clarifier (powdered seeds), honey (flower nectar), medicine (all plant parts), ornamental plantings, bio-pesticide (soil incorporation of leaves to prevent seedling damping off), pulp (wood), rope (bark), tannin for tanning hides (bark and gum), and water purification (powdered seeds)(Adebayo *et al. ,* 2011; Popoola and Obembe, 2013; Leone *et al. ,* 2015.).

The seed cake remaining after oil extraction may be used as a fertilizer or as a flocculent to purify water. The seeds can eat fresh as peas, roasted or powdered, and the seeds powder can be used for water treatment (Fahey., 2005). Additionally, for human consumption, the young fresh pods, kernels and roots as pickles, sauces, juices and vegetables have been used due to traditional medicine purpose (Adebisi., 2016). Moringa seeds gave high yield of oil, which has good antioxidant capacity with great potential for industrial, nutritional and health applications.

Large scale cultivation of this economic plant could be used as poverty alleviation strategy in Nigeria. Moringa seed kernels contain oil that is valued for culinary and cosmetic use (Adedokum *et al.,* 2010). M. oleifera oil on a small scale might be economically feasible if it were marketed to restaurants, hotels and others high-end venues as a locally produced alternative to imported olive oil. Utilization of nutrient dense foods that are locally available, affordable and culturally acceptable would be a more sustainable strategy for addressing

child malnutrition among low-income, rural communities. Due to several recent developments, the potential utilisation of Moringa oleifera in products is vast and constantly expanding (Nouman *et al.,* 2014).

2.5 Constraints Associated with *Moringa oleifera* Production

The low levels of awareness of the inherent benefits of the plants have challenged the level of its cultivation in some parts of the world. Other challenges to the cultivation of the plant include uncertainty of markets in some developing countries and inadequate knowledge about its cultivation and uses. Lack of access to markets was one of the challenges that were faced by the *Moringa oleifera* growers Household's. Difficulties with a reported failure of an international buyer of *Moringa* leaves by some rural households shows the importance of secure markets which allow the producer to develop this perennial crop. Although those Growers Household's (MGHs) were disappointed because the economic gain did not materialize, this resource, for example, could still be used to fulfill the mineral nutritional requirements of their household and/or livestock especially during the dry season and at the onset of the rainy season when other vegetables and forage crops are scarce (Jiru *et al.,* 2010).

Raising community-wide awareness on the multiple uses of *Moringa oleifera* is required to create market demand and maximize resource utilization. Moringa leaves browsed and shredded by insect larva are less appealing for human dietary consumption. Furthermore, diseases, pests and parasitic plants lead to decrease in foliage biomass production and in extreme cases kill the trees. Insect Larva foraging on the leaves reduced leaf biomass production and damaged leaves are unappealing for use as human food. Seeds in the pods bored by larva were damaged and became unviable for seeding and seedling production, and for other uses. Moreover, insufficient supports from the government and public policies, lack

of appropriate management and institutional strategies have been drastically eroded *Moringa oleifera* cultivation and uses. Protection and conservation of medicinal plant resources were not considered as a major concern.

2.6 Factors Influencing Utilization of *Moringa oleifera*

Socio-economic characteristics of rural households play significant role in their lives in the sense that they influence willingness to accept changes that contribute significantly in rising farm level productivity and ultimately their standard of living. Various researches had been conducted to identify socio-economic characteristics of small-scale farmers in relation to plants production. Socio-economic factors such as age, household size, formal education, income, social status and family size were all found to be significantly related to agricultural production of rural farmers.

2.6.1 Age

The age of an individual affects his mental attitude to new ideas and may influence adoption in one of several ways. For instance, as the farmer ages, it is expected that his willing to embrace new ideas would diminish. Younger farmers have been found to be more knowledgeable to new practices (Ojo *et al*., 2013); more receptive and adaptable to new technological innovations and may be more willing to bear risk and adopt a technology. The older the farmer, the less likely he adopts new ideas as he tends to be more conservative by gaining more confidence in his old ways methods as newly introduced technology usually comes with additional cost (Hossain, 2012) observed that it is generally believed that males are often more energetics and could readily be available for energy demanding jobs like *Moringa oleifera* and some plants farming.

2.6.2 Marital status

Moringa oleifera in the developing countries is dominantly produced by male farmers. This is contrary to the general opinion that the majority of smallholder farmers are women. However, it is also known that male farmers mostly feature on production of commercial crops. study conducted by Odeyinka and Ademosun, (2007) on awareness and knowledge of *Moringa oleifera* in Nigeria also indicated a higher proportion of male farmers compared to females. Furthermore, another study conducted by Thamaga and Chitja (2014) on the consumption of Moringa reported that most of the respondents consuming Moringa products in Nigeria were males. The possible reason for woman to be less involved in Moringa farming might be that large sizes of farms are owned by men while woman are focusing on household activities and production in the backyards, in order to stabilize home food supplies. This trend of production may also suggest a strong commercial potential of the plant, hence the clear interest by male farmers.

2.6.3 Household size

This is defined as the total number of people living with the farmer family unit. That is, it comprises all the people living under the same roof and who eat from the same pot with the farmer. This variable is brought into the model because it plays an important role in determining what occurs on the farm. Some previous studies show this variable is positively related to adoption behaviour as it provides a larger supply of family labour while other studies view that this variable has a negative relationship with adoption since increased household size increases consumption pressure. Hence, household size and adoption will depend on the balance of the opposing forces of family demand (Nsoanya *et al.,* 2011).

2.6.4 Level of education

Educational level is defined as the total amount of formal schooling received by the farmer. The adoption of improved technology is a managerial concern that requires some managerial skills. Such skills are often gained through education (Ayanwale and Amusan, 2012). Also, education reduces the level of ignorance of an individual by improving his ability to decode, understand and process information and therefore is a measure of the ability to assess new technology. (Zeleke *et al.,* 2008.) asserted that higher level of education is believed to associate with access to information on improved technologies and higher productivity.

Education is a major pathway from health to productivity and from socio-economic status to health, and also affects the demographic transition. The revealed that there is a positive relationship between the education level of household head/inhabitant and the adoption of improved technologies and adaptation. Health status strongly influences the quantity and quality of labor and achieved educational status. Education in infant-feeding practices, weaning foods, and consumption choices for children and adults is also important for nutritional status, as is education on allocating time for and improving the quality of child care (Rasul *et al.*, 2009). The high risk of child mortality prevents households from going through the demographic transition to smaller families and better educated children.

2.6.5 Farming experience

Farmers having a longer farming experience were in a better position to get income from moringa tree farming system than farmers with shorter farming experience. Moreover, farmers with longer farming experiences have a cumulative knowledge of expanding Moringa farming practice and could diversify its components. This in turn enables them to get higher income from moringa farming system than farmers with short farming experience (Nkamleu and Manyong, 2005). This shows that farmers will be able to make sound decision

as regards resources allocation and management of their farm enterprises. More farmers started planting Moringa after realizing its nutritional and health benefits as well as possibilities of income generation from its products.

2.6.6 Farm size

Sufficient size of land holding is the basic requirement for adoption of improved agricultural technologies. A farmer with more land is more able and willing to experiment with a new technology (Ashenafi, 2011). It was thus expected that the farmers who have larger farm size would have got higher income from the practice than those of small farm size. cultivated is a function of production pressure, family size and financial background of the farmers. One major characteristics of small-scale farming is fragmented land holding.

2.6.7 Farm income

This is the net farm income per hectare of the farm. Since this variable can be viewed as a proxy for wealth, the options to acquire and use technologies may be expanded by it (Rasul *et al*., 2009). It is included to determine whether the potential adopters,social status and purchasing power have an effect on technology use. This is because wealthy farmers have sufficient resources to absorb the cost and risk of failure of the innovation. The variable is expected to have a positive relationship with adoption as the farmer tends to experiment with new ideas that tend to increase net farm income. Agricultural production remains an important source of income for most of those living in rural areas and its growth will continue to be a mainstay of poverty alleviation.

According to (Ayanwale *et al.,* 2012) posited that the main criteria often used to classify rural farmers by various researchers are, the level of income of the farmers, land size of the

farmers, purpose of production and other important factors. However, the death of a working adult may be catastrophic for the household. Mental health problems are as frequent among the poor as among anyone else, probably more so given the additional stress, and this may be manifest as alcohol and drug use, gambling, crime, etc. In addition, low income farmers are at high risk for suicide as well as for unemployment.

2.6.8 Membership in association/Cooperative society

Cooperatives enhance the interaction and cross-fertilization of ideas among farmers. The influence of credit for instance on Moringa plant usage is measured in terms of membership in cooperatives as its use is promoted by cooperatives. If a farmer is a member of a cooperative, credit and new technological innovations such as Moringa plant are provided to him as a package. Thus, membership in a cooperative is very important in the adoption of a technology since it indicates higher socio-economic status. Having access to other sources of credit may not have much effect on the purchase of Moringa plant because a farmer may not know where to buy them. Cooperatives are a useful instrument for effecting rural change. They have been useful in channeling funds to small scale producers through on-lending from commercial banks and other formal credit institutions. Farmers are mainly socio-cultural and religious groups and not really agricultural production or farm interest based associations or cooperatives that would have a positive input on their farming activities by raising production levels and hence, their income and living standards.

2.6.9 Extension contact

The information which farmers obtain during the year on the importance and application of new technological innovations through counseling and demonstrations by extension agents on a regular basis. The impact of this information on adoption decisions vary, however

according to its channel, sources, content, motivation and frequency (Lee, 2008). Thus, based on the innovation-diffusion literature, the expected sign for the coefficient of this variable is positive. defined Extension as a service or system which assists farm people, through educational procedures, in improving farming methods and techniques, increasing production efficiency and income, elevating their levels of living and lifting their social and educational standards. The function of extension may be applied to several subjects, both agricultural and non-agricultural, such as health. When it is applied to agriculture, it is called agricultural extension.

2.6.10 Distance to market

Farmers who are near to market will have up-to-date information than farmers who are far from market. And farmers who have up-to-date market information are more responsive to newly introduced agricultural technologies than those who have no access to market information which is associated with distance from market. Therefore, the longer the distance from the market farmers will be discouraged to adopt moringa tree based agroforestry practice. Thus, income from moringa tree based agroforestry is negatively correlated with distance from market (Ashenafi, 2011).

2.6.11 Sources of information on utilization *Moringa oleifera*

Information plays a critical role in any human endeavour and how this information is sourced is no less important. The present era, also known as the information era, requires creation of information expressway interlinking farmers, markets, corporate bodies, agricultural scientists, and buyers of agricultural products. This may help producers to realize maximum share from the price paid by end consumer. Agriculture plays an essential role in every culture throughout the world. Everyone has to eat. Our modern world is engaged in global

commerce with nearly ubiquitous, instant communications. Through this access to this information, people are now becoming aware of what is in their food or how it is produced.

Effective communication has long been recognized as vital to the food and agricultural enterprises of societies. Agricultural communications, in its simplest understanding encompasses all kinds of human communication in relation to agriculture, food, natural resources and rural interests. The effective development and management of *Moringa oleifera* can indeed contribute to sustainable production and utilization *Moringa oleifera* in developing countries. For this to take place, appropriate communication media. The medium of this dissemination could be called a channel.

Channels of information communication are, this will be measured by the number of information Sources by the respondents through radio, family and relation, television and extension workers. Technology has made it possible for human society to communicate easily irrespective of geographical location through the aid of telephones, telegram, fax, radiophone, television, e-mail, telex, internet, intranet, computer etc. Okafor and Malizu, (2013) asserts that information is a critical economic resource for *Moringa oleifera* utilization.

2.6.12 Utilization

Farmers indicated that they use *Moringa oleifera* in several ways, such as: A source of income, a high nutritional supplement for good health, food security, immune booster, livestock feeding, water purification, medicinal purposes to prevent many diseases and energy booster.

2.6.13 Availability of *Moringa* plant

The adoption of a technology is promoted by its availability since it is obvious that the technology will not be used unless made available in the right quantity form and time. The farmers also indicated that they sell Moringa products from their own produce and have not yet started sourcing from other farmers. Majority of farmers produce *Moringa oleifera* with an intention of marketing their products. it was observed that 3.2% of the farmers do not sell their products, reason being that the trees are still young but the ultimate intention is to sell the leaves at a later stage. weak market links and poor bargaining power among marketers and adulteration with fake plants in order to hike their profits (Grosvenor, 2016). Few farmers produce *Moringa oleifera* and sell it in various forms including, teabags, capsules, fresh leaves, seeds and seedlings. Farmers, who produce teabags and capsules, are the ones who have established the markets and managed to purchase the processing machines. Majority of the farmers sell their products within their immediate community, while only a few of well-established producers sell to the supermarkets and pharmaceutical shops.

2.7 Theoretical Framework

Various studies have been conducted to understand extent of utilization of *Moringa oleifera* tree products Theoretical frameworks used to understand and explain the perceived health benefit of *Moringa oleifera* tree products is the perception theory. The perception factors are mainly a combination of rural households' personal attributes (e.g. education, age, gender and household size), the economic variable which includes characteristics of the farm (e.g., farm size and tenure system) and contextual aspects (e.g. change income, livestock, labour and market for both inputs and farm produce) all of which determines perception toward utilizing *Moringa oleifera* tree products. Other factors (communication and socio-psychodynamic variables) geared toward information seeking are mainly behavioural factors

influencing utilization. The behavioural factors are shaped by the knowledge, attitude, subjective culture and perceived behavioural response (favourable or unfavourable).

2.8 Conceptual Framework

This consists of concepts that are placed within a logical and sequential design and represents less formal structure. Ekong (2010) views conceptual model as a broad system of explanation which is founded not so much on prior research finding but largely on untested and unproved assumptions about social realities. Furthermore, Asika (2011) reported that these relationships and functions can be represented schematically or mathematically. The conceptual framework of this study shows the relationship between institutional factors, intervening, independent and dependent variables. The independent variables of the study includes the socio-economic characteristics such as age, level of education, membership of cooperative, farm size, gender, and farming experience etc, perceived health benefits of *Moringa oleifera* tree products and constraints associated with *Moringa oleifera* tree products utilization.

This relationship between dependent and independent variables will be further affected by other factors that are not thoroughly investigated in this study which are intervening variables like cultural factors, socio-political factors, economic factors and value system as well as government policies. These variables are expected to have direct and indirect relationship with dependent variable and expected outcomes. The overall interaction of these variables will affect the extent of utilizing *Moringa oleifera* tree products.

However, utilization of *Moringa oleifera* tree products by rural farmers in the study area is considered to be influenced by the farmer's socio – economic characteristics, farmers' perception about the health benefits and constraints faced in accessing healthcare services.

Therefore, the illustration in Figure 2.1 shows how the independent variables and the intervening variables influence the dependent variable. The independent variables include socio – economic characteristics of rural farmers, accessibility and utilization of healthcare services, farmers' perception about the health benefits and constraints associated with utilization of *Moringa oleifera* tree products. Intervening variables are those variables that come between the independent and dependent variables which accounts for the indirect or direct unobservable psychological process that in turn account for behaviour effect. Therefore, Government policies, cultural practices and environmental factors as well as availability, accessibility and affordability are considered as the intervening variables.

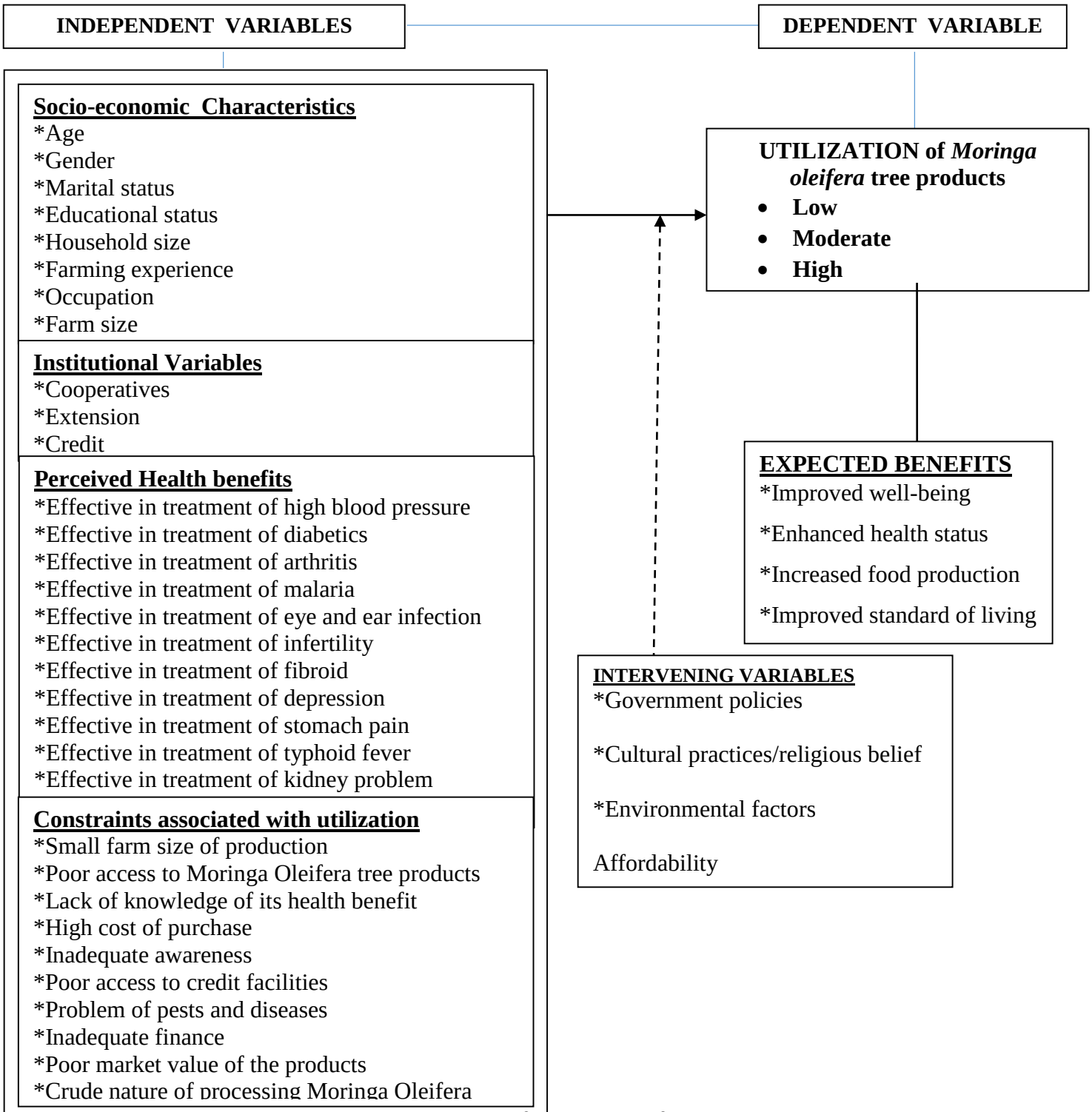

Figure 2.1: Conceptual model on utilization of Moringa oleifera in the study area

Source: Adopted and Modified from Bature (2016).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Area

The study was conducted in Nasarawa state. The state is located in the middle belt zone of the country. It lies between Latitude 7º 45'-9º 25'North and Longitude 7º 00'-9º 37'East, and shares common boundaries with Benue State to the South, Kogi State to the West, the Federal Capital Territory (FCT), Abuja, to the North West, Kaduna and Plateau states to the North East, and Taraba State to the South East. Nasarawa state with as Lafia the capital was eventually created on 1 October, 1996 from defunct Benue and Plateau provinces of Northern Nigeria (Nasarawa state geographical information system (NAGIS), 2018).

The 1991 census put the State's population at 1.2million, while the State's population by 2006 was about 2.0 million. However, with the influx of people particularly into Karu and Keffi LGAs, due to their proximity to the Federal Capital Territory (FCT), Abuja, as well as into Lafia, being the state capital, places the current estimated population of the state at 2,444,803 as at 2018 using 2.8% growth rate with males constituting 51% and females 49% of the population.

The State has a climate typical of the tropical zone, because of its location. Its climate is quite pleasant with a minimum temperature of 60º F and Maximum temperature of 80º F ,recorded while rainfall varies from 313.73cm in some places to 145cm in other areas. The month of December, January and February are cold period (sometimes quite cold) due to the very dry Harmattan winds blowing across the state from the North-East. The State is characterized by two distinct seasons: dry and wet. The dry season start from November to February, while the rainy season is from March to October. Average daily sunshine in the state is 6.2 hours and daily vapour pressure is 26hpg.

The physical features of the State are largely mountainous and covers very large area of the State, much of which are rocky and undulating highlands of average height of about 1,400m above sea level. The coastline of river Benue and its trough created alluvial fertile soil, which is very good for crop production. Other smaller rivers cover most parts of the state and empty into the river Benue. The sediments are generally comprised of sandstones, siltstones and subordinate inter-bedded clays all of cretaceous age. Alluvial soils are found along the Benue trough and their flood plains. These are always swampy in nature due to availability of water all the year round. The forest soil, which are rich in humus, and laterite soils are found in most parts of the state.

Over 80% of the people of the state are subsistence farmers and live in rural areas. Major crops suitable to the state ecological conditions are rice, sesame, soya beans, groundnut, cassava, yam, maize, cashew, sorghum, melon, mangoes, citrus and vegetables. There is an estimated water surface area of over 5,645 square kilometer and favourable climatic conditions for the fish industry.

3.2 Sampling Procedure and sample size

The population for the study were rural households residing in Nasarawa State that were into *Moringa oleifera*. The State is divided into three (3) Agricultural Zones (South, North and West). Multi-stage sampling techniques was used to select all the respondents in the study area. First stage involved random selection of two (2) Local Government Areas, from each agricultural zones of the state. The six (6) Local Government Areas are South zone (Lafia and (Doma), Northern zone (Kokona and Nasarawa eggon) and Western zone (Karu and Toto). The second stage involved random selection of two (2) villages from each of Local Government areas to get twelve (12) villages in the study area namely: Akwanga, Awe,

Ancio, Babba, Agwanshi, Agyaga, Wana Boher, Yelwa, Andaha, Uke, Tunga and Umaisha. The third stage involved the use of Yamane formula for appropriate sample size determination. In overall, a total of 244 respondents were sampled from all the villages using Taro Yamane formula given as:

$$n = \frac{N}{1+\mathrm{N(e)2}}$$

Where:

n = sample size

N = finite population

e = limit of tolerate error (level of precision (0.5))

1 = constant

Table 3.1: Sampling outlay of the respondents in the study Area

State Zones	LGA	Villages	Sample Frame	Sample Size
Northern	Nasarawa eggon	Wana	31	22
		Alushi	29	20

	Kokona	Boher	20	14
		Yelwa	31	22
Southern	Doma	Doka	37	26
		Okuba	35	24
	Lafia	Akwanga	23	16
		Awe	20	14
Western	Karu	Uke	37	26
		Gunduma	29	20
	Toto	Tunga	23	16
		Umaisha	35	24
Total	**6**	**12**	**350**	**244**

Source: Nasarawa State Agricultural Development Project, 2018

3.3 Method of Data Collection

Data for this study were obtained from primary sources with the use of structured questionnaire. The questionnaire was administered on the respondents to collect information on their socio-economic characteristics, the extent of utilization of *Moringa oleifera* by the respondents; the perceived health benefits of *Moringa oleifera,* the factors influencing the extent of utilizing *Moringa oleifera* and the constraints associated with the *Moringa oleifera*.

3.4 Measurement of Variables

3.4.1 Dependent variables

Dependent variable for this study is the extent of utilizing *Moringa oleifera*. This was measured using 3-point Likert type of scale involving High utilization (3), Moderate utilization (2) and Low utilization (1). The mean score for the scale calculated as 3+2+1=6 divided by 3 to give 2.0 was considered as bench mean score for the scale. Thus, mean Score ≥ 2 was adjudged = High utilization, while mean Score < 2 was adjudged = Low utilization

3.4.2 Independent variables

1. Socio-economic characteristic of rural households:

Age: - This was measured by the actual number of years of the respondents at the time of data collection.

Gender: - This was measured as a dummy variable where male is assigned, 0 if otherwise)

Level of education: - This was measured by the number of years spent in formal education school under three major categories: Primary, Secondary and Tertiary.

Household size: - This was determined as the number of people living in a family.

Farm size: - This was measured in hectare(ha)

Income: - This was measured as total amount of money realized by the respondents from the sale of *moringa* products. It was measured in Naira.

Credit access: - It was measured in Naira over a period of one year.

Cooperative membership: - It was measured by the number of Cooperatives the respondents belong (number)

Extension contact: This is the numbers of times the respondents received extension agent per annum.

Farming experience in *Moringa* production:- Measured in number of years the respondents have been Farming moringa.

Experience in *moringa* utilization: measured in number of years the respondents have been utilizing *moringa* tree products.

Part of Moringa tree products utilized: was measured in number by asking the respondents to indicate the part of moringa products utilized in the study area

Purposes of utilizing Moringa tree products: This was measured based on the purposes of utilizing moringa tree products as consumption assigned 1, while otherwise is 0.

2. The constraints faced by moringa oleifera farmers was determined using a 3-point Likert type of scale involving Very Severe (VS) = 3, Severe (S) = 2 and Not Severe (NS) = 1. Thus, mean scores of ≥ 2 implies Severe constraint, while mean scores of < 2 = Not Severe constraint.

3.5 Method of Data Analysis

Objective i, ii, iii and v.

Objectives i, ii, iii and v were achieved using descriptive statistics such as frequency distribution, percentage, mean and standard deviation.

Objectives i, ii, iii and v

Objectives ii, iii and v were achieved using descriptive statistics (Three point likert scale was used to measured the extent of Moringa oleifera utilization among the rural households as HU = Highly Utilization (3), MU = Moderate Utilization (2) and LU = Low Utilization (1)

Objective iv

The factors that influence the extent of *moringa* utilization objective (iv) was achieved using inferential statistics of Logit regression; The implicit form of the model is given as:

$Y = f(X_1, X_2, X_3, X_4, X_5 \ldots\ldots\ldots\ldots\ldots\ldots X_{12})$

The Logit regression model in its explicit form is expressed as below:

$Y = b + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + \ldots\ldots + b_{12}X_{12} + U$

Where;

Y = Extent of utilizing *Moringa oleifera* (1 = high utilization, 0 = otherwise)

X_1 = Age (years)

X_2 = Gender (male=1, female=0)

X_3 = Education level (years)

X_4 = Household size (number)

X_5 = Farm size (hectares)

X_6 = Farming experience (years)

X_7 = Extension contact (number)

X_8 = Cooperative membership (number)

X_9 = Credit access (yes =1, otherwise =0)

X_{10} = Part of Moringa tree products utilized (number)

X_{11} = Purposes of utilizing Moringa tree products (Consumption = 1, otherwise = 0)

X_{12} = Perceived health benefits Moringa tree products (Perception score)

U = error term.

3.6 Testing of Hypothesis

The Pearson Product Moment Correlation (PPMC) analysis was used to test hypothesis ii, while hypothesis i was tested using the z-value from the Logit regression. The PPMC formula is given as:

$$r = \sum \frac{n\sum xy - \sum x \sum y}{\sqrt{[n(\sum X2) - (\sum X)2\}[n(\sum Y2) - (\sum Y)2]}}$$

Where;

r = correlation coefficient

Y = Health benefits

X = Extent of utilization

N = total number of observations

$\sum$ = summation.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter discussed the results of analysis from information provided by the respondents on their socio-economic characteristics, extent of utilization of *Moringa oleifera*, perceived health benefit of *Moringa oleifera*, factors influencing extent of utilization of *Moringa oleifera* and constraints associated with *Moringa oleifera* in the study area.

4.1 Socio-economic characteristics of the rural households

The Socio-economic characteristics of the respondents includes age, sex, marital status, household size, educational status, farming experience, farming status, access to farmland and farmland acquisition. The results of these variables are presented in Table 4.1

4.1.1 Age of the respondents

The result in Table 1 revealed that most (60.7%) of the respondents were within the age range of 31 – 60 years with a mean age of 40 years implying that the rural households were in their mid-age and most productive stage of life where they could utilize *Moringa oleifera* tree products and appreciate its' health benefit. Young people are reported to be active in every economic activities and quick in decision making process as it affect their livelihood. Thus, they are inclined towards utilizing *Moringa oleifera* tree products based on its health benefit. This result is in agreement with Etonihu *et al.* (2013) who posited that active farming age was between 41 – 60 years with a mean age of 43 years.

Table 4.1: Distribution of respondents based on their socio-economic characteristics (n = 244)

Variable	Frequency	Percentage	Mean
Age (years)			
< 31	70	28.7	**40**
31 – 40	89	36.5	
41 – 50	38	15.6	
51 – 60	21	8.6	
> 60	26	10.7	
Sex			
Male	158	64.8	
Female	86	35.2	
Marital Status			
Single	74	30.3	

Married	134	54.9	
Divorced	12	4.9	
Separated	4	1.6	
Widowed	20	8.2	
Household size (No)			
< 6	138	56.6	**7**
6 – 10	63	25.8	
11 – 15	17	7.0	
16 – 20	9	3.7	
> 20	17	7.0	
Educational status			
No formal	39	16.0	**13**
Primary	42	17.2	
Secondary	72	29.5	
Diploma/NCE	55	22.5	
Degree/HND	36	14.8	
Faming experience (years)			
< 6	14	5.7	**23**
6 – 10	29	11.9	
11 – 15	46	18.9	
16 – 20	65	26.6	
> 20	90	36.9	
Farming status			
Full term	132	54.1	
Part term	112	45.9	
Access to farmland			
Access	231	94.7	
No Access	13	5.3	
Farmland acquisition			
No Access	13	5.3	
Inheritance	150	61.5	
Purchase	22	9.0	
Rent/Lease	56	23.0	
Gift	3	1.2	

Source: Field Survey, 2020

4.1.2 Sex of the respondents

The distribution of the respondents based on their sex is presented in Table 4.1 as most (64.8%) of the respondents were males, while 35.2% were females implying that males were the dominant household heads in the area. Males are the major decision makers and breadwinner in most rural household settings because of the role they play in the society. They provide the basic needs of the family like food, clothing and shelter as well as provide

healthcare which could be achieved through utilization of *Moringa Oleifera* tree products. This finding is in line with the work of Thamaga and Chitja (2014) who reported that most of the respondents consuming Moringa products in their study area were males.

4.1.3 Marital status of the respondents

As shown in Table 4.1, more than half (54.9%) of the respondents were married, while 30.3% were single and others were either widowed (8.2%), divorced (4.9%) or separated (1.6%), implying that the respondents are responsible individual with sense of responsibility to provide the basic needs of their families. Married individual are responsible for pro-creation of next generation that will assist in farming operations. This result agrees with the work of Onyebu (2016) who reported that majority of the respondents in his study area were married and more involved in income generating activities than those that are single.

4.1.4 Household size of the respondents

Table 4.1 revealed that more than half (56.6%) of the respondents had household size of less than 6 people with a mean household size of 7 people implying a relatively large households. Rural households comprises of all the people living under the same roof and eat from the same pot. It plays an important role in determining what occurs on the farm through supply of family labour. An increased family members increases the consumption expenditure of the households which could enhance the utilization of *Moringa Oleifera*.

4.1.5 Educational status of the respondents

In terms of the educational status of the respondents, majority (84.0%) of the respondents acquired one form of formal education or the other (primary, secondary and tertiary) with a mean of 13 years of formal schooling. This implies that most of the respondents are educated (i.e. could read and write), with at least acquiring secondary education. Education is a major

pathway for improved health, productivity and socio-economic status. Hence, high literacy level in the study area could be associated with enhance utilization of *Moringa oleifera* tree products. This agrees with Ayanwale and Amusan (2012) who reported that high level of education improves an individual's ability to understand and process information about health benefits of *Moringa oleifera* tree products.

4.1.6 Farming experience of the respondents

Furthermore, Table 4.1 showed that more than half (57.4%) of the respondents had been into farming between 6 – 20 years with a mean farming experience of 23 years. This implies that the respondents are experienced which is an asset in farming because it inspires farmers' rational decision making with respect to inputs utilization. Farmers with longer farming experiences have a cumulative knowledge of *Moringa oleifera* tree products and could diversify into its production based on the health benefits and income among others. This finding agrees with work of Nkamleu and Manyong (2015) who reported in their study that more farmers started planting *Moringa oleifera* after realizing its nutritional and health benefits as well as possibilities of income generation from its products.

4.1.7 Farming status of the respondents

As shown in Table 4.1, more than half (54.1%) of the respondents were full term into farming, while 45.9% were part term into farming. This implies that most of the rural households were fully into farming as primary occupation. Farming is a major occupation of the rural area as most rural societies are agrarian in nature which could increase the possibilities of utilizing *Moringa oleifera* tree products.

4.1.8 Access to farmland by the respondents

Table 4.1 revealed that majority (94.7%) of the respondents had access to farmland for agricultural activities, while only few (5.3%) of the respondents not having access to farmland. This implies that majority of the rural households have access to farmland for farming activities in the study area. Sufficient access to land holding is the basic requirement for adoption of improved agricultural technologies for increased output and well-being. This is in line with Ashenafi (2011) who reported that farmer with access to land holdings is more able and willing to experiment with new technologies.

4.1.9 Farmland acquisition by the respondents

The result of the farmland acquisition by the respondents as presented in Table 4.1 revealed that most (61.5%) of the respondents acquired their farmland through inheritance which could be fragmented farmlands, 23.0% of the respondents acquired their farmland through rent/lease and 9.0% of the respondents acquired their farmland through purchase. This implies that inheritance is the predominant means of acquiring title to land in the study area as most of the respondents owned their farmland through inheritance. Ownership of farmland determines level of production as it could influence the rural farmers to go into *Moringa oleifera* production based on its health benefits. This is in agreement with Teshome *et al*. (2014) who reported in their study that land ownership could positively influence farmers to efficiently utilize improved production resources.

4.1.10 Institutional variables of respondents

The institutional variables accessed by the respondents in the study area include extension contact, cooperative membership, access to credit and labour usage which are presented in Table 4.2.

4.1.10.1 Extension contact by the respondents

As revealed in Table 4.2, most (59.4%) of the respondents did not have contact with extension agents, while 40.6% had contact with extension agents implying that contact with extension agents is very poor in the study area which could affect the extension services received by the rural households. Access to extension service is expected to positively influence rural farmers perception towards utilization of *Moringa oleifera* tree products based on its health benefits. In terms of frequency of extension contact with extension agents by the respondents that had contact with extension agents, 14.8% had contact annually, while 12.3% had contact monthly, 10.6% had contact quarterly and only 2.9% of the respondents had contact with extension agents weekly. This implies that access to extension and advisory services by the rural households was very poor.

4.1.10.2 Cooperative membership by the respondents

Table 4.2 showed that most (66.8%) of the respondents were not member of cooperative societies, while 33.2% of the respondents were member of cooperative societies with a mean of 7 years as a member. This implies that most of the rural households were not member of cooperative societies, although some of them belongs to cooperative societies. Cooperative societies are a very useful instrument for effecting rural change as it enhances interaction and cross-fertilization of ideas among farmers. The number of years spent as a member of cooperative societies is expected to boost farmers knowledge and enhance their participation in cooperative activities. Thus, membership of a cooperative is very important in the utilization of *Moringa oleifera* tree products as its health benefits could be emphasize easily at cooperative meetings.

Table 4.2: Distribution of respondents based on institutional variables accessed (n = 244)

Variable	Frequency	Percentage	Mean
Extension content			
Contact	99	40.6	
No contact	145	59.4	
Frequency of contact			

Weekly	7	2.9	
Monthly	30	12.3	
Quarterly	26	10.6	
Annually	36	14.8	
Cooperative membership			
Member	81	33.2	**7**
Not member	163	66.8	
Credit access			
Access	79	32.4	**₦162,205**
No Access	165	67.6	
Sources of credit			
Bank of Agriculture	9	3.7	
Commercial Bank	17	7.0	
Cooperative	28	11.5	
Friends and Family	25	10.2	
Labour usage			
Family	134	54.9	
Hired	19	7.8	
Both	91	37.3	

Source: Field Survey, 2020

4.1.10.3 Access to credit by the respondents

More so, Table 4.2 showed that most (67.6%) of the respondents had no access to credit, while 32.4% of the respondents had access to credit with a mean sum of ₦162,205 credit accessed by the respondents. This implies that most of the rural households had no access to credit, although some of them were able to access credit in the study area. Credit is a catalyst for increased agricultural production and technology adoption especially among rural households as access to credit could enhance purchase and utilization of *Moringa oleifera* tree products by the farmer. This result agrees with the work of Baumgart-Getz *et al*. (2012) who posited that credit plays significant role in adoption of improved agricultural technologies especially those that have significant effect on their livelihoods. However, among the respondents that had access to credit, 11.5% sourced their credit from cooperative societies, while 10.2% sourced their credit from family and friends, 7.0% and 3.7% of the respondents sourced their credit from commercial and bank of agriculture, respectively. This implies that cooperative as well as family and friends are

the main source of credit by the rural households which could facilitates utilization of *Moringa oleifera* tree products.

4.1.10.4 Labour usage by the respondents

As revealed in Table 4.2, more than half (54.9%) of the respondents used family labour in their agricultural production, while few (7.8%) used hired labour. However, 37.3% of the respondents employed the service of both family and hired labour in their farming activities. This implies that the rural households use more of family labour than hired labour in the study area. Labour is used in farm operations to ensure activities are carried out on the farm as at when due This is done to achieve smooth farming operations for greater output. The use of family labour in most rural farming households is to help minimize costs of production especially cost incurred by hiring labour. This result agrees with the work of Ikramullah *et al.* (2015) who reported that family members constitutes the main labour force for farming operations in most rural settings.

4.2 Extent of Utilization of *Moringa oleifera* Tree Products by the Respondents

4.2.1 Utilization of *Moringa oleifera* tree products by the respondents

As revealed in Figure 4.1, almost all (99.0%) of the respondents utilized the *Moringa oleifera* tree products, while very small (1.0%) of the respondents did not utilized the *Moringa oleifera* tree products. This implies that the rural households in the study area have the knowledge of *Moringa oleifera* tree products' health benefits and utilized it. Aside from the health benefits (i.e. medicinal purposes to prevent many diseases), *Moringa oleifera* could be utilized in several other ways as source of income, nutritional supplement, food security, immune booster, livestock feeding, water purification and energy booster. This result is in line with the work of Leone *et al.* (2015) who reported that *Moringa oleifera* tree products has been of many uses to human race ranging from consumption to domestic usage.

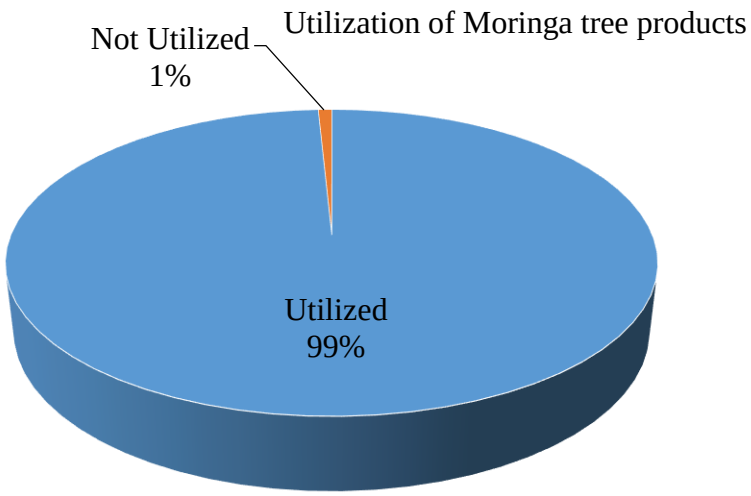

Figure 4.1: Utilization of *Moringa oleifera* tree products by the respondents

4.2.2 *Moringa oleifera* tree products utilized by the respondents

The distribution of the respondents based on the *Moringa oliofera* tree products utilized in the study area is presented in Figure 4.2. The result revealed that majority (99.2%) of the respondents utilized Moringa leaves, followed by Moringa Fruits/Seeds (89.8%), Moringa roots (87.7%) and Moringa barks (64.3%). This implies that the leaves, fruits/seeds, roots and barks are the most utilized Moringa tree products by the respondents in the study area. However, less than half (45.5%) of the respondents utilized Moringa branches as the tree products, while 44.3% of the respondents utilized Moringa stems and 32.1% utilized Moringa flowers.

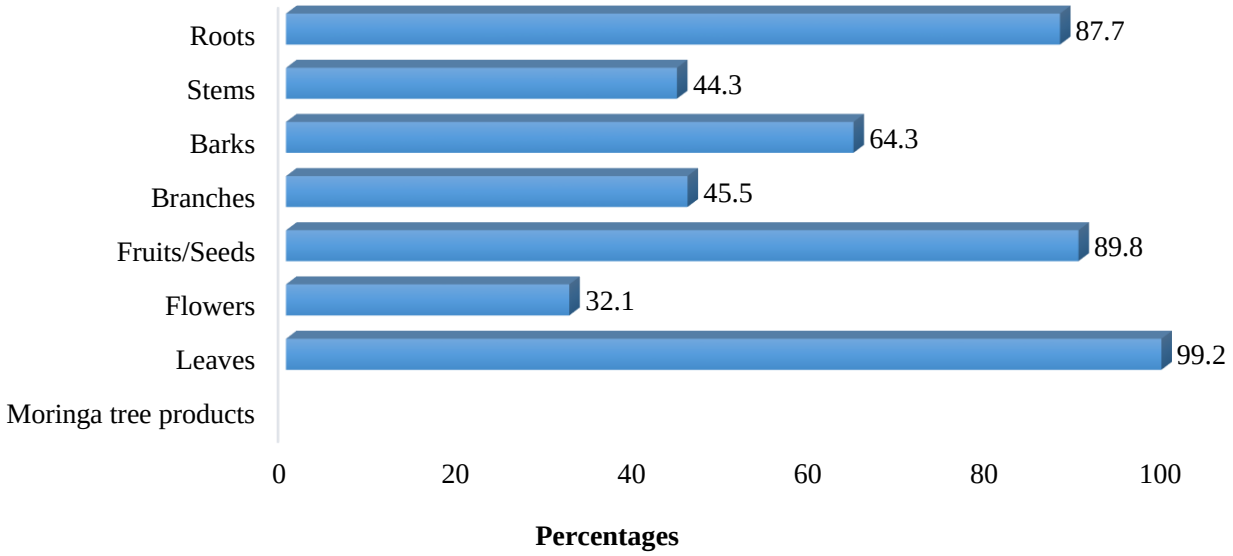

Figure 4.2: *Moringa oleifera* tree products utilized by the respondents

4.2.3 Extent of utilizing *Moringa oleifera* tree products by the rural households

The result on the extent of utilizing Moringa oliofera tree products as presented in Table 4.3 revealed that Moringa leaves ($\overline{X}$ = 2.84), Moringa fruits/seeds ($\overline{X}$ = 2.07) and Moringa roots ($\overline{X}$ = 2.05) recorded the highest extent of utilization among the Moringa tree products in the study area. However, low extent of utilization was recorded for Moringa barks ($\overline{X}$ = 1.75), Moringa branches ($\overline{X}$ = 1.60), Moringa stems ($\overline{X}$ = 1.59) and Moringa flowers ($\overline{X}$ = 1.47) in the study area. This implies that Moringa tree products such as leaves, fruits/seeds and roots were highly utilized by most of the rural households in the study area as compared to barks, branches, stems and flowers.

Table 4.3: Respondents' extent of utilizing *Moringa oleifera* tree products (n = 244)

Products	HU (3)	MU (2)	NU (1)	Sum	Mean	Remark
Moringa leaves	215 (88.1)	20 (8.2)	9 (3.7)	694	2.84	High Utilization
Moringa fruits/Seeds	43 (17.6)	175 (71.7)	26 (10.7)	505	2.07	High Utilization
Moringa roots	55 (22.5)	145 (59.4)	44 (18.0)	499	2.05	High Utilization

Moringa barks	35 (14.3)	114 (46.7)	95 (38.9)	428	1.75	Low Utilization
Moringa branches	30 (12.3)	86 (35.2)	128 (52.5)	390	1.60	Low Utilization
Moringa stems	34 (13.9)	77 (31.6)	133 (54.5)	389	1.59	Low Utilization
Moringa flowers	23 (9.4)	68 (27.9)	153 (62.7)	358	1.47	Low Utilization

Sources: Field Survey, 2020

Note: HU = Highly Utilization (3), MU = Moderate Utilization (2) and LU = Low Utilization (1)

Bench mean score = 2.0

4.3 Perceived health benefits of *Moringa oleifera* tree products by the respondents

Table 4.4 revealed the result of perceived health benefits of utilizing Moringa oliofera tree products in the study area. As shown in Table, the respondents agreed to all the health benefits of Moringa tree products that it is effective in the treatment of High Blood Pressure ($\overline{X}$ = 4.23) ranked 1st. They also agreed that Moringa is effective in providing vitamins/minerals ($\overline{X}$ = 4.10), Moringa is effective in treatment of malaria ($\overline{X}$ = 4.06), Moringa is effectively helpful in aiding digestion ($\overline{X}$ = 4.02), Moringa is effective in the treatment of Diabetes ($\overline{X}$ = 4.01) and Moringa is effective in the treatment of stomach pains ($\overline{X}$ = 4.00) ranked 3rd, 4th, 5th and 6th, respectively. Other perceived health benefits of Moringa oliofera tree products as agreed to by the respondents were that Moringa is effective in the treatment of Typhoid fevers ($\overline{X}$ = 3.91), Malnutrition ($\overline{X}$ = 3.90), stimulating appetite ($\overline{X}$ = 3.89), Arthritis ($\overline{X}$ = 3.83), Eye/Ear infection ($\overline{X}$ = 3.82), enhancing low Libido ($\overline{X}$ = 3.79), Skin diseases ($\overline{X}$ = 3.68) , Liver/Kidney disease ($\overline{X}$ = 3.60), Anti-microbial agents ($\overline{X}$ = 3.59), overcoming Depression ($\overline{X}$ = 3.59), Fibroid ($\overline{X}$ = 3.57), Anemia ($\overline{X}$ = 3.50), Infertility ($\overline{X}$ = 3.41) and Sexual diseases ($\overline{X}$ = 3.41) ranked 7th, 8th, 9th, 10th, 11th, 12th, 13th, 14th, 15th, 17th, 18th and 19th, respectively.

Table 4.3: Respondents' perceived health benefits of *Moringa oleifera* tree products (n = 244)

Perception Statements	SA	A	UN	D	SD	WS	WM	Rank	Remark
Moringa is effective in treatment of High Blood Pressure	76(31.1)	156(63.9)	6(2.5)	4(1.6)	2(0.8	1032	4.23	1st	Agreed
Moringa is effective in providing vitamins/minerals	64(26.2)	155(63.5)	12(4.9)	11(4.5)	2(0.8)	1000	4.10	2nd	Agreed
Moringa is effective in treatment of Malaria	64(26.2)	150(61.5)	15(6.1)	11(4.5	4(1.6)	991	4.06	3rd	Agreed
Moringa is effectively helpful in aiding digestion	53(21.7)	154(63.1)	29(11.9)	4(1.6)	4((1.6)	980	4.02	4th	Agreed
Moringa is effective in treatment of Diabetis	49 (20.1)	163(66.8)	22(9.0)	6(2.5)	4(1.6)	979	4.01	5th	Agreed
Moringa is effective in treatment of Stomach pains	45(18.4)	169(69.3)	18(7.4)	10(4.1)	2(0.8)	977	4.00	6th	Agreed
Moringa is effective in treatment of Typhoid fevers	44(18.0)	141(57.8)	53(21.7)	5(2.0)	1(0.4)	954	3.91	7th	Agreed
Moringa is effective in treatment of Malnutrition	40(16.4)	166(68.0)	20(8.2)	9(3.7)	9(3.7)	951	3.90	8th	Agreed
Moringa is effective in stimulating appetite	45(18.4)	135(55.3)	59(24.2)	2(0.8)	3(1.2)	949	3.89	9th	Agreed
Moringa is effective in treatment of Arthritis	30(12.3)	151(61.9)	59(24.2)	4(1.6)	0(0.0)	935	3.83	10th	Agreed
Moringa is effective in treatment of Eye/Ear Infection	48(19.7)	141(57.8)	32(13.1)	9(3.7)	14(5.7)	932	3.82	11th	Agreed
Moringa is effective in treatment of Low Libido	36(14.8)	153(62.7)	34(13.9)	10(4.1)	11(4.5)	925	3.79	12th	Agreed
Moringa is effective in treatment of Skin diseases	25(10.2)	141(57.8)	57(23.4)	17(7.0)	4(1.6)	898	3.68	13th	Agreed
Moringa is effective in treatment of Liver/Kidney diseases	28(11.5)	106(43.4)	97(39.8)	10(4.1)	3(1.2)	878	3.60	14th	Agreed
Moringa is effective as Anti-Microbial agents	25(10.2)	106(43.4)	104(42.6)	7(2.9)	2(0.8)	877	3.59	15th	Agreed
Moringa is effectively helpful in overcoming depression	21(8.6)	139(57.0)	59(24.2)	12(4.9)	13(5.3)	875	3.59	15th	Agreed
Moringa is effective in treatment of Fibroid	14(5.7)	118(48.4)	107(43.9)	4(1.6)	1(0.4)	872	3.57	17th	Agreed
Moringa is effective in treatment of Anemia	27(11.1)	104(42.6)	91(37.3)	8(3.3)	14(5.7	854	3.50	18th	Agreed
Moringa is effective in treatment of Infertility	16(6.6)	102(41.8)	104(42.6)	11(4.5)	11(4.5)	833	3.41	19th	Agreed
Moringa is effective in treatment of Sexual diseases	11(4.5)	106(43.4)	111(45.5)	3(1.2)	13(5.3)	831	3.41	19th	Agreed

Sources: Field Survey, 2020

Note: SA = Strongly Agreed (5), A = Agreed (4), UN = Undecided (3), D = Disagreed (2), SD = Strongly Disagreed (1), WS = Weighted Sum and WM = Weighted Mean.

Thus, mean scores of ≥ 3.0 implies Agreed, while mean scores of < 3.0 implies Disagreed.

4.4 Factors Influencing the Extent of Utilization of Moringa Oleifera

The result of logit regression analysis on factors influencing extent of *Moringa Oleifera* utilization is presented in Table 4.7. The result showed Pseudo R^2 of 0.4189 implying that 42% of the variations in extent of moringa utilization was explained by the independent variables included in the model. The Chi–squared statistic of 141.01 was statistically significant at 1% level of probability indicating the goodness of fit of the overall model. Nine variables (marital status, household size, education, farming experience, cooperative membership, credit, moringa products, purpose of utilization and perceived health benefits) out of the twelve variables included in the model were statistically significant ($p<0.05$).

Marital status had positive t-value (2.05) and statistically significant at $p<0.05$ implying that married individual had direct relationships with extent of utilizing *moringa oleifera*. Married individual have higher propensity to utilize moringa tree products to improve the health status of their household.

Household size had positive t-value (2.04) and statistically significant at $p<0.05$ implying that household size had direct relationships with extent of utilizing *moringa oleifera*. Increase in household size of the respondents will increase the probability of utilization which could be due to the perceived health benefit. Most rural household are familiar with moringa tree products and the various forms of utilization.

Education had positive t-value (2.83) and statistically significant at $p<0.01$ implying that education of the respondents had direct relationships with extent of utilizing *moringa oleifera*. Education exposes an individual to health benefits knowledge as it affects their overall well-being.

Table 4.7: Logit regression estimates of extent *Moringa Oleifera* utilization (n=244)

Variable	Coefficient	Standard error	z–value

Age	0.0083	0.0263	0.32
Sex	-0.1781	0.4049	-0.44
Marital status	0.8726	0.4247	2.05**
Household size	0.0939	0.0461	2.04**
Education	0.1293	0.0457	2.83***
Farming experience	0.0467	0.0257	1.82*
Extension contact	-0.0032	0.0507	-0.06
Cooperative membership	0.5802	0.3180	1.83*
Credit	0.0128	0.0039	3.23***
Moringa products	0.8619	0.1330	6.48***
Purpose of utilization	0.1867	0.0668	2.79***
Perceived health benefits	0.0428	0.0197	2.17**
Constant	7.2128	2.0231	3.57***
Pseudo R^2	**0.4189**		
Chi - squared	**141.01*** **		
Log likelihood	**-97.8046**		

Source: Field Survey, 2020

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

Farming experience had positive t-value (1.82) and statistically significant at p<0.10 implying a direct relationships with extent of utilizing *moringa oleifera*. The higher the farming experience of the rural household, the more they utilize moringa tree products because of the health benefits.

Cooperative membership had positive t-value (1.83) and statistically significant at p<0.10 implying that cooperative membership had direct relationships with extent of moringa oleifera utilization. This shows that cooperative membership increases the probability of the respondents to utilize moringa tree products Cooperative societies play various roles in enhancing social networking which goes a long way in influencing people' perception. This is in line with Shoji *et al.* (2012) who reported that rural household who participated more in social networking are more likely to enjoy better public services and adopt natural medicine which in turn improve the overall health status.

Access to credit had positive t-value (3.23) and statistically significant at $p<0.01$ implying that access to credit had direct relationships with extent of moringa oleifera tree products utiization. In most cases, rural poor often find it difficult to access formal credit and therefore rely more on informal forms of credit to purchase or treat household members. Thus, an increase in rural households' access to credit will invariably increases their utilization of moringa tree products.

Moringa products had positive t-value (6.48) and statistically significant at $p<0.01$ implying a direct relationship with extent of moringa oleifera tree products utilization. People tends to utilize different parts of the moringa tree products for different reasons. Some people utilize the the leaves, stem, root and bark of moringa tree products for various health benefit.

Purpose of utilization had positive t-value (2.79) and statistically significant at $p<0.01$ implying a direct relationship with extent of moringa oleifera tree products utilization. Moringa tree products could be utilize for different health issues including treatment of blood pressure, malaria and typhoid, indigestion and other body diseases.

Perceived health benefits of moringa tree products had positive t-value (2.17) and statistically significant at $p<0.05$ implying a direct relationship with extent of moringa oleifera tree products utilization. This shows that the rural household had positive perception about the health benefits of moringa tree products.

4.4.1 Marginal effect of the factors influencing extent of utilizing moringa tree products

The result of marginal effect estimates of the significant variable is presented in Table 4.8. It revealed that the probability of marital status influencing extent of moringa tree products utilization increases by the coefficient value of 0.8726 implying that a unit increase marital status (i.e the more the respondents get married) will lead to about 87.3% increase in extent of utilization,

while household size coefficient is 0.0939 implying that a unit increase in household size will increase the extent of utilization of moringa tree products by about 9%. However, the coefficients of education (0.1293), farming experience (0.0467), cooperative membership (0.5802), access to credit (0.0128), moringa tree products (0.8619), purpose of utilization (0.1867) and perceive health benefits (0.2201) increases the extent of moringa tree product utilization by about 13.0%, 5%, 58.0%, 1.3%, 86.2%, 18.7% and 22.0%, respectively with every unit increase in each of the variable. This shows that all the identified variables plays significant roles in influencing extent of moringa tree product utilization.

Table 4.8: Marginal effect of the logit regression estimates

Variable	dy/dx	Std error	z – value
Marital status	0.1126	0.0531	2.12**
Household size	0.0121	0.0058	2.10**
Education	0.0167	0.0032	3.00***
Farming experience	0.0060	0.0032	1.86*
Cooperative	0.0749	0.0401	1.87*
Credit	0.0166	0.0048	3.48***
Moringa products	0.1112	0.0102	10.91***
Purpose of utilization	0.0241	0.0082	2.95***
Perceived health benefits	0.0055	0.0025	2.24**

Source: Field Survey, 2020

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

4.5 Constraints associated with Utilizing *Moringa oleifera* tree products

The constraints faced by the respondents to utilization of Moringa tree products in the study area is presented in Table 9. The major constraints indicated by the respondents were inadequate finance to purchase Moringa ($\bar{X}$ = 2.70), poor access to credit facilities ($\bar{X}$ = 2.61) and inadequate extension services ($\bar{X}$ = 2.32) ranked 1st, 2nd and 3rd, respectively among the constraints perceived to be severe. Other severe constraints include inadequate awareness of Moringa products ($\bar{X}$ =

2.29), poor market value for Moringa products ($\bar{X}$ = 2.12), small farm size of Moringa production ($\bar{X}$=2.09) and crude nature of processing Moringa products ($\bar{X}$ = 2.06) ranked 4th, 5th, 6th and 7th, respectively. However, lack of knowledge about Moringa benefits ($\bar{X}$ = 1.98), high cost of purchasing Moringa products ($\bar{X}$ = 1.76), problem of pests and diseases ($\bar{X}$=1.75) and poor access to Moringa tree products ($\bar{X}$ = 1.68) ranked 8th, 9th, 10th and 11th, respectively were the constraints perceived not be severe by the respondents.

Table 4.9: Respondents' constraints to utilization of *Moringa oleifera* tree products (n = 244)

Constraints	VS	S	NS	WS	WM	Rank	Remark
Inadequate finance to purchase Moringa	187	40	17	658	2.70	1st	Severe
Poor access to credit facilities	165	64	15	638	2.61	2nd	Severe
Inadequate extension services	127	68	49	566	2.32	3rd	Severe
Inadequate awareness of Moringa products	128	59	57	559	2.29	4th	Severe
Poor market value for Moringa products	120	33	91	517	2.12	5th	Severe
Small farm size of Moringa production	108	50	86	510	2.09	6th	Severe
Crude nature of processing Moringa products	105	48	91	502	2.06	7th	Severe
Lack of knowledge about Moringa benefits	83	74	87	484	1.98	8th	Not severe
High cost of purchasing Moringa products	47	92	105	430	1.76	9th	Not severe
Problem of pests and diseases	43	97	104	427	1.75	10th	Not severe
Poor access to Moringa tree products	26	114	104	410	1.68	11th	Not severe

Sources: Field Survey, 2020

Note: VS = Very Severe (3), S = Severe (2), NS = Not Severe (1) (Bench mean score = 2.0)

4.6 Hypotheses testing

4.6.1 Hypothesis I:

The result of Hypothesis I which stated that there was no significant relationship between the selected socio-economic characteristics of rural households (age, gender, education, experience etc.) and extent of utilization of *Moringa oleifera* in the study area is presented in Table 4.10. It revealed that marital status (2.05), household size (2.04), education (2.83) farming experience

(1.82) and access to credit (3.23) were all statistically significant at 1%, 5% and 10% level of probability. Therefore, the null hypothesis that says there is no significant relationship was rejected and the alternative hypothesis was accepted. This implies that the selected socio-economic variables influence the extent of moringa tree products utilization.

Table 4.10: Regression estimate of hypothesis I

Variable	Coefficient	Standard error	z–value
Age	0.0083	0.0263	0.32
Sex	-0.1781	0.4049	-0.44
Marital status	0.8726	0.4247	2.05**
Household size	0.0939	0.0461	2.04**
Education	0.1293	0.0457	2.83***
Farming experience	0.0467	0.0257	1.82*
Credit	0.0128	0.0039	3.23***

Source: Field Survey, 2020
Note: *** implies p<0.01, ** implies p<0.05 and * implies p<0.1

4.6.2 Testing of Hypothesis II

The result of Hypothesis II which stated that there was no significant relationship between the perceived health benefits and extent of utilization of *Moringa oleifera* in the study area was tested using Pearson's Product Moment Correlation (PPMC) and the result is presented in Table 4.11. The correlation (r) value of 0.1537 showed that there was a weak relationship between the extent of utilization and the perceived health benefits of moringa oleifera tree products. Thus, the null hypothesis was rejected, while the alternative hypothesis accepted.

Table 4.11: Correlation estimate of hypothesis II

	r	
Extent of *Moringa oleifera* utilization	1.0000	
Perceived health benefits of *Moringa oleifera*	0.1537*	1.0000

Source: Field survey, 2019 ***signifies relationship**

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

Based on the empirical evidence from the findings of this study, it could be concluded that majority of the respondents were male, married and educated. Leaves, fruits/seeds and roots are the most utilized Moringa tree products utilized by the respondents and were perceived to have health benefits as it is effective in the treatment of various ailments. On the factors influencing extent of utilizing moringa tree products, marital status, household size, education, farming experience, cooperative membership, access to credit, moringa tree products, purpose of utilization and perceived health benefits were found to be significant. The major constraints identified by the respondents were inadequate finance, poor access to credit and inadequate extension services.

5.2 Recommendations

From the findings of this study, the following recommendations were drawn:

i. The study revealed that the respondents were in their active age with high illiteracy levels. Therefore, it is recommended for NGOs and extension agencies to educate and develop skills of the rural household toward ways of utilizing moringa oleifera.

ii. It was therefore recommended that adequate awareness should be created through extension agency on the need to utilize Moringa oliofera tree products. Natural medicine stakeholders should also endeavour to educate rural farmers on the health benefits of utilizing Moringa tree products.

iii. In view of the low levels of education of the respondents, policy makers, programme designers and relevant stake holders should ensure adequate sensitization of the rural household.

iv. Respondents had positive perception of health benefit of moringa oleifera, it was therefore recommended that finance should be made accessible to the rural households for them to effectively utilize moringa tree products

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RESEARCH QUESTIONNAIRE

Dear Respondent,

I am a master student of the above named institution currently undergoing research work titled **"Perceived health benefits and utilization of moringa tree products (*moringa oleifera*) among rural farming households of Nassarawa State, Nigeria"**. This act is in partial fulfilment of the requirement for the award of MTECH degree in Agricultural Extension and Rural Development. Please, kindly supply the necessary information required to execute the study by answering the questions provided here. I assure you that all the information supplied will be keep as confidential and use strictly for academic purpose only.

Thank you for your anticipated cooperation and understanding.

ZARMA, Haliru Mohammed
MTECH/SAAT/2017/7274
08028550539

Local Government Area:…….…….…….
Name of the village:…….…….
Enumerator's Name/Phone No:…….……
Name of Respondent/Phone No:……..…….……
Questionnaire No:……..……....

SECTION (A): SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

1. Gender: (a) Male [ ] (b) Female [ ]

2. Age of respondent in Years…….

3. Indicate your marital Status:

(a) Single [ ] (b) Married [ ] (c) Divorced [ ] (d) Separated [ ] (e) Widowed [ ]

4. Kindly indicate your total household members…….

i. Number of wife(s)…….……

ii. Number of male child…….…….

iii. Number of female child……..

iv. Number of other dependents……...

5. What is your educational status?

(a) Primary [ ] (b) Secondary [ ] (c) Diploma/NCE [ ] (d) HND/Degree [ ] (e) Non-formal [ ]

6. How many years did you spend in formal schooling?.....

7. How many years did you spend in non-formal schooling?.....

8. How long have you been into farming?.....

9. Kindly indicate your farming status. (a) Full term [ ] (b) Part term [ ]

10. What is your primary occupation?

(a) Farming [ ] (b) Gathering [ ] (c) Trading [ ] (d) Civil service [ ] (e) Artisan [ ]

(f). Agro-processing [ ] (g) Others (specify)…….……

11. What is your Secondary occupation?

(a) Farming [ ] (b) Gathering [ ] (c) Trading [ ] (d) Civil service [ ] (e) Artisan [ ]

(f). Agro-processing [ ] (g) Others (specify)…….……

12. Do you have access to extension service? (a) Yes [ ] (b) No [ ]

13. If no, state reason?

……..……..

……

14. If yes, how often do you have contact with extension agents?

(a) Weekly [ ] (b) Monthly [ ] (c) Quarterly [ ] (d) Annually [ ] (e) Others (specify)……

15. Do you belong to cooperative societies? (a) Yes [ ] (b) No [ ]

16. If Yes, how many cooperative? .....

17. If Yes, how many years? …….…….

18. Do you have access to credit facilities in farming? (a) Yes [ ] (b) No [ ]

19. If yes, from which source did you access credit?

(a) Agric. Bank [ ] (b) Commercial bank [ ] (c) Cooperatives [ ] (d) Friends/Relatives [ ]

(e) Others (specify)…….

20. How much did you access as a credit in naira? ₦…….…….

21. Do you have access to land for your farming activities? (a) Yes [ ] (b) No [ ]

22. If yes, what is the mean of acquisition?

(a) Inheritance [ ] (b) Purchase [ ] (c) Rent/Lease [ ] (d) Gift [ ]

23. What type of labour do you use in farming activities?

(a) Family labour [ ] (b) Hired labour [ ] (c) Both [ ] (d) Others (specify)…….

24. Kindly indicate the number of labour used in your farming activities.

(a) Male……..…… (b) Female……..……. (c) Children……

25. What is the daily labour wages for your farming activities?

(a) Male ₦…… (b) Female ₦…… (c) Children ₦……

SECTION (B): RESPONDENTS' EXTENT OF UTILIZATION OF *MORINGA* PRODUCTS

26. Are you aware of the Moringa tree products? (a) Yes [ ] (b) No [ ]

27. Do you utilize *Moringa* tree products? (a) Yes [ ] (b) No [ ]

28. What are the purposes of utilizing Moringa tree products?

(a) Food [ ] (b) Medicine [ ] (c) Commercial [ ] (d) Manure [ ] (e) Others (specify)……

29. How long have you been utilizing Moringa tree products in your household (in years)…….

30. Which part of Moringa tree products did you utilized for your health benefits?

Products	**Yes**	**No**
Leaves		
Flowers		
Fruit/Seeds		
Branches		
Barks		

Stems		
Roots		
Others (specify)……		

31. Kindly indicate the extent of utilizing the following Moringa tree products.

Products	**High Utilization (3)**	**Moderate Utilization (2)**	**Low Utilization (1)**
Leaves			
Flowers			
Fruit/Seeds			
Branches			
Barks			
Stems			
Roots			
Others (specify)……..			

32. Kindly indicate the extent of utilizing *Moringa* tree products for the following purpose.

Purpose	**High Extent (3)**	**Moderate Extent (2)**	**Low Extent (1)**
Water purification			
Vegetable			
Medicine			
Nutritional supplement			
Animal feed			
Income generation			
Extraction of seed oil			
Green manure/fertilizer			
Ornamental			
Life fencing			
Immune boosting			
Maternal/Child care			
Others (specify)……			

33. How often do you consume the following Moringa tree products?

Products	**Daily**	**Weekly**	**Forth-nightly**	**Monthly**	**Annually**	**Never**
Leaves						
Flowers						
Fruit/Seeds						

Branches						
Barks						
Stems						
Roots						
Others (specify)…….						

SECTION (C): RESPONDENTS' PERCEIVED HEALTH BENEFITS OF MORINGA PRODUCTS

34. Are you aware about the health benefits of Moringa tree products? (a) Yes [ ] (b) No [ ]

35. What are your sources of information about the health benefits of Moringa tree products?

Information sources	**Tick**
Print media	
Radio	
Television	
Internet	
Extension agents	
Friends and relation	
Non –Governmental Organizations (All farmers association and Cooperative groups)	
Governmental Organizations (ADP, NAMDA, Ministries and Departments of Agric.)	

36. Kindly indicate your perception about the health benefits of Moringa tree products.

Perception Statements	**Strongly Agreed**	**Agreed**	**Undecided**	**Disagreed**	**Strongly Disagreed**
Moringa tree products is effective in the treatment of High Blood Pressure					
Moringa tree products is effective in the treatment of Diabetic					
Moringa tree products is effective in the treatment of Arthritis					
Moringa tree products is effective in the treatment of Malaria					
Moringa tree products is effective in the treatment of Eye and Ear infections					
Moringa tree products is effective in the treatment of Infertility					
Moringa tree products is effective in the treatment of Fibroid					

Moringa tree products is effective in the treatment of Low Libido					
Moringa tree products is effectively helpful in overcoming Depression					
Moringa tree products is effective in the treatment of Malnutrition					
Moringa tree products is effective in the treatment of Anemia					
Moringa tree products is effective in providing Vitamin A, B, C and minerals					
Moringa tree products is effectively helpful in aiding Digestion					
Moringa tree products is effective in stimulating Appetite					
Moringa tree products is effective in the treatment of Skin problems					
Moringa tree products is effective in the treatment of Stomach pains					
Moringa tree products is effective in the treatment of Typhoid fevers					
Moringa tree products is effective in the treatment of Liver and Kidney problems					
Moringa tree products is an effective Anti-microbial agent					
Moringa tree products is effective in Sexually Transmitted Diseases					

SECTION (D): CONSTRAINTS ASSOCIATED WITH UTILIZATION OF MORINGA PRODUCTS

37. Kindly indicate with respect to severity, the constraints (s) you encounter in utilization of *Moringa oleifera* products.

Constraints	**Very Severe**	**Severe**	**Not Severe**

Small farm size usage in production of Moringa			
Poor access to Moringa tree products			
Lack of knowledge of the health benefits			
High cost of purchase			
Inadequate extension service			
Inadequate awareness about Moringa products			
Inadequate finance			
Poor access to credit facilities			
Problem of pests and diseases infestation			
Poor market value for Moringa products			
Crude nature of processing Moringa products			

38. Others (specify)……

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THANK YOU FOR YOUR COOPERATION AND UNDERSTANDING