ADOPTION OF RECOMMENDED PRACTICES FOR GINGER PROCESSING FOR EXPORT AMONG PROCESSORS IN KACHIA AND KAGARKO LOCAL GOVERNMENT AREAS OF KADUNA STATE, NIGERIA

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE IN AGRICULTURAL EXTENSION AND RURAL DEVELOPMENT

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DECLARATION

I hereby declare that this dissertation titled "**Adoption of Recommended Practices for Ginger Processing for Export Among Processors in Kachia and Kagarko Local Government Areas of Kaduna State, Nigeria**" is a product of my research work. No part of this work has been presented in any previous or current application for another degree or diploma at any other institution. All borrowed ideas have been duly acknowledged in – text and on the list of references provided as mandated by academic and institutional ethics, rules and regulations.

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Date

CERTIFICATION

The dissertation titled "Adoption of Recommended Practices for Ginger Processing for Export Among Processors in Kachia and Kagarko Local Government Areas of Kaduna State, Nigeria" by Christopher John DARIYA (P15AGAE8009) meets the regulations governing the award of Master of Science in Agricultural Extension and Rural Development of Ahmadu Bello University, Zaria and it is approved for its contribution to knowledge and literary presentation.

Professor T. K. Atala **Chairman, supervisory committee**	**Date**
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Professor S. A. Abdullahi **Dean, School of Post Graduate Studies**	**Date**

DEDICATION

This work is dedicated to my father, Mr. John Shebenyan Dariya (of blessed memory) who introduced me to the world of rural development through his dedication and passion for rural development research; my mother, Mrs. Rose Saraya Dariya (retired teacher but not tired) who stood by me in this long journey; and all enthusiasts of rural development across the developing world.

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ABSTRACT

The main objective of the study was to determine the factors influencing adoption of recommended practices for ginger processing to meet export standards among local processors in Kaduna State. Multiple-stage sampling method was used to randomly select 215 respondents for the study. Descriptive statistics, multiple linear regression analysis and Z – test statistic were utilized to achieve the objectives and test the hypotheses of the study. The study found that majority of the ginger processors were males (61%), married (78%) and 30 % of the respondents had secondary education while the mean age of the processors was 45 years. Also, 31%of the processors had experience of between 16 – 25 years with 16 years being the mean and the dominant family size was 6 – 10 persons (29%) with 9 being the mean. Furthermore, 59.1% obtained credit while the mean credit was ₦84,000 and only 41% had extension visits. Furthermore, the mean output was 480kg while majority earned between ₦100,001 – 200,000 and the mean was ₦191,000. Factors influencing adoption with their respective coefficients were sex (-0.592), membership (0.619), complexity (0.329) and cost (-0.129) significant at 1 percent while marital status (0.266), educational level (0.235), and processing experience (0.254) were significant at 5 percent. However, credit received (-0.073) was significant at 10 percent. The Z - test showed that adoption had a significant effect on income at 5 percent probability level. The study found that in order of importance the dissemination channels used were extension agents (41%), fellow processors (25%) and radio (14%) while the most preferred channels were extension agent (53%), cooperative (20%) and fellow processors (15%). The highest awareness rates were washing thoroughly with clean water (91%) and selection of variety (87%). The highest adoption rates were selection of variety (58.17%) and washing thoroughly (50%) while the least adopted practices were chemical treatment (15%) and microbial control (11%). The main constraints to adoption were high cost (27%), labour intensiveness (20%) and insufficient capital (16%). The study recommended that facilitating factors of adoption such as education/training, credit and extension services should be emphasized while the benefits of adoption should be publicized to encourage mass adoption by local processors. Also participatory technology development, extension programmes design and implementation which lead to the development and effective dissemination of more compatible, less complex and cost effective processing technologies were recommended. Furthermore, preferred channels/sources of information such as extension agents, association, fellow processors and radios should be primarily used for dissemination of processing practices to improve adoption rates among local ginger processors.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

In the unending search for increased income and improved livelihood in rural social systems ginger processing is viewed as a viable long-term contributor to the wellbeing of the rural people, eradication of poverty and pro-poor economic growth (Maliki, 2013). Ginger processing has therefore, attracted attention in recent times because it connects overall national economic growth and the rural poor with increased value to local processors when appropriate processing practices are adopted and export standards are attained (FAO, 2016; Bamidele *et al.,* 2008). Furthermore, adoption of agro processing and value addition activities is now increasingly seen as better and more sustainable essentials for poverty alleviation and for securing the people's food and nutritional needs (Saddiq, 2015). Rural dwellers are also increasingly engaging themselves in the processing of crops and other activities for additional income to enhance household financial viability and mitigate the effects of economic recession (Gadzama, 2015; World Bank, 2010).

However, in Nigeria, small scale processing of ginger is facing enormous challenges in adoption of recommended practices which limit its marketability due to inability to achieve the high quality accepted in the export market. Thus, restricting it to local markets offering lesser prices and amenable to market glut as a result of oversupply during harvest and this needs to be addressed urgently to deepen and expand the activities of ginger processors as a means of empowering the rural sector while at the same time growing and developing the Nigerian economy (Odusanya, 2016; Olomola, 2007; Adene and Oguntade, 2006). Ginger processing is an important source of rural livelihood and contributes to the agricultural sector performance which

accounted for 40.9 percent of Nigeria's GDP in 2005 (Adekoya and Tologbonse, 2005) rising to 42 percent in 2013 (NBS, 2013) although it dropped to 21.6 percent in 2017 (Index Mundi, 2018).Ginger processing is thus, crucial for poverty eradication, employment of rural people, increasing income levels, stimulating demand for consumer goods and services while also stimulating growth in the other sectors of the economy due to interconnections and linkages in the national economy (FAO, 2016).

Rural farmers make up more than 70 percent of Nigeria's population (NPC, 2006) and they play a key role in agricultural production, processing and marketing (FAO, 2016). They are almost entirely responsible for the production and processing of crops for additional income to enhance household financial viability (Augustine, 2015; Anka, 2010). However, majority of farmers in the rural areas still live in difficult conditions and earn little from their labour due to their inability to add value through adoption of improved processing technology due to socioeconomic, institutional and technological challenges and this situation has to be addressed through an increased rate of awareness and adoption of processing standards to increase the value and price of ginger for increased income and level of living among local processors (Itobiye, 2015). Despite Government's intervention and the efforts of Non-Governmental Organizations ginger processing is still operated with traditional technology due to low awareness and adoption of recommended practices and this situation cannot be allowed to persist if the wellbeing of local processors is to be improved (Obinna *et al.*, 2014; Ganiyu, 2014).

According to Augustine (2015), agro processing is labour intensive and involves high cost of hired labour, equipment and inputs. Ginger processing is cumbersome, time consuming, characterized by low quality, low output per time/resource input, risky and unreliable due to market uncertainties and stressful due to management and resource pressures. There is the need

for emphasis on the use of appropriate technology and increasing the capacity of ginger processors to adopt recommended processing practices for better income from sale of ginger in the international market. This has led to the introduction of several labour-intensive machinery for use in ginger processing such as washers, graters, oil press, dryers, millers, slicers, sealing machines etc. but their impact has been minimal due to processors inability to adopt them in their operations hence, adoption of such technology has remained low (Kabir, 2011).

The capability of ginger processors to rise to the occasion and contribute to the economy is not in doubt and cannot be ignored. However, many limiting factors such as credit constraints, low extension visits, high cost and complexity of technological packages affect their ability to add value to ginger through adoption of appropriate processing practices (Ilyasu, 2016). Rural farmers' make significant contribution to food production and processing but policy makers seem to make the major decisions that affect their lives without their input by using a top - bottom approach and these policies mostly fail to address their problems (Itobiye, 2015). It is imperative to find ways of improving ginger processing among local processors who at present mostly perform their tasks manually under strenuous and unhygienic conditions due to constraints which limit adoption of better innovations and recommended practices for higher value and exportability (Augustine, 2015).

1.2 Problem Statement

The demand for ginger has been increasing significantly over the years offering Nigerian processors an opportunity to meet the rising demand in local and export markets. But this activity of processing harvested ginger into a more stable and exportable form has been hampered by the inability of ginger processors to adopt recommended processing standards for export leading to low prices, product deterioration in storage and its rejection in the international market with the

major effect being the resultant loss of income among ginger processors. Despite the introduction of ginger in Nigeria in 1927, inadequacies in extension services has resulted in low awareness and adoption rates of export processing practices among ginger processors (Uwandu *et al.*, 2014;Agricultural Performance Survey, 2015).

Locally processed ginger has been found to be deficient in meeting export standards in the export market as a result of contamination, high aflatoxin concentration and low essential oils/spice content. Thus, locally processed ginger is either rejected, attracts low prices or is graded as B or C instead, of grade A which is accepted in the export market and attracts the highest price because it meets the required standards. As a result of processors inability to obtain maximum moisture of 6 to 12%, maximum impurities of 0 to 2% and minimum oleoresin oil content of between 1 to 2%. In addition, the International Standard Organization (ISO), Indian and European Spice Association Standards are also required but are not currently being met by ginger processors (Raghavan, 2000; Agro Nigeria, 2016).

At present, information is lacking regarding the reasons for low awareness and adoption of value enhancing practices for attaining processed ginger export standards. Since most studies on ginger tend to focus on adoption of improved agronomic practices to increase yield, emphasize the existing potential for increased production, economic importance, challenges and diseases affecting its production in Nigeria (Agricultural Performance Survey, 2015 and 2013; Okafor, 2015). There has been less emphasis on how to improve the quality of ginger to meet international export requirements/standards through adoption of recommended processing practices. There is therefore, the need to investigate the factors influencing the low rate of adoption of recommended processing practices to obtain the internationally accepted standards

for ginger export among processors in the study area. This study is therefore, aimed at finding answers to the following research questions:

i. What are the socio-economic characteristics of ginger processors in Kachia and Kagarko LGAs of Kaduna State?
ii. What are the improved practices that are being disseminated to ginger processors by extension agents in order to attain export standards?
iii. What are the rates of awareness and adoption of recommended practices for ginger processing for export among ginger processors?
iv. What are the factors influencing adoption of recommended practices for ginger processing for export among ginger processors?
v. What are the effects of adoption of recommended practices for ginger processing for export on output/income of processors?
vi. What are the constraints faced by ginger processors in adoption of recommended practices for ginger processing for export?

1.3 Objectives of the Study

The broad objective of the study is to analyze factors influencing adoption of recommended standards for ginger processing for export in Kachia and Kagarko local Government Areas of Kaduna State, Nigeria. While the specific objectives were to:

i. describe the socio-economic characteristics of ginger processors in Kachia and Kagarko Local Government Areas of Kaduna State;
ii. identify the improved practices being disseminated to ginger processors by extension agents in order to attain export standards;

iii. find out the rate of awareness and adoption of recommended practices for ginger processing for export among ginger processors;

iv. determine the factors that influence the adoption of recommended practices for ginger processing for export among ginger processors;

v. determine the effects of adoption of recommended practices for ginger processing for export on the output and income of ginger processors; and

vi. identify the constraints faced by ginger processors in adoption of recommended practices for ginger processing for export.

1.4 Justification of the Study

Ginger is an important crop in Nigeria today because of its high demand in the local and international market. It is therefore, important to find ways of improving its processing, quality and acceptability in the export market to improve the income and level of living of farmers.

This study provided data on the challenges and outcome of adoption of recommended practices for ginger processing for export among local processors in Nigeria. This is crucial as there is a dearth of information on the constraints and outcome of adoption of processing practices for export which would have been of immense benefit to extension agents, Non Governmental Organizations (NGOs) and international development agencies/partners in the design and implementation of extension programmes.

The results of this study would also add to existing knowledge and serve as guide to policy makers in making policies for the improvement of the activities of ginger processors and researchers seeking information on ginger processing for export. This would enhance the growth, empowerment and development of ginger processors and processing in Nigeria.

1.5 Research Hypotheses

In this study the following null hypotheses were tested:

Ho_1:There is no significant relationship between socio-economic characteristics of ginger processors and adoption of recommended practices for ginger processing for export among ginger processors.

Ho_2: There is no significant relationship between adoption of recommended practices for ginger processing for export and output/income of ginger processors.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview of Ginger Production in Nigeria

Ginger is widely grown as a commercial crop in South and South East Asia, tropical Africa (especially Sierra Leone and Nigeria), Latin America, the Caribbean (especially Jamaica) and Australia. Nigeria has the largest cultivated area of ginger (FAO, 2009; APS, 2015). Nigeria produces an average of 140,000 metric tons of fresh weight ginger per *annum* and out of this production, an average of 70% of the total production is exported (Uwandu, *et al*., 2014).

Ginger is a well known rhizome (underground stem) of *zingiber officianale* Roscoe (Okwuowulu, 2005). Other species in the ginger family (*zingiberaceae*) include Cardamon (*electriarcardamomum*) and Turmeric (*curcumalonga*). *Zingiber officianale* Roscoe possibly originated from and is indigenous to India. The ginger family of plants consists of more than 1,200 species in 53 different genera. The genus *zingiber* includes 85 species of aromatic herbs from East Asia and tropical Australia (Ewuziem*et al*., 2011) but for the purpose of this study "ginger" refers to *Zingiber officianale* Roscoe.

Ginger is basically an export crop because of its high demand in industrialized countries. However, local markets also exist and the local demand for ginger is increasing. It is estimated that 20% of dried ginger is consumed locally for various uses and 80% is exported (Ewuziem*et al*., 2011). Ginger powder is fast becoming a household kitchen item globally. Nigeria's ginger export is to four international regional markets namely: Europe (51%); USA and Canada (29.5%); Asia (13%); and Africa (0.5%). The world trade in ginger is estimated at $190 million per year (Ewuziem *et al*., 2011). The main competitors in ginger export are China, Nigeria and Thailand. In 2004, Nigeria's ginger export was ten percent of the global trade in ginger valued at $21.8 million (Ewuziem *et al*., 2011).

Nigeria's production in 2007 was estimated at 140,000 MT an increase of about 28,000 M/T and has the largest cultivated area of ginger in the world (FAO, 2009). Ten percent (10%) is locally consumed as fresh Ginger while 90% is locally processed for sale to dealers who grade itfor sale in the local or export markets (Ewuziem *et al*., 2011). Nigeria's ginger is rich and highly valued internationally due to its chemical, oil and spice content. Ginger is known by different local names in Nigeria, these include "Chitta" (Hausa), "Oso-ala" (Igbo), and "Akale" (Yoruba) (Ewuziem *et al*., 2009).

In Nigeria, two cultivars of ginger are commonly grown. They are "*Tafingiwa*" (Elephant root or yellowish variety) with plump rhizome, "*Yatsunbiri*" (Monkey finger or Black Ginger). A third cultivar "foreign" rather smaller and darker often referred to as "Main China" is grown by a relatively insignificant number of farmers in Nigeria (Uwandu *et al*., 2014). Nigerian cultivars are highly rated and regarded in the global market for their high content of essential oils and Oleoresin (Chuckwu and Emechute, 2003). In recent times interest in ginger production, processing and marketing has increased due to its high income potential for ginger farmers and processors (Okafor, 2002).

Ginger is an important spice crop cultivated mainly in the North-West and North-Central zones in Nigeria. The land area for ginger production is estimated at about 152, 510 ha in 2012 and increased to 164, 440 ha in 2013 which is a 7.8% increase over the 2012 figure (Agricultural Performance Survey, 2013).. Similarly, ginger production according to the Agricultural Performance Survey (2013), increased by 8.7% from 456, 960 MT in 2012 compared with what was obtained in 2013 estimated at 496,920 MT (Agricultural Performance Survey, 2013). The forecast for areas under ginger cultivation is projected to increase by 9.6% over that of 2014 (Agricultural Performance Survey, 2015).

2.1.1 Economic importance of ginger

Ginger is important as a source of income for local farmers/processors and foreign exchange for the nation from its export (Igbo *et al*., 2014). The high value of Nigerian ginger is due to its unique chemical and oil content. The list of ginger uses is almost endless, being a pungent spicy herb and one of the most popular food spices (Chuckwu and Emechute, 2003). They range from baked products like gingerbread, ginger beverages and pharmaceuticals. Dried ginger is used predominantly for flavouring coffee especially in the Middle East (Raghavan, 2000). It has medicinal qualities and it is also used to calm nausea and aid digestion. One of the main benefits of the herbal ginger remedy is the ability to stimulate the blood circulating system (Ajibade and Dauda, 2005).

2.1.2 Prospects of ginger production and processing in Nigeria

Ginger has a bright prospect in Nigeria given its high demand in the international market. Ginger is basically an export crop because of its high demand in advanced medical and confectionary industries in Europe, Asia and the United States (FAO, 2009). Ginger production can also be done alongside agro-forestry practices and other environmentally friendly practices in agriculture such as intercropping and mixed farming which protect and preserve the soil, control erosion and re-fertilize overused soils (Ivbijaro, 2012).

Nigerian ginger has one of the best qualities in the world hence, the ever increasing demand for it and this represents an opportunity for increased production and processing of ginger in Nigeria (SPC, 2014). The local price of ginger stood at between ₦250,000 to ₦300,000 andinternational price of US$2250 –US$2500 per MT is a strong motivation for farmers wishing to enhance their income and improve their level of living. But for successful export ginger has to be processed into stable forms that retain and preserve its essential oils, taste, aroma and nutrients by sorting,

splitting, and drying based on international market requirements (SPC, 2014; FAO, 2016). Given Nigeria's vast land resources and huge population of farmers Nigeria can produce many times its current level of production/processing thereby, helping to lift many farmers out of poverty and boost foreign exchange earnings (Musa, 2013).

Nigeria can also develop its local capacity in the production of ginger based products and also add value to the ginger produce by locally extracting essential oils and chemicals in ginger for export to other countries. According to the Agricultural Performance Survey (2015), the forecast for the areas under ginger production is bound to keep growing and is expected to grow by 9.6% in the 2015 planting season. Currently, many food, chemical and pharmaceutical industries, now depend on ginger for their industrial production. Therefore, the Nigerian local ginger processor has an opportunity to expand production continuously as market demand keeps increasing and to further boost his income substantially through adoption of recommended ginger processing standards for export (Agricultural performance Survey, 2015). Emmanuel (2008) is of the view that, Nigeria has the potential to expand ginger production in the long run once viable investment strategies such as the Commercial Agricultural Development Programme (CADP) captures most ginger processors in a viable and sustainable manner thereby, supporting them to adopt recommended export processing practices which result in higher efficiency, productivity, product quality and income (FAO, 2016). Thus, ginger production and processing can impact the socio-economic landscape in a sustainable manner when required standards for export are met (Uyanga and Ilesanmi, 2003).

2.2 Recommended Ginger Production Practices

Production of ginger (*zingiberofficianale Roscoe*) in Nigeria started in 1927 in Southern Kaduna and was introduced by the colonial administration. After many trials and over several decades of

cultivation, Nigeria eventually became the world's leading producer and exporter of ginger (Obinna *et al*., 2014).

According to the report of a national survey on exportable agricultural commodities in Nigeria (2007 - 2009), 23 States were listed including FCT as producers of ginger in 2009 (Uwandu*et al*., 2014). However, five States namely; Kaduna, Nassarawa, Imo, Benue, and Niger are the major producers with Kaduna being a distant highest producer. Ginger production has been steadily increasing and averaged 128, 256 MT from a harvested area of 133,766 hectares in the last decade (Amadi, 2012). Ginger recommended production, processing and storage practices are meant to improve yield, prevent diseases, pest infestation, contamination or degradation of processed ginger during processing, storage and transportation (Bernard, 2008).

Ginger requires tropical, subtropical and humid climate for its commercial production. It can also grow in drier ecologies under irrigation. Ginger requires a mean annual rainfall of 1000mm that is well distributed, good garden soil rich in humus, light, loose, friable, well drained and of at least 30cm depth. Dry weather with a temperature range of 28 - 30°C for about 7 to 8 months before harvesting is ideal. High humidity throughout the crop period is necessary (Ewuziem*et al*., 2011).

The time of planting ginger should coincide with the time of steady rainfall. In Nigeria the ideal time to plant has been when the rains have become regular, usually by mid-April in the Southeast. In the Guinea savannah, planting is usually, done in May/June depending on the stability of the rains. The conventional planting material for ginger has been the rhizome pieces obtained by splitting the fat ginger knobs into desirable seed ginger called "setts". The size of the setts ranges from 10 – 20 cm. The planting of larger seed setts, leads to higher yield of rhizome. Ten gram (10g) setts produce seed ginger while 20g setts produce ware ginger (Uwandu *et al*.,

2014). Spacing is 20cm both between rows for ware (processed) ginger production and 10 – 15cm within and between rows for seed ginger production. Mulching is an imperative agronomic practice in ginger production, and the convenient mulching material usually includes wilted Guinea grass (*Panicummaximum*) or leaves of dicotyledonous species, such as the "Elizabeth" weed (*Cromohenaodoratum*) and Para rubber (*Haveabrazilians*). Wilted leaves at about 10 tons per hectare give the desirable 5cm thick coverage at the time of planting.

Ginger exhausts soils hence, requires high potassium (K) and Nitrogen (N) and Magnesium (Mg) and Phosphorus (P). Ginger requires NPK 15:15:15 at 300kg/ha in split doses, ½ at planting and ½ at 4-6 WAP (Weeks after planting) (Nwaogu *et al*., 2014). Weed interference in ginger production is greatly reduced with good soil preparation (ploughing, harrowing etc.), ensuring a fine tilt and 5cm depth of mulch material and correct row spacing. It is recommended that, ginger fields be weeded at 4 - 6 (WAP) by manual method using the West African hand hoe (Uwandu *et al*., 2014).

Subsequently, in ginger production rouging is done two to three times before harvest. Also, herbicides could be used to control weed in ginger but this should be combined with hand weeding and rouging for better results. A combination of Primextra and Gramoxone applied at product producer recommended doses before the emergence of plants is recommended (Uwandu *et al*., 2014). Pest and disease infestation in ginger production are rare when it is planted on fertile soil. However, fungal diseases such as leaf spot and soft rot could lead to premature death. In Nigeria, ginger comes to maturity in 7 to 8 MAP (months after planting). The onset of dry season usually leads to a premature termination of growth. Harvesting is manual and is done using a garden fork to scoop off the top soil bearing rhizome (Uwandu *et al*., 2014).

In Nigeria, the most common practice among resource poor farmers is to intercrop Ginger with an array of field crops such as maize, pepper, soybean and okra (Bermuda, 2003). The result is reduced yield due to a high population of other field crops resulting in acute crop competition for available growth resources, low crop yield and quick soil nutrient depletion (Bationo, 2003; Dugje, 2004).In the practice of intercropping ginger with other crops as is the case with most small holder farmers. The highest improvement in ginger yield and soil chemical attributes was achieved with one row of ginger planted with two rows of legume crops (Nwaogu and Muogbo, 2014).

2.3 Importance of Adoption of Recommended Practices

Adoption of recommended practices and standards in the production and processing of agricultural products is a sure way of improving both the quality and quantity of the produce (Agbamu, 2006). A well-developed and well supported agricultural research system is a prerequisite for the design of new technologies and their dissemination and adoption (Ado, 2012). Recommended practices represent innovations which are products of painstaking research endeavours' aimed at making agro processors to gain more from their efforts (Ilyasu, 2016). The major objective of extension services is to encourage the adoption and diffusion of standard farm practices certified as better alternatives or improvements of current practices (Agbamu, 2009) which increase output, check pests and diseases (Amajor, 2014).

The adoption of recommended standards of ginger production and processing enhance the chemical composition, quality and exportability of processed ginger (Adelaja *et al*., 2008). According to Bationo (2003) translating knowledge gains and research outputs from processes into farm practices is a sure way to boost productivity and farmers income. According to the Central Bank of Nigeria Anchor borrowers report, many farmers have hit gold in the production

of ginger as a result of financial support which has enhanced their ability to utilize modern tools and standard practices which increased their output and the acceptability of their processed products in the local and international markets (KADP, 2016). The quality of ginger and its allied products depends on adherence to specified standards in processing. According to Florence Edwards president of the ginger growers and marketers association (GGMA), the greatest challenge facing the association is the lack of processing plants to make the commodity meet international standards (Agro Nigeria, 2016). The president, went on to advocate for the establishment of ginger processing plants to dry ginger rather than spreading it by the roadside which is not healthy because when Ginger is dried by the roadside, dust and other contaminants go into it which makes it not to meet international standards (Agro Nigeria, 2016; FAO, 2016).

It is very important to encourage the adoption of innovations so as to exploit the inherent gains and value it adds to the processor's production process and livelihood (Ekong, 2010). In addition, contrary to the expectation of experts most innovations diffuse at disappointingly slow rate (Rogers, 2003). The consensus among adoption specialists such as Ekong (2010) Atala (1980), Mijindadi (1985) among others is that the level of adoption of recommended practices has close relationship with some socio-economic, socio-cultural and institutional factors of farmers and it affects production levels, income and farmer's livelihood (Lawal, 2010).

2.3.1 Adoption of recommended practices for ginger production and Processing

Agricultural processing technologies represent a wide range of equipments, tools, methodologies and machinery used in improving the shelf life, utility, appearance and bulkiness of agricultural commodities (SPC, 2014). Generally, dried ginger is preferred because it is process friendly, has longer shelf life, is easy to handle and weigh, and has higher taste and intensity than its fresh and extracted forms (Agro Nigeria, 2016). Improved processing of agro products depends on the

effectiveness of research in generating technologies and the uptake of the improved technology by farmers for improve production through diffusion (Ado, 2012).

Agricultural innovations have a close relationship with product performance and outcomes such as higher income, quality and export market acceptability of product when they are adopted and utilized in the production and processing of agricultural commodities (Lawal, 2010). Hence, the availability of agricultural technology must in addition link up with factors such as suitability, ease of use, affordability and cost effectiveness (Itobiye, 2015). According to Augustine (2015) mechanical processes aided by modern tools help in the mechanical processing of farm products and other farm commodities, and these technologies include graters, oil presses, dryers, mixers boilers, sorters, millers and grinders.

These technologies and many others assist agro processors in the processing of agricultural commodities more efficiently, with less time input and product enhancement (Okoh, 2015). On the other hand Augustine (2015), observed that the high cost of technologies make it unaffordable to small scale processors to adopt innovations even though, access to technology is crucial in the activities of agro-processors for achieving set standards and it must be enhanced by higher adoption rates (Raw Materials Research and Development Council, 2004).

Processing technologies assist in transforming ginger into more valuable, contaminants free, storage durable and chemically rich commodity. Without proper handling, processing methodology and technology, the valuable aroma and oils in ginger can be easily lost (Israel, 2003). The use of washing, splitting, drying, sorting, packaging and storing facilities helps in ensuring that ginger is well processed and meets export standards and international quality requirements. Proper use of processing tools/methods maintains the chemical and medicinal

components of ginger enabling it to maintain its potency for medical and industrial purposes (Ndukwu and Ben-Nadibia, 2005).

2.4 Use of Communication Channels in Dissemination of Recommended Practices

Agricultural practices are dependent on information dissemination to raise the level of awareness and adoption. It is important to note that the pace of agricultural progress is dependent on idea sharing and communication of recommended practices through appropriate channels (Ekoja, 2002). Farmers need access to current information on modern agricultural technologies to improve their production processes and level of income (Manyong *et al*., 2005). There are various sources of information on agriculture. Farmer's choice of appropriate medium is crucial in information delivery by extension services as it has a positive relationship with high rate of awareness and adoption of recommended standards (Cartmel l*et al*., 2004).

The choice of an extension communication channel is dependent on the reliability, affordability, accessibility and type of information delivered from the source through the channel to meet the present needs of the farmer. Hence, channels such as mass media, face-to-face communication or the folk media system of information transmission can be used depending on farmer access and preference (Muhammad, 2005). Farmers in all areas of agriculture cannot operate successfully without the diffusion of innovations which refers to, the process of the spread of new ideas from its source of invention or creation, to its ultimate users or adopters and communication is a critical catalyst in the process (Ekong, 2010).

Adoption which is the main objective of diffusion of agricultural technology using the mass media and other extension communication channels and strategies refers to the decision to accept and continue the full use of an innovation (Nwachuckwu, 2013). While the adoption process is the mental process through which an individual passes from hearing about an innovation through

a communication channel which may be face-to-face, folk media or mass media to the final adoption. The adoption process involves awareness, interest, evaluation, trial and finally, adoption (AIETA) and extension plays a key role in the process (Ekong, 2010 and Rogers, 2003).

The sources of information to farmers include: mass media; neighbours; friends and relatives; government agricultural agencies; and Salesman and dealers. In addition, Ekong (2010) also ranked the order of information sources on awareness of agricultural information beginning with the mass media, friends and neighbors, agricultural agencies and lastly, dealers and salesmen. The media system, technologies and techniques supporting it evolved alongside the increasing population, needs and complexities of societies including the agricultural sector with the potency and capacity to provide vital knowledge to farmers and impact behaviour positively. The modern media can be exploited by extension services due to its potency and effectiveness in providing information to agro processors to improve knowledge of processing standards thereby, adding value to farm produce (Agbamu, 2006).

The concept of a process of innovation requires a notion of a sequence of acts of insight which leads to a synthesis of many items which were originally independent. Hence, the need for extension of such innovations almost immediately to farmers using the mass media channels in an effective, timely and impactful manner (Jacobson and Kar, 2013). Agro-processing is a critical value adding activity hence, the need for information on how to improve it (Montpellier, 2016). Without effective information dissemination by extension services agro-processing will not succeed as an endeavour in the Nigerian agricultural sector because agro processors would not be able to utilize agricultural processing technologies to add value to farm produce (Iliyasu, 2016). There is presently, a big gap between achieved and potential quality of processed ginger

among local processors. This arises due to challenges of dissemination of adoptable technologies by extension systems and the challenges of adoption (Irfan, *et al*., 2006). A study by Irfan*et al*. (2006) revealed that, 54.1% of the respondents gave first reference to television, 25.0% gave second preference to radio and 16.7% gave third preference to print media as a source of agricultural information. This indicates that, 95.8% of the respondents get their agricultural information from one mass media channel or the other. Thus, only 4.2% who get their information from face-to-face or folk communication system.

One of the identified weaknesses of agricultural extension systems in the past has been a "top down" approach with a rigid design resulting in a one-way flow of communication (Ekong, 2010). This tended to exclude people from participating in the utilization of mass communication media to also relay their needs to each other and to extension agents and specialists thereby, ignoring communication as a two-way process between users and planners (Glendenning *et al*, 2001). The transfer of technical information from the source to the desired audience requires appropriate channels of communication (Okwu, 2011). The mass media among other communication channels is a tool utilized by agricultural extension to enhance the adoption of new technologies in agriculture (Ekoja, 2002).

Agriculture cannot develop without an effective and robust utilization of communication resources and channels by extension services to promote best practices through effective information dissemination. The current agricultural information system used by extension services as regards disseminating information to farmers has to be improved to effectively communicate with farmers in a two way communication process (Muhamamd, 2005). It is worthy of note that improved extension systems have great potential for providing farmers/agro processors with more and better information through viable communication channels in an

impactful manner (Morkah, 2014; Suleiman and Davis, 2012). Extension systems therefore, need appropriate impact assessment and evaluation tools to constantly assess the success and challenges their information dissemination strategies (Crosbie, 2002).

Attitudinal and behavioural changes in individuals towards new practices are greatly influenced by the type of communication channels used because not all channels are preferred equally by farmers (Montpellier, 2016). Preference depends largely on how farmers have been sensitized, socialized and perceive the reliability and acceptance of a particular channel used (Ekoja, 2002). Extension specialists and agents who desire to influence and improve adoption behaviour of farmers must not only develop appropriate messages but also use appropriate communication channels in disseminating recommended practices and innovations (Suleiman and Davis, 2012). To first of all get the message across as efficiently, effectively and distinctly as possible to the intended audience. Extension messages should be clear, simple and easy to comprehend so as to encourage farmers to take the intended positive action to accept, adopt and effectively utilize innovation to change their circumstances (Iliyasu, 2016).

Thus, successful dissemination of agro processing practices is dependent upon the design capability with perceived needs as well as the use of the "right" structures, media and messages for dissemination to encourage awareness and adoption of relevant technologies for agro processing (Nazari and Hassan, 2011). Information is critical to success in the rural agricultural sector and is indispensible in creating awareness of agro processing practices and market standards (Ekong, 2010). The way information is packaged, disseminated and how it is perceived by the intended user has a great effect on whether an innovation is accepted or rejected (Onwuala et al., 2013; Khushk and Memnon, 2004; Runyon *et al.*, 1996).

2.5 Importance of Agricultural Processing to the Agricultural Sector

According to Augustine (2015), agricultural processing is very important in the agricultural value chain because it adds value to farm products and increases the income of farmers when farm products are converted into more convenient, less bulky, directly consumed or industrially usable inputs. In addition, processing also impacts storage capacity and minimizes post-harvest losses. Agricultural processing is also, an additional source of income and employment to rural dwellers. Gadzama, Yakubu and Mudiare (2017) and Labo (2013) are of the view that ginger processing and marketing increase farmers' income and impact the ability to procure fertilizer and other farm inputs positively.

Another dimension of development is the role small holder farmers and local agro processors play in the overall development process of the society not just in the agricultural sector (Alanana, 2006). Rural farmers including women play a very key role in ginger processing and marketing. They assist their husbands in processing and adding value to ginger and other commodities (Pintar, 2004). It is therefore, essential to encourage agro processors to adopt recommended processing standards for export in their production and processing of commodities, so as not to be at a disadvantage in terms of employment and income earning capacity (Ilyasu, 2016; Augustine, 2015; FAO, 2015).

2.6 Socio-economic Characteristics of Ginger Processors

Some studies on the socio-economic characteristics of people involved in agricultural processing have revealed that there exists a close relationship between their socio-economic characteristics and their participation in agricultural processing ventures (Ilyasu, 2016; Augustine, 2015). According to Fopojuwo (2010) farmers can be supported with credit and improved technologies

to make much more vital impact in agricultural production, processing, and marketing (Gadzama, Yakubu and Mudiare , 2017; FAO, 2016;FAO, 2015).

With an estimated 193 million inhabitants and a population growth rate of 2.5 percent annually, Nigeria is the most populated country in sub-Saharan Africa and the 10th most populous in the world (NBS, 2016; NPC, 2016). About 49 percent of the population engages in agriculture as their major occupation, with over 70 percent of the active labour force in rural areas employed in agriculture (FAO, 2015; World Bank, 2010).

2.6.1 Income level of local ginger processors

Income level of ginger processors represents income in naira derived from marketable surpluses after subsistence needs have been secured (FAO, 2015). Small holder farmers produce for their food security.Their income is derived from sale of surpluses or processed crops for income to meet other personal, family and household needs. Farmer's income obtained from the sale of processed ginger contributes significantly to household income (Ukohas 2010)Ater*et al*., 2006). Studies have indicated that the income of ginger processors is low and needs to be boosted to improve their livelihood (Lawal, 2010).

The income of local agro processors varies with the type of crop (food, cash or export) crops he deals with, his farm size, farming system adopted and output. All add up to determine the level of income obtained by the ginger processor. Through value addition processes and marketing of ginger (FAO, 2016; Itobiye, 2015; Augustine, 2015).

2.6.2 Level of living of local ginger processors

Level of living is a function determined by the quantity of goods and services actually consumed by an individual and his family (Ekong, 2010). The consumption of items such as radio, television, refrigerator, cooker, regular and high nutrient meals, appropriate clothing, decent

accommodation, type of transportation. According to Atala (1980) the level of living is positively associated with high levels of adoption of recommended standards.

2.6.3 Small scale ginger processors contribution to household income

The role of micro enterprises including small scale ginger processing by farmers cannot be underestimated. It has been observed that movement from primary to secondary and tertiary levels of production has a value adding function and hence offers a viable opportunity for farmers and other investors to earn more income (Essiet, 2014). The role that the agro processing industry can play in the value chain can be improved by improving the availability, accessibility, affordability, suitability, sustainability and support of agro-processors with technologies and resources (FAO, 2016). Ginger processors need a widening range of inputs and outputs as agro processing offers an avenue for improved livelihoods and income generation through value addition (Augustine, 2015).

The landscape in rural and urban areas in Nigeria is dotted by the economically active poor engaged in micro enterprise ventures and agro processing to improve their livelihood and this must be encouraged and supported to empower families economically and reduce the poverty burden in Nigeria (Alanana, 2006).

2.6.4 Challenges faced by ginger processors

Agro processing is relevant to social systems and is a practical solution to unemployment, source of income and value addition to crops produced by rural farmers (Amos, 2009). As suggested by a survey of extension programmes in the United States of America 2013 by the United States Department of Agriculture (USDA), there are many limitations, obstacles and challenges of adoption in the area of agro processing and storage technologies. Ordered from most critical to

least critical by Jacobson and Kar (2013) challenges to agricultural production and processing include:

i. Lack of familiarity with recommended agro-processing technologies.

ii. Low rate of awareness of recommended production and processing standards.

iii. Lack of financial support and availability of credit facilities.

iv. Absence of demonstration sites in agrarian communities.

v. Inadequate training and expertise in processing methods/technology.

vi. High cost of adoption of recommended processing practices.

vii. Lack of information about agro-processing standards for export.

viii. Apparent inconvenience of some recommended practices.

ix. High cost of seed and lack of improved seed and seedling sources.

x. Inadequate scientific research and ineffective extension services.

Agricultural processing by traditional methods and techniques is labour intensive, gives low output, low quality, value and gains (Augustine, 2015). The value chain in the agricultural system is critical to the agricultural industry because it enhances commodity values through (processing of crops) value addition but the challenges of inappropriate processing practices and the menace of middle men in the market constrain such activities (Akpoko, 2004). In addition, time-saving and yield increasing technology may not translate into expanded production without cost minimization and profit maximization at the processing stage (Augustine, 2015). On the other hand, application of improved processing technology and mechanization results in reduced processing time, higher output, improvement in quality, higher income and acceptability in the market, which in turn encourages further production and increasing returns on investment (Igbo *et al*., 2014).

Agricultural processing is essential to the agricultural sector because it enables the utilization of agricultural products such as groundnut, soybeans, palm kernel, cassava etc. and without processing the utility of such produce will be limited (Okafor, 2002). Agricultural processing is the conversion of an agricultural commodity from its raw state to a form more acceptable to the buyers. Adoption of standard agro processing practices improves the utility, benefits, appearance and prolongs the shelf life of farm produce (Augustine, 2015). It also contributes to household food security and nutrition by providing extra income for processors to meet their food and nutritional requirements (Saddiq, 2015). In some cases traditional methods are effective in agro-processing but cannot be done on a large scale thus, needing adoption of modern innovations. Processing is also important in improving the palatability and value of agricultural commodities (RMRDC, 2004).

Processing also helps in reducing the bulkiness of crops and in value addition (IITA, 2004). Marketing is another constraint faced by most agro processors. Most ginger processors suffer in the hands of unscrupulous middle men who exploit them by undervaluing the worth of their products thus, robbing them of the rewards for their efforts a reality that is being intensified by capital penetration in Nigeria's rural sector (Akpoko, 2004). Another major constraint facing ginger processors is the lack of storage and processing facilities. Since most farmers do not have standard stores for long term storage they are compelled to sell immediately after harvest during market glut resulting from oversupply and this fetches them a very low price for their produce (Ilyasu, 2016).

Agro processing is in distress in Nigeria (Iliya*et al*., 2009) and sub-Saharan Africa due to inability to adopt standards leading to huge crop losses, hunger, low quality of produce, and poverty due to low earning power. The solution lies in empowering farmers to adopt

recommended practices for better outcomes (Gadzama, 2015; Itobiye, 2015; Lawal, 2010). Augusine (2015) also reports high cost of technology, low access to technology, limited access to credit and insufficient extension staff to teach new innovations as constraints to small scale agro processors.

Furthermore, Itobiye (2015) reported that small holder farmers and local agro processors have access to only ten percent (10%) of the entire credit volume in the economy and have to rely on personal savings and other informal funding sources for their financial needs. Augustine (2015) also reports high cost of technology, low access to credit and low extension contact as constraints to adoption of recommended practices and standards.

2.7 Required Standards for Ginger Export

The Standard Organization of Nigeria was established by the SON Act of 1st January 1970, to standardize methods and products in Nigerian industries and to provide for other matters connected thereto. To achieve its core mandate SON in conjunction with other Nigerian and international agencies regularly develops Nigerian standards for local and international markets (Agro Nigeria, 2016). A Nigerian standard is a document established by consensus and approved by SON, that provides for common and repeated use, rules, guidelines or characteristics for products and services and related processes or production methods, aimed at the achievement of the optimum degree of order and quality in a given local context and the export market (SON, 2017). In addition, it may also include or deal exclusively with terminology, symbols, packaging, marking or labeling requirements as they apply to a product, process or production method to attain international requirements. These standards help to ensure that products and services are fit for their purpose and are compatible and comparable with internationally acceptable standards

for the local and export market. Thus, recommended standards for ginger export are accepted and enforced by SON for the international market (SON, 2017).

Other collaborators and partners in the enforcement and regulation of local ginger processing, locally and internationally include: NAFDAC; Manufacturers Association of Nigeria (MAN); International Standard Organization (ISO); World Trade Organization (WTO); the African Standards Organization; and the British Standards Institution [BSA] (SON, 2017). The list of SON standardized exportable goods includes but is not limited to:

(1) Cocoa Beans.

(2) Ginger.

(3) Cashew Nuts.

(4) Dried Hibiscus.

(5) Cotton Lint.

(6) Cotton Seed.

(7) Sesame Seed.

(8) Gum Arabic.

(9) Crushed Bone and Hoof meat.

(10) Soya Beans.

(11) Copra.

(12) Kola Nuts.

(13) Shea Nuts.

(14) Capsicum.

(15) Coffee.

(16) Rubber.

(17) Palm Kernel.

(18) Groundnut.

(19) Hide and Skin.

(20) Garlic.

(21) Onions.

(22) Turmeric.

(23) Locust Beans.

(24) Yam.

(25) Cassava Flour.

(26) Cassava Chips.

(27) Beans (Cowpea).

Recommended practices for ginger processing for export are meant to guide farmers to process exportable ginger to meet the international standards organization (ISO 22000) certification. SON ginger export standard specification is based on international standards and is essential for ginger to meet the requirements of importing countries such as the United Kingdom, Germany, Spain, Netherlands, France, USA, Russia, Saudi Arabia and others which have very high food safety and hygiene requirements. In addition, to the standards required by their respective industries (Foramfera, 2017; SON, 2017).

Although, some countries have localized and country specific standards the international standard specifications for ginger export (ISSFGE) standards are accepted by the standard organization of Nigeria (SON) which include:

1. Moisture content, 6 – 12% max;
2. Oil content, 1 – 2% minimum;

3. Impurities, 0 – 2% max.

The Indian and European Spice associations in addition to SON Standards have the following ginger quality parameters (Raghavan, 2000; SPC, 2014):

1. Total ash (%W/W) max (ISO 928);
2. Acid insoluble ash (%W/W) max (ISO 930); and
3. Moisture (%W/W) max (ISO 939);
4. Volatile oil (%W/W) max (V/W) min (ISO 6571);
5. Extraneous matter and foreign matter should not exceed 1% and 2%.
6. Should be free from live or dead insects, insect fragments and rodent contamination visible to the eye.
7. Microbiology:
   (i) Salmonella should be absent in at least 25g of material.
   (ii) Yeast and mould 105/g (target) absolute max (106/g).
   (iii) E-coli absolute max 102/g (target) absolute max (103/g).
   (iv) The European Union (EU) has fixed limits for aflatoxins which should not exceed 10ppb (total aflatoxins), and 5ppg for aflatoxins BI.
   (v) Individual EU members have their own aflatoxin limits varying from 1ppb –20ppb.

2.7.1 Recommended practices for ginger processing for export

The ginger processing methods and practices recommended for the attainment of set export standards by the National Root Crops Research Institute (NRCRI), Nigerian Export Promotion Council (NEPC) and National Agricultural Extension Research and Liaison Services (NAERLS) include:

i. Sorting: involves the separation of extraneous matter and shrivelled roots.

ii. Washing: ginger is packed into a big bucket or basin and washed several times. A large quantity of water is usually needed to thoroughly wash the ginger clean.

iii. Slicing: to enhance drying, slices of 1.5 to 2.0mm are often made.

iv. Drying: involves placing split ginger in the sun to dry on a clean treated floor or on a clean flat sheet material.

v. Chemical treatment: such treatments are used to control germ and pest infestation, fungi growth and to improve the appearance of ginger and they involve alkali treatment, lime treatment, sulphur and hydrogen peroxide bleaching.

vi. Insect and microbial control: using fumigants such as Methyl Bromide, Ethylene Dibromide, Ethylene Oxide and Formate. Irradiation of ginger is also considered as an ideal option.

vii. Packaging: packaging materials used must be such that it will properly protect the ginger from deterioration and preserve the flavour, colour, oil and chemical contents. Recommended packaging materials include polythene bags, paper containers and laminates.

Additionally, Uwandu *et al.* (2014) advise that the most important factors to control to achieve high quality of processed dried ginger acceptable in the export market include:

i. The appearance of the final product - especially for whole roots (not so important if the product is to be ground or used for oil extraction).

ii. Content of volatile oils and fibre especially for extracting oils.

iii. Level of pungency – especially for the extraction of oils.

iv. Aroma and flavour – especially for extraction of oils.

Furthermore, it is important to note that the quality of the final product is determined by both pre-harvest and post-harvest factors such as:

i. The cultivar of ginger grown determines the flavour, aroma and pungency, level of essential oil, fibre content, and medicinal value.
ii. Planting with appropriate sett size (20g/20mm).
iii. The stage of maturity of the rhizome at harvest most suitable at 8 to 9 months.
iv. Post- harvest handling including appropriate cleaning and drying to achieve maximum moisture content of between 7 to 12%.
v. Growth of mould should be avoided.
vi. Storage for a long time should be avoided as it results in the loss of flavour and pungency.

2.8 Empirical Studies on Socio – Economic, Institutional and Technological Factors Influencing Adoption.

There are many studies that have established a significant relationship between socio-economic, institutional and technological factors and behaviour of farmers' towards adoption of innovations. A study by Baffoe - Asare, Danquah and Annor - Frempong (2013) revealed that the socio-economic factors influencing farmers' decision to adopt technologies include experience, training, age of household head, household size and social capital as the key variable that positively influence the decision of farmers' to adopt cocoa pest disease control. They also found out that farm size and belonging to societies such as clubs, produce buying cooperative organizations and technological characteristics and perceived benefits of the innovation influenced adoption positively.

Past studies on adoption have tended to posit that farmers' agricultural technology adoption is dependent on their socio-economic characteristics, institutional and technological factors such as cost, risk index, complexity and compatibility. The often mentioned socio-economic factors are age, gender, education level, amount of labour force available, land size, number of livestock owned, off-farm income, affordability, ease of use and perception of risk versus benefits. Straus *et al*. (1991) found out that farmers' education level is generally associated with superior ability to acquire, process and use improved technology information. Therefore, educated farmers' are expected to adopt new innovations much more than farmers with less or no education.

Age has also been found to increase or wear away confidence: hence, as a farmer ages he/she becomes more or less averse to risk regarding new technology (Kaliba*et al.*, 2000). Thus, the general position or *apriori* expectation which has also been verified in many studies is that farmers' age can increase/decrease the rate of adoption of innovations by farmers'.A study by Mmbando and Balyegunhi (2016) revealed that five variables are identified to have statistically influenced adoption of improved maize technologies, including: access to credit; extension visits; membership of farmer groups/associations; participation in on-farm trials/demonstrations; off – farm income; and level of education.

Mmbando and Balyegunhi (2016) established that access to extension variable is statistically significant with a positive influence on adoption of improved maize varieties. The found out that the odds ratio for extension is 6.129; this implies that those that have access to extension are over six times more likely to adopt maize innovations compared to those without and this is consistent with Sisay *et al.*(2015) and Kaliba *et al.*(2000) who all reported that the number of extension visits by extension agents and other forms of educational contact has a positive and significant

association with adoption in most parts of Nigeria and sub-Saharan Africa (Ojo and Ogunyemi, 2014).

Similarly, studies have shown that farmers' with access to credit facilities are more likely to adopt innovations compared to those without access. The odd for adoption as a result of access to credit is three times for those with access as compared to others without access (Mmbando and Balyegunhi, 2016). Also, Gecho and Punjabi (2011) found out that paucity of funds and lack of access to credit were factors that have profound effect on adoption of improved technologies by farmers' as confirmed by numerous studies (Gyinadu *et al*., 2015; Onmadu and Osahon, 2014).

Kaliba *et al*. (2000) also found out that gender of the household head determines access to new information. It is indisputable that social behaviour and role allocation in the African context makes male extension agents and other information facilitators to address male headed households leaving female headed households without much needed information which aids adoption decisions. Furthermore, labour availability, farm size and physical capital endowment (wealth status of household) makes wealthy farmers' to have resources for purchase of improved farm technologies. Hence, a positive relationship has been found to exist between adoption decisions and household wealth (Kaliba *et al*., 2000).

Mmbando and Balyegunhi (2016) also indicated a positive relationship between diversified income sources involving off – farm activities and income as influencing to a large extent adoption decisions by farmers'. Studies by Zhang *et al*. (2002) established that farmers' who are aware of improved technologies are likely to have higher adoption rates than those who are not aware of improved technologies.

The educational variable has also been established as a major factor influencing adoption positively. Mmbando and Balyegunhi (2016) in their study statistically established an odds ratio

of 8.01 which implies that a year's increase in a farmers' education can increase the likelihood of adoption 8 times. This is in agreement with many studies that reported a positive relationship between farmers' level of education and adoption of improved farm technologies in developing countries (Deepa*et al*., 2015; Kebede and Tadese, 2015; Onumadu and Osahon, 2014; Baidu – Forson, 1999).

Also, findings by Helder *et al*. (2005), Ranson *et al.* (2003), Rearson *et al.* (2007) and Dirro (2013) established that households involved in off-farm activities can afford to invest in improved technologies in agricultural production and processing activities. Improved technologies demand financial investments for their purchase and use. Farmers' who have off – farm streams of income easily overcome working credit constraints by financing productivity enhancing inputs such as improved seeds, herbicides and pesticides, and fertilizer.

Farmers' membership of farmer groups/organizations has also been found to be significant in influencing farmers, adoption decision. The odds ratio for adoption by farmers by farmers belonging to groups reported by Mmbando and Balyegunhi (2016) was 2.56 which implies that farmers' who are members of groups, associations and clubs/cooperatives are nearly three times more likely to adopt improved technology. Sisay (2015) also reported that farmers' membership of groups has a significant positive influence on farmers' adoption behaviour. These results are in concordance with similar findings by Ugunmadu and Okechukwu (2014), Ojo and Ogunyemi (2014), and Amaza *et al*. (2007).

Training via on-farm trials/demonstrations has been found to also influence the adoption of improved technology by farmers in developing countries such as Ethiopia, India and Nigeria as confirmed by studies by Kebede and Tadesse (2015), Gecho and Punjabi (2011), Zhang *et al*. (2002) and Aiitchedji *et al.* (2010).

Studies by Imanogor and Unuigbe (2016) revealed a significant influence of personal characteristics such as farm size, level of education, social participation and contact with extension agents on farmers' acceptance and continuous use of agricultural innovations. Usman (2015) also reported that majority (74.4%) of farmers in his study indicated increased quantity and quality of output as a result of adoption but were negatively influenced and unable to fully adopt the full technological packages by high labour costs, inadequate extension information, complexity of technology and lack of credit. This agrees with several findings which showed that high labour costs, inadequate extension information and lack of credit had significant effect on adoption by farmers.

Jamala, Shehu and Garba (2011) in their study on adoption of innovation among irrigated rice farmers' found out that five variables had significant influence over adoption of improved technologies. These are farming experience, household size, gender, market access and labour availability.

Technological factors such as affordability, complexity, compatibility, relative advantage and cost of adoption have been found to have significant influence over farmers' adoption behaviour (Ekong, 2010). Ibukun (2009) found out in her study that technological characteristics such as ease of use, risk index and divisibility of the technological package have significant influence on adoption decision of farmers'. Also, studies by Dutse (2017), Augustine (2015), Saleh (2014) and Saddiq (2012) corroborated the fact that technological characteristics of an innovation significantly influence farmers' adoption behaviour. Caffey and Kazmierczak (1994) identified a link between type of technology, ease of use and perceived benefits of the technology compared to existing practices as major influence over technology adoption and diffusion.

2.9 Theoretical Framework

This is the frame of view or perspective chosen in theory to further explain relationships between phenomena or certain variables that interact or influence one another. Theory can be considered as a set of abstract and logical statements that have been tested and found a reflection of reality. The theories utilized for the study are Lewin's theory of planned social change and theory of adoption and diffusion of innovations.

2.9.1 Theories of social change

Theory is a set of abstract logical compositions which attempts to explain relationships between phenomena based on certain assumptions about reality (Lawal, 2010). Social change involves change in ideas, values and processes (Haralambos and Holborn, 2000) and social change theories serve as general principles and framework for understanding social processes and change in a society (Haralambos and Holborn, 2008). For this study Kurt Lewin's planned change theory and the theory of adoption and diffusion of innovations are used. Social change theories are utilized with emphasis on their planned change aspects. Social change according to Ekong (2010) takes the following forms:

i. Modifications in human attitude and behavioural pattern as a result of education.
ii. Alteration in social conditions as a result of changes in the policies of a social organization.
iii. Effecting reform in major legal and functional system of society, eg. Agricultural Transformation Agenda (ATA).
iv. Changes in material culture.

2.9.2 Kurt Lewin's theory of planned social change

In the society social equilibrium and social change are important stages showing how society evolves on a time continuum (Lewin, 1947).In advocating for or understanding the phenomenon of planned change it is important to focus on factors that influence people to change, and the three stages according to Lewin are: unfreeze, change (transition) and freeze (refreeze). Thus, Lewin's planned change theory is usually referred to as unfreeze, change, freeze (refreeze) theory of social change. These stages can be quite complicated in real life but Lewin gives a simplistic view and avoids unnecessary complications which are not necessary for an easy grasp of the fundamentals of the theory. Although, this opens up the theory to criticism of being too simplistic and abstract.

The world has changed but Lewin's postulations and model presented in 1947 are still relevant today. In fact, many recent models are based on Lewin's planned change model (Connelly, 2016). The three change stages proposed by Lewin in 1947 are explained thus:

Stage 1: Unfreezing.

The unfreezing stage is probably one of the more important stages to understand in the world of change we live in today. At this stage the society is getting ready to change. It involves getting to a point of understanding that change is necessary and getting ready to move away from our current comfort zone. The first stage is about preparing ourselves, or others, before the change and therefore, ideally creating a situation in which we want the change. The more it is felt that change is necessary, the more motivated we are to make the change. Unfreezing and getting motivated for change is all about weighing up the advantages and disadvantages of the proposed change and if the advantages outnumber the disadvantages and the change is perceived as not likely to threaten existing socioeconomic and institutional realities to an unmanageable extent

(crisis point). The change is readily accepted, supported and massively engaged by members of the society. This is what Lewin views as the force field analysis (FFA). If on the other hand the change is seen as not being beneficial and harmful. It is rejected and where it is forcefully imposed, it is resisted vehemently by the people. Therefore, before change occurs the force field is in equilibrium between forces favourable to change and those resisting it. For change to happen the status quo or equilibrium must be upset either by adding conditions favourable to the change or by reducing resisting forces. According to Lewin (1947) whenever the driving forces are stronger than restraining forces, the status quo or equilibrium will change (Sutherland, 2013). At this point in the dissemination and diffusion process information is being passed to ginger processor who evaluate the benefits and otherwise of the recommended practices being disseminated to them as they decide to adopt or not based on the information that awakens (unfreezes) them to a new way of processing ginger for maximum value in the export market.

Stage 2: Change or transition.

According to Lewin (1947) change is not an event, but rather a process. He called that process a transition. Transition is the inner movement or journey we make in reaction to a change. This second stage occurs as we make the changes that are needed people are "unfrozen" and start moving towards a new way of life. This stage is often the hardest as people are unsure or even fearful. This is not an easy time as people are learning about the changes and need to be given time to understand and work with both the change in place and the change agents. Transition occurs at different rates for each individual, community or nation depending on the success of dissemination and diffusion efforts. It has no set time limit even after change programmes and projects initiated as part of a planned change strategy have been implemented to disseminate and diffuse innovations. To ensure change occurs in a definite, acceptable and sustainable manner at

this crucial stage. Support is really important and can be in the form of training, coaching and correcting mistakes in dissemination and adoption as part of the change process. At this stage using role models and allowing people to develop their own solutions or specific adaptations to change will help the adoption process to succeed. It is really important at this point to keep communicating a clear picture of the desired changes and the benefits. So that people don't lose sight of where they are headed and the accruable future benefits. This stage represents the necessary adjustments processors make to adopt the recommended ginger processing practices for export so as to maximize its benefits to them.

Stage 3: Freezing (or refreezing).

Lewin refers to this stage as "freezing" but others see it as "refreezing". As the name suggests, this stage is about establishing stability once the changes are accepted and become the new norm. People form new relationships and become comfortable with their routines. This can take time and is usually the point that a cogent criticism of the Kurt Lewis change model is made because there is never a time when society "freezes" since social change is a continuous and constant phenomenon in the society. It is useful though to note that, Lewin's view expressing change as a journey with a beginning, midpoint and an end is a simple framework for understanding the dynamics of the change process (Morrison, 2017). At this freezing stage Lewin is concerned about reinforcing and solidifying the rate of adoption achieved among ginger processors' thereby, ensuring that the desired change is widely adopted and used continuously (coincides with adoption stage by Rogers, 2003) and maintained into the future. Without such a safeguard people tend to go back into doing what they are used to doing. It is important to freeze (solidify) the gains of a planned change to ensure its continuity and livelihood impact maximization.

Lewin's perspective suits this study because adoption is a change and development strategy which aims to encourage the acceptance and continuous utilization of recommended practices for better agro processing outcomes. To enhance adoption among ginger processors they have to be convinced prepared, trained and supported and all these involve Lewin's 3 stages of planned social change.

2.9.3 Theory of adoption and diffusion of innovations

Rogers (2003) views social change from the perspective of planned or unplanned change in the social system and planned change entails direct human intervention and effort while unplanned change happens irrespective of man's efforts such as earthquake, flood, lightning blast, hurricane, cyclone, tsunami, locust infestation, quela bird invasion among others as a result of natural phenomena. Planned change according to Ekong (2010) involves direct human intervention in directing change towards predefined goals.

Technology can be seen as the process by which humans modify nature to meet their needs and want (Ilyasu, 2016). Agbamu (2006) views technology as the application of scientific laws and use of mechanical arts in the processes of life and production activities. Technology serves as a tool utilized for the uplifting of human society through rationality which produces innovations.

The process of adoption and innovation decision of individual farmers, countries and non-governmental organizations is affected by policy variables, government inducement and intervention (Noun, 2015). Most of the world's poor are engaged in agriculture in rural areas. According to Pawan (2011) Activities designed to address the vulnerability of these rural poor are often geared towards improving agricultural practices as a means of increasing productivity, efficiency and, ultimately, income. Governments, NGOs, Aid agencies and extension workers have long known that the success of any project depends in part, on whether farmers adopt the

offered technologies and, if they do, whether those farmers adopt the technologies in an ideal combination and for the prescribed length of time needed to produce designed result. He goes further to argue that, by understanding how farmers and communities decide whether to adopt a technology or not, rural development professionals can refine their agricultural technology outreach projects to address the conscious and sub conscious concerns of targeted communities, and increase the probability that farmers will be willing and able to participate in project activities.

The process of agricultural technology adoption and diffusion can be understood using the factors that determine the adoption of technology across space and time including: time series analysis; cross sectional analysis; and panel data analysis. This is critical because an understanding of such factors will definitely lead to better extension system planning and approaches that are viable to the farmer who will ultimately benefit from better agricultural technology which has direct impact on his outcome and standard of living (Ekong, 2010;Pawan (2011).

“Innovation” (new agricultural technology) is similarly used with the nuance of a new or recommended practice being disseminated for adoption. “Diffusion” refers to the stage in which the technology spreads to general use and application. “Interaction” connotes a sense of acceptance and perhaps transparency within the user environment. The rate of adoption is defined as the relative speed at which participants adopt an innovation. Rate is usually measured by the length of time required for a certain percentage of members of a social system to adopt an innovation. The rates of adoption for innovations are determined by an individual’s adopter category. In general, individuals who first adopt an innovation require a shorter adoption period (adoption process) when compared to late adopters.

In measuring the process of agricultural technology adoption and diffusion, researchers most commonly use three methods to unearth the underlying influences that improve the chances and rate of adoption of technology by farmers. Technology is assumed to mean a new, scientifically derived often complex input supplied to farmers by organizations with deep technical expertise. It is important to note that just as there are different types of technologies, there are different kinds of adoption. Pawan, 2011 makes three distinctions in types of adoption listed below:

1. Individual versus aggregate adoption,
2. Singular versus pockets of technologies available for adoption,
3. Divisible versus non divisible technologies.

The first option is at the individual level. It involves internal deliberative process but is ultimately manifested as a dichotomous decision and the aggregate adoption behaviour observed as the diffusion of technology and its corresponding adoption throughout a discrete space. According to Pawan (2011) adoption is an individual process detailing the series of stages one undergoes from first hearing about a product to finally adopting it. Diffusion signifies a group phenomenon, which suggests how an innovation spreads. According to Carr (2016) Adoption refers to the stage in which a technology is selected for use by an individual or an organization. Crucial aspects of adoption/diffusion are the decisions taken about it over time. In this regard the five stages in the decision making process theory explain that potential adopters of a technology progress over time through five stages in the diffusion process (Rogers, 2003). First, they must learn about the innovation (knowledge); second, they must be persuaded of the value of the innovation (persuasion); they them must decide to adopt it (decision); the innovation must then be implemented (implementation); and finally, the decision must be reaffirmed or rejected

(confirmation). This process is also captured as AIETA (Awareness, Interest, Evaluation, Trial and Adoption) (Rogers, 2003; Ekong, 2010).

The perceived attributes theory of diffusion and adoption of innovations views the attributes of an innovation from five angles of judgment; that is can be tried out (triability), that results can be observed (observability), that it has an advantage over other innovations or the present circumstance (relative advantage), that it is not overly complex to learn or use (complexity), that it fits in or is compatible with the circumstances into which is will be adopted (compatibility).Therefore change which leads to progress is usually anchored on innovation, adoption of the innovation and its spread (diffusion) within the social system. Diffusion is he process by which an innovation is communicated through certain channels over time among the participants in a social system leading to social change and progress. There are four main elements that influence the spread of a new idea: the innovation itself, communication channels, time and the social system. As innovations become cultural symbols when they are adopted by a few (trendsetters/innovators) and become successful in use. This encourages others to adopt as it eventually reaches a critical mass. The categories of adopters are: Innovators, early adopters (trendsetters), early majority, late majority and laggards (Rogers, 2003; Ekong, 2010).

2.10 Conceptual Model

Ekong (2010) describes conceptual model within the context of a broad explanation of social realities different from prior research findings and therefore untested and unproved. The model below shows the socio-economic, institutional and technological characteristics of ginger processors.

Socioeconomic variables comprise age, marital status, household size, educational level, and processing while institutional factors include extension visits, amount of credit received, and

membership of a cooperative. Technological characteristics include compatibility, complexity and cost of adoption. Figure 1 shows that the independent variables (**X**) would influence the dependent variable (**Y**) which is the adoption of recommended standards for ginger processing for export and lead to observed effects/outcome. There are other intervening variables not shown in the diagram such as weather, price changes, natural disaster, pest and diseases, changes in public policy and security challenges among others.

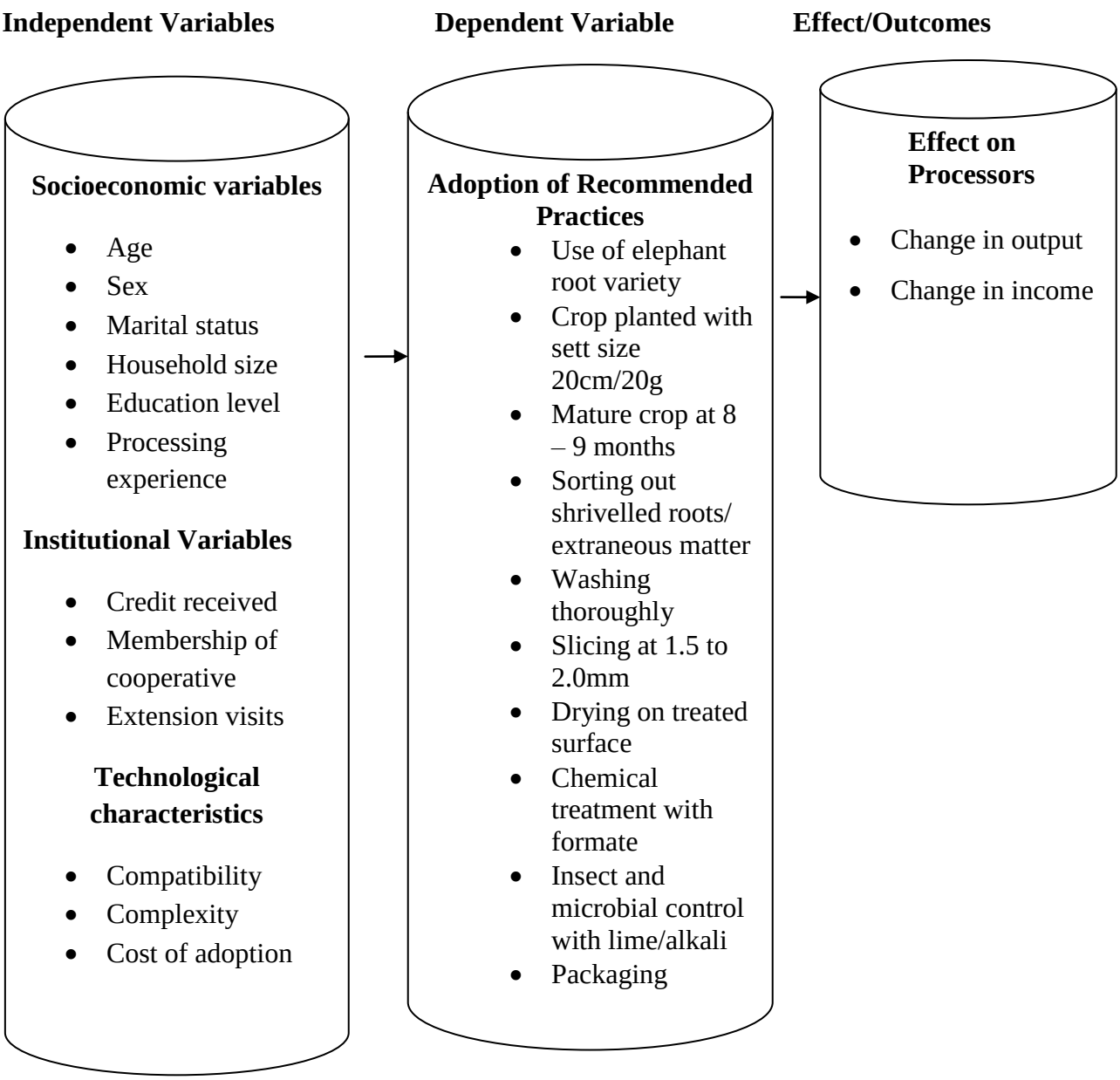

Figure 1: Diagram showing factors influencing adoption of recommended Ginger processing practices for export.

CHAPTER THREE

3.0 METHODOLOGY

3.1 The Study Area

The study was carried out in Kachia and Kagarko Local Government Areas (LGAs) of Kaduna State which are located in the southern part of Kaduna State, Nigeria. They both have similar climatic, geographical, vegetation, population and occupational characteristics of a derived Savannah with moderate rainfall, savannah vegetation and fertile soil. The study area is characterized by rural features and an agrarian economy. Majority of the people are farmers but in addition to farm production, farmers in this area are also involved in ginger processing in the ginger value chain to improve the marketability, preservation and storage of ginger (Okoh, 2015).

Kachia and Kagarko LGAs are resource poor areas which lack public institutions, private industries and other sources of income apart from agriculture. Ginger is considered a major source of income because of its high demand and relatively high price compared to other farm products. It is therefore, produced widely and partly processed in commercial quantities thus, helping to reduce the high level of poverty and deprivation in the two LGAs. Processed ginger as an important source of livelihood in the study area needs to be improved through the adoption of recommended processing standards for exportability and higher prices which translates to higher income and improved livelihood to ginger processors in the study area.

Kachia Local Government Area shares boundaries with Zangon Kataf in the East, Jaba in the South, Kajuru in the North and Kagarko in the West (Dariya, 2016). According to the 2006 population census; the estimated population of Kachia local government area was given as 252,568 consisting of 127, 624 males and 124, 944 female which at 3.2% population growth rate

is projected to be 370,806 in 2018 (NPC, 2006).The local government area has different ethnic groups including Adara, Kuturmi, Jaba, Bajju, Hausa and Fulani (Dariya, 2016).

Kagarko Local Government according to the National Population Commission census figures (2006) had an estimated population of 239, 058 people which consisted of 121, 041 males and 118, 017 females which is projected to be 350,971 in 2018 based on a 3.2% annual base rate (NPC, 2006).

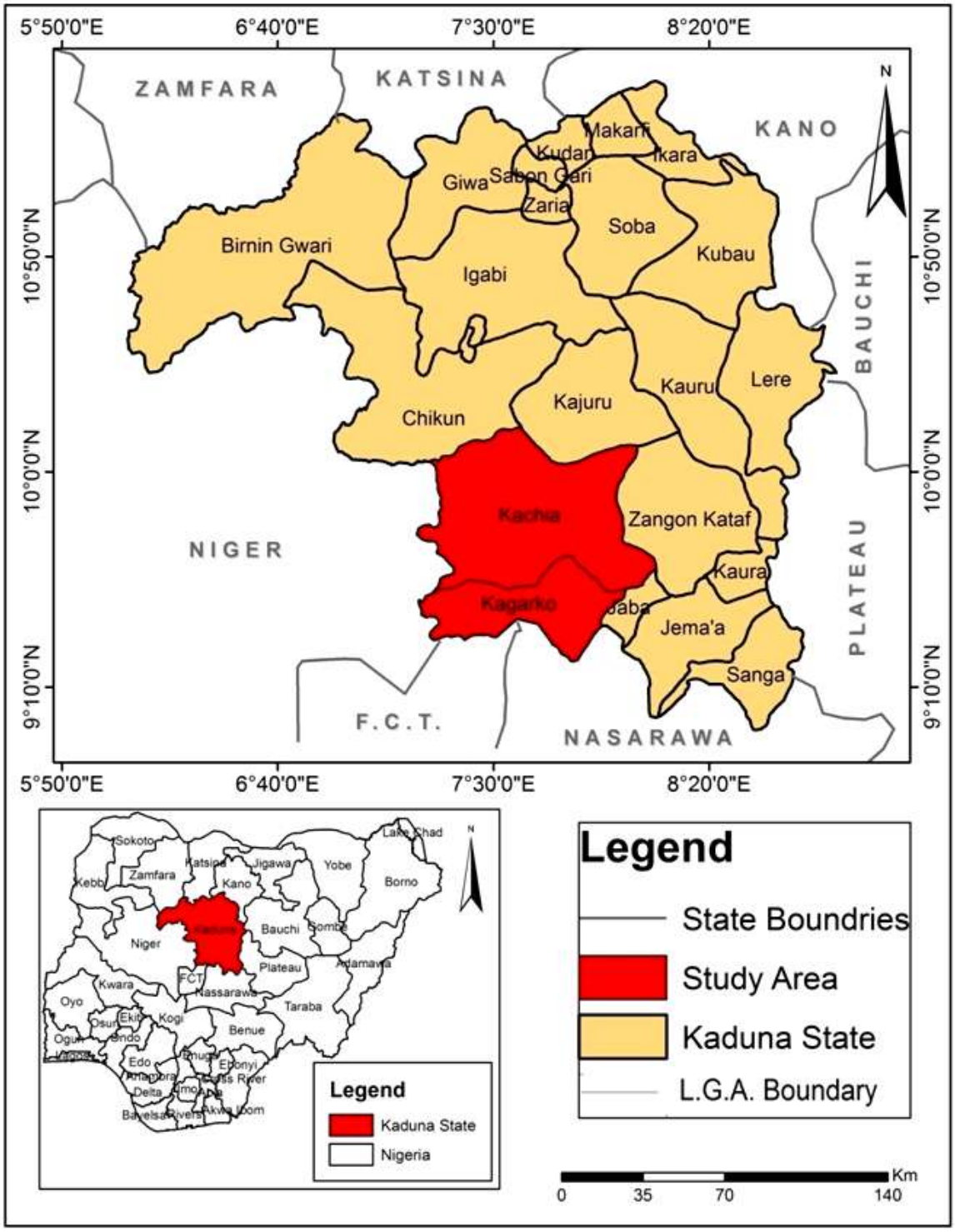

Figure 2: Map of Nigeria and Kaduna State showing the study area.

3.2 Sampling Technique and Sample Size

A multi-stage sampling technique was used in determining the sample size for the study. Kachia and Kagarko LGAs were selected because they are prominent ginger processing LGAs. Ginger production and processing is a major activity in the two LGAs because of the climatic conditions favourable to its production and its importance as a source of income to the residents who are mostly small holder farmers. The next stage was the random selection of five ginger processing districts from each of the two LGAs. The Kaduna State Agricultural Development Programme [KADP] (2016) documented 473 ginger processors in the ten randomly selected ginger production and processing districts in the two LGAs which were used as the sample frame from which a proportion of 45.4% i.e. 215 processors were randomly selected for the study.

Finally, using Slovian formula, the sample size was determined. The Slovian formula is given as:

$$n_o = \frac{N}{1+N\,(e^2)}$$

Where: n_o =sample size; e = 0.05; N = total number of observations. Therefore:

$$n_o = \frac{N}{1+N\,(e^2)}$$

$$n_o = \frac{473}{1+494\,(0.05 \times 0.05)}$$

$$n_o = \frac{473}{1+494\,(0.0025)}$$

$$n_o = \frac{473}{1+1.2}$$

$n_o = \frac{473}{2.2} = 215$. Therefore, $n_0 = 215$, i.e. 45.4% of the sampling frame.

A sample size of n = 215 satisfies the central unit theorem which asserts that, a sample size of at least n = 30 is large enough to ensure a normal distribution in the sampling process (Ladele and Chah, 2015; Runyon *et al.*, 1996; Webster, 1995)

Table 3.1: Sampling technique and Sample Size

LGA	**District**	**No. of ginger processors (Sampling frame)**	**No. of ginger processors (45.4% of sampling frame)**
Kachia	Gumel	53	24
	Kachia Urban	43	20
	GidanJibrin	45	20
	SabonSarki	52	24
	GidanMana	44	20
Kagarko	Aribi	55	25
	KurminJibrin	40	18
	Kagarko North	47	21
	Kagarko South	43	20
	Jere South	51	23
Total		**473215**	

Source: Author's Field Survey, 2017

3.3 Method of Data Collection

A structured questionnaire was utilized for data collection. The questions were designed to meet the objectives of the study.

Reconnaissance visits were conducted in Kachia and Kagarko L.G.As in the first week of October 2017 to have an accurate view of the study area. Two enumerators assisted in data

collection for the study and they were trained and supervised by the researcher. Data was collected for a period of two months from 1st November - December 31st 2017. A pre – test data collection and analysis was done using 22 questionnaires representing 10 percent of the sample size in Gumel to test the validity and appropriateness of the questionnaires. The questionnaires were validated and deemed appropriate and sufficient to achieve the aim of collecting useful data for the study.

3.4 Analytical Techniques

Analytical tools that were used to achieve the objectives of this study and test the hypotheses include descriptive statistics, multiple regression model and Z – test statistic.

3.4.1 Descriptive statistics

This involves using means, percentages and frequencies, to summarize data to achieve objectives (i) which is to describe the socio - economic characteristics of ginger processors in the study area, (ii) which is to identify the improved ginger processing practices being disseminated to ginger processors, (iii) find out the rate of awareness and adoption, and (vi) find out the constraints of adoption of recommended ginger processing practices among processors in the study area.

3.4.2 Multiple regression analysis

Multiple regression analysis was used to achieve objective (iv) which is to determine the socio-economic, institutional and technological factors that influence adoption of recommended ginger processing practices to attain export standards and to test hypothesis 1 (Ho_1) of the study:

Ho_1: There is no significant relationship between socio-economic characteristics of ginger

processors and adoption of recommended practices for ginger processing for export in the study area.

The Multiple regression equation is expressed as follows:

$Y= \alpha + \beta_1X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_{9...}\beta_{12}X_{12} + U$. Where:

Y= Adoption of ginger processing practices (yes = 1, No = 0)

X_1 = Sex (Male = 1, Female = 2)

X_2= Age (in years)

X_3 = Marital Status (Single = 1, Married= 2)

X_4 = Education level (Number of years in formal schooling)

X_5 = Household size (number of persons)

X_6 = Credit received (in ₦)

X_7 = Membership of Association (yes = 1, no = 0)

X_8 = processing experience (in years)

X_9 = Extension visits(number per year)

X_{10} = Compatibility (compatible = 1, not compatible = 0)

X_{11} = Complexity (easy to use =1, not easy to use =0)

X_{12} = Cost of adoption (in ₦)

U= error term

α = Constant.

3.4.3 Z - test statistic

The Z-test was used for sample sizes greater than 30 to show the outcome/effect of adoption on ginger processors' output and income. It was used to test hypothesis (ii) and to achieve objective five.

Ho_2: There is no significant relationship between adoption of recommended practices for ginger processing for export and output/income of ginger processors.

The **Z**- test is represented as follows:

$$\mathbf{Z} = \frac{\overline{\mathbf{X}_1} - \overline{\mathbf{X}_2}}{\sqrt{\frac{S_1}{n_1} + \frac{S_2}{n_2}}}$$

Where Z = the calculated **Z** value

$\overline{\mathbf{X}_1}$= mean output/ income after adoption

$\overline{\mathbf{X}_2}$= mean output/ income before adoption

$\mathbf{S_1}$ = Standard deviation after adoption

$\mathbf{S_2}$ = Standard deviation before adoption

$\mathbf{n_1}$= number before adoption

$\mathbf{n_2}$= number after adoption

3.4.4 Level of adoption

The adoption level formula was used to achieve objective (iii) and it is given as:

$$\text{Level of adoption of Standards} = \frac{\text{No. of recommended standards adopted}}{\text{Total available recommended standards For ginger processing for export}} \times 100$$

3.5 Operationalization of Variables

3.5.1 Independent variables

i. **Sex (X_1):** This refers to the biological attribute of being male or female it will be measured as male = 1 and female = 2. This attribute also has gender roles attached to it as the gender roles which affect the role male and female play agricultural activities. Men for instance, due to their biological attributes and social roles have greater capacity and likelihood to obtain/access production resources such as land, credit, extension services etc. and as heads of households men (male) take production decisions and control resources much more than women (female) (Ekong, 2010).

ii. **Age of respondents (X_2):** It is defined as the chronological age of a farmer and is measured as age of a respondent in years attained and earned in a life time the time of the study. Age is noted to be a very important variable and at plays an important role in the farmers' role play, attitude and behavior. As the Processor's age increases, his/her aversion to risk increases hence, adoption of new technology seems less likely (Dutse, 2017).

iii. **Marital status (X_3):** This refers to the character of being single or married, divorced or widowed. Married was categorized as = 1 and single = 2. A processor's marital status is an important factor in the adoption process as it acts as either an impediment or enhancer of adoption because married people are considered more responsible and more likely to adopt practices that can improve their output, income and livelihood. It can also affect adoption because of risk aversion and the desire for stability among the married while singles may be more willing to adopt due to less responsibilities (Dahunsi, 2012).

iv. **Educational level (X_4):** This refers to the extent to which the ginger processor has acquired knowledge through organized or formal schooling. Processor's exposure to education is expected to provide more access to information acquisition, rate of awareness, rationalization of decision making and enhance adoption. This was measured by years of schooling in the formal education system (Dutse, 2017, Bonana-Wabbi, 2002).

v. **Household size (X_5):** This refers to the total number of people living in a house under the care of a particular household head. The total number of people in the respondents household will be his score (Saddiq, 2015).

vi. **Credit received (X_6):** It refers to the total financial support received by ginger processor in ₦ from governmental, nongovernmental and cooperative sources. The higher the credit received the higher the chances of adoption of recommended standards (Ado, 2012).

vii. **Cooperative membership (X_7):** This refers to processors' membership of a group and the number of years of membership (yes =1, no = 0). It is an *apriori* assumption that the number of years of group membership improves the chances of adoption of recommended processing standards (Augustine, 2015).

viii. **Processing experience (X_8):** This is the number of years spent in processing ginger. As the processor's number of years in processing increases the processor's production is likely to increase due to adoption and utilization of efficiency and quality enhancing tools and techniques (Augustine, 2015).

ix. **Extension Visits (X_9):** This refers to the number of visits by the extension agent to the ginger processor in a given period of time. It is measured by the total number of

contacts received by the farmer from extension agents in the previous production season (Dutse, 2017).

x. **Compatibility (X_{10}):** Refers to the nature of the technology and whether it is in line with current practices and socio-cultural realities. It was measured as compatible =1, not compatible = 0. The more compatible a recommended technology is the higher its adoption rate (Agbamu, 2006).

xi. **Complexity (X_{11}):** This is an indication of ease or difficulty of use of a technology. It was be measure by not complex = 1, complex = 0. The more complex a technology is the less likely it will be adopted by processors (Akpoko, 2004).

xii. **Cost of adoption (X_{12}):** Refers to the amount measured in Naira (₦) for the recommended practices to be put to use in ginger processing. Since most local processors are resource constrained it is assumed that the higher the cost of adoption the less likely adoption is going to occur among processors (Ekong, 2010).

3.5.2 Dependent variables

i**. Adoption:** This is a decision by a processor to accept and use a technology continuously over a period of time. It was scored as adopted = 1 and not adopted = 0 while the rate of adoption is measured by the percentage of agro processors who adopt recommended ginger processing practices for export measured in percentage (%) (Bonabana-Wabbi, 2002).

ii. **Effects of Adoption (Expected Outcome)**

1. **Output:** This is the quantity of ginger processed by a ginger processor measured in Kilograms (Kg) within a given period of time. Output of the ginger processor is a function of many factors including rate of adoption, access to credit, income etc. (Dutse, 2017).

2. **Income:** This is the amount of money received in Naira (₦) from sale of processed by ginger processors measured in ₦. Income is a major factor in adoption as it assists the processor to obtain all the necessary tools, equipment and inputs recommend for improved production (Lawal, 2010).

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

Introduction

This chapter focuses on the presentation and discussion of the results of the study. It deals with the findings related to the objectives stated and the test of hypotheses using appropriate analytical techniques. Two hundred and fifteen (215) questionnaires were administered and utilized in the study.

4.1 Description of Socio-economic Characteristics of Respondents

Important socio – economic variables such as age, sex, educational level, household size, and years of experience were considered important in this study in order to obtain valuable information on the effects of such variables on the awareness and adoption of recommended practices for ginger processing for export among processors in Kachia and Kagarko Local Government Areas of Kaduna State.

The age of the respondents is important in revealing the age group predominantly involved in ginger processing in the study area. The results in Table 4.1 reveal that the youthful, highly energetic and age bracket of 20 – 50 (70.6 percent) constituted an overwhelming majority of ginger processors while the older group aged 51 years and above constituted 29.4 percent of the respondents. The mean age of the respondents was 45 years. This agrees with studies by Ibukun (2009), Ekong (2010) and Dutse (2017) who reported a mean age of 45 years for majority of farmers. Ekong (2010) specifically, points out that the most active labour force in agrarian communities is between the ages of 25 to 50. This implies that ginger processing requires energy and those within the active age group are more likely to be involved in it.

Findings revealed that more men are engaged in ginger processing in the study area than women. Table 4.1 shows that majority of the ginger processors were males 131 while females were 84 representing 60.9 and 39.1 percent of the respondents respectively. This may not be surprising because most African households are headed by men as confirmed by Nwosu and Ndinda (2014), Nigerian Demographic and Health Survey [NDHS] (2003) and United Nations Development Programme [UNDP] (2017) who reported 63%, 83.4% and 73% and at the same time own the household economic production units and sources of income which make them the owners of ginger processing activities in their households even though women may form the bulk of the labour force as corroborated by Jiriko (2011) and Ekong (2010).

The household is the main source of ginger processing labour and to a large extent determines the quantity of ginger processed by processors. Responses on household size indicate that 99 respondents representing about 50 percent had 6 – 15 people in their households. The mean family size of the respondents was 9. This finding is consistent with findings by Ibukun (2009) who reported that the average family size in Africa is 9 people per household. This can be a motivation to the adoption of improved ginger processing technology because of the large labour capacity. It contrasts with the findings of Saddiq (2012) who reported a mean household size of 42 in Zamfara State and Saleh (2014) who reported a mean household size of 15 in 16 northern States of Nigeria due to several reasons, the major one being that polygamy is less practiced in the study area due to the predominant religious belief in the study area which approves monogamy. The study reveals that 167 of the respondents were married while 48 were single representing 77.7 and 22.3 percent respectively. This shows that an overwhelming proportion of the respondents were married. This is not surprising because agrarian communities where production is labour intensive marriage and family are strong incentives to increased production

Education as a variable is usually generally low for rural agrarian communities. Level of education has a strong effect and is linked to the ability of local ginger processors to positively view and comprehend new ways of doing things to improve output, income and livelihoods generally. Table 4.1 presents a vivid illustration of the level of education of the respondents which shows that 64 (29.8 percent) had secondary education followed by 50 (23.3 percent) who have primary education. Only 29 respondents (13.5 percent) of the respondents have tertiary education. This is in agreement with many studies which reveal low educational attainment in rural areas as majority of the respondents either attain education at the lower level or not at all as corroborated by Dutse (2017), Saddiq (2012) and Ibukun (2009).

Processing experience is an important factor in adoption and Table 4.1 shows that 22 (10.2 percent) of the respondents had been into ginger processing for 1 – 5 years, 102 (47.5 percent) while 20 (9.3 percent) had been into ginger processing for over 35 years. The mean ginger processing experience of the respondents was 16 years. Length of processing experience is known to assist processors in making positive and beneficial adoption decisions and choices.

One major characteristic of small – scale local agro processors is low output due to capital, labour, technological and credit constraints (Augustine, 2015) and this can be seen from the results in Table 4.1 which show that majority of the respondents 127 (68.2 percent) processed between 300kg – 1000kg. The mean quantity of ginger processed by respondents was 480kg. This implies that all the respondents were small – scale ginger processors. This limited capacity for adoption of recommended export processing practices due to resource limitations as some practices are capital intensive.

Low income is a major variable that impacts adoption of innovations by small - scale farmers and agro processors negatively. The results in Table 4.1 show that 72 (33.5 percent) earned

between ₦101,000 – ₦200,000 while 20 (9.3 percent) earned between ₦10,000 – ₦50,000. The highest earners were 19 (8.8 percent) and earned above ₦501,000 - ₦600,000. The mean income of respondents was ₦191,000 and it implies that all the respondents were small scale processors and this limited capacity for adoption of recommended export processing practices due to resource limitations as some practices are capital intensive.

Table 4.1(a): Distribution of respondents according to their socio-economic characteristics

Variable	Frequency (n = 215)	Percentage (%)
Age (years)		
20 – 34	33	15.3
35 – 40	65	30.2
41 – 50	54	25.1
51 – 60	31	14.4
61 – 70	32	15.0
Mean	**45**	
Sex		
Male	131	60.9
Female	84	39.1
Marital Status		
Married	167	77.7
Single	48	22.3
Household size (Number of persons)		
One (1)	25	11.6
2 – 5	43	20.0
6 – 10	62	28.8
11 – 15	37	17.2
16 – 25	42	15.5
Mean	**9**	
Level of education (Years of schooling)		
No formal education	47	21.9
Koranic education	21	9.8
Adult education	15	7.0
Primary education	50	23.3
Secondary education	64	29.8
Tertiary education	29	13.5
Processing experience (years)		
1 – 5	22	10.2
6 – 10	32	14.9
11 – 15	40	18.6
16 – 25	67	3.2
26 – 35	35	31.2
36 – 40	20	9.3
Mean	**16**	

Source: Author's Field Survey, 2017

Table 4.1(b): Distribution of respondents according their socio-economic characteristics

Socio-economic Characteristic	**Frequency**	**Percentage (%)**
Output (Kg)		
Less than 100	13	6.0
101 – 200	12	5.6
201 – 300	15	7.0
301 – 400	66	30.7
401 – 500	54	25.1
501 – 1000	27	12.6.
1001 – 1500	29	13.5
Mean	**480**	
Income (₦)		
10,000 – 50,000	20	9.3
50,001 – 100,000	15	7.0
100,001 – 200,000	72	33.5
200,001 – 300,000	34	15.8
300,001 – 400,000	31	14.4
400,001 – 500,000	24	11.2
501,000 – 600,000	19	8.8
Mean	**191,000**	
Total	**215**	**100**

Source: Author's Field Survey, 2017

Table 4.2 also shows that the major sources of credit for the 127 ginger processors that obtained credit were banks36 (28.3 percent),cooperatives 25 (19.7 percent), dealers 21 (16.5 percent) family members 20 (15.7 percent) and money lenders 25 (19.7 percent). A further probe of the results from Table 4.2 reveals that among the 88 (39.9 percent) non credit receivers the major reasons for non receipt of credit were lack of collateral 27 (30.7 percent), did not apply 15 (17 percent) and unsuccessful application 11 (12.5 percent).

Credit is an important source of capital in agrarian production systems and those who lack access to much needed capital for inputs and hiring of labour are at a disadvantage. It is imperative to note that for agricultural innovations to be easily adopted, recommended inputs need be purchased and used and credit can facilitate the process. Table 4.2 indicates that 127 (59.1

percent) of the respondents obtained credit for ginger processing while 88 (39.9 percent) did not. This is similar to the findings of Saddiq (2012) and Saleh (2014) who reported credit access of 45.14 and 48 percent respectively among farmers. About 27 (21.3 percent) received between ₦10,000 – ₦600,000 and above depending on the size of production and credit accessibility. The mean credit obtained by processors was ₦84,000. The result in this study is marginally higher probably due to ginger being seen as a cash crop and in high demand giving rise to multiple sources of credit to processors including dealers who give out credit to secure their supply of processed ginger from processors.

Cooperative groups are organized for the promotion of special interests or to meet certain needs that cannot be achieved by individual effort. They contribute to dissemination of new ideas, practices and products. Table 4.2 shows that 137 (63.7 percent) of the respondents belong to a group while 78 (36.3 percent) of the respondents do not belong to any group. Furthermore, out of the 127 respondents who belonged to a group 91 (42.3 percent) of the respondents belong to one group while 46 (21.4 percent) belong to two or more cooperative groups. This is expected to translate into quick and easy awareness of new ideas that improve ginger processing for export as a result of sharing information, collective inputs procurement, collective marketing, thrift, credit and training.

The effect of visits by both the agricultural extension agent and the ginger processor has been found to have positive effect on adoption as most studies revealed improved adoption rates of innovation as a result of higher number extension visits. Results in Table 4.2 show that majority 127 (59.1) percent of the respondents had no visits from extension agents throughout the year, 52 while (24.2 percent) were visited once. Only 13 (6.0 percent) were visited twice prior to the growing and processing season in the study area. Further probe of Table 4.2 shows that majority

152 (70.7 percent) of the respondents did not visit an extension agent while 33 (29.3 percent) visited extension agents for information. On satisfaction with extension visits 140 (65.1 percent) of the respondents were satisfied while 75 (34.9 percent) were not satisfied. These findings are corroborated by Ibukun (2009) and Dutse (2017) who found that majority of farmers had no contact with extension agents.

Table 4.2(a): Distribution of respondents according to their institutional variables

Institutional Factors	Frequency n = 215	Percentage
Membership of group		
Yes	137	63.7
No	78	36.3
How many groups do you belong to		
None	78	36.3
One (1)	91	42.3
Two and Above	46	21.4
No of Extension visits Per year		
Not visited	127	59.1
Once (1)	52	24.2
Twice (2)	14	6.5
Thrice (3)	13	6.0
Four Times(4)	5	2.3
Five (5) and Above	4	1.9
Visit to Extension Agents Per year		
Did Not visit	152	70.7
Once (1)	33	15.3
Twice (2)	20	9.3
Thrice (3)	4	1.9
Four Times(4)	4	1.9
Five (5) and Above	2	1.0
Are You Satisfied with Extension visits		
Yes	75	34.9
No	140	65.1
Did you obtain credit		
Yes	127	59.1
No	88	39.9
Total	**215**	**100**

Source: Author's Field Survey, 2017

Table 4.2(b): Distribution of respondents according to their institutional variables

Institutional Factors	**Frequency n = 215**	**Percentage**
Main Source of Credit	**Frequency n = 127**	
Bank	25	19.7
Cooperative	36	28.3
Dealers	21	16.5
Family members	20	15.7
Money lenders	25	19.7
Credit Received (₦)		
10,000 – 50,000	27	21.3
50,001 – 100,000	46	36.2
100,001 – 200,000	25	19.7
200,001 – 300,000	11	8.7
300,001 – 400,000	10	7.9
400,001 – 500,000	5	3.9
Above 500,000	3	2.4
Mean	84,000	
Major reason why you didn't receive credit?	**Frequency n = 88**	**Percentage**
Lack of collateral	27	30.7
Application not successful	11	12.5
Delay in disbursements	10	11.4
Did not apply	15	17.0
Difficult processes	9	10.2
High interest rate	10	11.4
Short repayment period	6	6.8
Total		**100**

Source: Author's Field Survey, 2017

Table 4.3: shows that 42 (33.1 percent) of the respondents that received credit were enabled to adopt some recommended practices because they received credit while majority 85 (66.9 percent) were not. In addition majority 104 (81.9 percent) of those that received credit were of the view that it was not sufficient while 23 (18.1) argued otherwise. Credit can aid adoption especially where high costs are involved but it has to be sufficient to cover such costs and where it is insufficient it may not impact the processors' ability to adopt appreciably.

Table 4.3: Distribution of respondents who received credit and adoption

Response	**Frequency n = 127**	**Percentage**
Did the credit received enabled You to adopt?		
Yes	42	33.1
No	85	66.9
Was the credit sufficient?		
Yes	23	18.1
No	104	81.9
Total		100

Source: Author's Field Survey, 2017

4.2 Improved practices being disseminated to ginger processors by extension agents to attain export standards.

The result in Table 4.4 shows that 132 (61.4 percent) of the respondents were made aware of ginger processing practices while 83 (38.6 percent) were not. Table 4.4 further shows that practices being disseminated to the respondents were selection of appropriate variety, appropriate sett size, maturity at 8 – 9months before harvest, washing thoroughly and packaging. This agrees with findings by Dutse (2017), Augustine (2015), Ibukun (2009) who found out that technologies

may be disseminated and most farmers' made aware but adoption may still be low due to other limiting factors.

Table 4.4: Distribution of respondents according to their awareness of processing practices

Response	**Frequency n = 215**	**Percentage**
Are processing Practices being availed to you		
Yes	132	61.4
No	83	38.6
Practice	***Frequency n = 132**	**Percentage**
Selection of variety	132	100
Appropriate sett size	113	85.6
Maturity at 8-9 months	120	90.9
Washing thoroughly	132	100
Sorting	129	97.7
Drying on treated surface	101	76.5.
Slicing at 1.5 - 2.0mm	75	56.8
Chemical treatment	97	73.5
Insect and microbial control	92	72.8
Packaging	100	75.7

Source: Author's Field Survey, 2017
*Indicates multiple responses

Table 4.5: shows that the main sources of awareness of ginger processing practices for export was extension agent 89 (41.1 percent) followed by, fellow processors 53 (24.7 percent) and radio 31 (14.4 percent). Dealers 3 (1.4 percent) ranked seventh was the least. The most preferred sources of information of respondents was extension agent 113 (52.6 percent) followed by, cooperative group 43 (20 percent), fellow processors 32 (14.9 percent), dealers 19 (8.8 percent) and the least is newspaper 2 (0.9 percent) which ranked seventh. This is corroborated by the

positions of Irfan*et al*. (2006), Agbamu (2006), Ekoja (2002) and Atala (1986) who observed that farmers preferred certain communication channels to receive information and when such channels are used adoption rates among farmer's is found to be higher than when other channels are used. This implies that extension communication should focus on farmers' preferred sources of information.

Table 4.5: Distribution of respondents according to sources of awareness and most preferred sources

Source	**Frequency n = 215**	**Percentage**	**Rank**
Extension Agent	89	41.4	1st
Fellow Processors	53	24.7	2nd
Radio	31	14.4	3rd
Cooperative	29	13.5	4th
Television	12	5.6	5th
Newspaper	9	4.2	6th
Dealers	3	1.4	7th
Most preferred Channels			
Extension Agent	113	52.6	1st
Cooperative	43	20.0	2nd
Fellow Processors	32	14.9	3rd
Dealers	19	8.8	4th
Radio	11	5.1	5th
Television	5	2.3	6th
Newspaper	2	0.9	7th

Source: Author's Field Survey, 2017

4.3 The rate of awareness and adoption of recommended practices for ginger processing for export among ginger processors.

Table 4.6 shows the level of awareness of various recommended processing practices among respondents for selection of variety. Majority of the respondents 188 (87.4 percent) were awareof practices such as appropriate sett size; maturity at 8 – 9 months; and washing thoroughly while

27 (12.6 percent) were not; the recommended practice processors were least aware of was drying on treated surface 55 (25.6 percent). The results show low, medium and high levels of awareness for different practices which was the *apriori* expectation in any agrarian system as reported in many studies (Dutse, 2017,Augustine, 2015 and Lawal, 2010). Awareness in any agrarian system depends on adopter categories, farmer characteristics, and effectiveness of extension communication, dissemination and diffusion of innovations.

With regard to the level of adoption among respondents, 125 (58.1 percent) adopted selection of variety while 90 (41.9 percent) did not; 99 (46 percent) adopted appropriate sett size while 116 did not, 83 (33.6 percent) adopted allowing ginger to mature at 8 – 9 months before harvest while 132 (61.4 percent) did not; 108 (49.8 percent) adopted washing thoroughly with clean water while 108 (50.2 percent) did not. The least adopted practice was drying on treated surface 57 (26.5 percent). Low adoption levels have been reported by many researchers such as Dutse (2017), Iliyasu (2016) and Saddiq (2012).

Table 4.6: Distribution of respondents' according to level of awareness and adoption of practices

Practice	**Frequency n = 215**		**Frequency n = 215**	
	Level of Awareness (%)		**Level of Adoption (%)**	
	Yes	**No**	**Yes**	**No**
Selection of variety	(188) 87.4	(27) 12.6	(125) 58.1	(90) 41.9
Appropriate set	(128) 59.5	(87) 40.5	(99) 46.0	(116) 54.0
Maturity at 8-9 months	(123) 57.2	(92) 42.8	(83) 38.6	(132) 61.4
Washing thoroughly	(195) 90.7	(20) 9.3	(108) 50.2	(117) 49.8
Sorting	(179) 83.3	(36) 16.7	(153) 71.2	(72) 28.8
Drying on treated surface	(55) 25.6	(160) 74.4	(57) 26.5	(158) 73.0
Slicing at 1.5 - 2.0mm	(99) 46.0	(116) 54.0	(45) 20.9	(170) 79.1
Chemical treatment	(81) 37.7	(134) 62.3	(41) 19.1	(174) 80.0
Insect and microbial Control	(81) 37.7	(134) 62.3	(33) 15.3	(182) 84.7
Packaging	(70) 32.6	(45) 67.4	(23) 10.7	(192) 89.3

Source: Author's Field Survey, 2017

Table 4.7 shows respondents reasons for adoption of recommended processing practices for export on selection of variety were yield 193 (42.4 percent), pungency 94 (20.6 percent) and chemical content 168 (37 percent); for appropriate sett size were yield 107 (33.9 percent), pungency 143 (45.4 percent) and chemical content 65 (20.6 percent); and for maturity at 8 – 9 months before harvest were yield 171 (45.6 percent), pungency 113 (30.1 percent), chemical content 91 (24.3 percent). The different responses shown in the Table reveal that yield,

pungency, chemical content and avoidance of contamination were the major reasons for adoption of recommended ginger processing practices.

Table 4.7 shows reasons for adoption of recommended processing practices for export. The table reveals that the main reason for adoption of sorting by 172 (33 percent) respondents was to avoid contamination. Also the main reason for drying on treated surface by respondents was to prevent contamination and it was adopted by 188 (32.7 percent) respondents. Furthermore, other main reasons for adopting other practices were adequate drying, toxin control, purity and prevention of mould growth.

Table 4.7(a): Distribution of respondents according to reasons for adoption of practices

Practice	Reason for Adoption	*Frequency n = 215	Rank	Total*	Percentage
Selection of variety	Yield	191	1st		42.4
	Pungency	94	3rd		20.6
	Chemical content	168	2nd	453	37.0
Appropriate size	Yield	106	2nd		33.9
	Pungency	143	1st		45.4
	Chemical content	65	3rd	314	20.6
Maturity at 8 – 9 months	Yield	170	1st		45.6
	Pungency	112	2nd		30.1
	Chemical content	90	3rd	372	24.3
Washing thoroughly	Appearance	123	2nd		19.4
	Pungency	116	4th		18.6
	Chemical content	122	3rd		19.2
	Purity	97	5th		15.3
	Removal of Dirt	172	1st	630	27.6

Source: Author's Field Survey, 2017

* Indicates multiple responses

Table 4.7(b): Distribution of respondents according to reasons for adoption of practices

Practice	Reason for adoption	*Frequency n =215	Rank	Total*	Percentage
Sorting	Appearance	144	1st		28.2
	Purity	103	2nd		20.0
	Avoiding dirt	91	3rd		18.3
	Avoid contamination	173	4th	511	33.6
Drying on treated surface	Appearance	114	4th		19.9
	Purity	133	3rd		23.1
	Avoiding dirt	140	2nd		24.3
	Avoid contamination	188	1st	573	32.7
Slicing	Fast drying	117	3rd		26.9
	Adequate drying	180	1st		36.8
	Moisture control	158	2nd	435	37.3
Chemical treatment	Appearance	127	4th		22.1
	Purity	142	2nd		24.6
	Avoiding Dirt	136	3rd		23.4
	Avoid contamination	174	1st	579	29.9
Insect and microbial					
Control	Preservation	131	3rd		15.7
	Appearance	120	4th		14.3
	Purity	115	5th		13.7
	Avoiding Dirt	113	6th		13.5
	Avoid contamination	178	2nd		21.3
	Prevention of mould	180	1st	837	21.5
Packaging	Maintain pungency	97	3rd		23.4
	Toxin control	163	1st		39.9
	Prevention of mould	155	2nd	417	37.4

Source: Author's Field Survey, 2017
* Indicates multiple responses

Table 4.8 shows that the reasons for non adoption of processing practices for export by ginger processors. On selection of variety were strenuousness 189 (42.5 percent), high cost 170 (38.2 percent) and complexity 86 (19.3 percent) from; on appropriate sett size and reasons were strenuousness 101 (32.1 percent), high cost 165 (52.4 percent) and complexity 49 (15.5 percent). Other reasons for non adoption of other recommended practices also varied between strenuousness, high cost and complexity.

Table 4.8: Distribution of respondents reasons for non adoption of practices

Practice	Reason n=215*	Frequency	Rank	Total*	Percentage (%)
Selection of variety	Strenous	189	1st		42.5
	Costly	170	2nd		38.2
	Complex	86	3rd	445	19.3
Appropriate sett size	Strenous	101	2nd		32.1
	Costly	165	1st		52.4
	Complex	49	3rd		15.5
				315	
Maturity at 8-9 months	Strenous	157	1st		51.5
	Costly	93	2nd		30.5
	Complex	55	3rd		18.0
				305	
Washing thoroughly	Strenous	124	1st		50.2
	Costly	67	2nd		27.1
	Complex	56	3rd		22.7
				247	
Sorting	Strenous99		1st		55.9
	Costly	41	2nd		23.2
	Complex	37	3rd		20.9
Drying on treated surface				177	
	Strenous65		3rd		23.6
	Costly	90	2nd		32.6
	Complex	121	1st		43.8
				276	
Slicing	Strenous	179	1st		60.0
	Costly	94	2nd		26.8
	Complex	78	3rd		22.2
				351	
Chemical treatment	Strenous	173	3rd		31.3
	Costly	182	2nd		32.9
	Complex	198	1st		35.8
				553	
Insect and microbial control	Strenous	187	1st		44.3
	Costly	141	2nd		33.4
	Complex	94	3rd		21.3
				422	
Packaging	Strenous72		3rd		
	Costly	165	1st		22.4
	Complex	84	2nd		51.4
				321	26.2

Source: Author's Field Survey, 2017

*Multiple responses

4.4 Factors influencing adoption of recommended practices for ginger processing for export among ginger processors.

This objective was achieved by testing the hypothesis 1 (Ho_1)of the study. The hypothesis was tested using the Multiple regression analysis (MRA) to accurately reveal relationships between socio – economic, institutional, technological variables and adoption of recommended ginger processing practices for export. The focus at this point was to show the contribution made by independent factors (variables) including socio – economic characteristics, institutional factors and technological variables on the dependent variables or outcomes which are adoption, output and income.

The hypothesis was that there is no significant relationship between socio-economic characteristics of ginger processors and adoption of recommended practices for ginger processing for export in the study area.

Sex (X_1): The multiple regression results in Table 4.9 show that the sex of respondents had a negative coefficient (- 0.592) and significant relationship with adoption at 1 percent level of statistical significance. This means that an increase in this variable decreases the likelihood of adoption.

Marital status (X_3): Findings also show that marital status had a positive coefficient (0.266) with a significant relationship with adoption at 5 percent statistical level of significance. This implies that a unit increase in this variable reduces the likelihood of adoption. This is in line with the *apriori* expectation that married persons are more likely to adopt practices that enhance their livelihood than unmarried persons.

Educational level(X_4): Findings also show that educational level had a positive coefficient (0.235) with a significant relationship with adoption at 5 percent statistical level of significance.

This implies that a unit increase in this variable reduces the likelihood of adoption. This is in line with the *apriori* expectation that the higher the educational attainment of a person the more likely to he or she will adopt practices that are recommended.

Credit received (X_6): Table 4.9 also shows that credit had a negative coefficient (- 0.073) and a significant relationship with adoption at 10 percent statistical level of significance. This implies that the more credit processors receive the likelihood of adoption. This agrees contrasts with the findings Dutse (2017) and Augustine (2015) who found out that there was a significant positive relationship between credit received and adoption. Since credit helps in the purchase of costly aspects of technological packages and agro processing labour but contrasts with the findings of Saddiq (2012) and Saleh (2014) who found no significant relationship between credit and adoption.

Membership (X_7): Table 4.9 also shows that a ginger processors experience had a positive coefficient (0.619) and significant relationship with adoption at 1 percent statistical level of significance. The implication is that a unit increase in this variable increases the likelihood of adoption among processors. This agrees with the findings of Saddiq (2012), Saleh (2014), Augustine (2015) and Dutse (2017) who found out a significant relationship between experience and adoption.

Processing experience (X_8): Table 4.9 also shows that membership of association had a positive coefficient (0.254) and significant relationship with adoption at 5 percent statistical level of significance. This implies that a unit increase in this variable impacts adoption positively therefore, the greater the number of years of a processors experience the greater the likelihood of adoption among processors. This agrees with the findings of Dutse (2017), Saddiq (2012),

Saleh(2014) and Augustine (2015) who found out a significant relationship between years of experience and adoption.

Complexity (X_{11}): Table 4.9 also shows that complexity of an innovation had a positive coefficient (0.329) and significant relationship with adoption at 1 percent statistical level of significance. This means that as a recommended practice becomes more complex the chances of adoption become higher. This goes against the *apriori* expectation that complexity reduces the likelihood of adoption. Among ginger processors this may be so because the more complex the practice is the more beneficial it is to the quality, value and price. So processors adopt such complex procedures to get the highest grade possible and maximize their income.

Cost of adoption (X_{12}): Findings also show that cost of adoption had a negative coefficient (-0.129) and a significant relationship with adoption at 1 percent statistical level of significance. This contrasts with the *apriori* expectation that the higher the cost the lower the rate of adoption. In the case of ginger processors this may be so because the more costly the practice is the more beneficial it is to the quality, value and price. So processors adopt such costly procedures to get the highest grade possible and maximize their income once the cost benefit analysis favours them to get more income.

This agrees with the findings of Saleh (2014) who found out a significant relationship between cost and adoption. This means that the cost implication of a recommended practice or technological package affects adoption and the higher the cost the higher the rate of adoption among ginger processors.

Other variables such as marital status, educational level, household size and membership of cooperative were not significant to adoption. The result of the multiple regression analysis in

Table 4.9 shows that the coefficient of regression (R^2) was 0.769. The implication being that 76.9 percent of the variation observed in the adoption of recommended ginger processing practices to attain export standards/requirements were explained by socio – economic, institutional and technological variables. The remaining 23.1 percent could be attributed to other factors that were not included in the model. The most related variables with the rate of adoption were sex, marital status, educational level attained, membership of association, processing experience, credit, complexity and cost. The least related variables to adoption were age, household size, number of extension visits and compatibility of technology. The general picture was that both socioeconomic, institutional and technological variables influence adoption but for technological characteristics such as complexity and cost lower adoption as they increase by each unit because they have negative coefficients or relationship with adoption.

Table 4.9: Relationship between socio – economic, institutional and technological variables and adoption.

Variables	Regression Coefficient	Standard Error	T – Value
Constant	1.855	0.715	2.594
Sex (X_1)	- 0.592	0.214	-2.770*
Age (X_2)	- 0.016	0.013	- 1.282
Marital Status (X_3)	0.266	0.109	2.437**
Education level (X_4)	0.235	0.110	2.140**
Household size (X_5)	0.118	0.125	0.944
Credit received (X_6)	- 0.073	0.043	-1.728***
Membership of Association(X_7)	0.619	0.045	13.766*
Processing experience(X_8)	0.254	0.124	-2.047**
Extension visits (X_9)	0.090	0.077	1.167
Compatibility (X_{10})	- 0.290	0.193	- 1.506
Complexity (X_{11})	0.329	0.049	6.669*
Cost of adoption (X_{12})	- 0.129	0.460	-2.821*

R= 0.877
R^2 = 0.769
Adjusted R^2 = 0.750
n = 215
F = 55.714

Source: Author's Field Survey, 2017

***Coefficient Statistically significant at 10% **Coefficient Statistically significant at 5%
*Coefficient Statistically significant at 1%
NS = not significant

4.5 Effects of adoption on the output and income of ginger processors.

It was hypothesized that here was no significant relationship between adoption of recommended practices for ginger processing output and incomeof ginger processors and this was used to achieve objective v of the study.

The Z – test for output indicates a calculated Z – value (0.67) which is lower than the tabulated Z – value (1.65) at 10 percent level of probability. Thus part of the null hypothesis that there was no significant relationship between adoption and output of ginger processors is accepted while the alternative was rejected. However, it is important to note that the main aim of adopting recommended ginger processing was not to immediately increase output of processed ginger but to improve the quality of processed ginger to meet international requirements for export which enables processed ginger to be accepted and bought at international prices. Increased output can be achieved in the long run with improved income from sales which can be reinvested in increased cultivation of ginger crop or increased quantity purchased in the market for processing.

The Z – test for income indicates a calculated Z – value (48.5) which was higher than the tabulated Z – value (1.65) at 10 percent level of probability. Thus part of the null hypothesis that there was no significant relationship between adoption and income of ginger processors' was rejected while the alternative is accepted. It is important to note that the main focus of adopting recommended ginger processing practices was to enable processed ginger to meet international requirements for export which enables processed ginger to be accepted and bought at international prices. The significant relationship established was an *apriori* expectation because when processed ginger is graded A, and is exported, its value increases from ₦150,000 – 200,000 per ton to $2250 – 2500 (₦ 800,000 – 900,000) per ton. Therefore, increase in price of

high quality processed ginger and increase in income to processors are immediate advantages of adoption of recommended ginger processing practices for export.

Table 4.10: Effects of adoption on the output and income of ginger processors

	Variable Mean	Difference	Z – Cal	Z - Tab
1. Output (Kg)				1.65
After Adoption (n = 179)	616.4			
Before Adoption (n = 179)	502.2	114.2	0.67^{NS}	
2. Income (₦)				1.65
After Adoption (n = 179)	158,081			
Before Adoption (n = 179)	133,100.6	24,980.4	48.5*	

Source: Author's Field Survey, 2017
*significant at 10%

4.6 Constraints faced by ginger processors in adoption of recommended practices for ginger processing for export.

Table 4.11 shows the constraints of adopting recommended practices for ginger processing for export. The table shows that the main constraint faced by processors in adoption is high cost of processing with a figure of 59 (27.4 percent) followed by, labour intensiveness43 (20 percent) and insufficient capital 34 (15.8 percent) while the least was wastage of time 15 (7 percent) followed by, limited production capacity 9 (12 percent).

Table 4.11: Distribution of respondents according to view on constraints to adoption

Constraint	Frequency	Percentage	Rank
High cost of processing	59	27.4	1st
Labour intensiveness	43	20.0	2nd
Insufficient capital	34	15.8	3rd
Insufficient Inputs	25	11.6	4th
Poor information dissemination	17	7.9	5th
Market challenges	15	7.0	6th
Wastage of time	12	5.6	7th
Limited production capacity	10	4.6	8th
Total	**215**	**100**	

Source: Author's Field Survey, 2017

Table 4.12 shows respondent's view on ways to improve awareness and adoption rates of recommended practices for ginger processing for export among processors. The table shows that the main methods of improving the rate of awareness and adoption of recommended processing practices among ginger processors is increased extension visits 190 (88.4 percent) followed by, use of local languages 118 (54.9 percent) and access to credit 207 (96.3 percent).Other suggested actions for improved awareness and adoption are the strengthening of cooperatives, provision of modern processing facilities, provision of processing chemicals, provision of packaging materials, market access and appropriate pricing.

Table 4.12: Distribution of respondents according to viewson ways of improving the rate of awareness and adoption

Response	***Frequency n = 215**	**Percentage**
Increased extension visits	190	88.4
Use of local languages	118	54.9
Access to credit	207	96.3
Strengthen cooperatives	198	92.1
Provision of modern processing facilities	194	90.2
Provision of processing chemicals	133	61.9
Provision of packaging material	151	70.2
Market access and appropriate pricing	145	67.4
Total	**215**	**100**

Source: Author's Field Survey, 2017

*indicates multiple responses

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The broad objective of the study was to assess adoption of recommended practices for ginger processing for export among ginger processors in Kachia and Kagarko L.G.As of Kaduna State, Nigeria. Multi-stage sampling was used to select five ginger processing districts in each of the L.G.As. Using the Slovian Formula 45.4% of the sample frame (473), i.e.215 respondents were randomly selected from the ten ginger processing districts for the study.

The first objective of the study was to describe the socio-economic characteristics of ginger processors in the study area. The study found out that majority 167 (77.7 percent) of the respondents were married, the most predominant age group was 35 – 40 years with 65 (30.2 percent) respondents while the mean age was 45 years. Majority of the respondents were male 131 (60.9 percent), the most predominant level of education attained was secondary education 64 (29.8 percent) while the mean output was 480kg. Additionally, 16 – 25 years experience with 67 (31.2 percent) was the dominant group and the mean was 16 years, the most prominent income group was ₦100,001 – 200,000 with 72 respondents (33.5 percent) while the mean income was ₦191,000 most households 62 (28.8 percent) had a size of 6 – 10 members with a mean of 9.

Furthermore, 137 (63.7 percent) of the respondents belonged to a group and 91 (42.3 percent) belonged to one group, majority 127 (59.1 percent) were not visited by extension agents and 152 (70.7 percent) did not visit extension agents while 140 (65.1 percent) were not satisfied with extension visits. Also 127 (59.1 percent) obtained credit and the major source of credit was cooperative 36 (28.3 percent) while the mean credit was₦84,000, the major reason for not receiving credit was lack of collateral 27 (30.7 percent) and majority of the adopters 85 (66.9

percent) were not enabled to adopt despite receiving credit. This implies that their low adoption rate was due to other factors or variables.

The study revealed that improved practices were being disseminated to ginger processors by extension agents in to order attain export standards and the main source of awareness among respondents was extension agents 89 (41.1 percent) ranked first while the least source of awareness was dealers 3 (1.4 percent) which ranked 7th. The most preferred source of information among ginger processors is extension agent 113 (52.6 percent) ranked 1st while the least is newspaper 2 (0.9) percent.

Findings on the rate of awareness and adoption of recommended practices for ginger processing for export among ginger processors indicated that washing thoroughly 195 (97 percent) was the most adopted practice followed by, sorting 153 (71.2 percent) and packaging 23 (10.7 percent) is the least. The practice with the least awareness rate, i.e. packaging also had the least adoption rate which confirmed the *apriori* expectation that awareness had a significant relationship with adoption. The study found out that the most prevalent reasons for adoption of selection of appropriate variety were to increase yield followed by, drying on treated surface to avoid contamination of produce. The main reasons for non adoption were found to be strenuousness, high cost and complexity of recommended practice.

The socio-economic factors that were found to have no significant influence on adoption of recommended practices for ginger processing for export among ginger processors were age, household size, number of extension visits, and compatibility of technology. The study however, found significant relationship between sex, marital status, educational level, credit received, membership of association, processing experience, credit received, complexity and cost and adoption.

The study also found out that adoption had significant effect on the income of processors. Furthermore, majority of the respondents who adopted had increase in output and income.

The constraints faced by ginger processors in adoption of recommended practices for ginger processing for export were found to be high cost of adoption 59 (27.4 percent) followed by. labour intensiveness due to lack of machinery 43 (20 percent). The least constraints are wastage of time 15 (7 percent) followed by, limited production capacity 10 (4.6 percent).

5.2 Conclusions

The study established that ginger processing was an important activity in the study area as it provided income and provided for the needs of households. To maximize the value of processed ginger through export awareness and adoption rates need to be improved to increase the benefits of adoption to processors which was low at present. Ginger processing is strenuous and constraints of adoption range from strenuous, complexity, cost, lack of credit and limited production capacity among other things. Adoption rates among ginger processors was low and one of the major reasons was the lack of information and use of inappropriate communication channels coupled with lack of or insufficient extension visits. It was also found out that socio-economic and institutional variables had significant effect on adoption of recommended practices for ginger processing. Adoption was found to positively affect outputand income respondents.

5.3 Recommendations

The study made the following recommendations:

i. It is recommended that extension services should design programmes and interventions that empower ginger processors with adequate extension visits, inputs, market access and credit.

ii. Majority of the respondents were of the view that recommended ginger processing practices were being disseminated but adoption rates were low due to some limiting factors which need to be addressed for improved adoption. Therefore, most preferred sources such as extension agents, cooperatives and fellow processors should be used much more than others by extension services to improve adoption rates among ginger processors.

iii. Awareness and adoption rates among ginger processors should be improved through increased extension visits by extension agents, involvement of Non Governmental Organizations and other communication channels on a continuous basis. Also ginger processors should be adequately trained using demonstrations and audio-visual aids on the recommended practices being disseminated by extension agents.

iv. Factors which were found to influence adoption such as education/training, credit, membership of association, extension visits and good technological characteristics should be encouraged, supported and provided by extension services and NGOs to enable ginger processors adopt recommended practices easily.

v. Constraints such as low information dissemination, low awareness and adoption should be tackled using increased extension visits and the use of preferred channels while high cost of processing, insufficient capital, insufficient inputs and low production capacity should be tackled by the government by improving access to credit, strengthening cooperatives, provision of modern processing facilities and inputs, and market access.

5.4 Contributions to Knowledge

The study established that:

i. The practices with the highest awareness levels(87.4%) also had the highest adoption levels. They are washing thoroughly with awareness of 90.7% and adoption level of 50.2%, selection of variety with awareness level of 87.4% and adoption level of 58.1%and sorting with awareness level of 83.3% and adoption level of 71.2% which meets the *apriori* expectation that high awareness levels increases the likelihood of adoption.

ii. There is an increase in adoption of recommended ginger processing practices for export from 25.2% reported by Ewuziem *et al*. (2009) to 71.2% which represents an increase of 45.7%.

iii. The number of extension visits to disseminate recommended ginger processing practices for export is very low (40%) as about (179) 60 percent of processors were not visited by extension workers in 2017 and this shows the deplorable state of the Kaduna Agricultural Development programme as reported in a study by Auta and Dafwang (2010) which needs to be improved by increasing the number of extension agents available to farmers.

REFERENCES

Adekoya, A. E. and Tologbonse, E. D. B. (2005).Adoption and Diffusion of Innovations .In Adedoyin, S. F. (Ed.).*Agricultural Extension in Nigeria*. Agricultural Extension Society of Nigeria. Pp. 29 - 32.

Adelaja, B. A., Adebayo, O. S., Adejoro, M. A. and Nwauguma, E. I. (2008).Status Assessment of Spice Resources in Nigeria. *Paper Presented At The First National Stakeholders Workshop On Spices.* Ibadan, Nigeria, NIHORT.

Adene, D.F. and Oguntade, A.E. (2006). The Structure and Performance of Commercial and Rural Based Poultry Industry In Nigeria. FAO, Rome. From http:/www.fao.org/document retrieved on 15th January 2017.

Ado, S. G. (2012). Contributions of Ahmadu Bello University to Agricultural Technology Generation and Transformation of Nigeria. In R. A. Dunmoye *et al.*(Eds.).*Proceedings of ABU at 50 Symposium, 12th to 14thNovember.* Held At ABU Main Campus, Zaria, Kaduna State, Nigeria.

Agbamu, J. U. (2006). *Essentials of Agricultural Communication in Nigeria.* Lagos: Malt House Press Limited.

Agbamu, J.U. (Ed.) (2009). *Perspectives in Agricultural Extension and Rural Development.* Owerri, Nigeria: Springfield Publishers Limited.

Agricultural Performance Survey (2013).*Wet Season in Nigeria National Report.* Zaria: *FDAE* and NAERLS, ABU.

Agricultural Performance Survey (2015).*Wet Season in Nigeria National Report.* Zaria: *FDAE* and NAERLS, ABU.

Agro Nigeria (2016).The Need for Ginger Standards for Export. Retrieved February 22nd, 2017, From http://www.agronigeria.com.ng/home/economy.

Aitchedji, C., Tenkouano, A. and Coulibaly, O (2010).*Factors Affecting the Adoption of Disease – Resistant Plantain and Banana* (*musa spp.*)Hybrids in Nigeria. Benin, Nigeria: IITA – Cotonou.

Ajibade, L. and Dauda, Y. (2005).*Ginger Extension Pamphlet*.Kafanchan, Nigeria: Kafanchan Ginger Company.

Akpoko, J. G. (2004). Factors Affecting Adoption of Recommended Soil Management Practices for Sustainable Agriculture in Kaduna State, Nigeria. *Savannah Journal*, 19(2): 27- 30.

Alanana, O.O. (2006). *Sociology of Development: An Introduction*. Kaduna: Joyce Printers and Publishers.

Amadi, C. O. (2012). Ginger Breeding In Nigeria: Achievement, Challenges and Prospects. *Journal of Applied Agricultural Research,* 4(2):155-163.

Amajor, E. E., Amadi, C. O., Nwaogu, F. N. and Ewuziem, J. E., Amajor, J. U., Alum, E. A. and Onyeka T. J. (2014).A Review of Ginger Diseases and Management In Nigeria. In P. O. Idisi, B. Okoye, E. E. Idu, A. A. Njidda, R. A. Oluwafemi and O. C. P. Agubosi (Eds.). *Emerging Issues in Agricultural Transformation In Nigeria. Proceedings of the 48th Annual Conference of the Agricultural Society of Nigeria.*

Amaza, P. and Kwacha, A. (2007).*Farmers' Perceptions, Profitability and Factors Influencing the Adoption of Improved Maize Varieties inthe Guinea Savannah of Nigeria*: *Research to Nourish Africa*. IITA, Ibadan.

Amos T.T. (2009). An Analysis of Productivity and Technical Efficiency of Small Holder Cocoa Farmers in Nigeria.*Journal of Social Sciences,* 15(2): 127-133.

Anka, M. L. (2010). Empirical Analysis of Rural Poverty in Sindh Province of Pakistan. Unpublished PhD Dissertation. University of Sindh, Pakistan.

Atala, T. K. (1980). Factors Affecting Adoption of Agricultural Innovations, Usage of Sources of Information and Level of Living In Two Nigerian Villages. Unpublished Msc Thesis, Iowa State University, Ames, Iowa, USA.

Atala, T. K. (1986). Role and Impact of Extension Agents Factors In Kaduna State Nigeria. Unpublished Ph.D Dissertation, Iowa State University, Ames, Iowa, USA.

Ater, P. I., Umeh, J. C. and Lawal, W. I. (2006). Comparative Analysis of The Impact of World Bank Roots and Tubers Expansion Programme on Poverty Alleviation of Peri-Urban and Rural Communities in Benue State, Nigeria. Post paper prepared for presentation At *The International Association of Agricultural Economics Conference Gold Coast Australia*, August 12th -18th, 2006.

Augustine, C. (2015). Factors Influencing Adoption of Recommended Cassava Processing Technologies by Women In Ankpa Local Government of Kogi State. Unpublished M.Sc. Thesis, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria.Pp. 1 - 95.

Auta, S. J. and Dafwang, I. I. (2010). The Agricultural Development Projects in Nigeria: Status and Policy Implications. *Research Journal of Agriculture and Biological Sciences*, 6(2): 138 – 143.

Baffoe – Asare, R., Danquah, J.A. and Annor – Frempong, F. (2013). Socioeconomic Factors Influencing Adoption of CODAPEC and Cocoa High – Tech Technologies Among Small holder Farmers in the Central Region of Ghana. *American Journal of Experimental Agriculture, 3 (2): 277 - 292.*

Baidu – Forson, J. (1999). Factors Influencing Adoption of Land – Enhancing Technology in the Sahel: Lessons from A Case in Niger. *Agricultural Economics, 49:311 – 333.*

Bamidele, F.S., Babatunde, R.O. and Rasheed, A. (2008) Productivity Analysis of Cassava Based Production Systems in the Guinea Savannah: Case Study of Kwara State, Nigeria. *American Eurasian Journal of Scientific Research,* 3(1): 33-39.

Bationo, A. (2003). Introduction to Soil Management Practices. In Gichuru, M. P., Bekunda, M. A.,Goma, H. C., Mafogonya, P. C. and Muwira (Eds).*Soil Fertility Management In Africa: A Regional Perspective.* Nairobi: TSFB-CIAT.

Bermuda, A. C.(2003). Improving Intercrop Yield of Ginger In The Tropics. *Being A paper Presented At The General Meeting of The Stakeholders In Ginger Value Chai nDevelopment In Nigeria*. Held at FMARD, Abuja, FCT on 6th April, 2003.

Bernard, A. (2008). Diseases, Pest and Other Factors Limiting Ginger Production In Rivers State. *Being A Text of A Paper Delivered During The Agricultural Product Development Strategy Workshop*. Organized by Uptonville Foundation. From http://www.uptonvilleoginstu.org/ginger.html.Retrieved on 21/02/ 2008.

Bonabana-Wabbi, J. (2002). Assessing Factors Affecting Adoption of Agricultural Technologies: The Case of Integrated Pest Management Technologies (IPMS) in Kumi District, Eastern Uganda. Unpublished MSc. Thesis submitted to the Virginia Polytechnic Institute, Virginia, USA.

Caffey, R. H. and Kazmierczak, R. F. (1994).Factors Influencing Technology Adoption inLousiana Aquaculture System. *Journal of Applied Economics*, 26 (1): 264 – 274.

Carr, V.H. (2016). *Adoption and Diffusion*.Retrieved on 20th April, 2016, from http://www.tlc.nlm.nih.gov/resources/ publications /sourcebook/ adoption and diffusion.html.

Cartmell, D. and Kelemen, D. (2004).*Methods of Information Dissemination to limited-Scale Land Owners.*From http://Www.Agnews.Tamu.Edu/Saas/2004/Infodiseemination.Pdf.

Chuckwu, G. O. and Emechute J. K. (2003). Fertilizer Efficiency and Productivity of Ginger on a Hapilyriscol in Southern Nigeria. In M. O. Akoroda (ed). *Root Crops: The Small Processor and Development of Local Food Industries for the Market Economy*. Ibadan: Ibadan Polytechnic Ventures.

Connely, M. (2016).*The Kurt Lewin Management* Model.Retrieved on 15th April, 2017, from http://www.Change-management-coach.com.

Crosbie, V. (2002).*What Is New Media: Digital Deliverance*. Retrieved on 15th April 2017, from http://www.Digitaldeliverance.Com..

Dahunsi, M.O. (2015). Determinants of Participation InTanugya Agro-Forestry Practice Among Farmers In Ekiti State, Nigeria. Unpublished M.Sc Thesis Department of Agricultural Economics And Rural Sociology, Ahmadu Bello University, Zaria.

Dariya, H. K. (2016). Impact of Gurara Dam on Barga Community Kachia LGA, Kaduna State. Unpublished B.sc Project Department of Geography Kaduna State University, Kaduna.

Deepa, R., Bandypadhyay, A. K. and Mandal, M. (2015) Factors Related to Adoption of Maize Production Technology in Cooh Behar District of West Bengal. *Agriculture, 5 (2): 775 – 777.*

Dirro, G. (2013). Impact of Off – farm Income on technology adoption Intensity and Productivity : Evidence from Rural Maize Farmers' in Uganda. *International Food Research Institute. Working Paper, 11.*

Dugje, I. Y. (2004). The Performance of Pearl Millet Varieties In Mixture With Groundnut In The Nigerian Savannah. *Samaru Journal of Agricultural Research, 20: 3-17.*

Dutse, F. (2017).Factors Affecting Adoption of Improved Conservation Technologies for Sorghum Production by Farmers in the North - West Zone of Nigeria.Unpublished Ph.D Dissertation, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria.

Ekoja, I. (2002). Channels of Communication Agricultural Information Preferred By Nigerian Farmers.*Quaterly Bulletin of IAALD,* XLVII (2) : 38-42.

Ekong, E. E. (2010) Rural Sociology: *An Introduction and Analysis of Rural Nigeria*.(3rd Edition). Uyo, Nigeria: Dove Educational Publishers.

Emmanuel, L. (2008). Technology and Ginger Farm Performance: Path of Production Efficiencies. *Overtime Agricultural EconomicsJournal,* (2): 297- 306.

Essiet, D. (2014). Farmers Explore Local Agro Processing. Fromhttp://Www.thenationalonline.Net/Home/ Business/ Agroprocessing.Html.Retrieved On 11-09-2016.

Ewuziem, J. E., Amadi, C. O.,Onyenobi, V. O., Nwaigwe, G. O. and Agoh, E. C. (2011). Review of Ginger Production in Nigeria. *Proceedings of the 45th Annual Conference of Agricultural Society of Nigeria, UDUS 2011.*

Ewuziem, J. E., Amaechi, E. C. C. and Onyenobi, V. O. (2009). Analysis of Ginger Export From Nigeria (1989-2004). *Proceedings of the 43rdAnnual Conference of Agricultural Society of Nigeria, FCT, Abuja.*

Food and Agricultural Organization (2015).*Keeping the Land Alive.* Retrieved on 17th February, 2017,fromhttp://www.fao.org.document/keeping the land alive.html.

Food and Agriculture Organization (2016).*The Agro Processing Industry and Economic Development.* Retrieved on 11th September, 2016,from http://www.Fao.Org/Docrep/ N5800e/W5800e12.Htm.

Food and Agricultural Organization (2016).*World Health Organization Codex Aalimentaria*. Retrieved on 22 February, 2017, from http://www.fao.org/fao-who-codex alimentaria.html.

FAOSTAT (2009).*World Ginger Production Estimates*. Accessed on 15th January, 2015, from http://www. faostat.org/ginger.html.

Fopojuwo, O.E. (2010). Influence of Socio-Economic Characteristics on Use of Modern Cassava Processing Technologies among Women Processors in Ogun State, Nigeria. *Journal o fSocial Sciences,* 24(1): 43-50.

Foramfera (2017).Dry White Ginger Production and Export. Retrieved on 10th February 2017, from http://www.foramfera.com.

Gadzama, I. U. (2015). Effect of Participation in Artisanal and Small-Scale Mining on the Output, Income and Standard of living of Farmers in Kaduna State. Unpublished PhD Dissertation Department of Agricultural Economics and Rural Sociology ABU, Zaria.

Gadzama, I. U., Yakubu, L. L. and Mudiare, P. U. (2017). Inefficiencies in the Supply and Distribution of Fertilizer*:* Implication for Food Security. *Kaduna Journal of Humanities*, (1)1: 438 – 449.

Ganiyu, L. (2014). Factors Affecting Adoption Of Forest Conservation Practices By Farmers In Kaima Local Government Area Of Kwara State: The Case Of Kainji Lake National Park. Unpublished Msc. Thesis Department of Agricultural Economics And Rural Sociology Ahmadu Bello University Zaria.

Gecho, y. and Punjabi, N. K. (2011).Determinants of Adoption of Improved maize Technology in Damit Gale, Wolata, Ethiopia.*Raj Journal of Extension Education, 19: 1 – 9.*

Glendinning, A, Mahapatra, A. and Mitchell, C.P. (2001) Human Ecology Journal, 29(3).From http://www.Question.Com/Library/ Journal/IGI.Htm.Retrieved on 10th February 2017.

Gyinadu, A., Bakary, J. E. A. and Osei, C.K. (2015). Determinants of Adoption of Yam Minisett Technology in Ghana: A Case Study of yam Farmers' in the Kintampo North District of Ghana. *Journal of Agricultural Economics, Extension and Rural Development, 3(7): 293 – 302.*

Haralambos, M. and Holborn M. (2000).*Sociology: Themes and perspectives.*(5th Edition). London: Harper Collins.

Haralambos, M. and Holborn, M. (2008).*Sociology: Themes and Perspectives.*(8th Edition.). London: Harper Collins.

Helder, Z., Edward, M. and Ralph, C. (2005).*Adoption of Improved Seed by Small Farmers' in Mozambique*. Department of Applied Economics and Management. Cornell University Ithaca, New York, U.S.A.

Ibukun, H. O. (2009). Factors Influencing Adoption of Recommended Cassava Production Technologies Among Women Farmers' In Mapomuro Local Government of Kogi State. Unpublished M.Sc. Thesis, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria.

Igbo, J. C., Ironua, C. F., Agu, C. V. and Mbadiwe, M. N. (2014).Ginger production In Nigeria: An Application of Mechanization Levels. In P. O. Idisi, B. Okoye, E. E. Idu, A. A. Njidda, R. A. Oluwafemi& O. C. P. Agubosi (eds). *Emerging Issues In Agricultural Transformation In Nigeria. Proceedings of the 48thAnnualConference of the Agricultural Society of Nigeria.*

International Institute for Tropical Agriculture (2004).*Pre-Emptive Management of Virulent Cassava Mosaic Disease Through an Integrated Cassava Development Approach for Enhanced Rural Economic Sector in the South-South And South-East Zones of Nigeria.*Ibadan: I.I.T.A.

Iliya, A. G., Usman S., Girema, A. K., Dada, M.Y., Mejo, I, Bila, B., Arka, A.Y. and Adamu, S.B. (2009).*Transforming Agriculture in Yobe State.In Proceedings of Yobe State Economic Summit, 2008.Y.* Ngama, Z. Bun and A. S. Shettima (Eds.). Ibadan: Spectrum Books Nigeria Limited.

Iliyasu, Y. (2016). Factors Influencing Adoption of Recommended Soybeans Production practice in SabonGari and Zaria local government areas of Kaduna state.Unpublished PGD project, Department of Agricultural Economics and Rural Sociology, A B U, Zaria.

Imanojor, P. A. and Unuigbe, O. M. (2006).Evaluation of Irrigation Technology Adoption in Edo State, Nigeria.*ANUL Journal, 1 (1): 1 – 10.*

Index Mundi (2018).*Agriculture's Contribution to Nigeria's GDP.*Accessed on 16th October, 2018, from http:www.Indexmundi.com.html.

Irfan, M., Muhammad, S., Khan, G.A. and Asif, M. (2006). *Role of Mass Media In The Dissemination Of Agricultural Technologies Among Farmers.*Islamabad, Pakistan: National Agricultural Research Centre.

Israel, G. (2003). *Determining Sample Size.PEOD6.*University of Florida Institute of Food and Agricultural Sciences. Retrieved on 7th July, 2009, from http:// www.edis.ifas.ufl.html..

Itobiye, H. E. (2015). Analysis of Growth Enhancement Scheme on Rural Women Livelihood in Kaduna State, Nigeria. Unpublished M.sc Thesis Department of Agricultural Economics and Rural Sociology, ABU, Zaria.

Ivbijaro, F.A (2012). Sustainable Development In Nigeria. In Ivbijaro, F. A. and Akintola, F. (2012) Ed. *Sustainable Environmental Management in Nigeria*.(2nd Edition.). Ibadan: Book Builder Publishers.

Jacobson, M. and Kar, S. (2013).Extent of Agro-Forestry Programs in the United States, 2013 Report.*United States National Agro-ForestryCenter Bulletin*.

Jamala, G.Y., Shehy, H. E. and Garba, A.T. (2011).Evaluation of Factors Influencing Farmers' Adoption of Irrigated Rice Production in Fadama Soils of North Eastern Nigeria.*Journal of Development and Agricultural Economics, 3 (2): 75 – 79.*

Jiriko, R. K. (2011). The Impact of Agape Microcredit on Trading, Income and Level of Living of Women Agricultural Traders in Nassarawa State, Nigeria. Ph.D Thesis Department of Agricultural Economics and Rural Sociology ABU, Zaria.

Kabir, U. L. (2011).Analysis of Agro-Forestry Farmers (Tree-Planning) In Giwal Local Government Area, Kaduna State. Unpublished MSc. Thesis Department of Agricultural Economics and Rural Sociology, Ahamdu Bello University, Zaria.

Kaduna State Agricultural Development Programme (2016).Kaduna Agricultural Development Project Ginger Farmers Anchor Borrowers Programme in Kaduna State. Document Published by the Anchor Borrowers Desk KADP, Kaduna.

Kaliba, A., Verkuiji, H. and Mwaji, W. (2000).Factors Affecting Adoption of Improved Maize Seeds Production in the Intermediate and 39 Lowland Zones of Tanzania. *Journal of Agricultural and Applied Economics, 32 (1):35 – 47.*

Kebede, W. M. and Tadesse, D. (2015). Determinants Affecting Adoption of Malt – Barley Technology: Evidence from North Gondar, Ethiopia. *Journal of food Security, 3(3):75 – 81.*

Khushk, A. and Memon, A. (2004). Impact of Devolution On Farm Extension System. P. *Daily Dawn*, November 1-7.

Labo, A. (2013). Political Economy of Contract Farming in Nigeria.*The Zaria Sociological Journal* 2 (1): 63-75.

Ladele, A. A. and Chah, J. M. (2015).Sampling Techniques in Agricultural Extension Research.In M. C. Maduekwe(Ed.).*AESON:.A Guide to Research in Agricultural Extension*. P. 50.

Lawal, A. (2010).Impact of Roots and Tubers Expansion Programme on Participants in Maigana Agricultural Zone, Kaduna State. Unpublished M.Sc Thesis, Department of Agricultural Economic and Rural Sociology, Ahmadu Bello University, Zaria.

Lewin, K. (1947). Theory of Planned Change. Accessed from http://www.linkedin .com/in/mikemorrisonrapidci

Maliki, A. S. (2013). The Sources of Women's Political Powerlessness in Nigeria: Facts, Fictions and Problems. *Zaria Sociological Journal*, 2(1): 89.

Manyong, V. M., Ikpi, A., Olayemi, J.K., Yusuf, S.A., Omonoma, V. and Idachaba, F. S. (2005) *Agriculture in Nigeria: Identifying Opportunities for Increased Commercialization and Investment.* Ibadan: IITA.

Mmbando, F. E. and Balyegunhi, L. J. S. (2016).Socio – economic and Institutional Factors Influencing Adoption of Improved Maize Varieties in Hai District, Tanzania.*Journal of Human Ecology, 53(1): 49 – 56.*

Montpellier (2016) *What Is Agro-Forestry?* Accessed on 12th September, 2016, from http:www.Montpellier.Inra.Fr/State/English.Htm.

Morkah, H. (2014). Sustainability of Agric Produce Through Appropriate Agro-Processing. In P. O. Idisi, B. Okoye, E. E. Idu, A. A. Njidda, R. A. Oluwafemi and O. C. P. Agubosi (Eds.). *Emerging Issues In Agricultural Transformation In Nigeria. Proceedings of the 48th Annual Conference of the Agricultural Society of Nigeria.*

Morrison, M. (2017).*Kurt Lewins Change Theory*. Retrieved 13th April, 2017, from Http://www.linkedin .com/in/mikemorrisonrapidci.

Muhammad, S. (2005). *Agricultural Extension Strategies and Skills*.Faisalbad, Pakistan: Unitech Communication Press. Retrieved on 15th April 2017.

Musa, I. (2013). Poverty and Sustainable Economic Opportunity in Nigeria.*The Zaria Sociological Journal*, 2(1):181-191.

Nandi, J.A., Gunn, P. and Yurkushi E.N. (2011).Economic Analysis of Cassava Production in Obubra Local Government Area of Cross River State, Nigeria. *Asian Journal of Agricultural Science*, 3(3): 205-209.

National Population Commission and National Bureau of Statistics (2016).*Nigerian population Projection Estimates*. Retrieved on 29th December 2016, from http://www.nigerianstat.gov.ng.

Nazari, M. R. and Hassan, M.S. (2011). The Role Of Television In The Enhancement Of Farmers 'Agricultural Knowledge. *African Journal of Agricultural Resources.* 6 (4): 1-6.

National Bureau of Statistics (2013).National Bureau of Statistics Report on the Poverty Profile in Nigeria. Retrieved on 24th April 2016, from http://Www.Rbs.Ng.Org/2013povertyprofile/Htm.

National Bureau of Statistics (2016).National Bureau of Statistics Population Projection Report. Retrieved on 24th April 2016, from http://Www.Rbs.Ng.Org/2013povertyprofile/Htm.

Ndukwu, B. C. and Ben-Nadibia ,N. B. (2005). *Ethnomedical Aspects of Plants Used As Spices and Condiments in the Niger Delta Area of Nigeria*. Port-Harcourt UNIPORT Press.

National Open University of Nigeria (2016) from http://www.non/edu.ng/uploads/awm503adoption-and-diffusion-of innovations/PDF Retrieved on 24th April 2016.

National Population Commission (2006).*National Population Commission Population Census Report of the Federal Republic of Nigeria*. National Population Commission, Abuja-Nigeria.

Nigerian Demographic and Health Survey [NDHS] (2003).Household Population and housing Characteristics. Accessed on February 13th 2019, from http://www.dhsprogram.com/02chapter02.

Nwachukwu, I. (2013). (Ed). *Agricultural Extension and Indigenous Promoting Rural Development.* Umuahia, Nigeria*:* Lamb House Publications.

Nwaogu, E. N. and Muogbo, P. C. (2014).Ginger Grain Legume Intercrop: Implications on Soil Fertility Management and Ginger Yield In The Guinea Savannah Zone of Nigeria. In P. O. Idisi, B. Okoye, E. E. Idu, A. A. Njidda, R. A. Oluwafemi and O. C. P. Agubosi (Eds). *Emerging Issues In Agricultural Transformation In Nigeria*. *Proceedings of the 48th Annual Conference of the Agricultural Society of Nigeria.*

Nwosu, C. and Ndinda, C. (2014).Female Household Headship and Poverty in South Africa: An Employment Based Analysis. Rand Research, South Africa.From http://www.randresearch.com/Householdheadship.Accessed on February, 13th 2019.

Obinna, A., Amajor, E. E., Amadi, C. O. and Ewuziem, J. E. (2014).Ginger production: An Overview. In P. O. Idisi, B. Okoye, E. E. Idu, A. A. Njidda, R. A. Oluwafemi& O. C. P. Agubosi (Eds). *Emerging Issues in Agricultural Transformation in Nigeria.Proceedings of the 48th Annual Conference of the Agricultural Society of Nigeria.*

Odusanya, O. (2016). Analysis of Maize production Among BabbanGona Farmers in Ikara Local Government Area of Kaduna State, Nigeria. Unpublished Postgraduate Diploma Project.Department of Agricultural Economics and Rural Sociology ABU, Zaria.

Ojo, S. O. and Ogunyemi, A. I. (2014). Farm Technology Adoption in Kenya: A Simultaneous Estimation of Inorganic Fertilizer and Improved Maize Variety Adoption Decisions. *Agricultural and Food Economics, 2:12 - 17.*

Okafor, G. I. (2002). Processing and utilization of Ginger: Effect of Ginger processing Methods on Product Quality and its Application in Fruit and Bakery products. India: TWAS-CSRI and CFTRI.

Okoh, M.A. (2015). Economic Analysis of Profitability and Resource Use Efficiency in Cassava Farming in Benue State, Nigeria. Unpublished M.Sc. Thesis Submitted to the Department of Agricultural Economics And Rural Sociology, Ahmadu Bello University, Zaria.

Okwu, O. and Daudu, S. (2011) Extension Communication Channel's Usage and Preference By Farmers In Benue State, Nigeria. *Journal of Agricultural Extension and Rural Development,* 3(5): 88-94.

Okwuowulu, P. A. (2005). *Ginger in Africa and the Pacific Island. In Ginger: The* Genus *Zingiberofficianale*. London: CRC Press Limited.

Olomola, A.S. (2007). Strategies for Managing the Opportunities and Challenges of the Current Agricultural Commodity Boom in Sub-Saharan Africa. A Publication of the *AERC Senior Policy Seminar IX, African Economic Research Consortium* (AERC), Nairobi, Kenya.

Onmadu, F. N. and Osahon, E. E. (2014). Socio-economic Determinants of Adoption of Improved Rice Technologies by Farmers' in Ayanelum Local Government Area of Anambra State, Nigeria. *International Journal of Scientific and Technology Research. 3(1): 308 – 314.*

Onwualu, P. A., Jaloso, M. A., Uchegbu, K. I., Enwereuzoh and B. O. Olugbemi, B. O. (2013). RMRDC Publication Series 024 Nigerian Agro Raw Materials Development: Studies on Some Indigenous Spices for Domestic/Export Market. Abuja: RMRDC Publishing Unit.

Pawan, A. (2011). *Diffusion of Innovations*.Accessed on 20th April, 2016, available at http: //.www.corneluniversity.edu/policyreview/ 2011.

Pintar, J. (2004). *The Sociologically Imagined Self* (2nd Edition). Iowa: Kendal Hunt publishing company.

Raghavan, S. (2000).*Handbook of Spices, Seasonings and Flavourings*. Pennsylvania, USA: Techtonic Publishers.

Ransom, J. K., Paudyal, K. and Adhikam, K. (2003).Adoption of Improved maize Varieties in the Hills of Nepal. *Agricultural Economics, 29 (1): 299 – 305.*

Reardon, T., Stamoulis, K., and Pingali, P. (2007). Rural Non – Farm Employment in Developing Countries in an Era of Globalization. *Agricultural Economics, 37: 196 – 183.*

Raw Materials Research and Development Council (2004). *Report on the Survey of Agricultural Raw Materials In Nigeria: Cassava Study.* Raw Materials Research and Development Council. Abuja, Nigeria.

Rogers. E. (2003).*Diffusion of Innovations*.(5th Edition.). New York: The Free Press.

Runyon, R. P., Haber, A., Pitenger, D. and Coleman, K. A. (1996).*Fundamentals of Behavioural Statistics*.(Second Edition). New York: McGraw-Hill. P.104.

Saddiq, N. M. (2012). Socio – Economic Factors Influencing Adoption of Recommended Practices by Cotton Farmers in Zamfara State, Nigeria. Unpublished MSc Thesis, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria.

Saddiq, N. M. (2015). Impact of Seed Out-Grower Scheme On Income and Food Security of Participating Maize Farmers In North-Western Nigeria. Unpublished Ph.D Thesis, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria.

Saleh, M. K. (2014). Factors Influencing Adoption of Improved Dairy Cattle Production Technologies in Northern Nigeria.Unpublished PhD Thesis, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria.

Sisay, D., Jema, H., Degeye, G. and Abbi – Khalil, O. (2015). Speed of Improved Maize Seed Adoption by Smallholder Farmers' in South Western Ethiopia: Analyzing Count Data Models. *Journal of Agricultural Economics, Extension and Rural Development, 3(5): 276 – 282.*

Standard Organization of Nigeria (2017).*Ginger Standar*ds *for Export Document*. Retrieved on February, 17, 2017., from http://www.son.gov.ng/standards.html. .

SPC (2014).ISO 22000 *Certification for Ginger Export: Increasing Agricultural Commodity Trade Project*. Retrieved 25th December, 2016, from http://www.spc.int.

Srauss, J., Barbosa, M., Teixera, S., Thomas, D. and Gomes, J. R. (1991). Role of Education and Extension in the Adoption of Technology: A Study of Upland Rice ans Soybean Farmers' in Central West Brazil. *Agricultural Economics, 5 (4): 341 – 359.*

Suleiman, R.V. and Davis, K.D.C. (2012).*The New Extensionist Roles, Strategies and Capacities To Strengthen Extension Advisory Services*. Global Forum for Rural Advisory Services (GFRAS), Lindan, Switzerland.

Sutherland, K. (2013). Applying Lewin's Change Management Theory to the Implementation of Bar Code Medical Administration. *Canadian Journal of Nursing Informatics*.Vol. 8, No. 1&2.Retrieved on 12th April 2017, from http:// www.cjni.net/journal/%3fp% 322888.html.

Ukoha, O. O., Okoye, B.C. and Emetu, J. (2010). Analysis of the Determinants of Total Factor Productivity Among Small-Holder Cassava Farmers In Ohafia Local Government Area of Abia State. *Munich Personal REPEC Archive (MPRA) Paper, 26125.Pp 1-7.*

Usman, M. (2015).An Assessment on Effect of Adoption of small Scale Irrigation Technologies by Fadama Users in Agricultural Zone III of Niger State, Nigeria.*Journal of Agriculture and Ecology Research, 3 (2):59 – 66.*

United Nations Development Programme (UNDP) (2017). Household and Composition Around the World. Retrieved on February 13th 2019, rom http://www.un.org/development/population.

Uwandu, Q. C., Amajor, E. E., Amadi, C. O. and Ewuziem, J. F. (2014).A Review of Ginger production, processing and Marketing In Nigeria: An Overview. In P. O. Idisi, B. Okoye, E. E. Idu, A. A. Njidda, R. A. Oluwafemi& O. C. P. Agubosi (Eds). *Emerging Issues in Agricultural Transformation in Nigeria*. Proceedings of the 48th Annual Conference of the Agricultural Society of Nigeria held at University of Abuja, FCT, Nigeria 24th – 27th November 2014.

Uyanga, J. and Ilesanmi, F. A. (2003).*Essentials of Environmental Impact Assessment. Yola*, Nigeria: Paraclete Publishers.

Webster, A. L. (1995). *Applied Statistics for Business and Economics*.(Second Edition). Chicago, USA: McGraw-Hill.

World Bank (2010).Development of Rural Financial Markets in Sub-Saharan Africa.*World Bank Discussion Paper 219.* Washington D.C., USA

Zhang, X., Fan, S. and Cai, X. (2002). The Path of Technology Diffusion: Which Neighbours to Learn from? *Contemporary Economic Policy, 20 (1): 470 – 478.*

Appendix i

QUESTIONNAIRE FOR GINGER PROCESSORS
Department of Agricultural Extension and Rural Development
Faculty of Agriculture Ahmadu Bello University, Zaria

Dear Sir/Madam

I'm an M.sc student of Ahmadu Bello University, Zaria currently working on the topic: **Adoption of Recommended Practices for Ginger Processing for Export Among Processors in Kachia and Kagarko Local Government Areas of Kaduna State.**

I will be grateful for your kind cooperation in filling this research questionnaire designed purely for academic purposes. Please answer the questions to the best of your knowledge, all information supplied will be treated with confidentiality.

Thank you.

Section A: Background Information

Name of Respondent.....
Name of Village……
Local Government Area.....

Section B: Socio-economic Characteristics of ginger processors:

1. Age (years):…….....
2. Sex: Male ( ) Female ( )
3. Marital Status: Married ( ) Single ( )
4. Indicate the number of the members of your household as follows:
   (a) How many wives do you have? .....
   (b) How many children do you have? .....
   (c) How many are staying in your household now? .....
5. How many relatives are living with you? ……....
6. Household size .....

Level of Education

7. What level of education did you achieve? Tick as appropriate

No formal education	( )
Koranic education	( )
Adult education	( )
Primary education	( )
Secondary education	( )
Tertiary education	( )

8. Years spent in formal education ……..……years

Processing Experience

9. How long have you been into ginger processing? ……..…..years
10. Has your experienced helped you in ginger processing activities? Yes ( ) No ( )
11. Does your experience enable you adopt processing standards for export? Yes ( ) No ( )

Group Membership

12. Do you belong to any cooperative or association? Yes ( ) No ( )
13. If yes, how many social associations do you now belong to? One ( ) Two and above ( )
14. If yes, for how long have you been a member?.....Years

Institutional Factors

15. How many times did extension agents visit you in the year 2016?.....Times
16. How many times did you visit the extension agents for information on recommended of ginger processing for export in the year 2016?.....Times
17. Are you satisfied with the extension visit(s)? Yes ( ) No ( )
18. If yes, give reasons……
……. ……...
19. If no, give reasons…..……
…….
20. Did you receive credit for ginger processing in the last 2 years? Yes ( ) No ( )
21. If yes, state sources and amount of credit received in the years 2015 and 2016.

S/No	Year	Sources	Amount (₦)
i	2015		
ii	2016		

22. If yes, were you able to repay the credit after selling processed ginger? Yes ( ) No ( )
23. Did the credit received enable you to adopt recommended processing practices for export? Yes ( ) No ( )
24. If yes, did adoption of recommended processing practices for export enhance your output and ability to repay the credit? Yes ( ) No ( )
25. If you were unable to pay the credit please give reasons for non-repayment of the credit.
……
……
26. If you did not receive credit how did you finance your ginger processing activities?
Personal Savings ( )
Family Members ( )
Sale of farm products ( )
Credit and Thrift Associations ( )
All of the Above ( )

Section C: Recommended Ginger processing Practices Disseminated to Processors.

27. Which of the recommended ginger practices have you been made aware of by extension agents?

		Awareness	
S/NO	**Ginger processing Practices**	**Yes**	**No**
1.	Selection of appropriate variety		
2.	Appropriate Ginger sett cutting size		
3.	Allowing ginger to reach maturity at 8 to 9 months before harvesting		
4.	Washing thoroughly with clean water		
5.	Slicing: making slices of 1.5 to 2.0mm		
6.	Drying on treated surface		
7.	Chemical treatment using alkali, lime, sulphur and hydrogen peroxide		
8.	Insect and microbial control using fumigants such as Methyl Bromide, Ethylene Dibromide, Ethylene Oxide and Formate.		
9.	Packaging Using polythene bags, paper containers and laminates		

28. Through which channels did you become aware of recommended ginger processing practices which is your most preferred in order of importance?

S/NO	**Channel**	**Rank**
1.	Radio	
2.	Television	
3.	Extension Agent	
4.	Newspaper	
5.	Cooperative	
6.	Fellow processors	
7.	Dealers	

29. Are you satisfied with the current level of awareness of recommended ginger processing practices to achieve export standards Yes [ ] No [ ]
30. If yes why? …….
31. If No why? .....

Section D: Recommended Ginger processing Practices Adopted by processors.

32. Which of the recommended ginger practices have you adopted as introduced by extension agents?

S/NO	**Ginger processing Practices**	**Yes**	**No**
1.	Selection of appropriate variety		
2.	Appropriate Ginger sett cutting size		

3.	Allowing ginger to reach maturity at 8 to 9 months before harvesting		
4.	Washing thoroughly with clean water		
5.	Slicing: making slices of 1.5 to 2.0mm		
6.	Drying on treated surface		
7.	Chemical treatment using alkali, lime, sulphur and hydrogen peroxide		
8.	Insect and microbial control using fumigants such as Methyl Bromide, Ethylene Dibromide, Ethylene Oxide and Formate.		
9.	Packaging Using polythene bags, paper containers and laminates		

33. If yes state reasons for using processing practices below:

S/NO	**Ginger processing Practices**	**Reason for adopting the recommended practice**
1.	Selection of appropriate variety	
2.	Appropriate Ginger sett cutting size	
3.	Allowing ginger to reach maturity at 8 to 9 months before harvesting	
4.	Washing thoroughly with clean water	
5.	Slicing: making slices of 1.5 to 2.0mm	
6.	Drying on clean surface	
7.	Chemical treatment using alkali, lime, sulphur and hydrogen peroxide	
8.	Insect and microbial control using fumigants such as Methyl Bromide, Ethylene Dibromide, Ethylene Oxide and Formate.	
9.	Packaging Using polythene bags, paper containers and laminates	

34. If No state reasons for not using processing practices below:

S/NO	**Ginger processing Practices**	**Reasons for not adopting/non continuation of use**
1.	Selection of appropriate variety	
2.	Appropriate Ginger sett cutting size	
3.	Allowing ginger to reach maturity at 8 to 9 months before harvesting	
4.	Washing thoroughly with clean water	

5.	Slicing: making slices of 1.5 to 2.0mm	
6.	Drying on clean surface	
7.	Chemical treatment using alkali, lime, sulphur and hydrogen peroxide	
8.	Insect and microbial control using fumigants such as Methyl Bromide, Ethylene Dibromide, Ethylene Oxide and Formate.	
9.	Packaging Using polythene bags, paper containers and laminates	

Section E: Output of Processed Ginger

35. What quantity of ginger did you process in 2015? .....Kg
36. What quantity of ginger did you process in 2016? .....Kg
37. Did you record any increase in output after adoption of the recommended processing practices? Yes ( ) No ( )
38. If yes, what was the quantity of the increase?.....Kg

Section F: Income and Level of living of ginger processors

39. What is the amount of money you spend per month in your household on the following:
    a. Food/feeding.....₦
    b. Health .....₦
    c. Children's education.....₦
    d. Energy/power.....₦
    e. Entertainment.....₦
    f. Others specify.....₦
40. How much did you earn from sale of processed ginger before adoption ……..…₦
41. How much did you earn from sale of processed ginger after adoption……..…₦
42. Indicate the Property you purchased with the money from selling processed ginger

S/N	Item	Quantity	Market value at Purchase Time	Current market value if to be sold ₦	Total value ₦
1.	Buses				
2.	Pick ups				
3.	Motor cycles				
4.	Bicycles				
5.	Donkeys				
6.	Horses				
7.	Cattle				
8.	Sheep				
9.	Mobile phone				
10.	Radio/TV				
9.	Goats				
10.	Ox-plough				
11.	Processing Machinery				

12	Others specify				

43. What was the price (Naira) per……. 100kg of processed ginger in 2016?
44. How much did you earn from the sale of processed ginger in 2016?.....Naira.
45. Is there any change in your output, Income Level and Level of Living as a result of adoption of recommended ginger processing practices? Yes [ ] No [ ]
46. If yes, how? Increase ( ) Decrease ( )

S/NO	Expected outcome	Increase	Decrease
I	output		
II	Income Level		
III	Level of Living		
IV	Acceptance in the market		
V	Higher market price		

47. If there was increase, how did the increase influence change in the following?

S/NO	Expected Outcome	Stated How increase Influenced Change
I	Quantity of processed ginger	
ii	Income Level	
iii	Level of Standard Living	
iv	Quality of processed ginger	

48. If there was Decrease, how did the decrease influence change in the following?

S/NO	Expected Outcome	Stated How Decrease Influence Change
I	Quantity of processed ginger	
ii	Income Level	
iii	Level of Living	
iv	Quality of processed ginger	

Section G: The Constraints Encountered by Ginger processors in Adoption of Recommended Processing Practices

49. The following ginger processing Practices are expensive to adopt (Affordability)

S/No	Ginger processing Practices	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
I	Selection of variety					
II	Washing					
III	Sorting					
IV	Slicing					
V	Drying					

VI	Chemical treatment					
VII	Insect and microbial control					
VIII	Packaging					

50. The following ginger processing practices meet my needs and values (Compatibility)

S/No	Ginger processing Practices	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
I	Selection of variety					
II	Washing					
III	Sorting					
IV	Slicing					
V	Drying					
VI	Chemical treatment					
VII	Insect and microbial control					
VIII	Packaging					

51. The following ginger processing Practices are difficult to adopt due to technicalities and can be confusing: (Complexity)

S/No	Ginger processing Practices	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
I	Selection of variety					
II	Washing					
III	Sorting					
IV	Slicing					
V	Drying					
VI	Chemical treatment					
VII	Insect and microbial control					
VIII	Packaging					

52. Apart from the above, what other problems are you facing in the adoption of ginger processing for export in your area?

(A) High cost of processing facilities ( )
(B) Labour Intensity ( )
(C) Lack of inputs ( )
(D) Wastage of time ( )
(E) Insufficient capital ( )
(F) Lack of information ( )
(G) Market Challenges ( )
(H) Limited production capacity ( )
(I) Others specify.....

53. What suggestions will you give to improve the rates of awareness and adoption of recommended practices for ginger processing export in your area?

……
……