EFFECT OF ACCESS TO INFRASTRUCTURE ON PRODUCTIVITY AND EMPOWERMENT OF RURAL WOMEN FARMERS IN SOUTHWESTERN NIGERIA

BY

Taiwo Kafayat ALAO
MATRIC NO: 136855

B.Agric. Agricultural Economics and Farm Management, University of Agriculture Abeokuta,
M.Sc. Agricultural Economics, University of Ibadan

A Thesis in the Department of Agricultural Economics
Submitted to the Faculty of Agriculture in Partial Fulfilment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY,

of the

UNIVERSITY OF IBADAN

SEPTEMBER 2021

CERTIFICATION

I certify that this work was carried out by Taiwo Kafayat ALAO in the Department of Agricultural Economics, Faculty of Agriculture, University of Ibadan, Nigeria

……...

Supervisor

Professor FolusoOkunmadewa

B.Sc., M.Sc., Ph.D Agricultural Economics (Ibadan)

Department of Agricultural Economics

DEDICATION

This work is dedicated to my family: my dad, my mum, my husband, my kids, and my siblings. This would not have been possible without you. I LOVE YOU ALL.

ACNKOWLEDGEMENTS

I am eternally grateful to almighty Allah for this special privilege. At every point in my Ph.Djourney, I met divine favour. The highlight of this journey was the grace to have had my departmental presentation before COVID-19 struck. That only affirmed that ALLAH is indeed the best of planners. Which of your favours will I deny? NONE!

To my Supervisor, Professor F. Okunmadewa, who painstakingly provided encouragement, counsel, and support from my M.Sc. through my Ph.D., thank you very much sir. I am blessed to have crossed path with you and do not take your patience and interest in my work for granted, sir. My sincere gratitude and heartfelt prayers go to my supervisory committee, Dr K.K Salman- May Allah reward you abundantly for all that you have done, Dr OgheneruemuObi-Egbedi, I could not have done this without your support and patience through the years, I am grateful, ma.

My profound appreciation goes to the Head of Department, Professor S.A Yusuf- you have been a blessing throughout my sojourn in the Department, May Allah's mercy never depart you, sir. I am equally grateful to other lecturers in the Department; Professor V.O. Okoruwa, who unknowingly propelled me to continue this journey when he made me class representative during the coursework, God bless you, sir. Professors M.A.Y. Rahji, T.T Awoyemi, A.O. Oni, B.T. Omonona, Dr F. Sowunmi (Thank you for your help), Dr C. Idiaye, Professor KemiAdenegan (Thank you for encouraging me at every opportunity ma), Professor AdetolaAdeoti, Drs.Adeola Olajide, OluwakemiObayelu, AbimbolaAdepoju, OlubunmiAlawode- thank you all for giving me the enabling environment to thrive. I appreciate all non-academic staff of the Department, Mrs.M.B.Onifade, Mr.OgboluChuks, Mrs.O. Adesina and Mr K. Kola- Thank you.

I also appreciate and thank my colleagues: Dr WaheedAshagidigbi, Dr OmobolajiObisesan, Dr MutiatSalawu, Dr Mistura Rufai, Dr Yetunde Oladokun, Mr Bayo Ogunniyi,Mr Gbenga Dada, Mr Wale Ogunleye, Mr Femi Awoyomi, MrsAnifatBolarinwa, Mr Idowu Fasakin and Mrs TosinOyedele for their support throughout the period of my joggling between Lagos and Ibadan and demanding their assistance on weekends and public holidays. Afolabi Oladimeji and my other field

officers, thank you for the numerous trips we made to get things done.Mr Wale Akinremi and Mr LekanAnimashaun,thank you for the support during my stay at the university.

This journey was quite eventful with so many stakeholders who could not wait for me to achieve this feat against all odds. His Imperial Majesty, OoniAdeyeye Enitan Ogunwusi; My father, my brother, friend, boss, and greatest cheerleader, I have finally achieved the much awaited. Thank you for giving me the wings to fly and for your timeless encouragement. God bless and keep you Kabiyesi, sir. To my late friend, Ibidunni Ajayi Ighodalo, how I had planned to tell you I made it, thank you for the support, using your driver to and from Lagos effortlessly. My darling friend, Temitope Olajide, thank you for accommodating me in your home countless times to grant me ease and proximity to UI, may you never lack shelter. My numerous supportive friends, Mrs Temitope Lawal of Animal Science, thanks for all you do, may the Lord reward you. Shola Adeleke, AsiyahAlao, IyinoluwaFagbamiye, Tolu Adewale, thank you for the encouragement, I appreciate. My dear sister, TolulopeMuritala Ajani and Mr Tunde Ajani, thanks a lot for your support.

To my adorable kids, Abdul-Lateef and Hafsah, your sacrifice, even when you were too young to understand, is worth it after all. You both gave me strength to do this, may the Lord almighty grant you strength to achieve more than this. Amen.

How do people get through life without a twin sister? Kehinde, to acknowledge you is to write another thesis, thank you for everything, May Allah grant us ease in all our endeavours. Idowu, my dear sister, thank you for the various trips to and from UI to pick and drop documents, may Allah reward you. My three Akintayo brothers; Lanre, Biodun, Kunle, and three Akintayo sisters, Laide, Salamat and Seyi, I have brought the trophy home (smiles), thank you for all that you do, may Allah spare our lives together in good health. My dear AkimBolarinwa, no long story, thanks for the Sunshine!

How do I begin to thank my parents? Thank you, daddy (Alhaji B.G. Akintayo) for those words in 2006 August when I started my M.Sc. (as a first-time nursing mum), “No, you can’t give up, you must do it”, I HAVE DONE IT daddy, I am extremely grateful. My mum, in whom I have drawn all my strength, Alhaja M.B. Akintayo (BITLAK), I am nothing without your prayers and unending support and we are all

nothing without the Grace of God. May Allah grant you both good in this world and hereafter.

ABSTRACT

Ineffective time allocation, reduced productivity and unempowerment among women have been linked to limited access to infrastructure. Empirical evidence linking infrastructure, productivity and women empowerment is scanty. Therefore,effect of infrastructure access on productivity and empowerment of rural women farmers in Southwestern Nigeria was investigated.

A four-stage sampling procedure was used. Ogun, Ondo, and Osun States were randomly selected from the six states in Southwestern Nigeria. Twelve Local Government Areas (LGAs) were selected from Osun, ten from Ogun and eight from Ondo. A total of thirty rural LGAs and sixty villages were randomly selected from sampled states proportionate to size. Ten women farmers were randomly selected from each village to give a total of 600 respondents, out of which 575 were used. Structured questionnaire was used to collect data on socio-economic characteristics (age, household size, marital status, educational status, farming experience, type of farming, and access to credit); infrastructure components (physical infrastructure - electricity, Motorable Road (MR), Potable Water (PW), telecommunication, Modern Storage (MS), Modern Market (MM); and social infrastructure - health and education). Others were value of farm inputs and output, and domains of empowerment in agriculture (production, resources, income, leadership and time allocation). Empowerment was measured using the women empowerment in agriculture domains and was categorised into empowered (1) and unempowered (0), while the level of access to infrastructure was classified into low (0.0-33.9), moderate (34.0-67.9) and high category (68.0-100.0)using composite score measure. Data were analysed using descriptive statistics, truncated regression, ordinary least squares regression, total factor productivity and instrumental variable regression at $\alpha_{0.05}$.

Age and household size were 47.7±7.1 years and 5.5±1.6 persons, respectively. Most women (67.8%) were married and had primary education (67.1%). Most households were male headed (65.7%), with farming experience of 19.84±7.9 years among women farmers. Telecommunication (0.95) was the most accessed infrastructure, followed by electricity (0.93), MM (0.72), education (0.67), MR (0.66), health (0.58) and PW (0.35), while MS facility was the least (0.03). The infrastructure access index was 0.61±0.1. Most (84.0%) of the women had moderate access to infrastructure, while 7.5% of women had high access to infrastructure. Productivity was high among the women (0.81±0.3), but most women (74.7%) were unempowered. The time domain (36.7%) contributed most to unempowerment, while the income domain contributed the least (1.3%). Age square (β=0.001), divorce (β=0.046), farming experience (β=0.002), preference for animal husbandry (β=0.129), and access to credit (β=0.052) increased access to infrastructure, while age (β=-0.018) and household size (β=0.008) decreased it. Access to infrastructure (β=0.216), household size (β=0.012), farming experience (β=0.031), female household head (β=0.021) and crop farming (β=0.050) increased the productivity of women. Infrastructure access (β=1.436) and productivity (β=1.641) increased women

empowerment while having a partner (β=-1.144) and wage employment (β=-0.950) decreased women empowerment.

Access to telecommunication was very high among the women. Access to infrastructure increased productivity and empowerment of rural women farmers in Southwestern Nigeria.

Keywords: Women farmers, Infrastructure facility, Productivity, Empowerment
Word count: 477

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX

ABBREVIATIONS AND ACRONYMS

AERC	Africa Economic Research Conservation
AFDB	Africa Development Bank
AVC	Average Variable Cost
BOI	Bank of Industry
DHS	Demographic and Health Survey
DID	Difference in Difference
EI	Education Index
ERS	Economic Research Service
FAO	Food and Agriculture Organization
FGT	Foster-Greer-Thorbecke
5DE	Five Domain of Empowerment
GDP	Gross Domestic Products
GEM	Gender Empowerment Measure
GDI	Gender-related Development Index
GII	Gender Inequality Index
GPI	Gender Parity Index
HDI	Human Development Index
IAI	Infrastructure Access Index
ICT	Information Communication Technology
IC	Infrastructure Component
IDC_i	Weight of Eight Infrastructure Access Component
IEG	Independent Evaluation Group
IFAD	International Funds for Agricultural Development
IFPRI	International Food Policy Research Institutes
II	Income Index
ILO	International Labour Organization
INF	Infrastructure Index
ISA	Integrated Surveys on Agriculture
IV	Instrumental Variable
LEI	Life Expectancy Index
LSMS	Living Standards Measurement Study
MANOVA	Multivariate Analysis of Variance
MC	Marginal Cost
MFP	Multi Factor Productivity
MLE	Maximum Likelihood Estimator

MPI	Multi-Dimensional Poverty Index
NCC	National Communications Commission
NDES	Nigeria Demographic and Education Survey
NDHS	Nigeria Demographic and Health Survey
NPC	National Population Commission
OLS	Ordinary Least Square
PCA	Principal Component Analysis
PFP	Partial Factor Productivity
RTS	Returns to Scale
SCi	Sum of Weighted Average of Each Infrastructure Component Indicator
2SLS	Two Stage Least Square
TFP	Total Factor Productivity
TVC	Total Variable Cost
UNDP	United Nations Development Programme
UN	United Nations
USAID	United State Agency for International Development
VIF	Variance Inflation Factor
WEAI	Women Empowerment in Agriculture Index
WEE	Women Economic Empowerment

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Infrastructure access is necessary for productive agricultural activities, and its adequacy is a key component of productivity, empowerment,development and sustainableeconomicgrowth ofdeveloping countries (Caldéron and Servén,2010; Olaseni &Alade, 2012;Adenipekun, 2013; Diaz-Sarachaga*et al.,*2016;Olaore*et al.,* 2021). According to emerging global trends, rural growth and development is crucial in advancing the African continent (Gurara, *et al.,*2018), andagriculture is key to this development since it is a major employer in the rural setting and a trigger for GDP and wealth formation process in many developing countries, including Nigeria (Ogbalubi&Wokocha, 2013;Gashu*et al.,*2019; Resnick*et al.,* 2020).

Women are key stakeholders in agriculture. However, they suffer inadequacywith respect to agricultural productivity due to various reasons such as uneven time distribution and inequalities in access to key resources and infrastructure such as education, extension and financial services among others (Diiro*et al.,* 2018). Women are also constrained by religious norms, cultural norms and traditions restrictingtheir ability to desire empowerment and inherit land; contributingto the widening gaps in effective women participation in agriculture (Odeny, 2013;Kemi&Jenyo, 2016). Most economic activities, including agriculture need appropriate resources and returns to be carried out optimally. Essential among these resources is human resource which comprises both male and female farm workers. Therefore, women farmers are a force to reckon with because they are involved in nearly all stages of agricultural activity. Human resource, otherwise known as human capital, has a direct influence on the way inputs are combined by farmers to get desired output, and subsequently agricultural productivity. The role of human resources in developmental process largely revolves round institutional supportsuch as infrastructure a

access. When factors that affect human resources in agriculture are put in perspective, they influence the acquisition, assimilation and implementation of information and technology which are key drivers of change and increased production (Kurbatova*et al.,* 2020). Increases in production from strong institutional support and women's involvement in agriculture could boost yield, raise overall agricultural output, increase food security while also increasing women's income in developing countries (Raney, 2011). However, as important as women are in all stages of agricultural production, they are often largely neglected and not empowered enough to give results commensurate with their efforts. This is because rural women are particularly affected by lack of infrastructure regarding the time they spend getting water for household and other productive agricultural activities: planting, irrigation, processing and marketing food and other non-farm products orgetting health services for themselves and other family members.

Nigeria is blessed with natural and human resources in abundance and grouped among the top 20 countries of the world if human resource is effectively managed (Olaseni &Alade, 2012). Women are laudable players in the agricultural sector; they make up to 80 percent of agricultural labour force in Nigeria depending on the location and produce up to two-thirdsof all outputs (Ogunlela& Mukhtar, 2009; Salman *et al.,*2020).

Infrastructureneeded for farm operations, human development and welfareis hinged on its provision and opportunity to use it (that is access), which in turn depends on investments in infrastructural facilities(also referred to as public goods) such as roads, market, storage facility, irrigation, electricity, portable water, schools,and hospitals(Grandа*et al*., 2019). However, infrastructure is mostly funded publicly, with about 70 -80 percent of the total infrastructure spending from public funding, and only about 20-30 percent from private sector through public private partnership (Mohun*et al.,* 2016), making infrastructure access largely dependent on government. According to World Bank research of 2010, there is a need for double spending on infrastructure every year to bridge the infrastructure deficit in Nigeria, other Sub-Saharan Africa nations and South Asia (Calderon *et al.,* 2018; Foster &Pushak, 2011).

Additionally, to achieve the Sustainable Development Goals (SDG's) targets, there must be access to infrastructure such as roads, improved water, health care, electricity and telecommunications, and women and girls should be given attention (Anderson*et al.,* 2021). For instance, SDG goal 5 which is to achieve gender equality and empower all women and girls is hinged on adequate provision and access to infrastructural facilities (Yount*et al.,*2019;Granda*et al*., 2019;Anderson*et al.,* 2021).

Statistically, about 783 million people in the low-income developing nationsdo not have the opportunity to use clean water (3 in 10 people lack access to improved water services), about 1.6 billion do not have electricity, whileup to 2.5billion do not have adequate sanitation (6 in 10 people)and almost a billion are without access to good road (World Bank, 2010). Accordingly, infrastructure has several effects on quality of life and well-being, and it is known to influence welfare in someways. First, it influences welfare through its availability which impacts capacity to earn incomeand productivity, which is an issue for rural agriculture. Also, it does through itsprimary consumption value, and as such satisfaction derivable from existing and budgeted incomes (Adepoju& Salman, 2013).

Infrastructural facilities are public goods of any country or region without which commercial and social activities may not be adequately performed (Kozak, 2015). Individuals, farms and businesses all depend on infrastructure access to carry out various activities needed to support production, operations and livelihoods.These facilities have considerable indirect effects on agricultural activities.Infrastructure access is both an opportunity and a means to use basic public goods for optimal functioning of the society. As such, access to different facilities varies across countries, regions, and income groups.Although,infrastructure access has the potential to enableall to perform better, it is known to positionwomen more effectively into the commercial economicdomain, butits impact with specific regards to women's empowerment has not been extensively explored in Nigeria.

According to Yusuf and Ukoje(2011), for rural development to be sustainable in terms of welfare, standards of living and security,there must be increased productivity occasioned

byaccessibility andavailability of adequate infrastructure.Consequently, rural infrastructural facilities are essential services without which productive activities may not be effectively carried out. The needed environment for primary, secondary, and tertiary agricultural activities to take place is lost without infrastructure access (Obayelu*et al.,* 2014). Lastly, infrastructure investments itself does not translate to inclusive growth, without measuring the quality and access to infrastructural services and its impact to the low income and marginalized groups, including women (Mohun*et al.,* 2016).

1.1.1Women Empowerment

Empowerment is a process, a goal and an outcome all at the same time. It isa process since it encompasses action on emancipating people; a goal since it ismostly to reorganize power relations in each society or context; and an outcome because it is the result of demands made and of struggles initiated by specific social categories wishing to better themselves (Egwurube, 2016). Empowerment is thus rooted in the local communities, in the needs of the 'less privileged, marginalized, poorest of the poor' including women.

The women empowerment concept relates to women ability to fend for themselves;manage their lives with or without the presence of their spouses; and capacity to make deliberate, tactical and meaningful choices and decisions related to their life as individuals (Kabeer, 2017). Women empowerment also refers to giving women the opportunity to improve their own lives, and not necessarily in competition with other gender, rather partnering and complementing domestic and economic growth.Empowerment plays a strategic role in development and in achieving human rights for all. This can be achieved by ensuring that power differencesare given attention through supporting women to act independently and take charge of their lifestyle without undue influence.

According to Mandal (2013) and Akpan(2015), for women in the rural area to be empowered, they must have access, ownership and control over the use ofkey resources and infrastructure (such as, education, health care, roads, markets, telecommunication, electricity and so on); and be exposed to opportunities that involve them in politics;design and implementation of policies that affect their lives.

Over time, it has been revealed that access to infrastructure is a precondition for the empowerment of women in the agricultural sector. Men and women differ greatly in their demand and need for infrastructure facilities and services, hence, the need for inclusive approaches to infrastructure which impact welfare of women positively. For instance, improvement in maternal and child mortality rates is possible with better access to healthcare, potable water, improved sanitation and accessible roads. With improved road network, the time spent by rural women in getting water for domestic and agricultural use and marketing their farm produce is greatly reduced.Hence, this makes them have more time to optimally participate in agriculture, and or engage in other income earning activities. Another dimension of women empowerment through infrastructure access is seen in the creation of better paying jobs, more functional markets and improved competitiveness because of improved services and improved wellbeing (Emmanuel &Fasakin 2015). In essence, inclusion, decision making, agency, expansion of choices, increased access to supporting institutions such as infrastructure for women are important tools for ensuring they can manage their resources with some level of autonomy.

Around the world, women are faced with discrimination in housing, land access, property acquisition, as well as economic resourcesand they are oftenfaced with limitations around accessing technologies and services that could lessen their workloads (Alzola & Marino, 2015), hence, inhibiting their productivity and ultimately their empowerment.In agriculture, women empowerment is reflected in agency and inclusion of women in the agriculture sector. To adequately capture this, relevant agricultural dimensions which reflect decision making capabilities and control over resources by women within the household and community are often considered. This helps to capture the status of women directly in agriculture while depicting gender parity within the household. According to Alkire*et al.* (2013), women empowerment in agriculture is thus reflected across five domains namely:

- Decision making in productive agricultural activities;
- access to productive resources and ability to decide on its use;
- income;
- community Leadership; and

- time allocation

1.1.2Agricultural Productivity and Access to Infrastructure

Infrastructure is a vital component of productivity and thereexistsstrong link between rural infrastructure access and agricultural productivity (Llanto, 2012). Productivity describes various measures of efficiency of production, that is, the efficiency with which productive resources are used. For example, availability and access to infrastructure would improve the efficiency with which inputs are combined to give the best output possible given all other institutional factors in place. Productivity offersan efficient,analytical and practical framework for reviewing the effect of the stock of physical infrastructure in the agricultural sector.With productivity increasing, more goods are likely to be produced at a lower cost per unit of output and at the same time maintaining quality. As farmers have access to adequate infrastructure, adopt new techniques, they become more productive, their output increases and subsequently income and welfare increase, while farmers who are not productive enough may be forced to exit the market to seek better welfare elsewhere.

As the world population continues to increase, agricultural productivity becomes increasingly important and factors affecting productivity should be given adequate attention. Infrastructure is therefore a mainfactorin productivity gains, largely by reducing operationalexpenses in input and output markets, in addition to integrating markets within sub regions more effectively (Cuevas, 2014).

Agricultural productivity increases will continue to drive economic growth and reduce poverty in both the agriculture and non-agriculture sectors, if access to adequate infrastructure is maintained, markets function welland there is access to appropriate technology to improve farming activities. Additionally, when farms are more productive, supplies and prices of food become stable and returns to farmers increase thereby leading to agricultural growth and improvements in other sectors. Accordingly, with respect to the Southwestern region of Nigeria, productivity increases induced by infrastructure access will make the region to produce at a lower opportunity cost than others; make them more

competitive; attract bigger market and consequently position them for greater agricultural gains.

1.2. Problem Statement

Infrastructure access is a major challenge facing Africa (Nchuchuwe&Adejuwon, 2012;Olukunle,2013; Collier and Cust, 2015). Less thanforty percent of Africans have access to electricity, only aboutone third have access to proper roads and just 5% of arable or farmland is irrigated (Keberuka, 2011). According to Adenipekun(2013), two issues are central to Nigeria's agricultural sector and food security: population dynamicsreflected by human resources needed for agricultural activities and infrastructural facilities, reflected by physical, social and institutional infrastructure facilities.Provision of infrastructure has been on the front burner for the Nigerian governments for decades.However, very little attention has been paid to the extent of accessibility, and opportunityfor the useof available facilities in the rural areas (Adenipekun, 2013).

Infrastructural development in parts of rural Nigeria isslower compared to parts of urban Nigeria, while investments in road construction, health, education and water supply are the focus of the government for urban areas, the rural area has not enjoyed commensurate infrastructural development.This has resulted to a rapidrural-urban migrationin Southwestern Nigeria affecting agricultural activities and productivity (Ogunmakinde*et al*., 2015).Women, who are major participants in agriculture are more vulnerable than their male counterparts. Being the primary caregiver in the household, they are often faced with ineffective time allocation between income generating activities and domestic activities. In the face of inadequate infrastructure, women are particularly more vulnerable, less productive, and ultimately more disempowered compared to others.

Additionally, in the rural areas, inadequate infrastructure access poses a serious threat to rural human capital. According to the World Bank (2018), Nigeria is 96^{th} on a scale of 100 in Human Development Index (HDI), making her number 152 out of 157 countries. Given these statistics, attention must shift to include human capital development indicatorssuch as women empowerment in infrastructural development. In recent times, there has been

relative infrastructural advancement in power, road transport as well as information communication and technology (ICT) networks in Nigeria compared to some other countries in West Africa. However, the rural areas are yet to benefit fully in terms of access due to neglect. In Nigeria, the road network condition is poor hence impairing national connectivity; only about 15 % of the rural population have access to some form of electricity compared to 55 % in the urban area; access to improved water is about 74% for urban population compared to only 43 % in the rural areas who depend mainly onsurface water, wells and springs (AFDB, 2013). Furthermore, only about 20 % of the existing 197,000km existing roads are accessible or paved, while up to 70 % are in a deplorable state (AFDB, 2013). Currently, power transmission is national in scope, but quality of supply is low across the country, out of the installed capacity of about 12,522MV as of 2018, only 4,103 power is being sent out(Oyedepo *et al.,* 2018;Onuoha, 2019). Also worrisome is the privatization of the Nigerian electricity sector which has the tendencies to reduce access to electricity since the supply of power to consumer has become a profit /business venture rather than a public good or social serviceto people.

Infrastructure access has been commonly acknowledged as a factor limiting women's productive economic opportunities. Policy and decision makers on provision of infrastructural facilities often do not pay attention to women's time in domestic labour, hence overlooking the effect and implication of infrastructure on women's capabilities (Koolwal& Van de Walle, 2013). In general, women do not particularly access different kind of infrastructure from their male counterparts, and the issues of infrastructure access concern women in addition to other underprivilegedor marginalized groups, however women are unique in the delivery of their roles, since they are primary caregiver in the household in addition to their productive endeavour. Women are significant among several unempowered subset of the society (marginalized, minority etc.), they are strategically placed within the household as individuals, and they overlap other categories of people.Family and household interactions are also central to unempowerment of women in ways different to other gender (Uyang*et al.,* 2016).

Women are particularly affected by lack of infrastructure regarding the time they spend sourcing water for their families and for productivepurposes, like irrigation,processing and marketing of produce. They are also affected when they spend productive time looking for health services for themselves and other family members. Also, regarding access to resources, women are more disadvantaged, making them less economically active and unable to participate in the labour market in the same way asothers (Independent Evaluation Group (IEG), 2017;Islam *et al.,* 2019). According to Adeyonu(2012), rural women farmers in Southwestern Nigeria spend considerably more of their time (65 %) on household activities in all cropping seasonsthan their male counterparts who spend approximately 35 % of their time. It was also noted that rural men in Southwestern Nigeria spend 89% more time than women on income generating activities, while women spend 21.7%less time on leisure activities than men due to housework in addition to their economic activities. Limited access to roads, electricity, storage, processing facilities andpotable water have been reported to severely impact rural women through several ways, such as poor quality of life, deteriorating health, ineffective time allocation, increased poverty rates and impaired agricultural productivity (Agénor&Agénor,2014;Ondiege*et al.,* 2013).

Additionally, existing socio-economic, religious beliefs, cultural norms, andgeographical spread, are major factors contributing largely to women empowerment in Nigeria. For instance, women in some parts of Nigeria are made not to work at all, work less than their male counterpart or partake only in domestic chores (Ayevbuomwan*et al.,* 2016), thereby limiting their economic productivity. This calls for consistent evaluation of women to get them aware of their situation and subsequently empower them to be more productive. Furthermore, despitethe effort of Southwestern and Eastern women in farming activities, they continue to suffer various setbacks because their voices are often not loud enough to bring about desired change towards empowering them or making them more productive(Ayevbuomwan*et al.,* 2016).

The current situation among the rural women in Southwestern Nigeria needs to be put in better perspective to have information that is consistent with reality and readily available for researchers and government for policy making. Additionally, Southwestern Nigeria is

of particular concern since most rural women are into faming (Salman *et al.,* 2020) and only few literatures examine women access to infrastructure and their productive capacities. The dearth of infrastructure,bad roads to transport their goods from farm gate to the market, poor access to health facilities, poor access to water, inadequate storage facilities for their produce amongst others, have consistently hampered their productivity and other survival strategies (Adeyonu, 2012;World Bank, 2018).

Studies (Yusuf *et al,* 2010;Ashagidigbi*et al.,*2011;Obayelu*et al.,*2014;Ayevbuomwan*et al.,*2016) have been conducted on infrastructure, productivity, women empowerment independently but there are onlyfew literatures linking the three(infrastructure access,productivity, andwomen empowerment) together.

From the foregoing, certain questions arise.

- What is the level of women farmers' access to infrastructure in the study area?
- What factors determine women farmers' access to infrastructure?
- What is the effect of infrastructure access on women farmers' productivity?
- What is the state of empowerment among women farmers in the study area?
- Do infrastructure access and productivity influence empowerment among the women?

1.3 Objectives of the Study

The broad aim is to examine the effect ofinfrastructure accesson productivity and women empowerment in Southwestern Nigeria. The specific objectives of this study are to:

1. Determine level of access to infrastructure in the study area;
2. Examine the factors affecting women farmers' access to infrastructure in the study area;
3. Determine the effect of access to infrastructure on productivity in the study area;
4. Assess the status of women empowerment in the study area; and
5. Examine the effects of infrastructure access and productivityon women empowerment.

1.4Justification of the Study

Infrastructure plays a major role in determining productivity and development (Gaal&Afrah, 2017).Improvement in infrastructure access does not only increase the efficiency of production but also aids in improving the living standards of citizens and creating economic opportunities for the rural areas(Kossymbayeva*et al.,* 2019).It also has huge implications on agricultural production outcomes. The role of infrastructure such as health care, good roads, water, electricity,communicationand transportation networks, in promoting development cannot be overemphasized. Infrastructure development is beneficial to all (men, women, children), however, the effect it has on women has the potential to translate into greater benefits for those who are around them. The study reiterates the realities, gender dimension and trends in status of infrastructure access in Southwestern Nigeria while contributing to policies on gender issues.

Given the role agriculture plays in the Nigerian economy, no significant socio-economic transformation can occur in the absence of improved and sustainable agricultural production. Agricultural productivity increase induced by institutional support must be in place, other farm level inputs should also be given adequate attention to fast-track and sustain progress, expansion and growth in the country. The study provides information on the productivityof rural women farmers in rural Nigeria. This will provide agricultural policy makers with insights into the various elements and inputs affecting farmers performance vis-a-vis giving pointers to government on where efforts should be concentrated for sustainable agricultural gains in Nigeria.

The status of infrastructure access of women in rural Southwestern Nigeria is revealed by the study. This will help policy makers understand the relationship between women and infrastructure access, its impact, and offer them insights into designing policies and programs that can effectively tackle gender disparities in infrastructural development needed to empower women for agriculture. The study also provides micro level rural women infrastructure access information which can be deployed at the macro level for necessary collective action towards policy formulation for national growth and development.

Currently, empirical studies (Obayelu*et al.,* 2014;Diiro*et al.*, 2018) have examined infrastructure, productivity, and women empowerment independently, however, only very few studies reveal the infrastructure access, productivity and women empowerment nexus. The study therefore adds to knowledge and helps bridge this gap by linking infrastructure access and productivity to women empowerment empirically. Furthermore, most literature focus on specific infrastructure sector rather than a group of infrastructures, the study will add to existing literature by reporting the effect and status of a combination of physical and social infrastructure on rural women in Southwestern Nigeria, while eliciting the infrastructure components that are least and most accessible as a target for stakeholder and government intervention.

While literature (Gupta *et al.,* 2017) is saturated with various works on women empowerment, most studies (Musa, 2011;Ayevbuomwan*et al.,* 2016) used descriptive statistics and proxies (education, employment) in their analysis of women empowerment. Only few studies employed direct measures such as domain of empowerment to measure women empowerment.This study measured women empowerment in agriculture directly using the WEAI fivedomain of empowerment (5DE),which adequately captures agency, control, resources in relevant Agricultural domains. Unlike other empowerment measures like Women Economic Empowerment (WEE), Gender empowerment measure (GEM) that measure women empowerment in the formal sector (where Agriculture is not adequately captured) using nationally representative data, the five domain of empowerment (5DE) uses individual level primary data of women to measure (capture their extent and role of women) their empowerment directly in agriculture.The 5DE adds to existing knowledge by showing the domains in which women are empowered and the domains where women are disempowered.This will help to reveal areas of concern for future studies and aspects of women empowerment needed for policy recommendation.

Finally, efforts must also be concentrated on increasing empowerment among women farmers, (Kilic*et al*., 2015). This is to ensure productivity and sustainable agriculture given the key role women play in most agricultural activities. For instance, making resources required to produce, process and market food products available and accessible

to women could increase outputs on women's farms by up to 30 percent (Quisumbing *et al.,* 2014).Also, since disparities are obvious through agricultural systems, effort is needed to empower women at all levels within the economy, from the individual, family unit, community, state, and regional level up to the national and international levels. In the light of this, this study evaluated women access to infrastructure in the study area in relation to their empowerment, while providing an insight into the current empowerment status of rural women farmers in Southwestern Nigeria. This will provide relevant information that will serve as funding and targeting tools for government and policy makers on how infrastructure contributes to empowerment among women farmers, while enabling policies needed for inclusive planning for women empowerment, rural growth and development.

1.5 Plan of Study

The study consists of five chapters which discuss the various elements that make up the research. Chapter one gives an introduction and background to the study while chapter two (Literature Review) discusses the theoretical review, methodology employed by the study in addition to a review of past studies on infrastructure, productivity and women empowerment. Chapter three which is the Methodology used for the study describes the study area and the various analytical techniques and tools used to analyse the data from field. The fourth chapter explains the results of the study and discusses the implications of the study.The last chapter, chapter five, summarizes major findings, discusses conclusions, describes policy implication and presents recommendations that emanated from the study.

CHAPTER TWO
LITERATURE REVIEW

This Chapter is divided into sections on theoretical review, methodological review, empirical review, andconceptual framework.The theories of production and change underpinning the study are discussed.Methodological review was on Index computation, measures of productivity, measures of women empowerment, and measurement of economic variables. The study reviewed literature on infrastructure,productivity, and women empowerment. Lastly,the conceptual framework was discussed.

2.1Theoretical Review

This study considers the theory of production, and theory of changewhich provide the framework for examining productivity and women empowerment issues.

2.1.1 Production Theory

Most agricultural activities are built on production at the individual, firm, and national levels. Physical inputs such as raw materials, semi-finished goods, and soft inputs such as technical know-how are converted into finished goods and services through various production processes. Production is hence a function of the factors of production in agriculture.The essence ofapplying economics to agricultural production at the micro-level is to help farmers or group of farmers to be more efficient in intra-farm allocation of resources over a period, to attain specific goals. To boost production, however, resources need to be maximized to produce a desirable output level, and production theory is needed to analyse the various output level changes. Production function has been the traditional tool for analyzing problem of resource productivity and returns to scale. Production function which relates input and output when some resources are fixed can be termed short run production functions.

This can be expressed mathematically as: -

$$Y = F(Xi), 1 < i < n \quad (2.1)$$

$Where \;\; Y = Output$
$Xi = Input$

Here, Y is a function of Xigiven the values of X to Xn. The production function can also be expressed as a linear function or Cobb- Douglas function as shown below:

$$Y = AX_1^E, X_2^E \quad (2.2)$$

$A = Efficiency\ parameter$
$E = Elasticities$
$X = Various\ Inputs$

2.1.1.1 Infrastructure as an Input of Production

Empirical studies (Sharma & Sehgal, 2010; Aymen*et al*., 2015) have used the production function framework to study how infrastructure influences productivity. This approach treats public goods (infrastructure) as either a factor enhancing multifactor productivity or a separate input in production (externalities), and it is assumed to be exogenous. Basically, public infrastructure is applied in an aggregate production; this is represented in equation 2.3;

$$Y = Af(K, L, R) \quad (2.3)$$

$Where\ Y\ is\ Output;\ A\ is\ TFP;\ K, = Capital;\ L, = Labour\ and \;\; R = stock\ of\ infrastructure$ (e. g. roads, education, electricity, water, etc.).

From the Equation above, public goods may affect aggregate output directly, that is $\frac{\delta f}{\delta R}$>0, or through the increase of production by increasing the economy wide productivity index (in a way like technological progress), that is,AS, with $\frac{\delta A}{\delta R}$>0. This assumes Hicks-neutral public capital, a common assumption in public capital literature (Merter, 2021).

A typical increase in production due to infrastructure improvements (assuming all other factors are kept constant) is illustrated in Figure 2.1. An increase in infrastructure from G^0 to G^1 will increaseoutput from $Q^{*1}$to Q^{*0} with other factors kept constant.

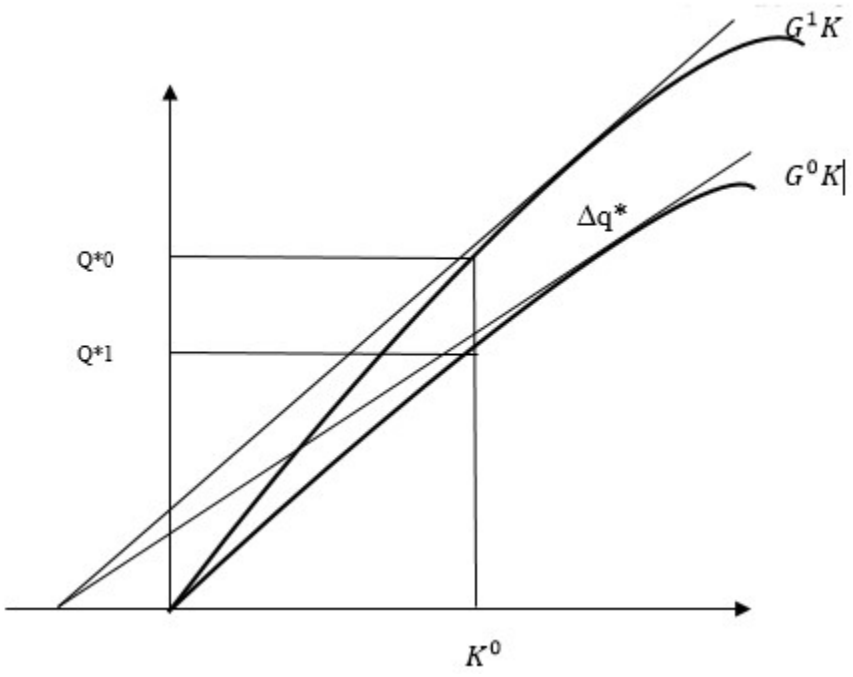

Figure 2.1: Increase in Production Due to Infrastructure

Additionally, infrastructure in combination with other inputs also affects output and productivity accordingly.Output increase due to infrastructure access and other inputs is illustrated in Figure 2.2. The change of the production function from (1) to (2) is due to increase in the input level (from P1 to P2) in addition to anincrease caused by access to infrastructure. Total output increase from T1 to T2 is then considered as the sum of both increase indicators(Aymen*et al.,*2015).

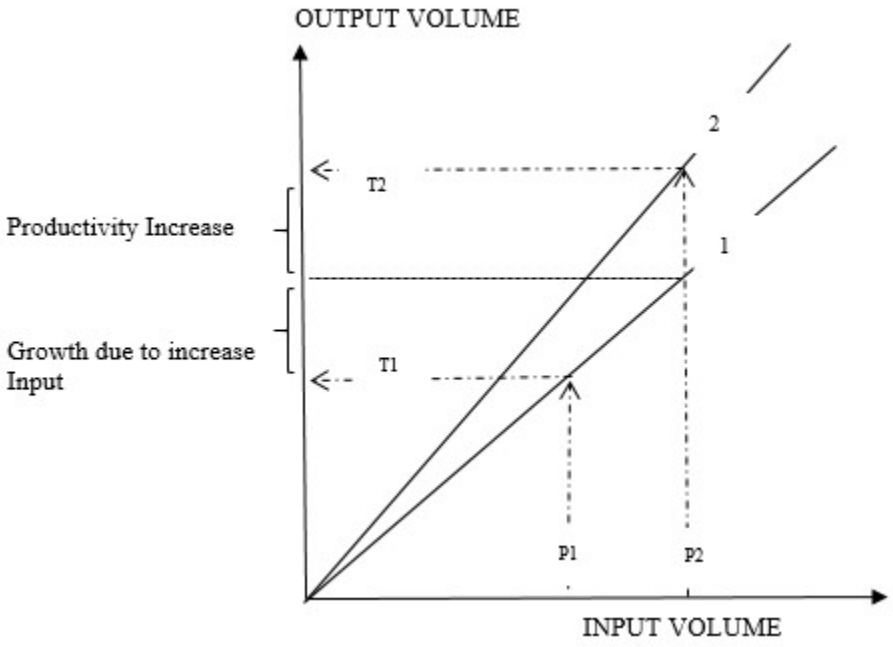

Figure 2.2: Increase in Output Due to Infrastructure and Other Inputs

2.1.1.2Returns to Scale in Agricultural Production – The focus of returns to scale in agricultureis on changes in output as factors of production change concurrently in the same proportion. The three concepts in relation to returns in production are:

Diminishing Returns: Elasticity of substitution is not infinite; there is a limit to which factors of production can be substituted for one another. Therefore, total production increases start to decline overtime due to diminishing marginal and average productivity. Consequently, other production inputs (which are external) such as infrastructure access, other institutional support, technological improvements must be in place, for there to be appreciable productivity gains in the rural areas (Amare *et al.,* 2017).

Increasing Returns: This is when same or additional inputs result in more than proportionate output increases in both physical and revenue terms. This is however only possible when economic disadvantages such as inadequate public goods, bad access road, inadequate extension services are minimal in the production process while commensurate inputs are employed (Anna, 2011).

Constant Returns to Scale: Here, each additional unit of resources employed gives the same amount of output in the total production.This occurs frequently when all resources are increased together, as in the case of individual level productivity.

The above is illustrated in a typical production graph in Figure 2.3, Returns to Scale, showing increasing, constant and decreasing returns to scale respectively.

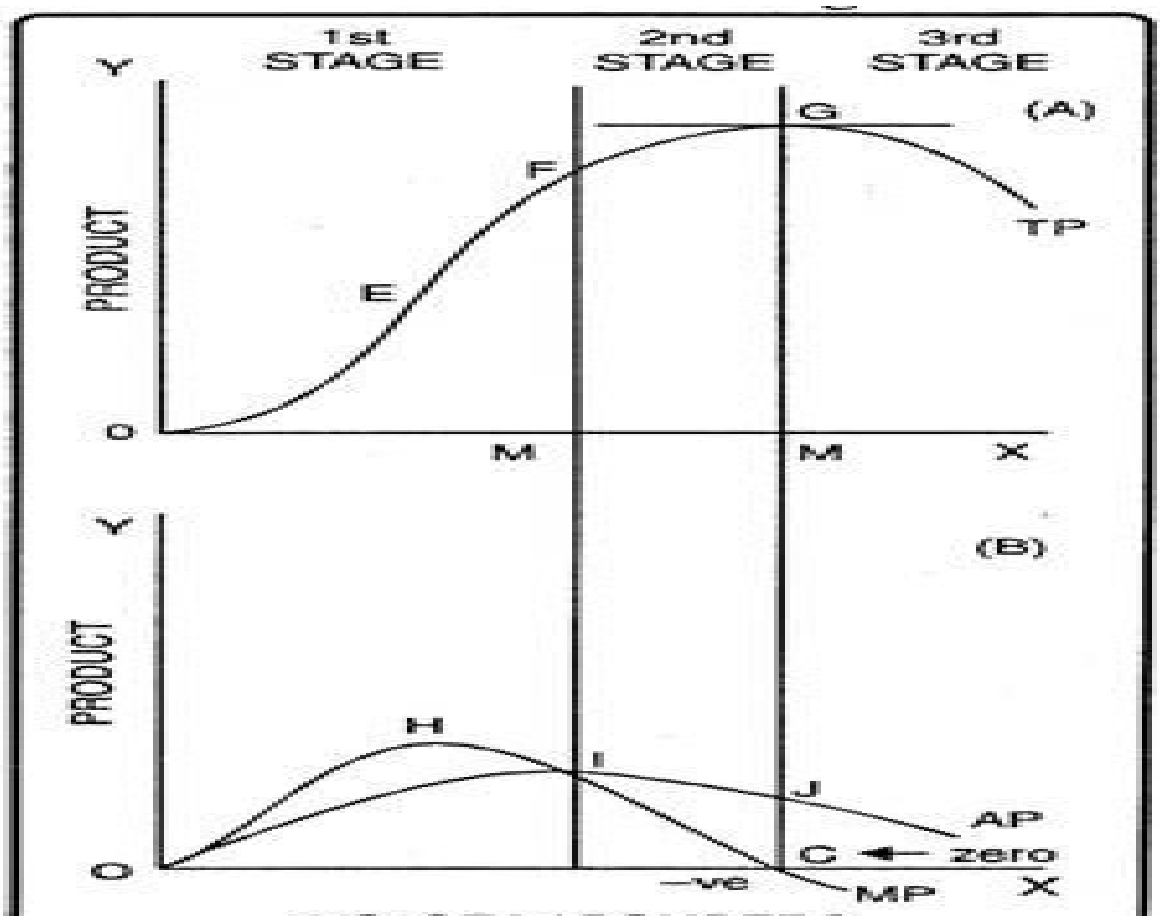

Figure 2.3: Returns to Scale in Agriculture

2.1.1.3 Effect of Infrastructure in a Competitive Market Economy

Conventionally, the role of infrastructure access in agricultural productivity is strategic as seen in indirect output gains and increases in productivity of factors employed in the production process. In a competitive market economy therefore, it is imperative to pay attention to factors that impact agricultural productivity and corresponding possible outcomes. Figure 2.4 depicts how theory explains the relationship between infrastructure access and productionin a market economy with numerous producers and consumers. When there is inadequate access to infrastructure, farms are faced with higher marginal cost (MC_1) throughout production, at the prevailing price of outputat Q_1. When there is an increase in infrastructure access, MC curve shifts down to the right (MC_2), from MC_1 to MC_2producing cost savings as shown inwxyzfor the original output level Q_1, thereby resulting in increases in output levels Q_1 to Q_2. This reduction in cost is as a result of direct interactions between infrastructure and other productive inputs, thereby increasing production efficiency. This interaction plays out in different ways, which can be seen in improved input-output combinations,decreases inmovement (transfer) costs, better input prices, technological improvements, better dissemination and diffusion of information, increased knowledge and commercialization, and improved businesscapabilities, all because of improvements in infrastructure.

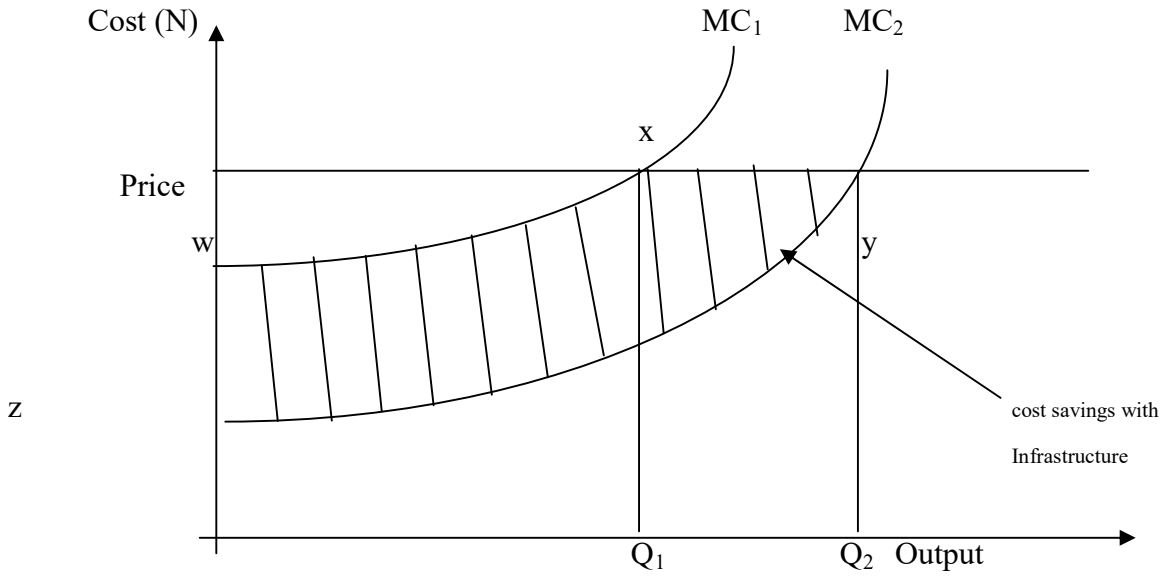

Figure 2.4: Effect of Infrastructure Access in a Competitive Market Economy

2.1.2 Theory of Change

The Change Theory employed for the study was coined froman all-embracing analysis of the fundamental problems that affect rural farmers in terms of their efficiency, output and productivity; distribution and equitable opportunities;autonomy and empowerment, following the pathway theory of change (Njuki*et al.,* 2013). The theory examined nexus between variousempowerment and equality models as it relates to women, drawn from the impact of issues that are strategic and internal to women's empowerment. The objectiveis to expand rural women's productivity and empowerment in a way that makes agriculture systems more equitableacross all stakeholders. The fundamentalissues that underpin the theory in relation to the marginalization of women, low agricultural productivity and severe food insecurityamong farmers are discussed as follows:

- The traditional inequality and power relations between men and women, patriarchal arrangements and rural systems, which result in indiscrimination, social exclusion, and unequal chances for farmers.
- Inadequate leadership, accountability, and concern at both the traditional and national levels for women. Women are not also adequately represented in institutions that support their productive capacities, hence leading to poor investments and food shortages overtime in production where women are found within the rural setting.
- Increased competition for available resources due to a decline in productivity of natural resources. This decline is linked to both natural (climate changes) and man-made causes.
- Market Challenges – Markets are increasingly becoming volatile, thereby inhibiting women's participation and gains from market activities. The commodity markets centres around food as a main transaction item in the rural areas, hence impairing the decision-making ability of women around other market functions compared to food functions.
- Developmental challenges- Smallholder farmers are heterogenous and constrained in various ways. However, development efforts fail to acknowledge this.

Development programs are inadequately planned to accommodate rural farmers constrained by resource optimisation, sub optimal livelihood, survival strategies and peasant living.

Across these contexts, five common components called changer levers illustrated in Figure 2.5 must be impacted to give desired outcome.

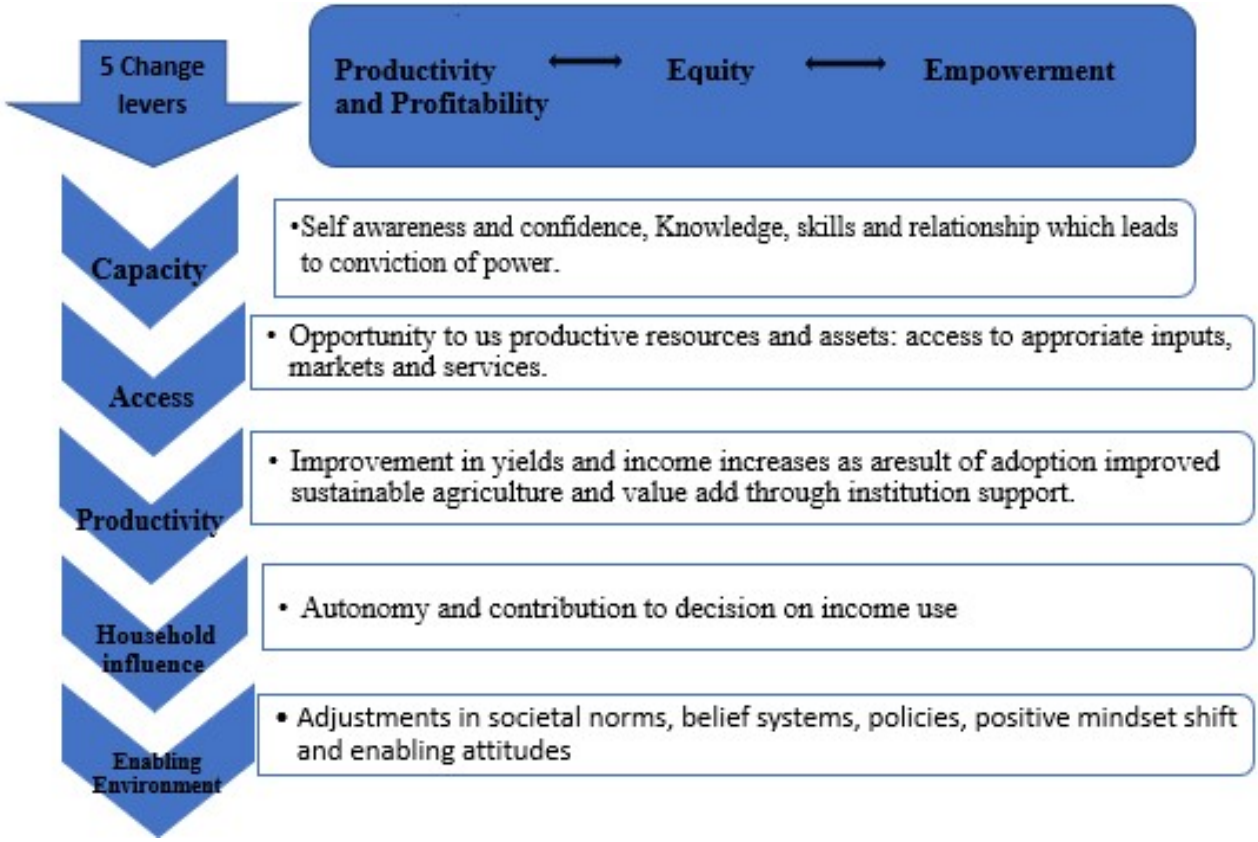

Figure 2.5: Theory of Change
Source:*Adapted fromNjuki, Kruger, & Starr (2013). Increasing the productivity and empowerment of women smallholder farmers.*

2.2Methodological Review

This section discusses construction of index, measures of productivity, empowerment and economic variables:

2.2.1 Construction of Index

Construction of index arises when there is a need to summarize the variation in a multivariate data set for informative index, for instance, data on infrastructure across eight different infrastructure elements, among various women in different communities in Southwestern Nigeria. Research by nature is multivariate and limiting approach to data analysis may not be sufficient togive in-depth analysis needed to draw meaningful economicconclusionsfrom mixed sets of variables.Index often reveals the patterns that exist in a data set, shows the inter relationship and helps to reduce the dimensionality of data.

An indicator can be measured directly or indirectly (using proxies). It can also be a calculation used to show the characteristics of a particular population, geographic location, human development, environmental, socio-economic indicators, or system of concern. To get values for indicators, data must be processed to give either a quantitative or qualitative measure. For instance,access to health which comprises various elements may be measured indirectly using proxies such as hospital attendance rate, mortality ratio of both mother and child, and life expectancy at birth and at old age.Women empowerment indicators can also be arrived at by combining elements of autonomy, decision making, education, participation in politics and other economic activities of women into an index which summarizes all variables into a meaningful measure (Sander & Keller, 2021).

Largely, composite indicescombinevariousseparate indicators to give a summary report of a multifaceted, multidimensionaland value addingsocial or economic issue.For instance,access indices, poverty indices, human development status, sustainability level, capacity, and risk. Specific indicators and sets of related indicators can be arranged and grouped to create sub-indices which represent the main components of the theme or areaof interest. A road access sub index might include indicators like cost of access, distance to paved road,while an education access sub-index may have elements such as attendance

rate, enrollmentrate, level of education and so on. These sub-indices are then aggregatedto give final composite index. Infrastructure access index in this study is organized into eight dimensions such asroad access, electricity access, improved water access, telecommunication access, health access, education access, improved storage access and market access. A summary index equation is shownas follows:

$$Index_i = \sum W_K X_{ki} \quad (2.4)$$

where $index_i$= index of the ith district, W_k= weight of the kth factor and X_{ki}= unit free value of the kth factor for the ith district (Nayak, 2014).

The various multivariate techniques used in index construction are shown in Table 2.1.

Table 2.1: Multivariate Techniques in Index Construction

S/N	Method	Aim
1	Descriptivemultivariate methods	Identifying patterns and relationships using data exploration.
2	Principal component analysis (PCA)	Reducing dimensions by constructing new variables called the principal component, thencombined linearly in the multivariate set.
3	Cluster analysis	Identification of natural groupings amongst different variables or elements.
4	Factor analysis	Correlation structure among variables is established in the multivariate response set by linking them to a set of shared factors.
5	Multivariate analysis of variance (MANOVA)	This is an extension of univariate analysis of variance to several variables simultaneously.The purpose is to separate the total sum of squares and cross-products matrix amongst a set of variates according to the experimental design structure.
6	Discriminant analysis	Establishing a function that allows two or more groups of entities to be dividedbased on multiple responses on all entities in the groups.
7	Canonical correlation analysis	Examining the connection between two groups, by establishing pairs of combinations of the variables in the multivariate set for each pair to in turn linear.The highest correlation between entities in the two groups is established.
8	Multidimensional scaling	Creating a "map" depicting a spatial relationship between several objects, beginning from a table of distance between the objects.

Source: *Adapted from Abeyasekera(2005). Multivariate methods for index construction.*

The study made use of the Composite index to generate the infrastructure access index, to maximize the variance in the data. Other indices of interest from literature include, Infrastructure Development Index (INF), The Foster-Greer-Thorbecke Poverty Index (FGT) and Multi-dimensional Poverty Index (MPI) to mention a few.

2.2.1.1. Infrastructure Development Index: This measures the extent of infrastructural development of a place using the average total cost attached to the infrastructure of interest (Obayelu*et al.,* 2014). According to Ahmed and Hossain (1990), the infrastructure development index depicts the extent of underdevelopment while higher infrastructural index value means the more under-development within a community.

$$INF = \sum_{i}^{n} W_i \tag{2.5}$$

Where W_i = weights of average transportation cost attached to infrastructure; n = number of respondents in each community. Other studies from literature that have measured infrastructure development index include; Patra& Acharya(2011) and Rana*et al.* (2017).

2.2.1.2. The Foster-Greer-Thorbecke Index (FGT): The Foster-Greer-Thorbecke Index (Foster *et al.,* 2010) is a general measure of poverty which studies the inequality among the poor, itpermitsvariation in the total weight on income levels in the calculation of poverty in the economy (Akinlade*et al.,* 2011). It is often desirable because of its properties, such as decomposition and subgroup consistency(Brück& Kebede, 2013) . The FGT indices are often used in literature as comparative poverty measures to the Multi-dimensional Poverty Index (MPI)

The FGT index is defined as:

$$P\alpha = \frac{1}{n}\sum_{i}^{q}\left(\frac{z-y_i}{z}\right)\alpha \ \ , \ \alpha \geq 0 \text{ for } Y \leq Z \tag{2.6}$$

Where; Pα is a poverty index(measure of poverty) ,

z is the poverty line (in terms of consumption),

n is total population, q is total number of poor housholds, and

y is the total consumption expenditure

The poverty index, Pα changes as α changes in values. For example, when α is 0, 1, and 2, Pα equals the head count index (P_0), the poverty gap index (P_1), and the poverty severity measure (P_2), respectively.

2.2.1.3. Multidimensional Poverty Index (MPI): The Multidimensional Poverty Index (MPI) was developed as a welfare measurement tool, which uses three factors namely: education, standard of living and health indicators to determine the incidence and intensity of poverty experienced by a population (Jane*et al.,* 2011). The Multidimensional poverty index (MPI) is premised on the fact that the well-being of people depends on more than just income or consumption, several other dimensions or capabilities are to be considered within a household (Adepoju, 2018). 'Cutoff' is set to determine deprivation across different indicators. An entity (e.g. household) is classified as deprived when they do not meet the 'cutoff'for a specified indicator (e.g. having at least one adult member with at least primary education). Each entity (household) is assigned a 'deprivation score' determined by the number of indicators, they are deprived in and the 'weights' assigned tothose indicators. Equal weighting is usually assigned to each dimension (Health, Education, Standard of Living, etc.) and each indicator within the dimension is also typically weighted equally (Sulaiman*et al.,* 2014).

Following the Alkire Foster (AF) methodology which also identifies multiple deprivations experienced by an individual in various aspects of wellbeing, the following equations are used in calculating the MPI;

$$\mathrm{H} = \frac{q}{n} \tag{2.7}$$

$$\mathrm{A} = \frac{\sum_{i=1}^{n} c_i\ (k)}{q} \tag{2.8}$$

$$\mathrm{MPI} = H * A \tag{2.9}$$

Where H is the Multidimensional head count Ratio, A is the Intensity of poverty , q = no of people poor, n, total population, c_i (k) censored deprivation score of individual i

Summarily, the MPI recognizes deprivations across multiple dimensions within the

household and individual across education, health and standard of living, thereby measuring the complexities of poor people's lives, individually and collectively annually.

2.2.2 Measures of Productivity

Productivity is concerned with how well inputs can be transformed into outputs, andcan be measured in different ways; profitability, partial productivity, and Total factor profitability (Plag, 2020). The objectives of productivity measure includeTechnological change, Efficiency, Cost savings, Bench marking production process, Living standards (Capalbo&Antle, 2015). The total factor productivity and partial factor productivity are discussed below; both are applicable in various studies based on purpose and data.

2.2.2.1 Total Factor Productivity(TFP)

According to literature (Fernald, 2014; Wang *et al.,* 2015;Abdul-Qadir*et al.,* 2016) total factor productivity (TFP) is measured as the ratio of aggregate outputs to aggregate inputs used in production. It is the ratio of output to capital, labour and other inputs used in production, and can be measured in physical or monetary terms (Reza Anik*et al.,* 2020). Monetary terms: thousands of Naira per all output to thousands of Naira per all inputs; physical terms: total output value per KG to total input value per Kg and so on. It is a useful tool in measuring performance within and across firms. All inputs used in the production process should be included to estimate TFP and must be measured in the same unit.

$$TFP = \frac{Q}{I} \tag{2.10}$$

$Where\ TFP = Total\ factor\ productivity, I = total\ input$ and $Q = total\ output$

A multifactor productivity (MFP) measure utilizes more than a single factor but not all factors used for production. MFP is the ratio of output to the combined inputs.

$$MFP = \frac{Q}{L + C} \tag{2.11}$$

$WhereMFP = multifactor\ productivity, L = labour, C = capital$ and $Q = total\ output.$

In economics, TFP and MFP are often used interchangeably, but in terms of measurement, there is a difference between the two terms. TFP uses all inputs (labour, capital, and intermediate inputs) while MFP does not include all inputs (O'Donnell, 2010; Ahmed&Bhatti, 2020). Two major approaches are used to obtain measures of total factor productivity (Dhehibi, 2015). This includes the frontier approach and non-frontier approach.

I. Frontier Measures of Total Factor Productivity: The estimation of a frontier function depicts the performance of the best firms (Chen*et al.,* 2015). The frontier function can either be estimated by parametric or non-parametric methods. Parametric frontier considers production as afunction of the inputs and specifies a particular function; examples are Cobb-Douglas, Tran slog, Constant Elasticity of Substitution etc. Non-parametric frontier analysis does not require specific functional form (Llewelyn& Williams, 1996). As a result, it does impose any restriction on the frontier function that might cause a distortion in the efficiency measures.

II. Non-Frontier Measures of Total Factor Productivity: This approach represents average response function. It has no regard for technical inefficiency. Variations in outputs are considered as random shocks outside the farmers' control (John &Seini, 2013). Estimation of an average function depicts the performance of an average firm (Chen*et al.,* 2015). The most common tool used in this approach is the linear programming. Linear Programming is a maximization and/or minimization technique that has its roots in applied mathematics. Average response function is a form of parametric non-frontier approach of measuring total factor productivity. It involves two methods; the linear aggregation and the geometric aggregation methods.

The different approaches to TFP measurement are illustrated in Figure 2.6.

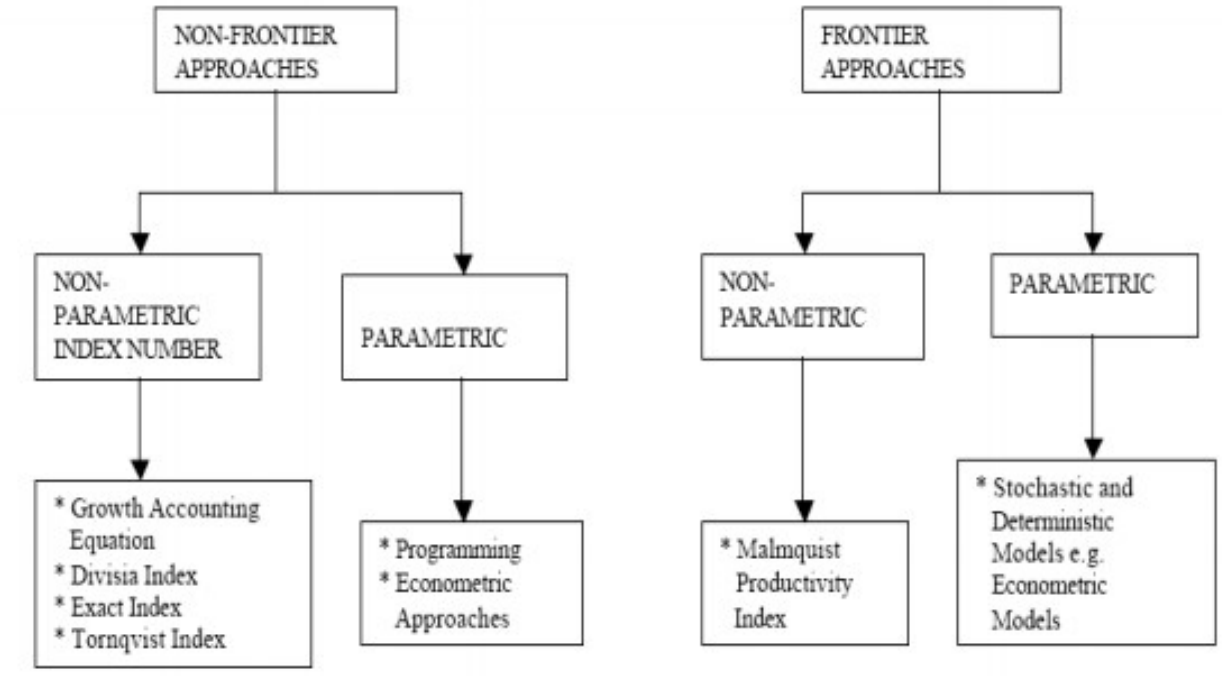

Figure 2.6– Approaches to TFP Measurement
Source: *Adopted from Aymen, Boubaker, Aden, Samia& Ali (2015). Approaches to total factor productivity measurements in the agriculture economy.*

2.2.2.2 Partial Productivity

Earliest approach to productivity measurement was by dividing aggregate output by the value of an input. This single or partial productivity measure has a unique advantage of computational simplicity and feasibility if the required aggregate single input data are available. One of thedefects of this approach to productivity measurement is its inability to identify the causal factor accounting for observed productivity growth. The formula is as follows.

$$PFP = \frac{Q}{L} \tag{2.12}$$

$$Where\ PFP\ =\ partial\ factor\ productivity, L\ =\ labour\ and\ Q\ =\ output$$

In certain instances, the use of partial factor productivity is preferred due to the availability of data. It is also useful when there is focus on a specific factor. The most used ratio is output/man-day (labour productivity), others include land productivity; ratio of output to size of land used in production.

2.2.3 Measures of Women Empowerment

Various measures are employed in assessing women empowerment.Several female empowerment indices exist in literature and use many indicators from different dimensions to generate a score as guide. Some of these measures are discussed below.

2.2.3.1 Gender Empowerment Measures (GEM): This is a formal measure of women empowerment whichshows participation of womenin economic and political activities of a nation. Indicators such asthe percentage of women in the parliament, no of female law makers, share of women in executive and managerial positions and number of white collar and technical female professionals across various industries are often tracked while the gender disparity in earned income, reflecting economic independence is also often tracked and calculated. The GEM, however, fails to capture the status of women in informal sector, where the agricultural sector belongs.

2.2.3.2 Gender Parity Index (GP1): The GPI measures empowerment gap between male and female while reflecting the percentage of women who enjoy parity,compared to others. The GPI is embedded in the WEAI; it makes up ten percent of the women empowerment in agriculture index while the 5DE makes up ninety percent.It compares the relative achievement of women to their male counterparts in gender studies and analysis. It is used to show the relative percentage achievement of females in comparison to the primary male in a household.

2.2.3.3 Gender Inequality Index (GII): The GII isused to show the ways inwhich women are disadvantaged across 3 dimensions namely: labour market, reproductive health, and empowerment (Hassanzadeh*et al.,* 2014). GII shows the loss in human development due to inequality between female and male achievements, it allows for adjustment in inequality of different population group, e.g., men and women. The GII is an improvement on GEM and Gender-related Development Index (GDI).

2.2.3.4 Women's Empowerment in Agriculture Index (WEAI): This follows Alkire Foster (2013) methodology, and it is a composite measurement tool that indicates women's control over critical parts of their lives in the household, community, and economy. WEAI measures women empowerment across five agricultural domains (5DE) and makes it possible to identify women who are disempowered and understand how to increase autonomy and decision making in key domains. The WEAI is particularly useful because it helps establish the link between agricultural growth, and empowerment. It is a combination of the 5DE and Gender Parity Index (GPI) to assess empowerment of women in relation to men in each household.

2.2.3.5 Gender-related Development Index (GDI): This index (GDI) considers disparity in Human Development Index (HDI) across gender, which compares the average level of income (based on GDP per capita), education (literacy and gross enrolment), and life expectancy, globally. The GDI is however not suitable in agriculture measures of women empowerment since it fails to capture women who earn informal wages (women in agriculture) as well as subsistence, reproductive and care activities in its components, for which women are particularly involved (Ledar, 2016).

The GDI,GII, GPI, GEM, all cover inequalityand disparities across comprehensive and extensive sets of domains but do not measure empowerment directly; they use aggregate data and do not capture control over resources and agency within the agricultural sector labour force, of which women account for 43 % (World Bank, 2010). This study employed the 5DE of the women empowerment in agriculture indexWEAI to capture women's agency and inclusion while measuring women empowerment in agriculture directly in relevant domains. Asummary of some empowerment /gender equality measures is shown in Table 2.2.

Table 2.2: **Gender Indices and Components**

Gender Index	Description	Authority
Index 1: Social Institutions and Gender Index **(SIGI)** **Scale:** 0-1, 1 means equality	Measures discrimination against women across four socio-economic elements namely:Restricted Civil Liberties, Family discrimination,Restricted physical integrity, restricted access to resources.	OECD
Index 2: Gender Empowerment Measure **(GEM)** **Scale:** 0-1, 1 means equality	Formal measure which shows participation of women in politics and in the economy.Women representation in national parliament, Percentage of women decision makers in the economy,and female share of income.	UNDP
Index 3: Gender Equity Index **(GEI)** **Scale:** 0-100, 100 means equality	Explores empowerment, representation, and equality of women across in Education, Economy, Politics.	Social Watch
Index 4: Gender – related Development Index **(GDI)** **Scale:** 0-1, 1 means equality	Global measure of gender depicted by Life expectancy, educational and Income. It shows the disparity in human development index across gender. It is formal and does not cover the informal Agric sector.	UNDP
Index 5: The Global Gender Gap Index **(GGI)** **Scale:** 0-1, 1 means equality	Designed to measure inequality and gender gap among men and women usingaccess to economic and productive resources, level of educational,political autonomy and wellbeing reflected in health and survival.	World Economic Forum
Index 6: Gender Inequality Index **(GII)** **Scale:** 0-1, higher figures show more disparity	GII measures disparity among males and females inreproductive health, political and educational Empowerment and Participation in thelabour market.	UNDP
Index 7: Women Empowerment in Agriculture index **(WEAI)** **Scale:** adequacy in 4 out of 5 domains means empowered	A direct measure of empowerment in Agriculture which captures agency, decision making and autonomy in five areas namely, production, resources, revenue and expenses,control and speaking in the community and use of time between domestic and economic tasks.	IFPRI

Source:*Adapted from Lan &Tavrow (2017). Composite measures of women's empowerment.*

2.2.4 Measurement of Relationship among Economic Variables

Theoretically, a relationship exists between infrastructureand other variables in determining outcomes (productivity, income, empowerment, welfare e.tc.) of farmers.This directly or indirectly affects regional and national economic indices. Relationship between economic variables explains the connection or association among variables quantitatively and shows the type, degree, cause, effect, direction of the relationship to help us make inferences and predictions needed in both micro and macroeconomics.

In theory,there is a simple relation (correlation) between two variables. For instance, demand of a commodity and the price consumers are willing to pay; or that variety of variables affect each other (Regression). Also, the productivity of a farmer is related to various inputs, technology, infrastructure and so on; an individual's empowerment is related to education, productivity, externalities; consumption is related to income, price of the commodity and that of other commodities and so on. According to literature (Ukoha*et al.*, 2010; Abdul-Qadri *et al.,* 2016;Wouterse, 2016), production and or productivity of farmers has a relationship with and is affected by various factors, inputs, socio-economic factors, welfare (empowerment), institutional support (in which infrastructure is one of them) among other things. This relationship must be estimated from observable data at different point in time to make meaningful inferences, predictions and conclusion to support Agricultural growth and development.

Correlation and Regression are the most used techniques for investigating the relationship between two quantitative variables. They are used to describe the type of and magnitude of the relationship between two or more variables. Primarily, correlation is concerned with association, while regression is focused on deductions which allow us to make extrapolations, forecastsand predictions.

2.2.4.1 Correlation

It describes the relationship between two variables without showing any differencebetween the variables. X is correlated to Y, and Y is correlated to X (Kozak *et al.,* 2012). The value ranges from -1 to +1 and shows the direction and strength of the

linear association between the two variables. Equation 2.13 denotes correlation coefficient according to Emerson (2015).

Sample correlation coefficient is stated in the equation below.

$$r = \frac{Cov(x, y)}{\sqrt{s_x^2 * s_y^2}} \tag{2.13}$$

$s_x^2 and s_y^2$ are the sample variances of x and y

2.2.4.2 Regression

Regression analysis is aneconometric measure of the average relationship between two or multiple variables of interest; the emphasis is on how one variable affects the other (Seber& Lee., 2012). The variable of interest whose value is influenced is called "Dependent Variable" (target, response, regressand, explained, endogenous variable) and the other external variables that influence the value of the other variable is called "Independent Variable" (predictor, regressor, explanatory, exogenous variables). Regression models are widely used for forecasting and establishing underlying effects and relationships among variables.

In Regression analysis, there are some assumptions which must be fulfilled as condition precedent to the use of normal regression analysis. One is the linearity relationships between the dependent and independent variables, another is the non-correlation between the error term and the variables. Once an assumption is violated and the association between the variables is not linear, we may employ one of two things,one is to transform the variables by taking the square, square root, or natural log of the values, so that the relationship between the transformed variables is more linear, or to run nonlinear regressions that attempt to fit a curve (rather than a straight line) through the data.

I. Simple Regression: This is used when we want to check the relationship between one explanatory variable and one explained variable as denoted by equation 2.14.

$$y_i = \beta_0 + \beta_1 X_1 + \varepsilon_i \tag{2.14}$$

where yi is Dependent variable, β_0 *is intercept,* β_1 *is coefficient,* X_1 *is independent variable and* ϵ_i *is error term*

II. Multiple Linear Regression: Multiple linear regression refers to a set of techniques for studying the connection between a continuous response variable and two or more explanatory variables based on a sample. It examines the linear relationships between the variables, denoted by equation 2.15 below,

$$y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_i X_i + \varepsilon_i \tag{2.15}$$

where yi is Dependent variable, β_0 *is intercept,* $\beta_1, \beta_2, \beta_i$ *are coefficient,* X_1, X_2 *are independent variable and* ϵ_i *is error term*

Subsequently, linear regressions quantify goodness of fit using R^2, and by extension Adjusted R^2which describes the variation in response variables caused by the explanatory variables. While both measures the proportion of variance due to explanatory variables, the adjusted R^2 measures the amount of variation explained by only those explanatory variables that contribute mainly to explaining the target or response variable, hence the difference is in the degree of freedom.

$$R^2 = \frac{SS_{regression}}{SS_{total}} \tag{2.16}$$

$$AdjR^2 = 1 - \frac{SS_{regression}/df_e}{SS_{total}/df_t} \tag{2.17}$$

Where

SS_{total} *is the total sum of square,* $SS_{regression}$ *is sum of square of regression,* df *is the degree of freedom*

III. Two Stage Least Square Regression Model (2SLS): This technique is the extension of the Ordinary Least Square regression (OLS) method. The 2SLS regression is used when an equation has at least one independent variablethat is endogenous (that is the correlation between the error term and the variable is not equal to zero).It results in simultaneous equation bias Gujarati (2004). The solution is thus to develop a simultaneous equation system and estimate it by a two or three stage least squares depending on the number of endogenous variables. As a result, the regression parameters are better enhanced. To correct for the possible endogeneity, Instrumental Variables (IV) are used for the potential

endogenous variable in the model.The IV to be used will be highly correlated with endogenous independent variable and uncorrelated with dependent variable. Structurally, this is shown in 2.18 and 2.19,where equation 2.18 represents the original equation, and 2.19 represents the estimated equation where the endogenous variable is regressed against the instrumental variable.

$$E_i = \beta_0 + \beta_1 G_1 + \beta_2 R_2 + \beta_n G_n + u \tag{2.18}$$

$$R_i = \alpha_0 + \alpha_1 G_1 + \alpha_2 Q + v \tag{2.19}$$

- *where Ei is the continous dependent Variable*
- $\beta_0, \beta_1, \beta_2, \beta_n, \alpha_0, \alpha_1, \alpha_2 are vectors of the parameters to be estimated$
- *u and v are the disturbance error term*
- $G_i and G_n are the estimable exogenous,$
- *R is the endogenous exogenous variable*
- *Q is the instrumental variable that is correlated with R and uncorrelated with the error term.*

2.2.4.3 Non-Linear Regression model

This isa non-linear combination of the parameters. The data are fitted by a method of successive approximations. Ordinary Least Squares are unsuitable to estimate parameters in nonlinear models where variables that are not normally distributed, e.g.,dummyor censored variables. Limited dependent variable models are examples of nonlinear regression models, for example, Logit, Probit and Tobit models.A regression model is nonlinear if the derivative of the model depends on one or more of the parameters, or if one or more of the conditions of linear model are not fulfilled.

$$Y = a + b^2 X \quad such\ that \quad \frac{\delta y}{\delta a} = 1, \frac{\delta y}{\delta b} = 2b \tag{2.20}$$

These regression models are applied when we have limited dependent variables;they are used in situations where dependent variable have some limitations (censored data, truncated, ordered or binary) and hence captured with some defined levels.For example, to adopt a technology or not, to have access to infrastructure or not, to have a joint or sole decision-making ability and so on, which usually take a no or yes answer converted to binary variables. Responses therefore fall into a certain category within a range of predictors.

The limited variables are also called quantal response (all or nothing), dichotomous, qualitative, and categorical outcomes. The probit, logit and Tobit models are appropriate for these variables depending on the available data and the aim of the analysis. Logistic regression models can also be referred to as double hurdle models. Logit and probit models are used for the first hurdle (Adoption models, dichotomous dependent variable), while Tobit is used for the second hurdle (here the dependent variable is not binary/dichotomous but "real" values, after some censoring). For example, in a decision to adopt improved seeds by farmers, they may be asked if they will adopt an improved seed (answers: yes and no, then logit or probit models are used depending on the distribution). If yes then how much will they pay for this seed, here we use Tobit model with the amount they will pay as dependent variable, hence the Tobit models use a mixture of discrete and continuous outcomes.

I. Logit and Probit Models: Logit model is used when the dependent variable is categorised into two groups, it could be binary commonly coded as (0 or 1) or multinomial (three or more outcomes). The Logit model operates under the logit distribution (i.e., Gumbel distribution) and is preferred for large sample sizes, while in theProbit model the dependent variable can take only two values, such that for three or more outcomes ranking or ordering is done (Moore, 2013). Illustrative applications include decisions to access or not a particular infrastructure, availability or not of infrastructure, adopt or not (Technology), empowered or not and so on.

As such, the dependent variable can only take two possible outcomes 0 and I. For Probit model, the specification of the functional form is the normal CDF, while the Logit model uses the logistic distribution. It is most often estimated using the standard maximum likelihood procedure**.**The conditional probabilities of Y=1 (i.e. Y occurring) given X is$\mathbf{Pr}(\boldsymbol{y = 1|X}) = \emptyset\,(\boldsymbol{X\beta})$

In the Probit model, it can be expressed in the equation below:

$$\emptyset\,(\boldsymbol{X\beta}) = \int_{-\infty}^{\boldsymbol{z}} \frac{1}{\sqrt{2\pi}} \exp \underset{\boldsymbol{Where\ z\ = X\beta}}{\left(-\frac{\boldsymbol{Z^2}}{2}\right)\boldsymbol{dZ},}; \qquad (2.21)$$

$\boldsymbol{where\ z = X\beta;\ X = variables, \beta = coefficients}$

The logit model is expressed in equation 2.22

$$\Lambda(\boldsymbol{X\beta}) = \frac{(\exp(\boldsymbol{X\beta})}{1+\exp(\boldsymbol{X\beta})} \; \boldsymbol{where} \; \Lambda = \boldsymbol{non\ linear\ function\ of\ X\beta} \qquad (2.22)$$

II.Tobit Regression Model: The Tobit model is used when we do not want to consider all the elements of an observation because they fall short of a given criteria. This is usually called latent unobservable variable y_i*. This variable is linearly dependent on the *Xi* variables via a vector of *βi*coefficients that determine their interrelationships. Additionally, there is a normally distributed error term μ to capture the random influence on this relationship. The observed variable y_i is defined as being equal to the latent variable whenever the latent variable is above zero and equal to zero otherwise. Hence, Tobit model is a relationship between independent variables and a non-negative dependent variable.

$$y_i = \begin{cases} y_i^* if\ > 0 \\ 0\, y_i^* \le 0 \end{cases} \qquad \text{Where } y_i^* \text{ is the latent variable.} \qquad (2.23)$$

Additionally, the Tobit Model uses MLE for consistency and has an ancillary statistic, sigma which is like the standard error in ordinary least square regression.

$$y_i^* = \alpha z + \tau_i, \tau_i N(0, \sigma^2) \qquad (2.24)$$

III.Instrumental Variable Probit Model (IV Probit): This is an extension of the probit regression model, where some independent variables are correlated with the error term $E(X, u) \neq 0$ making the result of the estimation inconsistent and biased due to endogeneity (Wooldridge, 2015). Here, we have a dichotomous dependent variables and endogenous independent variables. The estimation of the endogenous Probit model can be done through maximum likelihood estimation or a two-step procedure (Hans &Lee, 2019; Shang & Lee 2011). The assumption on the error term of original equation and reduced equation is that both are independent and identically distributed.

The model is specified follows:

$$Y_i = a_i + bX_i + u_i \qquad (2.25)$$

$\boldsymbol{Y_i}$ is a dependent binary variable (yes or no/1 or 0); $\boldsymbol{a}$ is the constant term; $\boldsymbol{b}$ is a k × 1 vector, X is an n× k matrix of covariates; u is the error term.

In this case, the correlation between the regressors and the error term is not zero $(E(X,u)\neq 0)$, hence we apply instrumental variables because of endogeneity.

The above model can be written in its reduced form:

$$Y^{*}=\beta y_{2i}+\alpha x_{1i}+u_i \tag{2.26}$$

$$y_{2i}=\gamma_1 x_{1i}+\gamma_2 x_{2i}+v_i \tag{2.27}$$

Where Y^{*} = is the dependent

Where, y_{2i} is a vector of endogenous variables (for instance productivity and infrastructure access in this case); x_{1i} and x_{2i} are, respectively, a vector of exogenous variables and variables used as "instruments"; β and α are vectors of other structural parameters.

In 2.26, γ_1 and γ_2 are matrices of parameters. By assumption, (u_i, v_i) ~ N (0, Σ).

2.3. Empirical Review

2.3.1Review on Infrastructure

Infrastructure is a prerequisite for economic activities and over time, studies have shown that public investment in infrastructureimproves local community andmarket development, which in turn has enormous impact on agriculture.Infrastructure access is known to promote development while impacting standard of living, productive capacity and welfare enormously. For instance, basic infrastructure facilities (electricity, water, telecommunication)are important for efficient production, with road access strategically placed as a necessary input in the production of nearly all commodities. In Nigeria, roadsremain the main means of transportation with about 80% of all transportation by road (Onokala, 2015).Hence, great emphasis is still needed to analyse the current state of road infrastructure vis –a –vis other infrastructure elements and rural urban connectivity.

According to Olorunfemi (2020),on rural road infrastructural challenge, and itsimpediment to agricultural development in Ondo State, Nigeria poor road network contributes significantly to high cost of transportation and inconsistent transport services. This led to food insecurity and low agricultural productivity. Using descriptive statistics and stepwise regression model on primary data collected from 200 farmers to analyse,he established that the main means of transportation in the rural area is motorcycle which is not sufficient to convey farm produce to the market, this subsequently led to post harvest loses.

Ovharhe(2020) reported a significant relationship (using correlation coefficient) between infrastructural facilities and livestock development.Market facility, water facility, and roads contributed significantly to livestock production in the study area. However, high cost of storage facilities and insufficient power supply were major impediments. The study reported that the more the intervention from adequate rural infrastructure,the better developed the livestock sector will be.

A study by Adeoye *et al.* (2014) in Oyo state examined profitability and rural infrastructure development in Fadama II and Non-Fadama II areas using gross margin and infrastructural index, respectively. With primary data across 264 farmers, they found that infrastructural development is higher in Fadama II Villages, and farmers under the Fadama II programme have higher output and gross margin, making them significantly better off in agricultural production and household income than their counterparts in the less developed Non- Fadama II LGAs. Level of access to infrastructure in rural Southwestern Nigeria in this study will help shed light on the status of infrastructure in the region vis-à-vis its impact.

Kiprono (2014), in his study of the effect of infrastructure improvement on Agriculture farm input, productivity and market participation using secondary data in Kenya, found that land allocation for agriculture, maize yield, market participation and intensity of use of inorganic fertilizer increased in areas with improved road access network. The study

used infrastructure as an external factor and examined its effect on other inputs and productivity. The result of the study confirmed that either infrastructure is treated as a direct or indirect input; it has a significant positive effect on productivity especially in far and remote areas. This study improved on Kiprono's study by using primary data to assess the relationship between infrastructure access (using a combination of different infrastructure element) and other inputs of production among rural women farmers.

According to Rahman(2014), the impact of rural infrastructure on development is complex and indirect. In his study in Bangladesh using bivariate Tobit Model to assess the relationship between rural infrastructure and farm/non-farm enterprise, he found that female headed households are more disadvantaged and did not partake in both enterprise making them earn less than others. His study also revealed that infrastructure has a significant but inverse effect on enterprise choices, income, inputs, farming experience and household assets.

Fellon*iet al.(*2011),in the analysis of gross agricultural output, found that concentration of roads per agricultural area has a positive and significant coefficient, while the elasticity for electricity consumption in rural areas is positive and significant. The consumption of electricity per agricultural worker was also significantly and positively related to the productivity of labor. The concentration of roads suggestsbetter access to information,improvedinputs and output markets due to better connectivity,and an advantage to factors of production and technology.Energy is also a key factor in agricultural activities, especially in mechanized, intensive and semi-intensive farming, which includes processing or intensification (intensive livestock rearing) of production, hence important gains in the productivity and efficiency of agriculture can be expected from investment in roads and electricity.In addition to electricity access in the Southwestern Nigeria, a combination of Physical and Social infrastructure was analysed to reveal the combined effect of a group of infrastructure on rural women farmers.

Li & Liu(2009)studied the effect of rural infrastructural development on agricultural production technical efficiency and found that all the selected rural infrastructure namely:electricity, road, telecommunication, water andskills education were all linked to

agricultural production and efficiency positively. Using Tobit model estimation, transportation was found to significantly affect technical efficiency, followed by education, power and water facilities. This confirms the relative importance of infrastructure on productivity and technical efficiency increases within the agricultural sector.

Egbetokun(2009), in his study of provision of rural infrastructure in Oyo state, used descriptive statistics to access the level of provision of basic infrastructures in the study area. He reported that provision of infrastructures served as incentives for increased economic efficiency and productivity in the rural community. This study revealed the levelof infrastructure access (across a combination of eight physical and social infrastructure components)using infrastructure access index amongst womenfarmersin SouthwesternNigeria.

Lastly, Fakayode*et al.*(2008), found that there was availability of basic infrastructure in Ekiti State Nigeria. However,access to the infrastructure was quite poor, as revealed by the infrastructure index value of 0.32.Data for the study was farm level data obtained directly from the farmers. This study adds to existing literature by analyzing a combination of infrastructure and determining the factors that affect access to infrastructure specifically among women who are major players at all levels of agricultural activities.

2.3.2. Review of Productivity

In Nigeria, agriculture is primarily rain fed and highly labour intensive, with low productivity often because of under development, infrastructuredeficit, low technology, government policies and crude farming methods (Amare *et al.,* 2017). If factors causing low productivity are addressed, there is room for an increase in the existing level of productivity across all regions in Nigeria even with the current levels of input (Amare*et al.,* 2017).

Fowowe(2020), employed panel data set from the LSMS–ISA to examine the relationship between financial inclusion and agricultural productivity in Nigeria. Using land productivity (income per hectare)to measure productivity, he found a significant relationship between financial inclusion and agricultural productivity (positive and significant) in Nigeria. Specifically, owning a bank account and saving money increase productivity while female headed household and high educational level reduced productivity. Although, this study did not examine financial infrastructure in the rural areas, result from this study is aimed to serve as input for future studies on access to financial services and productivity in the rural Southwestern Nigeria.

Diiro*et al.* (2018) found that maize productivity increasedwomen empowerment in a study carried out in Kenya, using the abbreviated WEAI andcross-sectional instrumental variable regression method. The study revealed a direct link among women empowerment, improved productivity and decrease in gender gap in agricultural production for plots managed by women. This study lookedat effect of productivity on empowerment using the domains of empowerment and IV Probit regression analysis to address endogeneity problem.

Fuglie (2018), in his study 'Is Agricultural Productivity slowing?', found no downward trend in global productivity growth but an interesting shift which concludes that Agricultural productivity is beginning to increase in developing countries, while decreasing in industrialized countries because of various factors such as reduced labour for agriculture. Secondary data from Economic research service (ERS) dataset on international agricultural productivity, the ILO estimates on labour and the FAO data on capital were used from 1961- 2014.

Abdul-Qadri *et al.* (2016) using three oil palm production systems across the farmers, processors and markets value chain of oil palm production, found the National TFP to be 0.9175 close to the benchmark of 1.0000 and the TFP for large, medium and small scale production systems to 1,0436, 0.9935 and0.8240 respectively indicating large scale had the highest TFP (showing progression and most profitable system),medium scale TFP close to the bench mark and small scale TFP indicates deterioration since it is less than 1.

Ukoha*et al*.(2010), evaluatedproductivity (TFP)and analyzed the determinants of total factor productivityamong small-holder cassava farmersusing OLS regression technique in Abia state. The coefficients for education, extension, gender and household size were negative and significantly related to total factor productivity (TFP) in contrary to expectations, while age, fertilizers and credit access were positive and significant as expected.In addition to the variables reported by Ukoha*et al.* (2010) this study used infrastructure access index, farming experience, access to credit as determinants of productivity in Nigeria.

Yusuf *et al.*(2010) examined women farmers productivity in the savannah area of Nigeria and found that women were productive, however, with a wide variation amongst them. The productivity indices have a wide margin of between 2.7 and 1104 with mean value of 489.9. By implication, the variation might be attributed to the way the women managed available resources to produce a given level of output.

Fakayode*et al*. (2008) examined the agricultural productivity of farm households in Ekiti State, Nigeria. The total factor productivity revealed that on the average, food crop productivity is 2.4. This result implies very low average variable costs (AVC) in the farms in the study area. The result of the analysis (using Cobb-Douglas equation) for the factors affecting agricultural productivity showed that infrastructure index, land measured in hectares and fertilizer measured in kilograms were significant.

A lot of studies on productivity employed TFP in their analysis of productivity. This study also determined the productivity (using TFP) of rural women, examined the effect of infrastructure access on productivity, taking into consideration the possible endogeneity (with the use of instruments) between empowerment and productivity. The factors influencing productivity of farmers range from socio-economic, institutional, infrastructural facilities, among others. From literature, some of these factors influenced productivity differently, either positively or undesirably while some of these factors are still inconclusive.

2.3.3. Review ofWomen Empowerment

In general, women take a central role in much of the studies on empowerment in literature. However, there are various terminologies (participation, gender inequality, gender discrimination, women's autonomy, women's land right, bargaining power, and so on) used in literature to capture empowerment (Sharaunga*et al.*, 2019). Empowerment, autonomy, and gender inequality interchangeably have been used to mean the same thing in the past.

Obayelu and Chime (2020) in their study on dimensions and drivers of women's empowerment in rural Nigeria using Nigeria Demographic and Health Survey (NDHS) data constructed women empowerment index (WEI) to capture the agency and decision-making capabilities of women in the household. They found that decisions were mostly made by a woman's partner, while decisions on disposable income were jointly made with spouse. More women were disempowered compared to men. Household size, education and being household head had direct effect on empowerment, age and husband's education had inverse relationship.

Adeleke and Akinbile(2019)analysed the implications of empowerment status of rural women's agricultural production capabilities in Nigeria using the following indicators: political, socio, economic,decision-making, and time-use statuses. They reported low empowerment despite high social and economic status. Rural women were also reported to have high time use and low political and decision-making abilities thereby inhibiting their productive capabilities.Income, education, household size and years of experience had a positive effect on empowerment.

Ayevbuomwan*et al.*(2016) using a multi-dimensional poverty measure constructed a women empowerment index from the 2013 DHS data. The result showed that about 43 percent of the women in rural Nigeria are disempowered and the intensity andincidence of empowerment varies across region in Nigeria.This study revealed the empowerment status of women in rural Southwestern Nigeria.

Acha(2014) used three proxies (education, employment, and literacy rate) as measures of empowerment. The three were strong determinants of economic growth.However, with employment being difficult to measure, and often not fully represented in informal

sectors(where rural women farmers belong),it will be misleading to make meaningful policies with such results. This further confirms the limitation of proxies as measures of empowerment. This study employed the 5 domains of agricultural empowerment in women which directly captures the agency and inclusion of women.

Lastly, according toOgato*et al.,*(2009) improving access to productive resources and agricultural services through gender empowerment is key. They analysedthe various factors limiting productivity of women andreported thatlimitedproductive resources access made women less productive than men, hence making them less empowered.

2.4 Conceptual Framework

The focus of the research is to elicit the relationship among infrastructure access, productivity, and empowerment among ruralwomen farmers in Southwestern Nigeria. This is important since infrastructure access is a prerequisite for productive agricultural activities and improvement in empowerment status of farmers. The conceptual framework of this study is developed on access to two categories of infrastructure (comprising of Physical and Social infrastructure elements) which interact with socio-economic factors, production inputs, technology, to impact productivity of women. Infrastructure access can equally affect women empowerment directly by providing the right environment needed for women to use their time productively, increasing their decision-making capacities on production and income, and improving their leadership skills within the community.The infrastructure facilities include physical infrastructure (good road, improved water, telecommunication, electricity, market, storage) and social infrastructure (health and education).

The determinants of access to infrastructure are also considered in order depict thesocio-economicfactors of women that influence their ability to access infrastructure. Factors such as age, age square, household size, farming experience, type of farming practice, household head, occupation, marital status,education, access to credit were considered.

Additionally, the empowerment of women farmers was captured across various domains; productive capacity, decision making capability on resources and income, their participation in leadership within the community and time use (defined by time spent on leisure and productive activities). Women Empowerment status in agriculture can be

improved if there is right policy intervention, especially in the domains discussed in this study. The linkage among infrastructure, productivity and women empowerment is illustrated inFigure 2.7.

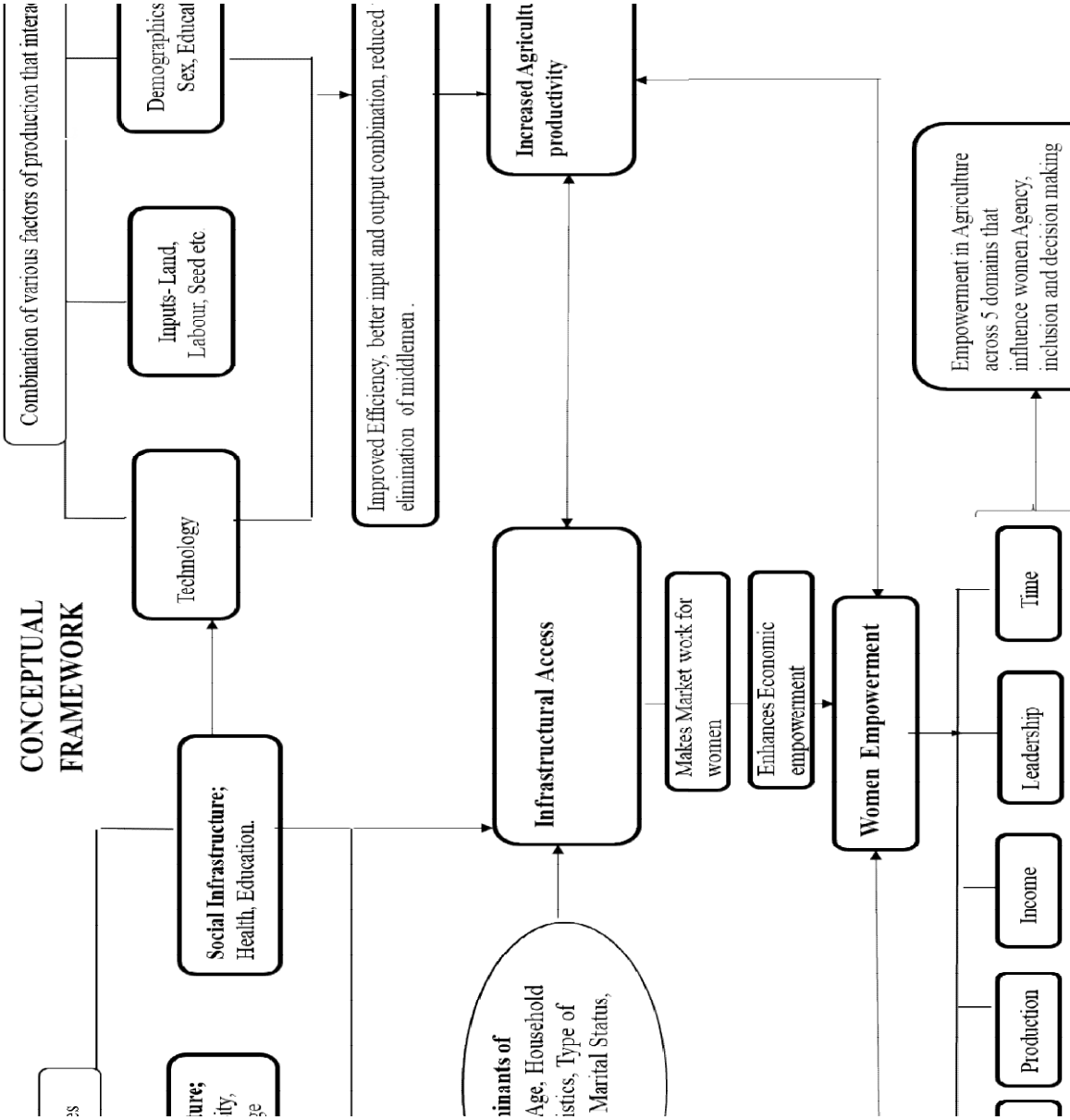

Figure 2.7: Infrastructure, Productivity, Women Empowerment Linkages.
Adapted from (Nadeem *et al.,* 2011, Dirro*et al.,* 2018)

CHAPTER THREE
METHODOLOGY

3.1 Study Area

The study was carried out in the Southwestern zone of Nigeria which consists of six (6) States; Ondo, Ogun, Ekiti, Osun, Lagos, and Oyo. The region is marked by longitude 6^0 to the East and 4^0 to the West, onlatitude 4^0 to the South and 6^0 to the North. It is surrounded by Kogi and KwaraStates to the North, by the Atlantic Ocean to the South, by Edo and Delta States to the East, and by Republic of Benin to the West.Based on proximity to each other and geographical location, the six States are usually classified based on the contiguous delineation into 3 clusters Lagos/Ogun Cluster, Oyo/OsunCluster and Ondo/Ekiti Cluster.There is relative homogeneity across the clusters and rural areas are predominantly agriculture-based economies. The climate around the yearin the Southwesterngeo-political zonesupports about three quarter of the populace to participate in farming (Afolabi, 2010). Various cash and food crops are grown in the area; they include tuber crops like yam, cassava; grains like rice, maize, cowpea, sorghum, soybean,and vegetables such as pepper, okra, melon, leafy vegetables and so on. They are grown either intercropped as mixed crops or as sole crops while cash crops include cocoa, citrus, and oil palm.The zone has a land area of about 114, 271Square kilometers, representing approximately 12 percent of Nigeria total land mass.

According to Llanto(2012), there is connection between infrastructure and growth; infrastructure deficits affect a region negatively and the path of causalityturns from infrastructure to economic growth. Regional imbalance in infrastructure availability and access has a significant impact on a district's economic growth prospects. The Southwestern zone is strategically placed in Nigeria, with the ability to contribute significantly to the GDP of the country through improved agricultural productivity gains. The choice of rural Southwestern Nigeria is justified to seek data that are consistent with reality in terms of the

region's infrastructural facilities vis-a-vis agriculture development and economic growth, also in response to the threat posed by rural urban migration (Okhankhuele&Opafunso,2013), inadequate infrastructure access and low productivity of the region (Amare *et al.* 2017). The map showing the six States that make up the zone is shown in Figure 3.1.

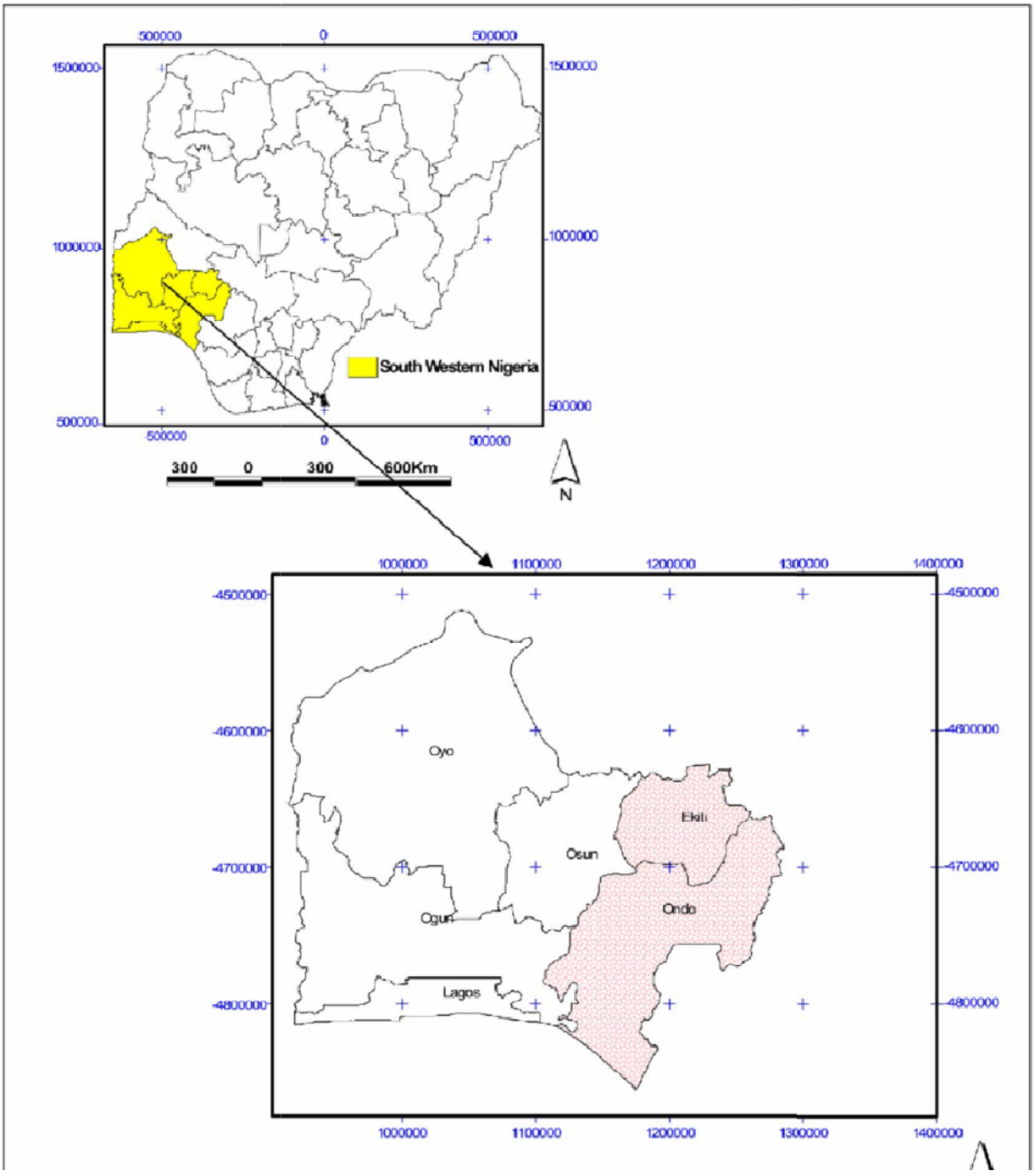

Figure 3.1: Map showing the Southwestern States of Nigeria.
Source:*Google map*

3.2 Sources and Type of Data

Primary data were used for the study usingwell-structured questionnaire administered to rural communities in Southwestern Nigeria. Data were collected on the various socio-economiccharacteristics of rural women, infrastructure facilities,education, road, water, electricity, telecommunication, storage, health and market. Details of women empowerment werecollected across resources, production, income, leadership, and time domains of agricultureas adopted from the Women Empowerment in Agriculture Index(WEAI) and information on farm inputs and farm outputs in monetary terms was collected to depict women productive capacities.

3.3 Sampling Techniques

A multistage (4 -stage) sampling procedure was used for the study. In the first stage, three states were randomly selected from the six states of the Southwestern geopolitical zone of the country, there is relative homogeneity among the selected states. Osun state was selected from the Oyo/Osun cluster, Ogun state was selected from the Lagos/Ogun cluster and Ondo state was selected from the Ekiti/Ondo cluster. The second stage involved the selection of thirty rural Local Government Areas (LGAs) across thegeopolitical zone proportionate to size (twelve LGAs were selected from Osun, ten from Ogun and eight from Ondo state). In the 3rd stage, twenty villages each were selected across the LGA's per state, making a total of sixtyvillages.In the last stage ten women per village were selected, making a total of 200 women farmers per state and 600 women in total sampled. However, only 575 pieces of questionnairewere deemed fit for the analysis. Table 3.1 shows the distribution of selected respondents across the Southwestern states.

ZONE	SOUTHWESTERN STATES	SELECTED STATES	NO. OF LGA	VILLAGES	SAMPLE SIZE	TOTAL ANALYSED
	OYO					
	OSUN	OSUN	12	20	200	191
SOUTHWESTERN	LAGOS					
	OGUN	OGUN	10	20	200	194
	EKITI					
	ONDO	ONDO	8	20	200	190
TOTAL			**30**	**60**	**600**	**575**

Table 3.1: Distribution of Respondents used for the study

3.4 Method of Data Analysis

The analytical tools used for the study comprise descriptive statistics, composite index, truncated tobitregression model, total factor productivity (TFP), ordinary least square (OLS) regression, five domain of empowerment (5DE) Score, adopted from the Women Empowerment in Agriculture Index(WEAI), and instrumental variable (IV) probitmodel.

3.4.1 Descriptive Statistics

Descriptive statistics such as frequency distribution,percentages, mean, standard deviation, tablesand charts were used to profilethe socio-economic characteristics of the rural women in the study area.

3.4.2. Composite Infrastructure Access Index (IAI)

The composite infrastructure access index was used to measure the level of women farmers' infrastructure access in the study area. Composite indices are often constructed by combining several variables or indicators together to depict the extent to which a specified outcome or objective is achieved. An indicatoris a function of many variables together which provides a direct measure of a specified aspect of an objective (Chakrabartty, 2017). Infrastructure access index for this study summarizes the access indicators across eight infrastructure componentswhich cannot be captured by a single indicator (Nayak, 2014)since infrastructure elements are not mutually exclusive. The complex and multi-dimensional reality of infrastructure access is thus summarized to support decision making using the access indicators of the following infrastructure components: road,electricity, telecommunication, water, storage, market, education, health. The access indicators for each infrastructure are described in Appendix 2.

For this study, the composite infrastructure access index (IAI) was generated as adopted from Letsara*et al.,*(2013); AFDB, (2013); Manoj, (2013); Baptista, (2014) and used to determine the women farmers' level of access to infrastructure following Manoj *et al.* (2013) in the following sets of equation.

$$SC_i^n = \sum_{j=1}^{N} IC_{ij} \quad . \qquad (3.1)$$

$$IDC_i = \frac{SC_i^n}{N} \qquad (3.2)$$

$$IAI = \frac{\sum_{i=1}^{n} IDC_i}{n} \qquad (3.3)$$

Where:

$IC = Infrastructure\ Component$

SCi = *Sum of Weighted average of each infrastructure component indicator*

$IDC_i = weight\ of\ 8\ infratructure\ accesscomponent$

$IAI = Infrastructure\ Access\ Index$

$N = No\ of\ Infrastructure\ Components;\ j = 1 - 8$

n $= No\ of\ Respondents\ ;\qquad i = 1 - 575$

The level of access among the women is thus categorized into 3 based on their access index, as stated below.

$1st\ Tercile\ (0 - 0.33) = Low\ Access$

$2nd\ Tercile\ (0.34 - 0.67) = Moderate\ Access$

$3rd\ Tercile\ (0.68 - 1) = High\ Access$

3.4.3 Truncated Tobit Regression

Factors influencing access to infrastructure were determined using the Tobit Regression Model. The Tobit Model assumes that there is a latent unobservable variable Y*. This variable is linearly dependent on the Xi variables via a vector of βi coefficients that determine their interrelationships. In addition, there is a normally distributed error term Ui to capture random influences on this relationship. For the study, the observable variable Yi is defined to be equal to the latent variables whenever the latent variables are above 0.333 (that is truncated).Independent variables used include the socio-economic variable of the women farmers and dependent variable was the infrastructure access index truncated at 0.333. The model is expressed below in the following equations.

$$\gamma i * = \beta' xi + \varepsilon i \qquad (3.4)$$

$$\gamma i = 0, if\ \ \gamma i \leq 0.333 \qquad (3.5)$$

$$\gamma i * = \gamma i,\ if\ \ 0.333 < \gamma i \leq 1 \qquad (3.6)$$

Where γ_i * is the limited dependent variable, which represents the infrastructure access index,

γi *is the observed dependent variable*
Xi *is the vector of independent variables*
β *is a vector of unknown parameters*
εi *is a disturbance term assumed to be independently and normally distributed with zero mean and constant variance* σ; $i = 1, 2, \ldots 16$ (16 *included independent variables*)

The following socio-economic variables were used as independent variables.

$Y = Infrastructure\ Access\ Index$

$x_{i=independent\ variables\ listed\ below;}$

$AGE = Age\ (Years)$

$AGE^2 = Age\ square\ (Years)$

$HHS = Household\ size\ (Numbers)$

$FRE = Farming\ experience(years)$

$FPA = Farming\ practice\ (Animal\ Husbandry = 1,\ Otherwise = 0)$

$FPM = Farming\ practice\ (mixed\ farming = 1,\ Otherwise = 0)$

$HHH = Household\ head\ (Yes = 1,\ No = 0)$

$SOT = Secondary\ Occuption(trading = 1,\ Otherwise = 0)$

$SOA = Secondary\ Occuption(Artisan = 1,\ Otherwise = 0)$

$MSD = Marital\ Status\ (divorced = 1,\ Otherwise = 0)$

$MSW = Marital\ Status\ (\ widowed = 1, Otherwise = 0$

$EDU = Education\ (Years)$

$PDE = Paid\ employment\ (Yes = 1,\ No = 0)$

$CCA = Credit\ (Credit\ Coop\ Association = 1, Otherewise = 0)$

$CIF = Credit\ (Credit\ informal = 1, Otherewise = 0)$

$CFF = Credit\ (Credit\ Family\ \&friends = 1, Otherewise = 0)$

The variablesthat describe the relationship of the independent variables in the model with infrastructure access are stated below.The apriori expectations of the variables used for the model are depicted with negative or positive signs and discussed as follows.

AGE (Age): Age is measured in years. The coefficient of age is expected to be positive or negative which implies that an increase in age can either increase or decrease access to infrastructure. This often depends on the need for infrastructure elements and other factors(Fielding *et al.,* 2012).

AGE^2 (Age square): This is an extension of agevariable; it measures the life cycle effect of age on the likelihood of access infrastructure. This helps to show the effect of age differences across a population by taking into consideration the fact that the relationship with age may not be linear all through. The coefficient could be negative or positive.

HHS (Household size): -This is captured as number of people in the same household. Household size is expected to influence likelihood of access to infrastructure directly or indirectly depending on the number and peculiar characteristics of members of the household, the coefficient can be positive or negative (Adelekan& Omotayo, 2017).

FRE (Farming Experience): The sign of the coefficient of farming experience (in years) on access to infrastructure is expected to be positive. It is expected that a more experienced farmer is better empowered to access infrastructure in order to improve her faming activity (Rahman, 2014).

FPA (Farming Practice: Animal Husbandry and FPM: Mixed Farming): This was captured as a dummy. The coefficient of the type of farming practice is expected to increase or decrease the likelihood of access to infrastructure. This is so because with the various practices come different combination of inputs and various output/yields, hence various reasons to access the various types of infrastructure facility (Olorunfemi, 2020).

HHH (Household Head): The coefficient of being a household head measured as a dummy (1= Yes, 0= No) is supposed to increase the likelihood of accessing infrastructure, that is with a positive sign. This is so because being the head of a household confers a high level of decision-making on individuals in a way that gives them power to make choices for themselves and other members of the household (Olajide, 2011).

SOT (Secondary occupation trading) and SOA (Secondary occupation Artisan): Having a secondary occupation in the rural community boosts economic prowess of dwellers, hence expected to increase the likelihood of accessing infrastructure. The sign of the coefficient is thus expected to be positive (Ovharhe *et al.,* 2020).

MSD (Marital Status divorced) and MSW (Marital Status widowed): Being married or otherwise is believed to influence household decision making. The coefficient of marital status of widowed and divorced women is expected to be negative or positive(Oluwagbamila& Samson,2017).

EDU (Years of Education): The apriori expectation of the effect of education on infrastructure access is positive. By implication, the more educated a woman, the better her chances of accessing infrastructure since she is expected to be well informed about the importance of infrastructure facility both domestically and economically (Alam*et al.,* 2019).

PDE (Paid Employment): Additional sources of income improve the economic capability of an individual, having a paid employment in addition to farming activities is expected to increase the likelihood of accessing infrastructure since a woman may have both the need and resources needed to do so. The coefficient is expected to be positive (Anindya, 2015).

CCA (Credit Coop Association), CIF (Credit Informal) and CFF (Credit Family & Friends): Having a means to access credit is a contributing factor to economic empowerment of individuals. The effect of credit on infrastructure access is expected to be positive (Cerra *et al.,* 2017).

Table 3.2: Apriori Expectations of factors determining access to infrastructure

Variables	Expected sign	Source
Age	+/-	Ojo*et al.,* 2012,Fielding *et al.,* 2012
Age square	+/-	Olajide 2011, Ojo *et al.,* 2012, Adelekan&Omotayo ,2017
Household size	+/-	Ojo *et al.,* 2012, 2009, Adelekan &Omotayo 2017, Fielding *et al.,* 2012
Farming Experience	+/-	Ojo*et al.,* 2012, Rahman, 2014,Oladeji 2011
Secondary occupation	+	Ovharhe *et al.,* 2020, Oluwagbamila & Samson 2017
Household head	+/-	Olajide 2011, Adelekan&Omotayo ,2017, Rahman, 2014, Egbetokun 2009,
Marital Status	+/-	Oluwagbamila& Samson 2017, Duy *et al.,* 2012, Oladokun&Adenegan 2019
Education	+	Alam *et al.,* 2019, Fielding *et al.,* 2012
Type of Farming Practice	+/-	Ovharhe *et al.,* 2020; Ofuoku &Agbamu, 2016
Paid employment	+	Anang*et al.,* 2015, Anindya, 2015
Credit	+	Olorunfemi, 2020, Cerra *et al.,* 2017

3.4.4 Total Factor Productivity (TFP)

The Total Factor Productivity was used to estimate the productivity of the women farmers in the study area. Following Rahji 2007;Adepoju and Salman 2013; Mwuese and Okorji, 2015; Doss, 2018,this can be computed as the ratio of outputs to the total inputs used.

$$TFP = \frac{Y}{TVC} = \frac{Y}{\sum P_i X_i} \tag{3.7}$$

Where: Y= monetary value of output, TVC = Total variable cost, P*i*= unit price of i^{th}variable input, and *Xi* = quantity of the i^{th}variable input. The Average value of the variables of production is shown in appendix 3.

3.4.5 Ordinary Least Square Regression Model (OLS)

Multiple regression model estimated with Ordinary Least Squares (OLS) was employed in the effect of infrastructure access on productivity of women farmers. Ordinary Least Square models are used in empirical works to make statistical inference about the effect of exogenous explanatory variables on a continuous response or dependent variable. OLS gives the best and most efficient estimators (unbiased) for the model's coefficients when the model's error termsatisfies the assumption of normality, independently and identically distributed. For this study, there is a suspected endogeneity between infrastructure access and productivity since infrastructure can be accessed at a cost. The causality between the two variables may run in the same direction making OLS unsuitable since it will produce biased estimates. However, endogeneity was tested using (Durbin –Wu Hausman test), H_0= Variables are exogenous was accepted since the Wu Hausmans P value was greater than 0.05.Also, the F static value was less than 10 at the first stage regression, hence ruling out suspected endogeneity between productivity and infrastructure access. Accordingly, this implies that the introduction of a second stage regression will only be making use of weak instruments (Keane & Neal, 2021).

The relationship between access to infrastructure and productivity of farmers was thus analysed using ordinary least square regression model following Fakayode*et al.*(2008); Ashagidigbi (2011) andObayelu*et al.* (2014).

The OLS model is specified below,

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots \beta_n X_n + \varepsilon i \quad (3.8)$$

$$Where\ Y\ is\ Productivity, \beta_0\ is\ intercept, \beta_1, \beta_2, to\ \beta_n\ are\ coefficient, X_1, X_2\ to X_n\ are\ independent\ variable\ and\ \varepsilon i\ is\ error$$

$$Y = Total\ Factor\ Productivity$$

The following socio-economic variables with infrastructure index were used as independent variables.

$AGE = Age\ (Years)$

$FRE = Farming\ experience\ \ (Years\ )$

$FRS = Farm\ Size\ (Ha)$

$HHS = Household\ Size\ (Number)$

$HHH = Household\ head (Yes = 1,\ No = 0)$

$MSD = Marital\ Status\ (divorced = 1,\ Otherwise = 0)$

$MSW = Marital\ Status\ (\ widowed = 1, Otherwise = 0$

$EDU = Education\ (Years)$

$OCU = Occupation\ (Yes = 1,\ No = 0)$

$ACR = Access\ to\ credit\ (Yes = 1,\ No = 0)$

$HMF = Household\ member\ on\ farm\ (Numbers)$

$IAI = \ Infrastructure\ Access\ Index\ (Number)$

$DEX = Dist\ to\ Extension\ Office (Km)$

$DMK = \ Dist\ to\ the\ nearest\ Market\ (Km)$

$MPG = Member\ of\ producer\ group\ (Yes = 1,\ No = 0)$

$MCG = Member\ of\ Coop\ \ group\ (Yes = 1,\ No = 0)$

$MWA = Member\ of\ women\ association\ \ (Yes = 1,\ No = 0)$

$MTG = Member\ of\ trade\ group\ \ (Yes = 1,\ No = 0)$

$PLT = No\ of\ plots\ culitivated (numbers).$

The apriori expectations of variables in the model are depicted with negative or positive signs. This describes the relationship of the independent variables in the model with productivity. It explains the likelihood of a direct or indirect relationship between the variables.

AGE (Age): Age is measured in years. The coefficient of age is expected to be positive or negative which implies that age can either increase or decrease farmers' productivity. Although, with age comes experience which should enhance productivity,however, aging reduces the ability of farmers to remain productive (Egbetokun, 2009).

FRS (Farm Size): The farm size is measured in hectares. Big farms are expected to yield higher output, depending on the available resources and the efficiency with which inputs are combined. The coefficient is expected to be positive (Tanko*et al.,* 2020).

HHS (Household size): This is captured as number of people in the same household. Household size is expected to have a direct relationship with productivity, since large household size makes household labour available for farming. The coefficientis expected to be positive (Oladeji,2011).

FRE (Farming Experience): The sign of the coefficient of farming experience (in years) on productivity is expected to be positive. It is expected that a more experienced farmer who had learnt best practices overtime, has better technical know-how and better enhanced to be productive (Adepoju&Salman, 2013).

IAI (Infrastructure access index): This was captured as a composite scoreindex (number) across eight infrastructure facility. Access indicators across the different infrastructure were combined to give an indexwhich depicts an opportunity to use a group of infrastructure. The coefficient of infrastructure access is expected to influence productivity positively (positive sign) since infrastructure interacts with other variables to reduce transaction cost and improve time effectiveness to yield better outputs (Nzomoi*et al.,* 2007;Fakayode*et al.,* 2008;Obayelu*et al.,* 2014).

HHH (Household Head): The coefficient of being a household head measured as a dummy is supposed to increase the likelihood of accessing infrastructure, hence with a positive sign. This is so because being the head of the household confers a high level of

decision-making on individuals in a way that gives them power to make choices for themselves and other members of the household (Oladokun&Adenegan, 2019).

OCU (Primary Occupation): This is captured as a dummy variable (Yes=1, No=0). Having farming as a primary occupation in the rural community boosts economic prowess of dwellers, hence expected to increase the likelihood of increased productivity. The sign of the coefficient is thus expected to be positive (Mariyono, 2018).

MSD (Marital Status Divorced) and MSW (Marital Status Widowed): Having a partner is believed to influence household decision making, hence the coefficient of marital status of widowed and divorced women is expected to be negative or positive (Oladeji ,2011).

EDU (Years of education): The apriori expectation of the effect of education on productivity is positive. By implication, the more educated a woman, the better her chances of combining her inputs efficiently to enhance her productivity.An educated farmer can harness all inputs, technology, farming practices and other factors of production better(Musa, 2011).

DEX (Distance to extension office): The distance to the extension office is measured in km. Extension services are important in educating farmers outside the formal education systems. This is particularly important since the farming population is characterized by low level of education. Farmers can get up to date information on new farm practices, input prices, price integration and so on when rural extension services are easily accessible to farmers. The sign of the coefficient is expected to be negative, meaning longer distances to extension services impacts productivity negatively (Oladeji, 2011).

DMK (Distance to Market): The distance to the market was captured in KM. The morefunctional and closer markets are to the farm gates, the better. Market is considered an essential factor in the rural areas; it serves a 2-way function for rural dwellers since they are both consumers and producers. Availability of markets affects food security, connects producers, retailers and consumers together. With market proximity, post-harvest losses and random price fluctuations are prevented, the sign is expected to be negative (Ahmed *et al.,* 2017).

MPG (Group Membership, Producer Group, Cooperative group, Women association, Trade group): Group membership is measured as categorical (1=Yes or 0=No). This is an important social capital which contributes significantly to farmers' human capital. Farmers can benefit from economies of scale, have easy access to information, able to access funds and inputs which enhance their productivity. Group membership also confers a level of leadership on members as they are able speak in public and contribute to decision making within the community through the various groups they belong too. The coefficient of group membership is expected to be positive (Nzomoi*et al.,* 2007).

PLT (Number of plots cultivated): This is a continuous variable used to depict land fragmentation. It measures the number of plots a farmer has and its effect on their productivity. Number of plots cultivated can increase or decrease productivity, the sign is expected to be positive or negative (Olarinre&Omonona, 2018).

ACR (Credit access): Credit is an important input for production. When a farmer can access funds to improve his farming activities, the expectation is higher output and higher productivity which translates to increased income and improved welfare over time. The coefficient of access to credit is expected to be positive (Mwuese&Okorji, 2015).

HMF (Household member on farm): Household characteristics play a vital role in farmers activities and decision making. This is a continuous variable captured by the number of household members who are available for farm activities, depending on the contribution of the household member to farming activities, the coefficient could be negative or positive (Olomola&Osinubi, 2018).

Table 3.3: AprioriExpectations of Effect of Access to Infrastructure on Productivity

Variables	Expected sign	Source
Age	+/-	Oladeji, 2011, Egbetokun 2009
Education	+/-	Musa 2011, Wouterse, 2016
Household Size	+/-	Oladeji, 2011, Egbetokun 2009,
Farming experience	+	Adepoju&Salman 2013, Obayelu*et al.,*2014
Farm size	+/-	Obayelu*et al.,*2014, Mwuese&Okorji, 2015,Tanko*et al.,* 2020
Household head	+/-	Oladokun&Adenegan, 2019, Olomola&Osinubi 2018
Marital Status	+/-	Oladeji, 2011
Primary Occupation	+	Mariyono, 2018, Obayelu*et al.,*2014
Distance to Extension office	-	Oladeji, 2011
No of plots	+/-	Wang *et al.,* 2015, Olarinre&Omonona 2018
Credit access	+	Olorunfemi, 2020,Tanko, 2019, Mariyono, 2018, Mwuese&Okorji, 2015
Infrastructural index	+	Nzomoi*et al.,* 2007, Fakayode 2008, Obayelu*et al.,* 2014
Household member on farm	+/-	Olomola&Osinubi 2018
Membership of association	+	Nzomoi*et al.,* 2007
Distance to the market	-/+	Tanko *et al.,* 2020, Ahmed *et al,.* 2017

3.4.6 Test of Multicollinearity

In multiple regression analysis, there is a tendency for independent variable to be highly correlated with one another. If this is not checked, the statistical significance of the model is undermined. To correct multicollinearity amongst explanatory variables in the model, Variation Inflation Factor (VIF) was used. When independent variables are highly correlated with one another, the standard error increases and some variables become affected,leading to wrong (insignificant when they should be significant) inferences. The VIF checks the extent of the discrepancy of an estimated regression coefficient, giving increases if the predictors are interrelated. When the VIF equals 1, it implies no significant correlation. That is, no multicollinearity among factors, VIF greater than 1 means predictor maybe moderately correlated, but not high enough as a concern. With a VIF value of between 5 and 10, there is problem of high correlation which may be problematic, VIF value greater than 10 implies that the regression coefficients are poorly estimated due to multicollinearity.

3.4.7 Five Domain of Women Empowerment(5DE) of the Women Empowerment in Agriculture Index. (WEAI)

The 5DE of empowerment adopted from the WEAI was used to assess the empowerment status of the women farmers. The 5DE measures the Empowerment, Agency and Inclusion of women in the agricultural sector using individual level data. The WEAI is composed of two sub-indices: the first index measures women's empowerment across five agricultural domains of empowerment as used by this study, while the second dealswith Gender Parity in empowerment within household. The weights of the 5DE and GPI sub index are 90% and 10%, respectively. In this study, only the 5DE sub index was adopted and used. The 5DE shows the empowerment status of women in the agricultural sector, while showing the roles and engagement of women in agriculture.The following equation was used to generate an empowerment score for each woman farmer.

$$5DE = He + Hn(Aa) \quad (3.9)$$

Where, $He = \%\ of\ women\ who\ are\ empowered$

$$Hn = \%\ of\ women\ who\ are\ not\ (1 - He)$$

$$Aa = \%\ of\ dimensions\ in\ which\ disempowered\ women\ have\ adequate\ achievements$$

The five domains (5DE) capture decision in production, resources and decision making, income use, leadership among women and women use of time. The 5DE assess the extentof empowermentacross these domains and the percentage of domains of unempowerment to know the areas of concernneeded to increase empowerment. This is illustrated in Table 3.4. Each dichotomous indicator indicated in Table 3.5. measures an individual's achievement, 1 ifadequate, and 0 if inadequate.Summarily, a farmer is classified as empowered in agriculture if she has adequacy in four of the five domains, enjoys adequate achievement in some combination of the weighted indicators that give an adequacy score of 80 or greater (Alkire*et al.,* 2013).

Table 3.4: TheFive Agricultural Domains Relating to Women Empowerment

Domain	Description of Domain
Production	Decision making on agriculture. Having joint or sole decision-making power on farming activities, both crop and animal farming. Having independence in agriculture production; for example, what to plant, the inputs to use, what animal to rear, where to rear it etc. This shows the extent of farmers' autonomy in decision making in production in relation to a mere desire to satisfy others or avoid them.
Resources	This is reflected in ownership of major household item, i.e.,Sole, or joint ownership. Shows if respondents partake in decision making on disposal (purchase, sale, re allocation) of assets. Reflects decision making capability regarding access to credit.
Income	This describes control over revenue and expenses. That is, do women decide solely or jointly on their remuneration and how they spend it?
Leadership	This is reflected by social capital, shows women involvement in group membership and how active they are in at least one group. For instance, Farmers group, Traders group, community groups etc. This is reflected by the ability to speak in public with ease and without fear or intimidation, on issues relating to infrastructure provision, community improvements, fairness in wages, settling family issues and so on. .
Time	Shown in the distribution of time between economic (productive) activities and non-economic (domestic) activities. Shown in time available for leisure and how happy women are with such time.

Source:*Adapted from Alkire,Meinzen-Dick, Peterman, Quisumbing, Seymour, &Vaz, (2013). The women's empowerment in agriculture index.*

Table 3.5: Indicators of Women Empowerment in Agriculture

No	Indicator	Weight	Aggregation Method	Deprivation Cut off
1	Input in productive decisions	0.10	Achievement in any 2 sub indicators	Inadequate if she has at least input in some decision or feels she could individually participate but does not.
2	Independence in production	0.10	Achievement in any	Inadequate if relative autonomy indicators <1
3	Asset ownership	0.70	Achievement in any	Inadequacy = household has none of the listed asset or owns most of it jointly.
4	Asset's sale, transfer, and purchase	0.70	Achievement in any if not only small animals e.g., chicken and non-mechanical farm equipment	Does not own any asset or owns but does not participate in decision making.
5	Access to credit and decision on it	0.70	Achievement in any	Noinput in decision making about credit in household or never used any source of credit.
6	Income- Use and control	0.20	Achievement in any	Inadequacy= individual has little input in decision aboutincome or no input.
7	Group member	0.10	Achievement in any	Inadequacy=non membership of at least one group.
8	Public Speaking	0.10	Achievement in any	Inadequacy= uncomfortabletalking in public.
9	Workload	0.10	Achievement in any	Inadequate if workload is > 11 hours in 24 hours.

10	Leisure	0.10	Achievement in any	Inadequate if not satisfied with leisure (<5).

Source:*Adopted from Alkire,Meinzen-Dick, Peterman, Quisumbing, Seymour, &Vaz, (2013). The women's empowerment in agriculture index.*

3.4.8 Instrumental Variable (IV) Probit Model

The effect of infrastructure accesson women empowerment was analysed using IV Probit model. Infrastructure and productivity were included in the model as explanatory variables; however, both are potentially endogenous to women empowerment. Hence, unobserved characteristics such as proximity and cost to infrastructure element and status of women in the community could influence infrastructure access,productivity and empowerment. Since both infrastructure and productivity can be assessed at a cost, the causality between empowerment and infrastructure access may run in both direction and this means that OLS estimation will be biased. For example, when a woman is empowered,she is positioned for increase agricultural productivity, through a more optimal allocation of resources and when a woman is productive, she potentially has increase yields and income which may contribute to her empowerment. The IV used were correlated with infrastructure and productivity, and uncorrelated with empowerment. Variables such as distance to the nearest market, distance to state capital, total transport cost, household size, years of farming, house head were considered as instruments. The IV Probit enhances the model because the correlation between the error term endogenous explanatory variables is reduced. Themodelisspecifiedbelow:

$$Y=\beta_0+\beta_i G_i+\beta_2 I_2+u \tag{3.10}$$

Where; Y is the women empowerment status (Empowered =1, Unempowered =0)

G_i is the estimable exogenous variables.

$I_2$is endogenous explanatoryvariables.

RegressI_2 on Z,G_i to obtain $\bar{I}_2$,

$$I_2=\alpha_0+\alpha_i G_i+\alpha_2 Z+v \tag{3.11}$$

Z is the instrumental variable.

Where,β_0, β_i, β_2, α_0, α_i, α_2 are parameters to be estimated; $u$is disturbance error term. $v$is a composite error term that is uncorrelated with G_i

The derived of $\overline{I}_2$ is then introduced into the initial equation for estimation.

$$Y = \beta_0 + \beta_i G_i + \beta_2 \overline{I_2} + v \quad (3.12)$$

$Y = \ Women\ Empowerment\ (\ Empowered = 1,\ Unmpowered = 0)$

Socio − economic variables, TFP and Infrastructure access Index were used as independent variables

$AGE = Age\ (years)$

$AGE^2 = Age\ square$

$SOT = Secondary\ Occuption(trading = 1,\ Otherwise = 0)$

$SOA = Secondary\ Occuption(Artisan = 1,\ \ Otherwise = 0)$

$WAE = Wage\ employment\ (Yes = \ 1,\ No = 0)$

$HLS = Household\ labour\ size\ (Number)$

$IAI = \ \ Infrastructure\ Access\ Index\ (Number)$

$DSM = \ Dist\ to\ the\ nearest\ Market\ (Km)$

$THH = Type\ of\ Household\ \ \ (Male\&Female\ Adult\ Only = \ 1,\ otherwise = 0)$

$PDV = Total\ Factor\ Productivity$

$OWP = Ownership\ of\ Phone(Yes = 1,\ No = 0)$

$TTC = Total\ Transport\ cost$

$HHS = Household\ size$

The apriori expectations ofvariables are depicted with negative or positive signs asstated and discussed below. This describes the relationship between the independent variables in the model and women empowerment.

AGE (Age): Age is measured in years. The coefficient of age is expected to be positive which implies that an increase in age should increase women empowerment.This is so since with age comes a relative degree of independence and decision-making authority (Wouterse, 2016).

AGE^2 (Age Square): This is an extension of age variable; it measures the life cycle effect of age on the likelihood of empowerment of farmers. A positive age and age square coefficient imply that on the long run the effect of age on empowerment becomes stronger. The coefficient can be negative or positive (Wiklander, 2010).

SOT (Secondary occupation trading) and SOA (Secondary occupation Artisan): Having a secondary occupation in the rural community boosts economic prowess of

dwellers, hence expected to increase the likelihood of women empowerment. The sign of the coefficient is thus expected to be positive (Ayevbuomwan*et al.,* 2016).

WGE (Wage employment): Additional sources of income improves the economic capability of an individual, having a wage employment in addition to farming activities is expected to increase the likelihood of empowerment since a woman may have additional resources which enable her to be independent and able to make sole decision. The coefficient is expected to be positive (Garbero&Perge, 2017).

HHS (Household size): This is captured as number of people in the same household. Household size is expected to influence likelihood of empowermentdirectly or indirectly depending on the number and peculiar characteristics of members of the household, the coefficient can be positive or negative (Diiro*et al.,*2018).

PDV (Productivity): The relationship between productivity and women empowerment is expected to be direct, with a positive coefficient. When a farmer is productive, she is likely to have more income which allows her to have a level of autonomy, hence empowered. Therefore, productivity increases, improves the likelihood of a women being empowered (Wouterse, 2016).

IAI (Infrastructure Access index): The apriori expectation of the coefficient of infrastructure access is expected to be positive, which implies that an increase in the access to infrastructure has the likelihood of increasing women empowerment among the farmers (Agénor&Agénor, 2014).

DMK (Distance to Market): The distance to the market was measured in KM. Rural women are faced with the multi functions of markets (Producers, retailers, and consumers). The closer a market is to women, the better for them. Market is considered an essential factor in the rural areas. Proximity to markets affects food security, reduces post-harvest losses and random price fluctuations the sign is expected to be negative (Salman *et al.,* 2020).

THH (Type of Household): Household type is measured as a dummy variable with 1 being a dual household (comprising a male and a female adult) and 0 being a single household (having only a female adult). The effect of having a partner on women empowerment is expected to be negative since overtime decision making in such

household is delegated to the male partner given the patriarchy system of rural Nigeria (Ayevbuomwan*et al.,*2016).

OWP (Ownership of Phone): This is captured as a categorical variable (Yes=1,No=0). Communication is increasingly becoming an essential tool for all, especially farmers (agricultural information, price fluctuations, other economic information are now transferred real time to the advantage of the farmers). The mobile phone means of communication has become the dominant means of communication, it reduces accessibility gap of the inputs and outputs markets and technological improvements which helps against market shocks. Markets signals are also greatly enhanced by owning a mobile phone. The coefficient is expected to be positive.

TTC (Total Transport cost): This is the total transport cost to each of the infrastructure elements within a community measured in Naira. This is an instrumental variable which is correlated with infrastructure.

HHS (Household size): This is depicted by the number of persons within a household. Household size plays a major role in the dynamics of productivity;hence it is used as an instrument. Large household size is correlated with productivity.

Table 3.6: AprioriExpectations of Effect Of Infrastructure Access and Productivity on Women Empowerment

Variables	Expected sign	Source
Age	+/-	Diiro*et al.* 2018, Wouterse, 2016
Age square	+/-	Wouterse, 2016
Type of household	+/-	Wiklander, 2010, Ayevbuomwan*et al.,* 2016
Secondary Occupation	+	Ayevbuomwan*et al.,* 2016, Salman *et al.,* 2020
Household labour size	+/-	Diiro*et al.* 2018, Wouterse, 2016
Own GSM(Yes)	+	Na
Nearest Market	+/-	Wouterse 2016 Ayevbuomwan*et al.,*2016, Salman *et al.,* 2020
Wage employment	+/-	Wiklander, 2010, Garbero&Perge ,2017
Infrastructural access index	+	Agénor&Agénor, 2014. Gayatrri 2010
Productivity	+	Diiro*et al,* 2018, Wouterse, 2016
Total Transport Cost	+	Egbetokun 2009
Household size	+	Fakayode 2008

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter discusses the results of the study. It describes the socio-economic characteristics of the respondents, the distribution of access to infrastructure components among women and level of access to infrastructure in rural Southwestern Nigeria. The chapter also explains the factors that determine access to infrastructure, the relationship among infrastructure, productivity and empowermentstatus of the farmers. The discussion of the results follows the objectives, starting with objective one through to objective five.

4.1. Socio-Economic Characteristics of Women

This section describes the socio-economic characteristics of rural women farmers in Southwestern Nigeria. These are age, marital status, education, household size, household head, occupation, farming experience, farm size, and years of residency.

4.1.1 Age Distribution of Women Farmers

Age of women is crucial in measuring their maturity and experience in handling vital economic decisions. This could inform how strong physically or emotionally they are or will be. Table 4.1 reveals that 89.22% of rural women farmers in Southwestern Nigeria were between 35 and 59 years, 1.74% were within 25-34years, while 9.04 % were above 60years. The overall mean age was 47.7±7.1years. With these statistics, most of the women are still in their energetic years and are expected to be productive to generate income to support their household. It is believed that with age, women gain more confidence to go about their daily activities, improve their knowledge, and they are ultimately propelled to take ownership of their life for improved well-being and empowerment. This agrees with Oladokun&Adenegan (2019) who found that most women in rural households had average age of 40 years, `and reported a relationship between age and relative achievements. Since there is a link between age and

achievement, the age of the rural women is an important factor in contributing to both their productivity and empowerment.

4.1.2 Marital Status

Marriage is held in high esteem in Nigeria, particularly in the rural areas where cultural norms are strong and binding. Being an unmarried adult is often frowned upon and discouraged in the rural setting. The study revealed that most (67.83%) of the respondents were married, 24.87% of the women were widowed and 7.20% were divorced. This indicates that more women were married and by implication, they have some responsibilities to take care of other people. Being empowered could help to provide the much-needed resources required to take care of the members of their households.This is in line with Jerumeh(2019) who found that majority of rural people in Nigeriawere married.

4.1.3 Educational Level

Education is often used as proxy for women empowerment. It is crucial in knowledge acquisition and participation in both farm and non-farm opportunities. Education is also needed to fit into most economic and productive roles andusing newly improved knowledge to achieve higher returns. The distribution of women according to educational levelrevealed that 19.30% of the respondents had no formal education, 67.13% of the respondents had at least primary school education, and only 13.57% had above primary school educational attainment. This is in line with Ajayi*et al.*(2016) who reported 82% women farmers having at least primary or secondary education. Educational level of women is important because low educational attainment is a great constraint to women empowerment, thereby limiting their chances comparatively to their male counterparts. With less education, young girls are married off at a tender age denying them their full potentials compared to others and limiting their productive capacity. However,high levels of educational attainment can lead to high levels of welfare, better time use, increased leadership and decision-making potentials implying greater empowerment and improved standard of living.

4.1.4 Household Size

Household characteristics playan important role in agricultural activities since it is believed to influence farmers' behaviour and decision making within the household. Household size is particularly relevant in agriculture given that labour is a major input in

most activities. Table 4.1 reveals that 76.52% of respondents had a household size of 4-6 people with mean value of 5.5 ±1.6 person, 19.30 % of the households had size greater than 6 members and 4.17% had less than 4members. This is in line with Jerumeh(2019) who reported a mean household size of 6 across ruralSouthwesternNigeria. This is however contrary to the expected large family sizes in rural Nigeria as earlier reported by Yusuf *et al.* (2010) and Ayodele *et al.*(2012).

4.1.5 Household Head

Furthermore, Figure 4.1 shows that a typical household in rural Southwestern Nigeria comprises male and female adults, of which only 34.36 % of these households had a female as the head, while majority of rural households are predominantly headed by a male (65.74%). This agrees with the socio cultural and religious norm in Nigeria which believes that the men should always be the head of the house. Accordingly, in some religions, women are never expected to head a household in any form or capacity. Patriarchy(that is male headed household)system is the major and mostly accepted household structure that exists in many traditional African set up. This is in line with Makama (2013) and Bulus and Adefila(2014) who found that majority of households in rural Nigeria are male headed.As reportedby Ayevbuomwan*et al.*(2016), being a partner or not being a household head has serious implication on productive decision making and empowerment of women across Nigeria.

4.1.6 Occupation

The distribution of occupation among the respondents revealed that the primary occupation of majority of the rural women in Southwestern Nigeria is farming. Most of the women (67.13%) were primarily into farming and 32.87% women were into farming plus other occupation (such as trading, Artisans and so on). These women farmers are involved in crop farming and animal husbandry; they produce food crops such as maize, cassava, vegetables, cowpea, and rear small livestock such as chickens, goats and so on. This may be because agriculture is considered as the main source of income of majority of people living in rural Nigeria, and agriculture employs the largest percentage of rural people (Salman *et al.,* 2020). Being engaged in farming within the traditional rural

settingoften comes with some advantages; the rural women produce more of what they consume, and they purchase less of what they consume.This implies that more of the income generated by the women could be used to expand their scale of farming operationwhich will bring in more income and lead to higher level of productivity and empowerment among the women.

4.1.7. Farming Experience

The mean farming experience of women farmers in Southwestern Nigeria is 19.84±7.94years. More than half (58.78%) of the respondents had 11-20years experience, 28.35 % of women farmers had above 20years, while 12.87% had less than 10 years' experience. This implies that women farmers in rural Southwestern Nigeria are relatively experienced farmers and expected to be aware of basic farm practices that will enhance their productivity and empowerment. This is in line with Nouman*et al.*(2013) who found that experience is a socio-economic indicator for rural dwellers improved performance.

4.1.8. Farm Size

Regarding the size of farm cultivated by women, only 17.91% of the rural women farmers in Southwestern Nigeria usedmore than 3ha.Most of the women (64.35%) used between 1 to 3ha for their farming activities, while 17.74% used less than 1ha. This indicates that most of the rural women are small holderfarmers who produce food at subsistent level.This is consistent with Musa(2011) who reported that a large portion of the women in Kogi State are small scale farmersand use between 1- 2ha for their farming activities.

4.1.9. Years of Residency

Residency statusconfers a relative boost to thesocial status of members within a community. It helps to increase awareness of available infrastructure and their location. This subsequently influences access toinfrastructureand ultimately allocation of time between domestic and productive activities among the women.Result indicates that 40.52% of the women have lived in their current location for 21-30 years, 36.52% for 11-20 years, 12.87% for above 30yearsand 10.09 % have lived in community for less than 10years. It shows that most of the farmers have lived in their respective communities for at least 10years which is an indication that they should be aware of the various

infrastructural facilities around them and should be able to access them freely given the resources needed to do so.

Table4.1.Socio-economic Characteristic of Respondents

Socio- economic Characteristics	Frequency	Percentage	Mean
Age (Years)			
25-34years	10	1.74	47.7± 7. 12
35-59 years	513	89.22	
60 years above	52	9.04	
Marital Status			
Married	390	67.83	
Divorced	42	7.20	
Widowed	143	24.87	
Educational Level			
No Education	111	19.30	
Primary Education	386	67.13	
Above primary Education	78	13.57	
Household Size			
< 4	24	4.17	5.5 ±1.6
4-6	440	76.52	
> 6	111	19.30	
Household Head			
Yes	386	65.74	
No	189	34.36	
Primary occupation			
Farming only	386	67.13	
Farming +Others	189	32.17	
Farming Experience(Years)			
≤ 10	74	12.87	19.84±7.94
11-20	338	58.78	
> 20	163	28.35	
Farm Size (Ha)			
≤1.0	102	17.74	2.64±2.60
>1.0-3.0ha	370	64.35	
> 3.0	103	17.91	
Years of Residency			
≤10	58	10.09	22.89±9.48
11-20	210	36.52	
> 20-30	233	40.52	
> 30	74	12.87	

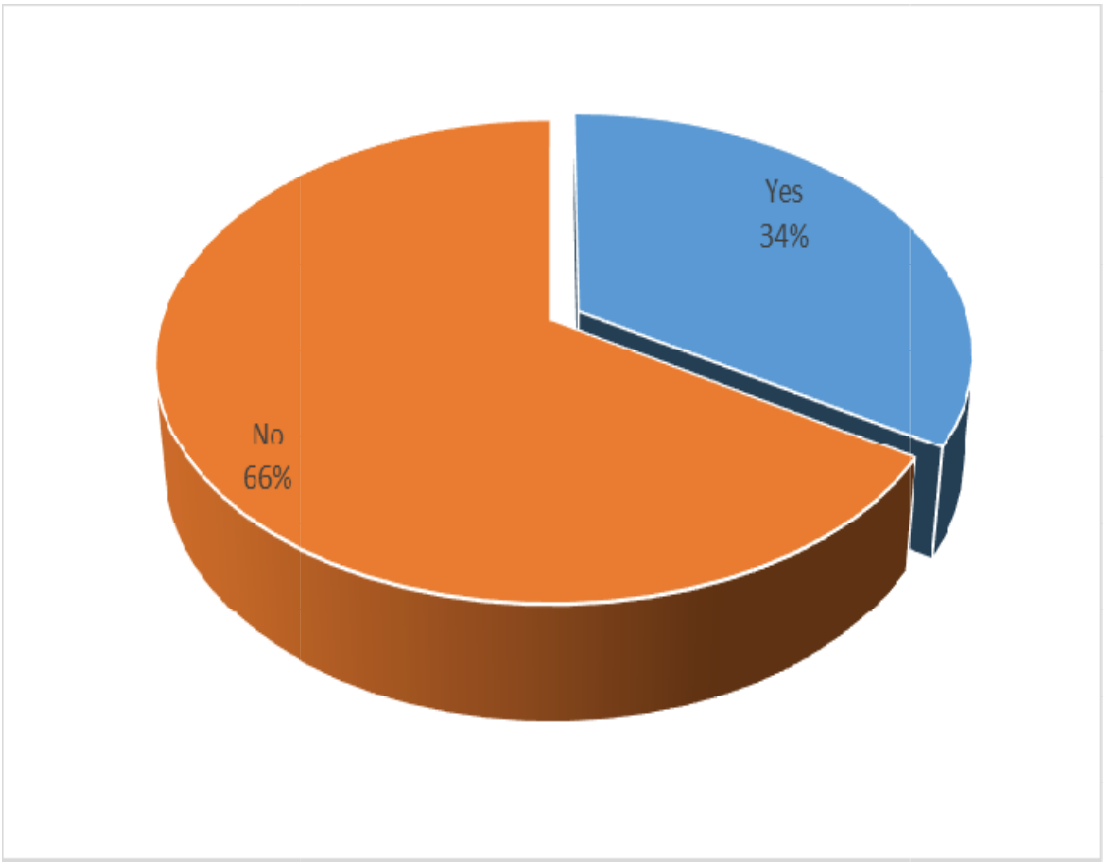

Figure 4.1: Female Household Head

4.2 Level of Women Farmers' Access to Infrastructure in the Study Area

Infrastructural facilities have a remarkable impact on the pattern of socio-economic life and development of rural areas.In addition to a positive impact that infrastructure access hason economic life of rural dwellers, it also has great potential for improving their wellbeing and welfare.

The distribution of women into level of access to infrastructure in rural SouthwesternNigeria is shown in Table 4.2. The infrastructure access index was 0.61 with standarddeviation 0.14, which indicates that women have a moderate opportunity to use infrastructure in the study area. Based on the different values, access was categorized into three levels.

Low access = 1st Tercile (0- 0.33)

Moderate access = 2nd Tercile (0.34- 0.67)

High access = 3rd Tercile (0.68-1)

Very few women(7.48 percent) had high access to infrastructure while a large population had moderate access (84.0percent).Infrastructure index had a mean value of 0.61, which implies that most respondents had access to infrastructure, however with an overallmoderate access to a combination of the eight infrastructure components. Access to infrastructure will contribute to improvement in their production activities, it will reduce the cost of production and increase the revenue generated by the women farmers. With regards to specific infrastructure facility, telecommunication was the most accessed while storage facility was the least accessed. The high access to communication using mobile phones implies that women have a good chance to receive information on prices, while also having seamless market information to curb the activities of middlemen and possible price volatility. Meanwhile, the low access to storage facility exposes the women to huge post-harvest loses and reduced selling prices amongst other inadequacies due to the inability to store their produce properly.

Table 4.2: Distribution of Women According to Level of Access to Infrastructure

Access to infrastructure	Frequency	Percentage
Low Access Category (LAC)	49	8.52
Moderate Access Category (MAC)	483	84.00
High Access Category (HAC)	43	7.48
Total	575	100
Infrastructure Access Index = 0.61±0.14		

4.2.1 Distribution of Access across Infrastructure Components

The study used a combination of physical and social infrastructure elements. Figure 4.2 reveals that Telecommunication has the highest access sub-index (0.95); followed by Electricity (0.93); Market(0.72); Road (0.67); Education (0.66); Health (0.58); Improved water (0.35); and Storage (0.03). This is discussed as follows:

4.2.1.1 Access to Storage Facility

Modern storage facility is important to reduce the impact of volatility in food prices from inter temporal trade and to prevent post- harvest losses leading to foodshortages. Without adequate storage facilities, prices fall during harvest because of glut and farm produce are wasted which results in scarcity during off season. Figure4.2reveals that modern storage facility is the least accessed infrastructure with an access index of 0.03; this implies an extremely low access to modern storage. This is in line with Egbetokun (2009) who reported that modern storage facility is not provided for farmers in Oyo state.

4.2.1.2Access to Water Facility

Improved water is useful for both household use and farming irrigation purposes which would ultimately contribute to farmer's output. Access to improved water (dams, borehole, and tap) helps to avert infectious diseases which could hamperwomen farmers'health and productivity through ineffective time allocation.The result of the water access index is 0.35,which implies a low access to improved water.The women often access water from streams, rivers and uncovered wells for their activities due to unavailability. Improved water sources are not easily accessed by the women due to epileptic supply of water, dilapidated boreholesandfar distance, where tap water was available.

4.2.1.3Access to Health Facility

The health facility access index is 0.58,which implies that women had average opportunity to health facilities. Respondents had access to health facilities such as primary health

centres and community patent medicines store. However, access isoftenimpeded by distance, cost, culture and belief. Some farmers do not access health facilities because they believe in the traditional method of health care. This correlates with Fakayode*et al.* (2008) who established availability and moderate access to health infrastructure in Ekiti State.

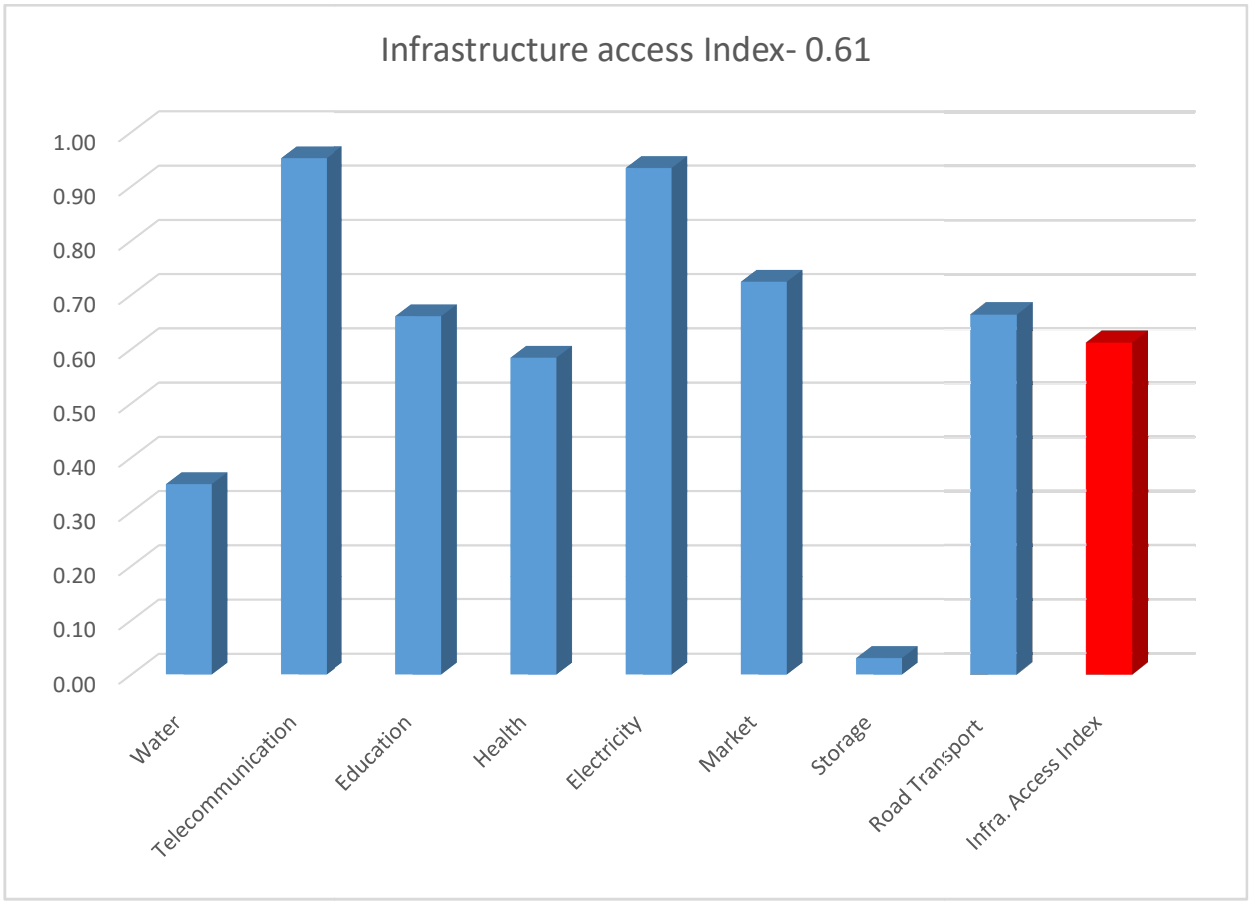

Figure 4.2: Overall Infrastructure Access Index and Sub-indices

4.2.1.4 Access to Educational Facility

Education is an important factor in the improvement of farmers' technological know-how. It, in turn, boosts production across individual farms and community. The educational facility access index is 0.66, which implies a moderate access to educational facilities in the rural Southwestern of Nigeria. However, only primary and secondary schools are available in the study area. Most respondents access these facilities for their wards as there are no vocational skills acquisition centers and adult education centres which could serve the adult women educational needs. This calls for attention in the provision of educational facilities tailored to meet the needs of the rural women farmers in the Southwesternzone.

4.2.1.5 Access to Road Transport Facility

Good transport facilities not only enhance the process of economic growth in the rural areas by making products and markets function more effectively, but they also increase social wellbeing of the rural population by facilitating movement to places where other essential social services such as health and education are available. The road transport access index is 0.67 indicating a moderate access to road infrastructure. Road transportation is the main means of transportation in the study area and as established by literature, over 80 % of transportation in Nigeria is done by road. Improvements in rural roads will increase connectivity and open rural markets for better competiveness and regional growth.

4.2.1.6 Access to Market Facility

Market facility is central to agricultural activities, in the absence of access to market facilities, it will be difficult for farmers to sell their produce profitably. The market access index is 0.72, this implies that most of the women have access to market. However, the women farmers have access to small, dailyand periodic markets which are mostly open markets, only few of the markets have covered stall and partitioned stalls. The fact that

agricultural produce in the study area is mostly traded in small markets around the vicinity of farmers might affect the selling price of farm products in these markets compared to the price traded for them in bigger periodic markets thereby reducing their profitability. This is in line with Fakayode(2008) who reported access of farmers to small markets in Southwestern Nigeria.

4.2.1.7Access to Electricity Facility

Figure 4.2 reveals a 0.93 access index for electricity through public power supply, however, with varying levels of supply within a period of 24hours. This implies thatthere is a high level of access to electricity connection in the study area which should impact both domestic and productive activities, which then leadsto an increasein productivity of the women. Most of the respondents reported that access to electricity makes domestic work easier, boosts their farming activities (machinery and equipment operation, processing, and storage), illuminates their surrounding for safety and ultimately empower them to improve their standard of living. However, the supply of electricity is epileptic.

4.2.1.8 Access to Telecommunication Facility

The global system of network (GSM) telecommunication facilityhas the highest access index of 0.95, as it is the main means of communication among the rural women.This facilitates faster and immediate communication with family, friends and markets which translates to better information dissemination, improved price transmission and enhances entry into new and more profitable opportunities.Most of the respondents have access to at least one of the available networks (MTN, AIRTEL, GLO AND ETISALAT) from the service providers in Nigeria. Access to telecommunication also improves farmers' welfare since they are able to access all kinds of information (health news, farming activities updates, security news and so on) on the go using their mobile phones. With the high level of access, rural farmers are well positioned for improved production, development and growth. Continued access should however be maintained by all stakeholders if the growth must be sustained.

4.2.2Access to Infrastructure across Socio-economic Characteristics

The distribution of access to infrastructure among rural women across socio-economic groups is discussed below.

4.2.2.1 Access to Infrastructure across Marital Status

Access to infrastructure could be influenced by the marital status of rural women. Figure 4.3 shows that women farmers, who are divorced, constituted the highest percentage of people with most access to infrastructure while married women constituted the most among people with low access to infrastructure. This may be because divorced women have less responsibilities and are burdened less, while being responsible for fewer people hence making them have more resources which could be disposed as desired to access the different infrastructure. This is in contrary with the traditional social structure and cultural system in Nigeria where marriage implies or confers some social status and recognition.

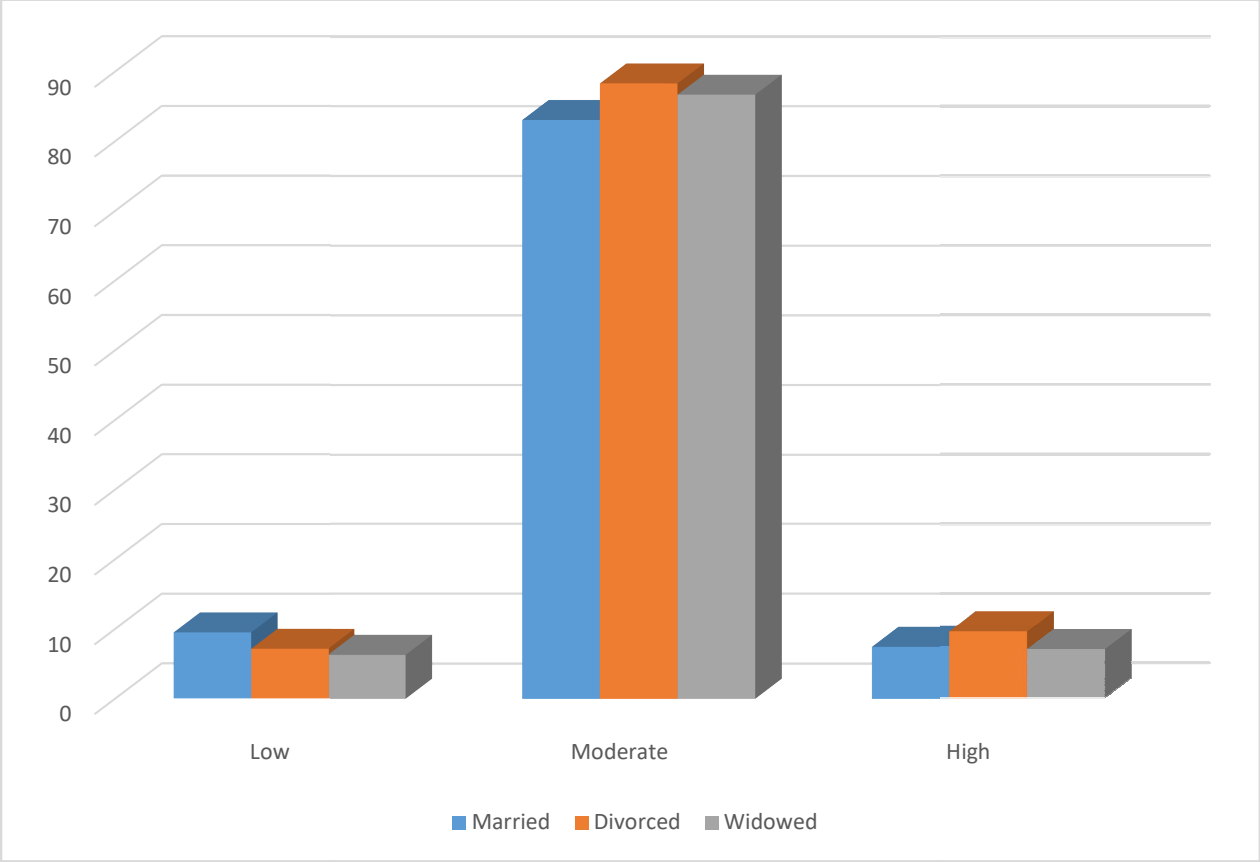

Figure 4.3: Distribution of Access to Infrastructure across Marital Status

4.2.2.2 Access to Infrastructure across Farming Experience

Thedistribution of access to infrastructure across farming experience in Figure 4.4revealed that woman with more than 20 years of farming experience have the least access to infrastructure while women with fewer (less than 10 years) experience have the highest access to infrastructure. This implies that as the experience of the women increase, their access to infrastructure reduces, which could be because farming experience is gathered with age. As the women gain more experience, they grow older and their need to access infrastructure reduces possibly because of reduced farm activities and the fact that older women often delegate responsibilities to youngermembers of their household. However, the younger women's higher access to infrastructure might be because of their being more active in both household and farm activities, thereby making them have greater needs for infrastructure for themselves and members of their households.

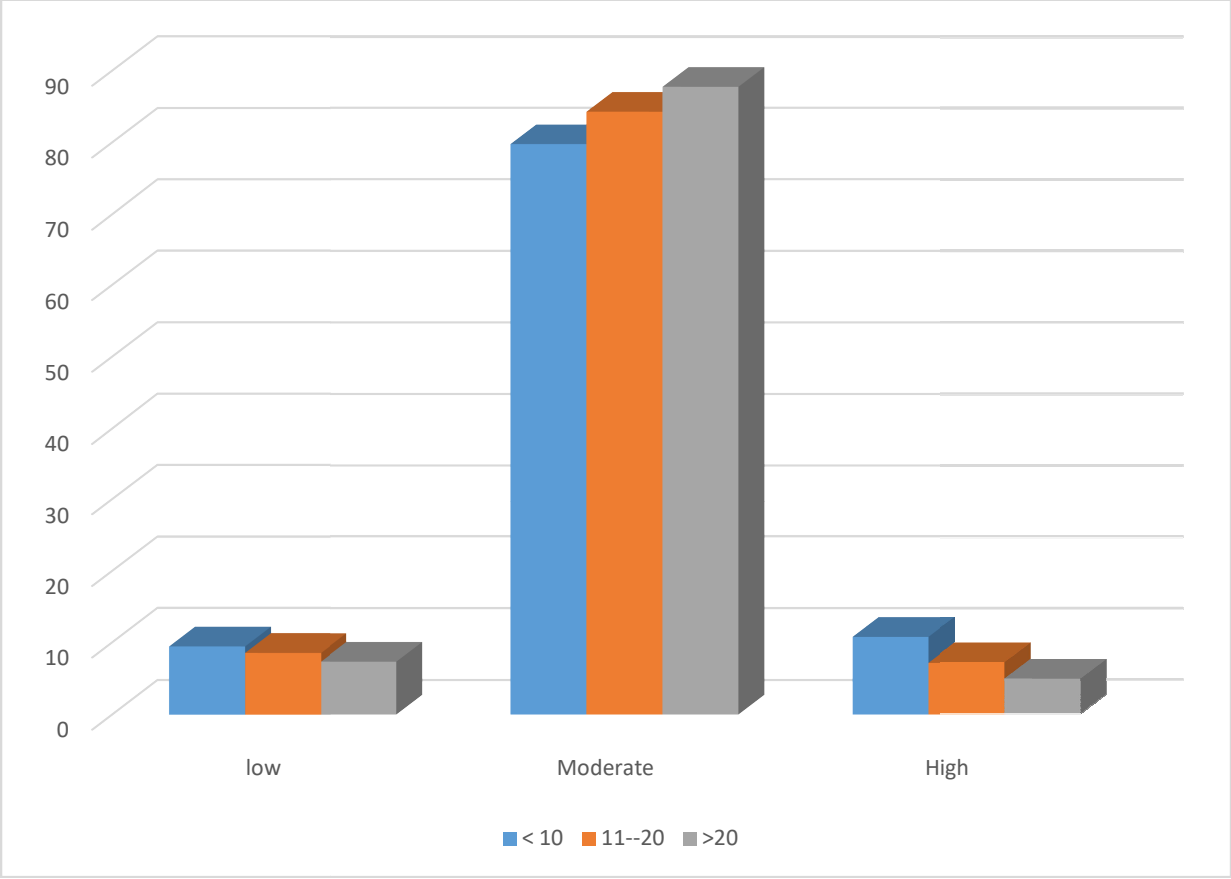

Figure 4.4: Distribution of Access to Infrastructure across Farming Experience

4.2.2.3 Access to Infrastructure across Occupation

Thedistribution of access to infrastructure across occupation in Figure 4.5 revealedthat women who areprimarily into farming constituted mostrespondents with moderate and high access to infrastructure. It is significant at 5 percent. This might be attributed to the fact that farming constitutes a major economic activity in the rural area which necessitates access to some peculiar physical infrastructure such as road for transporting produce from farm to the market, storage and market facilities in addition to other infrastructures such as telecommunication, energy, water,health and education. The high access of farmers to infrastructure also confirms the fact that infrastructure is prerequisite for farming activities and a key component of productivity.

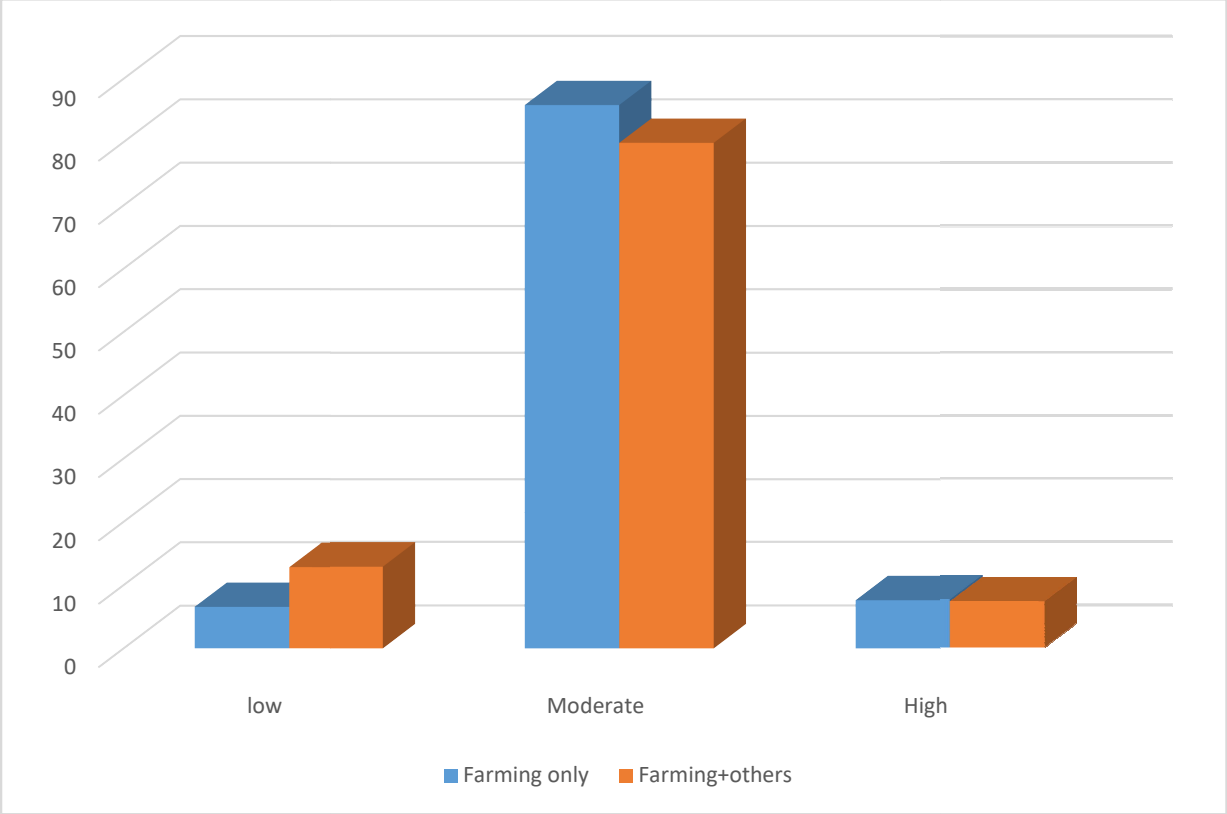

Figure 4.5: Distribution of Access to Infrastructure across Occupation

4.2.2.4 Access to Infrastructure across Household Type

Figure 4.6 shows the distribution of the respondents' access to infrastructure across household type.Women in households made of both male and female adult (dual household)constitute the majorityamongst women with moderate and high access to infrastructure, while women in single adult households constitute the majority amongst people with low access. This may be because dualhouseholds are more likely to have larger household size hence increasing their need for infrastructure and might also be because of increased farming activities where both adults are farmers. The female adult only house may have low access due to reduced needs which reduces their need to access infrastructure.

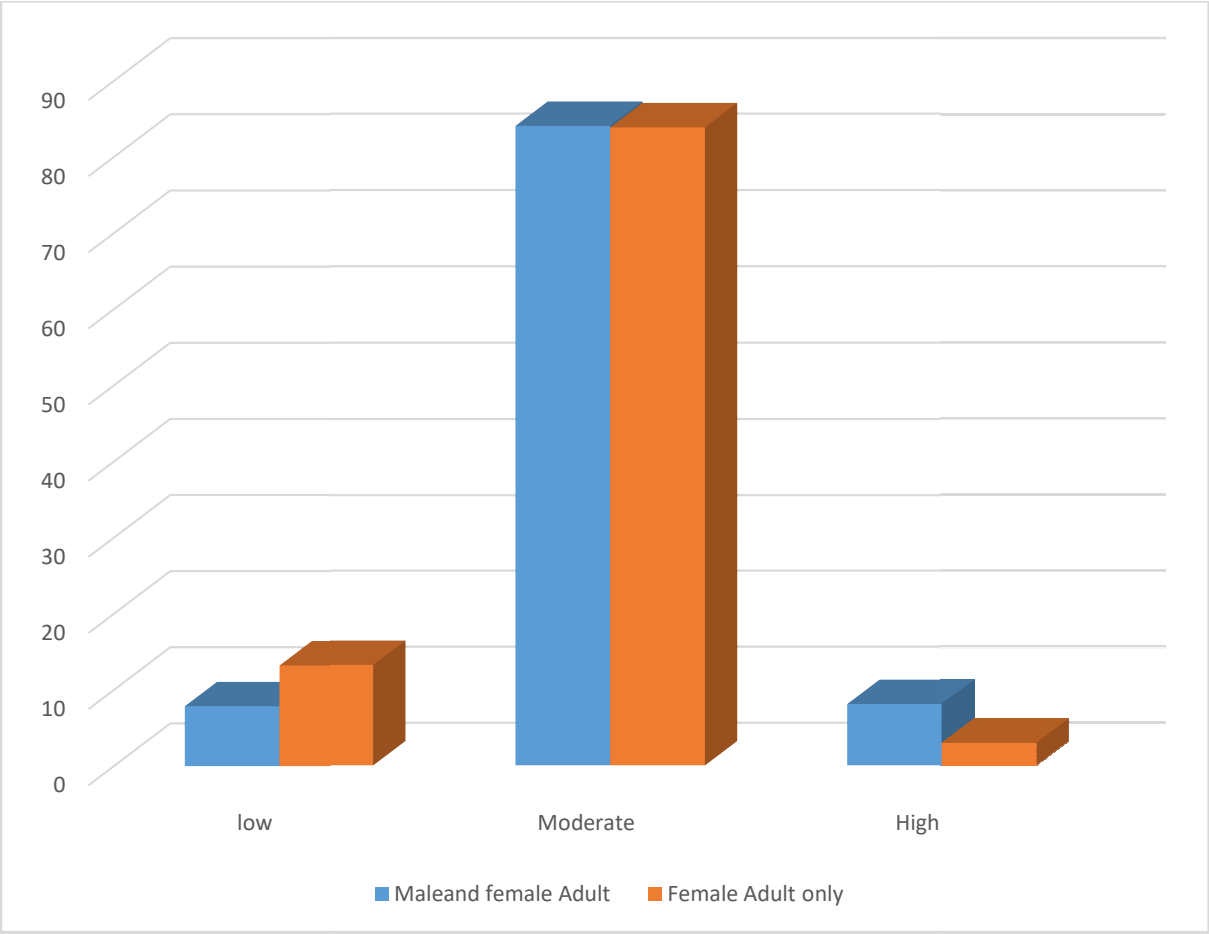

Figure 4.6: Distribution of Access to Infrastructure across Household Type

4.2.2.5 Access to Infrastructure across Years of Residency

The distribution of the respondents' access to infrastructure across years of residency is shown in Figure 4.7. Most of the women have stayed in their current location for more than 10 years, andmajority of those with moderate access have stayed for more than 10 years in their communities. Since infrastructure is a public good,it is believed that its availability in a location should increase awareness and access for all and sundry. Farming activities are usually carried out in groups, hence social status such as years of residency would impact knowledge of available infrastructure and access, hence justifying the higher number of women in the high and moderate access category.

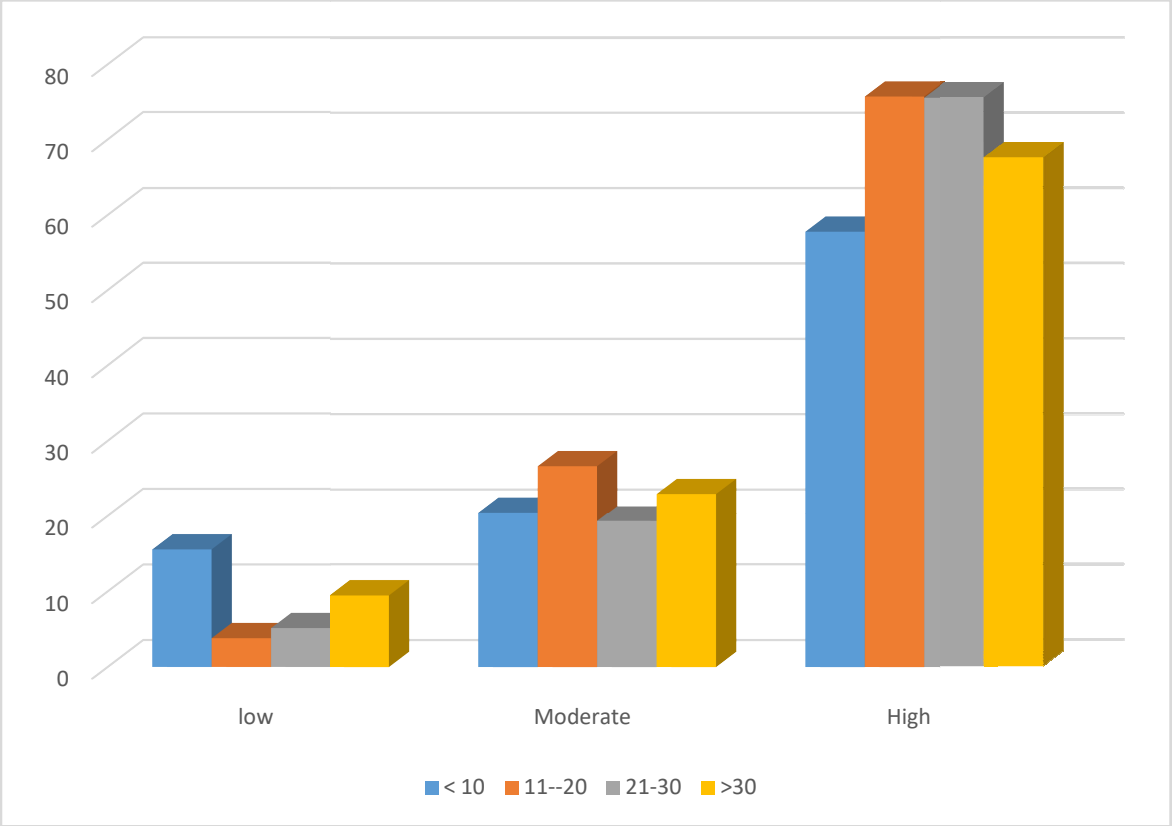

Figure 4.7: Distribution of Access to Infrastructure across Years of Residency

4.3 Factors Affecting Women Farmers' Access to Infrastructure

The results of the factors affecting women farmers' access to infrastructure are discussed in this section. The model is significant at 1 percent (P=0.0018), Log likelihood was 299.69 and WaldChi (2) was 37.51 indicating that the data set fit the model. From the model, seven of the variables were statistically significant at different levels ranging from 1, 5 to 10 percent. These variables areage, age square, household size, farming experience, farming practice, marital status and access to credit, and they are discussed as follows:

4.3.1 Age

It is revealed that if women's age increased by one unit, it will lead toa decrease in access toinfrastructure by 1.78 percent, this is significant at 5%.This is in line with Ojo*et al. (*2012) who found a significant relationship between age and access to agricultural resources. As the age of women farmers' increases, their access to infrastructure is likely to decrease. This might be becauseas women grow older, they become weaker and unable to undertake economic activities like they used to andhave lower needs for accessing infrastructure because they have delegated responsibilities to other household members.

4.3.2 Age Square

Age square has a significant and positive relationship with access to infrastructure. Table 4.4 shows that a unit increase in age will lead to a likelihood of 0.016 increase in access to infrastructure. It is significant at 10percent. This indicates that the overall effect of age on access to infrastructure will increase over time with continuous increase in farmers' age. Age square explains the life cycle effect of age on access and depicts the threshold at which we will have a decline.

4.3.3 Household Size

The coefficient of household size was negative and significant at 5%, indicating that an increase in household size will lead to decrease in access to infrastructure by 0.0082.This agrees with Awoyemi*et al.* (2011) and Ojo*et al.*(2012) who found a significant negative relationship between household size and access to infrastructure. This invariably means that increase in household size will lead to increase expenditure on meeting household needs (both consumption and material), and such household is left with limited resources that could be used to access infrastructure.

4.3.4 Farming Experience

A unit increase in the years of farming of rural women will lead to increase in access to infrastructure by 0.0022, which is significant at 5 %. This reveals that women who are more experienced have higher access to infrastructure compared to women with lower farming experience. This may be because women with higher experience have learnt better ways of farming overtime, which is in line with Ojo*et al.* (2012) who found a significant relationship between farmer's access to resources and experience.

4.3.5 Type of Farming Practice

Increase in the number of women who engage in animal husbandry will lead to an increase in access to infrastructure by 0.1296 compared to women that are engaged in other type of farming. It is significant at 5%. This corroborates the report of Doss (2018)which stated that women carry out a lot of livestock rearing around the home, which has the likelihood to increase their income and could increase infrastructure access among the women. Additionally, Doss reported that contributions from livestock activities are large in the total agricultural production values across farming systems.

4.3.6 Marital Status

As shown in the Table 4.3, increase in the number of divorced women compared to those that are married will lead to an increase in access to infrastructure by 0.0463. It is significant at 10%. This is in line with Oluwagbamila and Samson(2017). Women who are divorced have more control over their resources, they have fewer member of households

to provide for, which may explain why women that are divorced have higher level of access to infrastructure compared to women that are married.

4.3.7 Access to Credit

Access to credit through cooperative associations will lead to an increase in access to infrastructure by 0.0529. It is significant at 10%. Access to credit through cooperative activities provides additional funds for women to increase their farming operations. This could increase the total amount of revenue generated by the farmersand could enable the women farmers have higher access to infrastructure than women who do not have access to credit. Accessing credit through an association also means that the woman is a member of the associations; this confers additional advantage on the women in form of social capital. This increases their awareness about infrastructure, increasesknowledge and information gained from group activities, hence increasing their likelihood of accessing infrastructure.

Table 4.3:Factors Affecting Women Farmers Access to Infrastructure in the Study Area

Infrastructure Access Index	Coefficient	Std. Err	Z	P>|z|
Age	-0.0178**	0.0090	-1.97	0.048
Age square	0.0002*	0.0000	1.77	0.077
Household Size	-0.0082**	0.0038	-2.14	0.032
Farming Experience	0.0022**	0.0009	2.31	0.021
Farmingpractice(Animal Husbandry)	0.1296**	0.0536	2.42	0.016
Farming practice(Mixed Farming)	-0.0158	0.0175	-0.90	0.367
Household Head (No)	-0.0119	0.0194	-0.61	0.541
Sec Occupation Trading	-0.0167	0.0165	-1.01	0.312
Sec Occupation Artisan	-0.0125	0.0260	-0.48	0.631
Marital Status (Divorced)	0.0462*	0.0257	1.80	0.072
Marital Status (Widowed)	-0.0092	0.0231	-0.40	0.69
Education	0.0082	0.0182	0.45	0.654
Wage Employment	0.0025	0.0150	0.17	0.867
Credit (association)	0.0529***	0.0190	2.78	0.005
Credit (Informal)	-0.0125	0.0335	-0.37	0.708
Credit (Family & Friends)	-0.0026	0.0323	-0.08	0.937
Constant	1.0939	0.2148	5.09	0.000
Prob > Chi^2 = 0.0018				
Log Likelihood =299.69				

Wald Chi^2	**=37.51**	1% ***
Sigma	**= 0.000**	5% **
		10% *

4.4 Effect of Access to Infrastructure on Productivity of Women

The effect of women farmers' access to infrastructure on productivity is discussed in this section. The mean productivity of respondents is 0.81± 0.26.This shows that overall, the level of productivity is considerably high among the respondents. This is in line with Mwuese&Okorji(2015) who found that women farm enterprise in Benue State were productive and Abdul-Qadri *et al.* (2016) who found a high productivity among oil producing farmers in Nigeria. The high productivity among the women is expected to reduce the level of poverty among the women, while making them more empowered. It was discovered that 73.22% have high level of productivity, 20.87% have moderate level and 5.91 % have low level of productivity. Most of the women are small holder farmers whose production is on a small scale; they produce almost the same type of crops and rear similar domestic farm animals. They are often able to maximize resources due to economies of scale and access to similar productive resources, while utilizing similar technologyinnovation and government intervention to increase their output.

Table 4.4. Productivity among the Women in Southwestern Nigeria

Productivity	Frequency	Percent
Low	34	5.91
Moderate	120	20.87
High	421	73.22
Total	575	100
Mean	0.81±0.26	

4.4.1 Factors Affecting the Productivity of Rural Women Farmers in Southwestern Nigeria

Table 4.5 discusses the relationship between infrastructure access and productivity of farmers. Coefficient of determination (R^2)value of 0.52 indicates that explanatory variablescontribute 52percent of the changes that took place in the dependent variable. The model was significant at 1 % with a P value of 0.0003. The VIF was used to test for multicollinearity among the variables; a mean value of 1.51 as shown in Table 4.7 implies little correlation which does not influence our predictions. From the model, the following variables are significant at different levels ranging from 1 to 10 %; infrastructure access index, household size, female household head, credit access, distance to extension office, membership of cooperative group, occupation, farming experience and household member on farm.The implication is discussed as follows:

4.4.1.1 Infrastructure Access Index

A unit increase in infrastructure access will lead to 0.2155 increase in productivity of women farmers. It is significant at 5%. This may be possible sinceaccess to infrastructure facilitates ease of production and reduces the cost of production.With infrastructure access, the scale and the scope of production are increased with time.There is reduced drudgery and reduction in wastage among the farming household. This is so because increase in infrastructure contributes cumulatively to overall increase in productivity among the women. This agrees with Fakayode*et al.* (2008) who found thatrural infrastructure increased Agricultural productivity of crop farmers in Nigeria.

4.4.1.2 Household Size

Household size is an important factor that influences different variables and describes different kinds of relationship in farming households. The coefficient of household size is positive and significant at 5%. It indicates that as household size increases, productivity increases among the respondent by 0.1649. This is because higher household size means there will be higher labour supply and subsequent increase in output among the women farmers. This is in line with Yusuf *et al.*(2010) who found a positive and significant relationship between family size and productivity of women farmers in the derived savannah zone of Nigeria.

4.4.1.3 Household Head (yes)

As number of female headed households increases,productivity is likely to increase by 0.4484, which depicts a positive relationship between productivity and gender of household head. This is significant at 5 percent and indicates that as the number of women who are household heads increase, the productivity increases. This confirms the result of Wourtese(2016) who found that being ahousehold head is significant in determining the productivity of women farmers. This may be because these women are primary decision makers, and often can have sole decision-makingpower in productive activities which influence their output.

4.4.1.4 Access to Credit

An increase in access to credit will increase productivity by 0.4406. It is significant at 5percent. This reveals that increase incredit access results in productivity increase among the farmers.This is in line with expectations as access to credit is meant to increase available resources to purchase more productive inputs that could increase output and productivity. When farmers have access to credit, input levels increase, adoption rate of technology is impacted, there is more capital for investment and generally an improvement in household welfare ensued (Mwuese&Okorji,2015).Musa (2011) reported that access to credit among women farmers in Kogi State significantly improved their output, while Awotide*et al. (*2015) also confirmed a positive effect of credit access on cassava farmer's productivity in Nigeria.

4.4.1.5 Distance to Extension Office

The distance to extension office was significant at 5percent, however with an unexpected positive coefficient sign, which implies that an increase in distance to extension office will increase productivity by 0.1301. This is contrary to a prior expectation;however, this may be because women carry out their farming activities in remote areas which are usually far from urban areas whereextension offices are located, thereby limiting the impact of proximity of extension office. Diiro*et al.* (2018) also reported a negative connection between distance to extension office and productivity of all farmers (male and female) in Kenya.

4.4.1.6 Membership of Cooperative Group

An increase in number of women who are members of cooperative societies will lead to 0.3383 increase in productivity, compared to women who are non-members of cooperative society, and is significant at 10 percent. This is because belonging to a society provides needed social capital and additional source of information, resources, and funds for the women farmers to increase the scale of their farming activities. This could lead to increase in their output and likewise their productivity. Also, by implication the socio-economic status of women (through group membership) is important and influences their accessibility to productive resources. This result is similar to that of Odurukwe*et al.*(2006) and Adepoju(2018) who found that farmers' membership and participation in group activitiesimproved their access to decision making power and productivity.

4.4.1.7 Farming Occupation

As shown in Table 4.5, an increase in women whose primary occupation is farming will lead to 0.5866 increase in productivity among the rural women. It is significant at 5 percent. This indicates that as more rural women engage in farming primarily,there is the likelihood that productivity increases among the rural women in Southwestern Nigeria. This is in line with the report of Musa (2011) who found that participation rate of women in agriculture in Kogi State is high and significant among all categories of women sampledwho participated in agriculture. This might be as result of farming being the main source of livelihood of rural dwellers hence available resources are deployed efficiently

into farming operations which subsequently increases their productivity. Additionally, the traditional rural settings have cultural norms which support farming as an occupation of choice for rural dwellers thereby impacting the decision to take on farming as major occupation and means of livelihood in the rural Southwestern Nigeria. This results also corroborate Adepoju and Salman(2013) who found over seventy percent of households in rural areas of Oyo and Osun having farming as their primary occupation.

4.4.1.8 Farming Experience

Increase in years of farming will increase productivity by 0.0306. The implication of this is that with experience comes expertise which translates to increased productivity. Experienced rural women farmers inSouthwestern Nigeriacan use their knowledge and technical know-how to maximize inputs for productivity increases. This indicates that these women are most likely able to expand their scale of farming, to increase output therebyincreasing their productivity. This is in line with Abdul-Qadri *et al.*(2016) who also found a positive relationship between farming experience and productivity ofoil palm producers of Nigeria.

4.4.1.9 Householdmember on Farm

An increase in number of household members on farms will lead to 0.2976 decrease in productivity.It is significant at 10percent. This is against apriori as an increase in members working on farm should increase productivity given that additional labour is available for increased farm activities at reduced or no cost. However, household members' work on farm could reduce productivity when their presence does not translate to efficiency or does not bring about significant output increase. This might be becausethey are unpaid for (hence less efficient) or are not old enough to partake in farm activities which require strength and or experience.This is in line with Fakayode(2008) who found a negative relationship between labour and productivity because of family labourbeing unpaid for, hence not being efficiently utilized.

Table 4.5:Effect of Infrastructure Access on Productivity of Rural Women Farmers in Southwestern Nigeria

Productivity	Coefficient	Standard Error	T	P>|t|
Age	-0.0017	0.0163	-0.10	0.919
Farming Experience	0.0306**	0.0163	1.88	0.063
Farm Size	0.0384	0.0749	0.51	0.610
Household Size	0.1649**	0.0647	2.55	0.012
Household head (Yes)	0.4484**	0.1913	2.34	0.021
Education	0.0346	0.0263	1.32	0.191
Occupation (Farming)	0.5866**	0.2956	1.98	0.050
Infra Access Index	0.2155**	0.0851	2.53	0.013
Access to credit	0.4406**	0.1969	2.24	0.027
Marital Status (Divorced)	-0.5272	0.3362	-1.57	0.120
Marital Status Widowed	0.1453	0.2652	0.55	0.585
Distance from Extension office	0.1301**	0.0622	2.09	0.039
Number of plots cultivated	-0.0356	0.0316	-1.13	0.263
Member of Producer Group	-0.2485	0.2639	-0.94	0.348
Member of Coop Group	0.3383*	0.2347	1.44	0.102
Member of Trade Group	0.2923	0.6364	0.46	0.647
Member of Women Association	-0.3581	0.3109	-1.15	0.252

Household member on farm	-0.2976***	0.0919	-3.24	0.002
Distance to the Nearest Market	-0.0058	0.0387	-0.15	0.882
Constant	-1.5741	0.9638	-1.63	0.105

F(19) = 6.86
Prob > F = 0.0003
R-squared = 0.5268
Adj R^2 = 0.4115

1% *** 5% ** 10% *

Table 4.6: Multicollinearity Test Results of OLS Explanatory Variables

Variable	VIF	1/VIF
Age	1.83	0.547718
Farming Experience	2.08	0.479769
FarmSize	1.38	0.726782
Household Size	1.85	0.539411
Household head (Yes)	1.29	0.772926
Education	1.25	0.798741
Occupation (Farming)	1.98	0.504036
Infra Access Index	1.15	0.868137
Access to credit	1.4	0.714651
Marital Status (Divorced)	1.13	0.881898
Marital Status Widowed	1.37	0.731004
Distance from Extension office	1.65	0.607671
Number of plots cultivated	1.49	0.673376
Member of Producer Group	1.29	0.77238
Member of Coop Group	1.45	0.688798
Member of Trade Group	1.42	0.703697
Member of Women Association	1.54	0.650753
Household member on farm	1.88	0.532777
Distance to the Nearest Market	1.35	0.743453
Mean VIF	1.51	

4.5. Women Empowerment in Agriculture in Rural Southwestern Nigeria

This section talks about the empowerment status of women farmers in Southwestern Nigeria using five relevant Agriculture domains (5DE) which assess women decision making in production, resources, income, participation in leadership in the community and their use of time.This depicts the direct extent and role of women in Agriculture.The 5DE adequately captures women empowerment across the domains, while also reflecting the contribution of each domain to unempowerment among the women. The result is discussed below.

4.5.1 Women Empowerment Status among the Respondents

The indicators of the five agricultural domains of empowerment (5DE) were analysed to reveal the status of empowerment and show the contribution of each domain to unempowermentbased on each woman's empowerment profile. The study revealed mean 5DE Score of 0.71, which implies that the women are unempowered. Consequently, as shown in Table4.7, 74.61percent of the respondents are unempowered, while only 25.39 percent are empowered. This indicates that most of the women farmers are not empowered. This agrees with Malapit*et al.* (2014) who reportedwomen empowerment score 0.70 for Ghana andreported 75% of the women in Bangladeshareunempowered in the baseline study of 2014. The implication of the low empowerment status among the farmers is that they are not solely involved in decision making on their productive capacities and are not adequately represented in leadership within the community and do not use their time effectively.

Table 4.7: Distribution of Women according to Empowerment Status

Empowerment Status	Frequency	Percentage
Empowered	146	25.39
Unempowered	429	74.61
Total	575	100
Mean Empowerment score 0.71		

4.5.2 Contribution of the Agricultural Domains to Unempowerment

Therelative effects of the various domains to unempowerment are shown in Figure 4.8. This reveals that the highest contribution (37%) is fromthe Time domain, while Income contributed the least with 1%. This is similar to the findings of Ayevbuomwan*et al.*(2016) who also found that income and production domains contributed the least to women disempowerment, in ruralNigeria.

4.5.2.1 Time Allocation Domain

Time has a significant effect oneveryone;however,women have been significantly affected through ineffective time allocation among productive, unproductive and leisure activities. The result of the women empowerment reveals that the time domain, indicated by workload and time spent for leisure activities contributed the most (37%) to the unempowerment of women. The women also have workload of overeleven hours within a 24-hour period.This is consistent with a report of theDuflo(2012) which states that about 30 percent of women unempowermentis caused by the time domain.

4.5.2.2Resource Domain

The Resource domain contributed about one third(32%) to the unempowerment of the respondents. This is in the ownership of asset, decision making about credit and transfer or purchase of asset indicators. This points to the fact that input in decision making by women is limited and they did not have sole decision-making power to dispose assets or acquire new ones, and do not own any big household or productive assets. Most decisions were either made by their spouse or jointly with other members of the household.

4.5.2.3Leadership Domain

The leadership domain is depicted by the ability of women to speak comfortably in public and their membership in at least one group. According to Alkire (2013), when a woman feels comfortable speaking in public, she can contribute to decision making on provision of infrastructure, she is able to challenge unfair treatment of her contemporary within the community and so on. Also, when a woman belongs to at least one social, community or occupation group, she can harness the benefit of social capital as an input in her production process. The result in Figure 4.8 shows that the leadership domain contributed to unempowerment of women in SouthwesternNigeria with about 21 percent. This implies that most respondents did not achieve adequacy in this domain which accounts partly for the high unempowerment in the region. Decision making as a function of empowerment is backed with some leadership qualities which enable women to partake solely or jointly in productive decision making.

4.5.2.4 Production and Income Domains

The two domains of production and income jointly contributed 10 percent, making them the least contributor to the unempowerment of the women farmers in Southwestern Nigeria.This is consistent with the report of Ayevbuomwan*et al.*(2016) who reported that the income and production domain contributed the least to unempowerment of women in Nigeria across the six geopolitical zones of the country. Adequacy in these two domains implies that the woman is solely or at least jointly responsible for decision-making about what to produce, extent of production and the use of income.

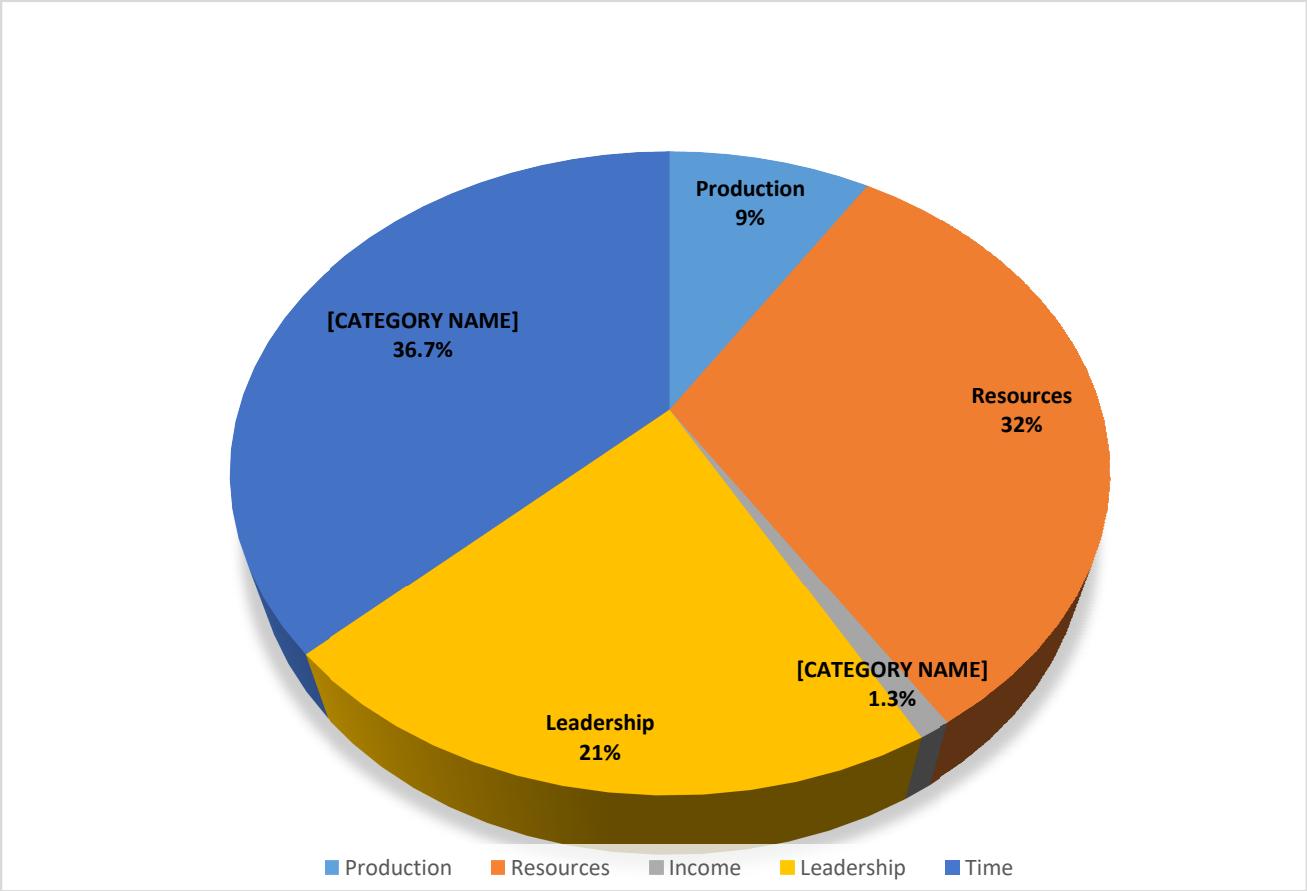

Figure 4.8: Contribution of Each Domain to Unempowerment

4.5.3Women Empowerment across Socio-economic Characteristics

The distribution of women empowerment status across socioeconomic characteristics is discussed in this section. This includes age, marital status, educational status, household size, primary occupation.

4.5.3.1 Women Empowerment across Age

The distribution of women empowerment across age is shown in Table 4.8,which reveals that women who are 60years and above are the most empowered and is followed by women who are within 35 to 59years. Women who are within the age of 25 to 34 years are the least empowered. This shows that empowerment increases with age among the respondents. The study showed that younger women are more unempowered compared to the older women, which might be because with age comes experience and with experience comes the confidence and know-how of the various aspects of farming. Additionally, as the women grow older, they become more confident and are able to take part in decision making in the household and in productive activities. This is ultimately because in most environments, older women are given more privileges of decision making.

4.5.3.2 Women Empowerment across Marital Status

As shown in the Table 4.8,the least empowered are the married women (79.74percent), followed by the divorced (73.81percent) and lastly the widowed women (60.84percent).This implies that the widowed are the most empowered, followed by the divorced women and then married women. This is likely so since married women are not the sole decision maker, often they make decisions jointly with their spouse regarding production and/or other issues within the households. In addition, the divorced and widowed women are more likely saddled with the responsibility of the household head

and positioned to be more empowered as the sole decision maker both in production and household issue.

4.5.3.3 Women Empowerment across Educational Status

The distribution of empowerment across educational status among respondents shows that women without any formal education are the most empowered, followed by women with above primary education and those with primary education are the least empowered. This is contrary to the apriori as increase in educational attainment is expected to contribute to higher level of empowerment among women. However, finding from this study points to the opposite; this may be because education is often very low among women in rural areas, and this may account for why educationdoes not increase empowerment among the respondents. Additionally, this finding confirms why using education as a proxy for empowerment might be misleading in policy making.

4.5.3.4 Women Empowerment across Household Size

Distribution of empowerment across household size shows thatwomen with small household size (less than 4 persons) are the least empowered, while women with household size of 4 and above are the most empowered. This indicates that women in bigger household size are more empowered than women in smaller households. This may increase the resources available to the household andcould lead to increase in empowerment among the women in the rural areas.

4.5.3.5 Women Empowerment across Primary Occupation

As shown in Table 4.8, women that carry out farming activities only are more empowered than women than carry out farming and other economic activities. This may be because the women allocate more time to farming activities thereby leading to higher level of productivity which may increase their level of empowerment.

.

Table 4.8:Distribution of Women Empowerment Status across Socio Economic Characteristics

Socio Economic Characteristics	Women empowerment status		Total
	Empowered	Unempowered	
	Freq (Percent)	Freq (Percent)	Freq (Percent)
Age (years)			
25 -34	0 (0)	10 (100)	10 (100)
35 -59	132 (25.73)	381(74.27)	513 (100)
60 &above	14 (26.92)	38 (73.08)	52 (100)
Marital Status			
Married	79 (20.26)	311 (79.74)	390(100)
Divorced	11 (26.19)	31(73.81)	42 (100)
Widowed	56(39.16)	87(60.84)	137(100)
Education			
No Education	41 (36.94)	70 (63.06)	111(100)
Primary Education	87 (22.54)	299 (77.46)	386(100)
Above primary education	18 (23.08)	60 (76.92)	78 (100)
Household size			
< 4	4 (16.67)	20 (83.33)	24 (100)
4-6	114 (25.91)	326(74.09)	440 (100)
> 6	28 (25.23)	83 (74.77)	111 (100)

Primary Occupation			
Farming only	120(31.09)	266 (68.91)	386(100)
Farming +others	26 (13.76)	163 (86.24)	189 (100)

4.6. Effect of InfrastructureAccessand Productivity on Women Empowerment

The result of the effect of infrastructure access and productivity on women empowerment is shown in Table 4.9, p-value of0.0472(P<0.05) indicating good fit in the model. The wald test of exogenity of the instrumented variable has a p-value of 0.0004(P<0.05). This means the use of instrumental variable probit model was appropriate. Women empowerment status was the dependent variable, and four variables were significant at different levels from 1% to 10%, these are Productivity, Infrastructural index, Type of households, and wage employment.

4.6.1 Productivity

Productivity measured by TFP has a positive relationship with women empowerment. The study revealed that a unit increase in productivity will lead to 1.4364 increase in empowerment among the women farmers. This implies that as productivity increases, the likelihood of being empowered among the women increases. This shows that productivity contributes to empowerment positively among the respondents. This agrees with Diiro*et al.*(2018) who reported a significant and positive link of empowerment on productivity of maize farmers in Kenya.

4.6.2 Infrastructure Access

As shown in Table 4.9, a unit increase in infrastructure access will lead to 1.6410 increase in empowerment among the respondents. This implies that as infrastructural access increases, the likelihood of being empowered among the women increases. It indicates

that access to infrastructure contributes to empowerment among the rural women. This is in line with Koolwal& Van de Walle (2013) who reported that increased access to water infrastructure, improved girl enrolment in school, women time for childcarebecause of reduced time to access water, ultimately increasing empowerment.

4.6.3 Type of Household

The likelihood of women empowerment is reduced when a woman has a partner, hence sharing decision-making responsibilities. Whena woman has a partner,the likelihood of her being empowereddecreases by 1.1441 compared to households with only female adults. This implies that women in household with male and female adultshave lower empowerment than households with only female adults. This is because decision-making in households with only female adults rest solely on the females unlike households with both male and female adults where the male tends to have domineering role in decision making. This is in line with Ayevbuomwan*et al.*(2016) who found that being a partner reduces empowerment of women and the possibility of women being empowered in multi dimension, in rural Households in Nigeria.

4.6.4 Wage Employment

An increase in women that engage in wage employment will lead to 0.9452 decrease in empowerment compared to women that do not engage in wage employment. This is contrary to aprioriexpectation, as wage employment is expected to bring a level of decision making on income earned by the women. However, since most women in rural areas are engaged in farming, they are less likely to be engaged in paid job. Hence wage employment does not contribute to empowerment among women in the study area. This is in line with the findings of Garbero&Perge(2017) who also reported that participation in paid employment had a negative but significant relationship with women empowerment.

Table 4.9:Effect of Infrastructure Accessand Productivityon WomenEmpowerment

Empowerment Status	Marginal Effect	Standard Error	Z	P>|z|
Productivity	1.4364*	0.8205	1.75	0.080
Infrastructure Access Index	1.6411*	0.9519	1.72	0.085
Age	0.1519	0.4639	0.33	0.743
Distance to the Nearest Market	0.0370	0.0332	1.11	0.265
Ownership of phone GSM	0.5750	0.5989	0.96	0.337
Male & Female Adult Household	-1.1441**	0.5438	-2.10	0.035
Wage Employment	-0.9452**	0.3997	-2.36	0.018
Age square	0.0018	0.0048	0.38	0.706
Household labour size	-0.1840	0.1566	-1.17	0.240
Sec Occupation (Trading)	-0.1372	0.4678	-0.29	0.769
Sec Occupation (Artisan)	0.4648	0.5844	0.80	0.426
Constant	-1.2165	9.8574	-0.12	0.902

Wald chi^2 (11) =19.87

Prob > chi^2 = 0.0472

Waldsexogenity = 15.83 Prob > chi^2 = 0.0004

1% * 5% ** 10% ***

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

The provision of adequate access to infrastructure would go a long way in increasing productivity and empowering rural women, given the strategic role they play in agriculture. Without infrastructural facility such as telecommunications, health, education, storage and market institutions, the rural communities will continue to lag in their productive capacity. Besides, rural women's empowerment will be threatened and the standard of living of rural households would be significantly affected.

5.1 Summary

The study examined the infrastructure access, productivity, and empowerment nexus of rural women farmers, using primary datafrom rural Southwestern Nigeria. The data were analyzed using Descriptive statistics, Composite index, Truncated Tobit Regression, Ordinary Least Square Regression, Total Factor Productivity, fiveagricultural domains of empowerment in agriculture (5DE) and IV Probit Regression Model.Access to infrastructure, women empowerment status and productivity levelwere determined,factors determiningaccess to infrastructure were examinedand the effect of infrastructure access on productivity and women empowerment was determined. The socio-economic profile of 575 women farmers across rural Southwestern Nigeria showed that most of the women had farming as their primary occupation. Other socio-economic characteristics profiled for the women are age, marital status, educational level, household size, farming experience and years of residency within the community.

The level of access to infrastructure was moderate, using overall infrastructure access index across eight infrastructure components. Telecommunication was the most accessed component, while modern storage was the least. Various socio-economic variables such as, age, age square, household size, farming experience, type of farming practice, marital status, access to credit were responsible for determining access to infrastructure among the women.

Additionally, the level of productivity was high, and infrastructure access had a positive and significant effect on productivity of the women farmers. Lastly, the study revealed that most of the women are unempowered, with only about a quarter being empowered. Across the five domains of empowerment in agriculture, time use domain contributed the most, while the income domain contributed the least to unempowermentamong the women. Both infrastructure access and productivity had a direct and significant relationship with women empowerment. The following were the major findings.

Majority (89.22 %) of rural women farmers in Southwestern Nigeria were between 35 and 59years, 1.74percent were within 25-34years, while 9.04 percent were above 60years. The mean age was 47.7±7.12 years.The study showed that most(67.83 %)of the respondents were married.About a quarter (24.87%) of the women were widowed and 7.20 percent were divorced. Also, 19.30 percent of the respondents had no formal education, 67.13 percent of the respondents had at least primary school education, and only 13.57 percent had above primary school education. Majority (76.52 percent) of respondents had a household size of 4-6 people with mean value of 5.5 ±1.6, only 19.30 percent of the household had size higher than 6. The study revealed only 34.36 percent of these households have a female as the head, while majority (65.74 percent) are headed by males.

Furthermore, 67.13 percent of the women were primarily into farming, while 32.87 percent women were into farming and other occupation such as trading, artisans among others. The mean years of farming experience of rural women in Southwestern Nigeria is 19.84±7.94 years with more than half having 11-20 years' experience. Most of the women were smallholder farmers, with majority (64.35 percent) cultivating between 1 to 3ha,and 17.74 percent cultivating less than 1ha. The study revealed that the mean infrastructure access index value of 0.61±0.14, telecommunication had the highest access with sub-index (0.95); followed by electricity (0.93); market (0.72); road (0.67); education (0.66); health (0.58); improved water (0.35); and the storage (0.03), being the least accessed. Among the women, 84 % had moderate access, 8.52 % had high access, and 7.48 % had low access. Older women farmers above sixty years of age had low access to infrastructure, while younger women between 25-34 years of age had high access to infrastructure compared to others. Additionally, most of the women have spent more than 10 years in

their communities and they constituted the majority among those with moderate and high access to infrastructure.

Women in households made up of both male and female adult constituted the majority with moderate and high access to infrastructure, while women in female only households constituted the majority amongst people with low access.Lastly, experienced women with more than 20 years of farming experience had the least access to infrastructure while women with less than 10 years of experience had the highest access to infrastructure. Women who were primarily into farming constituted mostof the respondents with at leastmoderate level of access to infrastructure.

In terms of determinants of access to infrastructure; Age, Age square, household size, farming experience, type of farming practice, marital status, and access to credit by being a member of an associationwere among the factors that significantly influenced access to infrastructure. These socio-economic factors that determined access to infrastructure had either a positive or negative influence.

Infrastructure access, household size, access to credit, membership of cooperative group and being a household head had positive and significant relationship with productivity, while distance to extension office had a negative effect on productivity in the study area.With respect to empowerment status, most (74.61%) of the respondents wereunempowered. The time domain contributed the most to unempowerment while the income domain contributed the least, women who are above 60years are the most empowered.With regards to marital status, the most empowered are the widowed,followed by the divorced and then the marriedwomen.Across educational status, women without formal education were the most empowered, followed by women with above primary education, while those with primary education were the least empowered. This is contrary to the apriori expectation, as higher educational status is expected to contribute to higher level of empowerment among women. This finding, however, reiterates the fact that using education as a measure of empowerment of women might be misleading.

Furthermore, women in small households(less than 4 persons)were the least empowered, while women with household size of 4 and above were the most empowered. Women who were primarily farmers are more empowered than women who engaged in farming and other economic activities. This may be because the women allocated more time to farming

activities thereby increase their level of empowerment through their inputs in decision making in agricultural production.

Lastly, the study showed that infrastructural access and productivityincreased empowerment among the rural women in Southwestern Nigeria, while having an adult partner within the household, and wage employmentdecreased empowerment among the rural women.

5.2 Conclusion

The study provides empirical evidence that bothinfrastructure access and productivity affectwomen empowerment positively.Majority (84%) of the rural women in the study area had access to infrastructure. The mean infrastructure access index value of 0.61 means that overall, women farmers had moderate access to infrastructure using the eight infrastructure components considered in this study, however, with varying level of access to each infrastructurefacility. Modern storage facility was the least accessed infrastructure, followed by improved water, health, education,road, market, electricity and telecommunication (GSM mobile phone) being the most accessed among the women.Older women are less likely to access infrastructure, so also large households, while age andhousehold size decreased access to infrastructure. Women who access credit through cooperative associations, more experienced farmers, women who practice animal husbandry, and women who were divorced are most likely to access infrastructure, as revealed by the result of the truncated Tobit Regression.

Productivity among the women farmers was high with a mean productivity of 0.81±0.26. This is because most women were small scale farmers who produce almost the same thing using shared resources. Infrastructure access, farming experience, household size, being household head, farming as a sole occupation, access to credit,distance to extension office, household labour size, membership of a cooperative society all significantly influenced the productivity of the rural women farmers.

Furthermore, the empowerment of the women using five agricultural domains namely:production, resources, income, leadership, and time revealed that about three

quarter of the women were unempowered, withonly one quarterbeing empowered.The mean empowerment score was 0.71, which is less than the 0.80 cut off as defined by the women empowerment in Agriculture index5DE criteria. This shows that most of the women did not achieve adequacy in their role and decision-making capability across the five domains.Thatis, they have little or no input in productive decision and do not either solely or jointly own productive assets, have limited leadership roles and do not effectively allocate their time. Additionally, the contribution of each of the domain to unempowerment showed that the time domain contributed the most (37%), followed by resources (32%), leadership (21%),production (9%) and income domain, which contributed only 1 % to unempowerment of the women. The result of the IV probit model showed that infrastructure access, productivity,having a partner, and wage employment influenced women empowerment significantly.

Summarily, a positive linkage was established among infrastructure access, productivity and women empowerment.This could translate to improved wellbeing and increased standard of living among the rural dwellers hence impacting the sustainable development goals.This will ultimately contribute to rural economic growth and development needed for Nigeria's comparative advantage among other African nations and for her international competitiveness.

5.3 Recommendations

Based on the findings from the study, policy makers will gain insight into status of available infrastructure and its access among rural women in Nigeria with the view of aiding infrastructural development plans. When women are put into consideration in infrastructure planning, provision of infrastructure tailored to meet the specific needs of rural women becomes a goal, thereby removing any biases and reducing facilities that do not meet the needs of women.

Considerably, for people to have access, infrastructure facility must be available. Given the moderate level of access to infrastructure reported in rural Southwestern Nigeria, Government policies should be made to track availability of infrastructure vis-a-vis access to justify the provision and level of infrastructural development in the study area. This will

assist in measuring both infrastructure availability and access needed to keep improving productivity and empowerment of the women.

Infrastructure access has been established to enhance productivity and increase the level of empowerment of women in rural Southwestern Nigeria, hence several recommendations identified. The study identified the importance of a combination of both physical and social infrastructure components on productivity and empowerment given that these infrastructural facilities are not mutually exclusive. For instance, without the rural roads being accessible, without adequate means of communication amongst others, it will be difficult to access services like health, education, market efficiently. Therefore, government and all other stakeholders should target an all-inclusive approach towards provision and access to infrastructure. Additionally, rural access is one of the most important indicators for measuring and achieving several of the Sustainable Development Goals (SDGs), efforts must therefore be made by Government to measure and track women access at geopolitical level to contribute to the achievement of SDGs goals in Nigeria. Women are particularly more affected by lack of access to infrastructure due to ineffective time allocation. Therefore, community and government awareness and or sensitization programmes should be targeted at women groups to emphasize the various benefits of infrastructure access on their comparative advantage and regional competitiveness as rural farmers and as major player in the agricultural sector.

The following are the recommendation from the study:

- **Provision of Storage Facility-**Intervention is needed in the provision of storage facility in the study area given that it is the least accessed infrastructure. Public and private sector should collaborate in the provision of modern storage facilities like, warehouses, silos, which would help prevent post-harvest losses and check price volatility. Public-private partnership, through the Ministry of Agriculture, should immediately roll out programmes and projects which will give priority to access storage facility while enlightening women on the benefits of modern storage.
- **Provision of Subsidized Inputs and Technology –** This to encourage more women engage in farming, increase their scale of agricultural production and

discourage rural-urban migration. Farming as primary occupation of the women increased their productivity.Productivity increase in agriculture will contribute significantly to the non-oil GDP of Nigeria's economy, thereby reducing the dependency on oil revenue.Improving the economy, and ultimately positioning the rural area for needed growth and development is possible through agriculture. Government in collaboration with the ministry of agriculture should embark on women friendly agricultural programmes that would ensure timely provision of inputs, provision of land for farming and access to technologies and extension services for more women to embrace farming. Government intervention programmes to help farmers increase the scale of agricultural production in the rural areas is required for necessary increases in food supply to the economy and to reposition the rural areas where most of the agricultural production in Nigeria takes place.

- **Financial Inclusion Mechanisms for Women -**Access to credit increased both infrastructure access and productivity. Possible interventions ranging from financial inclusion mechanisms, interest free loans, aimed at increasing ease of accessing credit, should be the crux of government agenda for women. This will help to gradually break the barrier towards women access to credit. Government should partner with institutions such as BOI, BOA, AFDB to bring banking and other economic services which support ease of access to credit for rural women.
- **Enabling Environment to Support Formation of Women Association and Groups-**Social capital, through group membership, increased the productivity of women in the study. Ministry of women affairs in collaboration with cooperatives and trades ministry across the Southwestern states should provide incentives and enabling environment for women to thrive in the study area. Women groups should be given priority and subsidies which will encourage women to belong to at least one group within their community.
- **Sensitizing Women on Time Management -**Timeddomain contributed the most to unempowerment of rural women in Nigeria. Hence, efforts should be made by government parastatals with rural development mandate, ministry of women

affairs, ministry of agriculture extension service departments, local community groups, religious organization, non-governmental organization to launch awareness programmes that sensitize women on the need to balance time between domestic, productive and leisure activities to get them empowered. Additionally, government should prioritize provisionand access to infrastructure to reduce time spent on domestic activities. Improved water project should be brought close to the rural communities where women can easily access it all year round for both farming and domestic use, provision of educational facilities which adhere to the UNESCO standards of limited walk time to and from schools for their wards. These will make more time available to the women for both work and leisure and their empowerment will likely increase.

- **Promotion of Anti-Discrimination and Anti-Segregation Campaigns toSupport Decision-making –** This is to educate women on the importance of their input in decision-making process in the household and within the community. Ability to partake in decision making is important for empowering women.Efforts should therefore be made to increase participation of women in decision making regarding production and earnings at all levels toempower them. Policies targeted at encouraging women to participate in group discussions and public speaking should be launched, which will improve women's voice within the community. When a woman can contribute to household decision making without fear and earn a living with household support, her self-confidence is increased and her innate capabilities in contributing meaningfully to sustainable development in the society is launched. This can be achieved through the combined effort of National orientation agency (NOA), ministry of agriculture and ministry of women affairs.When women are sensitized on the importance of speaking out and collaborating without losing their role as partner in progress to their spouse,they are bound to be more productive and empowered. This ultimately translates to output increases in the economy.
- **Sustained Infrastructure Accessin the Telecommunication Sector-** considering the high access to GSM telecommunication facility and the positive relationship of

infrastructureaccess withproductivity and women empowerment, infrastructural development and its functionality in rural Nigeria should be aimed at sustaining the existing facility through adequate maintenance and partnership with the National communications commission (NCC) and Multinational telecommunication companies.This will ensure improvements in existing network access, while checking to ensure status is not diminished. The ministry of agriculture and the National orientation agency (NOA) should also maximise the high access to telecommunications among the rural women by using the medium as main means of disseminating information to the rural areas.

5.4Contribution to Knowledge

The research has made the following contributions to knowledge:

1. Infrastructure is one of the most important inputs in agricultural production without which farmers' productive capacity and welfare are negatively impacted, while access to infrastructure is an indicator of the provision of infrastructure within a region. The study provides insight into institutional support (infrastructure) for rural women in Nigeria with a view to aiding infrastructural development plans to meet the peculiar needs of rural women inSouthwestern Nigeria.
2. Studies that measure a combination of infrastructure elements are rare. The study provides information on the status of a combination of physical and social infrastructure. This will serve as an input for an all-inclusive approach to provision of infrastructure.
3. The level of growth of the ICT (Telecommunication) in Nigeria was revealed by the study. Global system of mobile telecommunication (GSM) using mobile phones was the most accessed infrastructure in rural Nigeria. This indicates that information can be readily available and disseminated to farmers, which in turn translates to gradual elimination of middlemen exploiting farmers.
4. Funding is key to agriculture.The study revealed that access to credit impacts access to infrastructure and productivity positively,hence, affirming the importance

ofcapital an as an important factor of production.This serves as a pointer to the fact that credit accessibility is key to improving farmers' productive capacity.

5. Social capital is key to enhancing women productive capacity and improving their welfare.The study confirmed this since group membership increased the productivity of rural women in Nigeria. Group participation should be encouraged among women to keep improving their social status positively. Existing women farmers groups and cooperatives should be closely monitored to ensure sustainable and positive collective action.
6. The empowerment status of women in Agriculture was revealed using relevant agricultural domains.This has not been adequately captured in literature because measures of empowerment have failed to capture individual level characteristics of women directly in the informal sector where farming belongs. The study provides a direct measure of empowerment of women in rural Nigeria and empirical evidence of factors influencing empowerment.
7. The contributors tounempowerment of women in agriculture were analysed.The time use domain was found to contribute the most to unempowerment. With this, women should be sensitized on the need to manage their time better, while ensuring they take advantage of the available infrastructure to allocate their time productively among economic and domestic activities.
8. Being divorced or widowed had a positive relationship with infrastructure access, this is contrary to social structure and cultural system in Nigeria where marriage confers some social status, and recognition for women. The study, therefore, established areas of further study in this regard.
9. Lastly, with telecommunication being the most assessed infrastructure, further research is encouraged to examine the influence and relationship between telecommunications and or productivity and empowerment in the study area.

5.5 Outcome of the Study

- The studyrevealeda moderate access to infrastructure in rural areas of SouthwesternNigeria, however with a varying level of accessto different physical and social infrastructure components.
- The study also revealed that infrastructural accessincreases productivity among the farmers.
- The study empirically linked infrastructure, productivity and empowerment of women in rural Nigeria, while confirming that both infrastructural access and productivity help to increase empowerment among the rural women.
- The study established, empirically, the status of women empowerment in Agriculture in rural Nigeria.
- The study identified area for further study regarding marital status within the rural social structure and cultural systems in Nigeria.

REFERENCES

Abdul-Qadir, Okoruwa& Olajide 2016. Productivity of Oil Palm Production Systems in Edo and Kogi States, Nigeria: A Total Factor Productivity Approach. *International Journal of Advanced Science and Technology*, 97, 37-44.

Abeyasekera, S. 2005. Chapter XVIII Multivariate methods for index construction. *Reading (UK): University of Reading. hlm*, 377-378.

Acha, C. K. 2014. Trend and levels of women empowerment in Nigeria. *Am J Appl Math Stat*, *2*(6), 402-408.

Adelekan, Y. A., & Omotayo, A. O. 2017. Linkage between rural non-farm income and agricultural productivity in Nigeria: A Tobit-two-stage least square regression approach. *The Journal of Developing Areas*, *51*(3), 317-333.

Adeleke, O. A., &Akinbile, L. A. 2019. Implications of empowerment status in agricultural production capabilities of rural women in selected states of Nigeria. *Journal of Agricultural Extension*, *23*(1), 37-53.

Adenipekun, M. T. 2013. Sustainable rural infrastructural development in Nigeria within the context of Vision 20: 2020. *International Journal of Development and Sustainability*, *2*(1), 254-269.

Adeoye, A., Balogun, O. L., Yusuf, S. A., &Ayantoye, K. 2014. Impact of community driven development project: A case of Fadama II Project in Oyo state, Nigeria. *Ethiopian Journal of Environmental Studies and Management*, *7*(2), 178-187.

Adepoju, A. 2018. *Determinants of multidimensional poverty transitions among rural households in Nigeria* (No. 2058-2018-5335).

Adepoju, A. A., & Salman, K. K. 2013. Increasing agricultural productivity through rural infrastructure: evidence from Oyo and Osun States, Nigeria. *International Journal of Applied Agriculture and Apiculture Research*, *9*(1-2), 1-10.

Adeyonu, A. G. 2012. Gender Dimensions of Time Allocation of Rural Farming Households in Southwestern Nigeria. *Current Research Journal of Social Sciences*, *4*(4), 269-276.

Afolabi, J. A. 2010. Analysis of loan repayment among small scale farmers in Oyo State, Nigeria. *Journal of Social Sciences*, *22*(2), 115-119.

African Development Bank (AFDB) 2013. The Infrastructure Action Plan for Nigeria: Closing the Infrastructure Gap and Accelerating Economic Transformation: Summary Report.

Agénor, P. R.&Agénor, M. 2014. Infrastructure, women's time allocation, and economic development. *Journal of Economics*, *113*(1), 1-30.

Ahmed, R., & Hossain, M. 1990. *Developmental impact of rural infrastructure in Bangladesh* (Vol. 83). Intl Food Policy Res Inst.

Ahmed, T., & Bhatti, A. A. 2020. Measurement and Determinants of Multi-Factor Productivity: A Survey of Literature. *Journal of Economic Surveys*, *34*(2), 293-319.

Ahmed, U. I., Ying, L., Bashir, M. K., Abid, M., & Zulfiqar, F. 2017. Status and determinants of small farming households' food security and role of market access in enhancing food security in rural Pakistan. *PloS one*, *12*(10), e0185466.

Ajayi, J. O., Aderinola, E. A., Afolabi, J. A., Alfred, S. D. Y., &Okunlola, J. O. 2016. Households'perceived Causes of Poverty inSouthwestern Nigeria. *Scientific Papers: Management, Economic Engineering in Agriculture & Rural Development*, *16*(1).

Akpan, N. S. 2015. Women and rural development in Nigeria: Some critical issues for policy consideration. *Social Sciences*, *4*(5), 110-118.

Akinlade, R. J., Yusuf, S. A., Omonona, B. T., &Oyekale, A. S. (2011). Poverty alleviation programme and pro-poor growth in rural Nigeria: Case of Fadama II project. *World Rural Observations*, *3*(1), 27-33.

Alam, K., Mahumud, R. A., Alam, F., Keramat, S. A., Erdiaw-Kwasie, M. O., &Sarker, A. R. 2019. Determinants of access to Health services in regional Australia. *International journal of medical informatics*, *131*, 103960.

Alkire, S., Meinzen-Dick, R., Peterman, A., Quisumbing, A., Seymour, G., &Vaz, A. 2013. The women's empowerment in agriculture index. *World development*, *52*, 71-91.

Alzola K. J., & Marino, M 2015. Women's mental health around the world: Education, poverty, discrimination and violence, and political aspects. In *Psychopathology in Women* (pp. 3-24). Springer, Cham

Amare, M., Cissé, J. D., Jensen, N. D., & Shiferaw, B. 2017. The Impact of Agricultural Productivity on Welfare Growth of Farm Households in Nigeria: A Panel Data Analysis. *FAO. Rome*.

Anang B. T., Timo S., Stefan B. and Jukka K. 2015. Factors influencing smallholder farmers' access to agricultural microcredit in Northern Ghana. *African Journal of Agricultural Research.* 10(24), 2460-2469.

Anderson, C. L., Reynolds, T. W., Biscaye, P., Patwardhan, V., & Schmidt, C. 2021. Economic benefits of empowering women in agriculture: Assumptions and evidence. *The Journal of Development Studies*, *57*(2), 193-208.

Anindya Chaudhuri, Kenneth S. Flamm, John Horrigan. 2015. An analysis of the determinants of internet access,*Telecommunications Policy,*Volume 29, Issues 9–10,Pages 731-755.

Anna K. P. 2011. Agricultural Production and Productivity *Agric. Economics Journal* (3)95-101. Sadguru Gadage Maharaj College, Karad, India

Ashagidigbi, W. M., Abiodun, O. F., & Samson, O. A. 2011. The effects of rural infrastructure development on crop farmer's productivity in Osun state. *World Rural Observations*, *3*(1), 48-58.

Awotide, B. A., Abdoulaye, T., Alene, A., &Manyong, V. M. 2015. *Impact of access to credit on agricultural productivity: Evidence from smallholder cassava farmers in Nigeria* (No. 1008-2016-80242).

Awoyemi, T. T., Obayelu, O. A., &Opaluwa, H. I. 2011. Effect of distance on utilization of health care services in rural Kogi State, Nigeria. *Journal of human Ecology*, *35*(1), 1-9.

Ayevbuomwan, O. S., Popoola, O. A., &Adeoti, A. I. 2016. Analysis of women empowerment in rural Nigeria: A multidimensional approach. *Global Journal of Human Science: C. Sociology and Culture*, *16*(6), 35-48.

Aymen, F., Boubaker, D., Aden, A. H., Samia, A., & Ali, I. 2015. Approaches to total factor productivity measurements in the agriculture economy. *CGIAR Research program in dry land system*.

Ayodele, O. O., Akinola, A. A., &Owombo, P. T. 2012. Economic efficiency of land improvement techniques among cassava farmers in Kogi State, Nigeria. *Online Journal of Social Sciences Research*, *1*(5), 154-159.

Brück, T., & Kebede, S. W. 2013.Dynamics and drivers of consumption and multidimensional poverty: Evidence from rural Ethiopia.: *Evidence from Rural Ethiopia. Retrieved 5 16, 2021,* from http://ftp.iza.org/dp7364.pdf

Baptista, S. R. 2014. Design and use of composite indices in assessments of climate change vulnerability and resilience. *New York: The Earth Institute, Columbia University*.

Bulus, J. S., &Adefila, J. O. 2014. The study of rural infrastructural facilities in Kajuru area, Kaduna State of Nigeria: a spatial analysis for planning. *International Journal of Humanities and Social Science*, *4*(2), 286-295.

Calderon, C., Cantu, C., &Chuhan-Pole, P. 2018. Infrastructure development in Sub-Saharan Africa: a scorecard. *World Bank Policy Research Working Paper*, (8425).

Calderón, C., &Servén, L. 2010. Infrastructure and economic development in Sub-Saharan Africa. *Journal of African Economies*, *19*(suppl_1), i13-i87.

Capalbo, S. M., &Antle, J. M. (Eds.). 2015. *Agricultural productivity: measurement and explanation*. Routledge.

Cecilia Calderon and Milorad Kovacevic 2015 ; MultidimensionalPoverty Index (MPI) Construction and Analysis. UNDP, Human Development reports.

Cerra, V., Cuevas, A., Goes, C., Karpowicz, I., Matheson, T., Samake, I., &Vtyurina, S. 2017. Determinants of Infrastructure and Its Financing. *Emerging Economy Studies*, *3*(2), 113-126.

Chakrabartty, S. N. 2017. Composite index: Methods and properties. *Journal of Applied Quantitative Methods*, *12*(2), 25-33.

Chen, C. M., Delmas, M. A., & Lieberman, M. B. 2015. Production frontier methodologies and efficiency as a performance measure in strategic management research. *Strategic management journal*, *36*(1), 19-36.

Collier, P., & Cust, J. 2015. Investing in Africa's infrastructure: Financing and policy options. *Annu. Rev. Resour. Econ.*, *7*(1), 473-493.

Cuevas, A. C. 2014. Transaction costs of exchange in agriculture: a survey. *Asian Journal of Agriculture and Development*, *11*(1362-2016-107722), 21-38.

Diaz-Sarachaga, J. M., Jato-Espino, D., Alsulami, B., & Castro-Fresno, D. 2016. Evaluation of existing sustainable infrastructure rating systems for their application in developing countries. *Ecological indicators*, *71*, 491-502.

Dhehibi, B. (2015). Approaches to Total Factor Productivity Measurements in the Agriculture Economy.

Diiro, G. M., Seymour, G., Kassie, M., Muricho, G., &Muriithi, B. W. 2018. *Women's empowerment in agriculture and agricultural productivity: Evidence from rural maize farmer households in western Kenya*. *PloS one*, *13*(5), e0197995.

Doss, C. R. 2018. Women and agricultural productivity: Reframing the Issues. *Development Policy Review*, *36*(1), 35-50. Douglas C Montgomery A, Peck G and Vining G 2012. Introduction to Linear Regression Analysis. 5th Edition Publisher- John Wiley and Sons ISBN: 978-0-470-54281-1

Duflo, E. (2012). Women empowerment and economic development. *Journal of Economic literature*, *50*(4), 1051-79.

Duy, V. Q., D'Haese, M., Lemba, J., &D'Haese, L. 2012. Determinants of household access to formal credit in the rural areas of the Mekong Delta, Vietnam. *African and Asian studies*, *11*(3), 261-287.

Egbetokun, O. A. 2009. Provision of rural infrastructures in Oyo State of Nigeria. *Journal of Agricultural Sustainable Practice*, *1*(2), 69-70.

Egwurube, J. 2016. Challenges facing women empowerment in contemporary Nigeria. *MREVUE*, *2*(4-2016), 135.

Emmanuel, A. A., &Fasakin, J. O. 2015. Provision of critical infrastructure in urban hinterland and rural coastland of Southwestern Nigeria: comparing the efforts of CBOs. *African Geographical Review*, *34*(2), 125-141.

Emerson, R. W. 2015. Causation and Pearson's correlation coefficient. *Journal of visual impairment & blindness*, *109*(3), 242-244.

Fakayode, B. S., Omotesho, O. A., Tsoho, A. B., & Ajayi, P. D. 2008. An economic survey of rural infrastructures and agricultural productivity profiles in Nigeria. *European Journal of Social Sciences*, *7*(2), 158-171.

Felloni, F., Wahl, T., Wandschneider, P., & Gilbert, J. 2011. Infrastructure and agricultural production: cross-country evidence and implications for China. *TW.-2001-103. Washington State University: Pullman*.

Fernald, J. 2014, April. A quarterly, utilization-adjusted series on total factor productivity. Federal Reserve Bank of San Francisco.

Fielding, K. S., Russell, S., Spinks, A., & Mankad, A. 2012. Determinants of household water conservation: The role of demographic, infrastructure, behavior, and psychosocial variables. *Water Resources Research*, *48*(10).

Foster, J., Greer, J., &Thorbecke, E. 2010. The Foster–Greer–Thorbecke (FGT) poverty measures: 25 years later. *The Journal of Economic Inequality*, *8*(4), 491-524.

Foster, V., &Pushak, N. 2011. *Nigeria's infrastructure: a continental perspective*. The World Bank.

Fowowe, B. 2020. The effects of financial inclusion on agricultural productivity in Nigeria. *Journal of Economics and Development*.

Fuglie, K. O. 2018. Is agricultural productivity slowing?. *Global food security*, *17*, 73-83.

Garbero, A., &Perge, E. (2017). Measuring women's empowerment in agriculture.

Gaal, H. O., &Afrah, N. A. 2017. Lack of Infrastructure: The Impact on Economic Development as a case of Benadir region and Hir-shabelle, Somalia. *Developing Country Studies*, *7*(1).

Gashu, D., Demment, M. W., &Stoecker, B. J. (2019). Challenges and opportunities to the African agriculture and food systems. *African Journal of Food, Agriculture, Nutrition and Development*, *19*(1), 14190-14217.

Gbadebo, A. W., Ademayowa, A. A., Mobolaji, A. W., &Ayanyemi, A. A. 2013. Determinants of Farmers 'Demand for Micro Finance: The Case of a Rural Community in Nigeria. *Journal of Economics and Sustainable Development*, *4*(5), 24-31.

Granada, I., Monje, A., Pastor, M., Gutiérrez, M. C., Caldo, A., & Pérez, D. 2019. Linking Gender Equality (Goal 5) with Decent Work and Economic Growth opportunities (Goal 8) through the Development of Infrastructure (Goal 9) in Latin America and the Caribbean (LAC): Pilot Experiences in Bolivia, Paraguay and Nicaragua.

Gujarati, DN, Bernier, B., & Bernier, B. 2004. *Econometrics* (pp. 17-5). Brussels: De Boeck.

Gupta, S., Pingali, P. L., &Pinstrup-Andersen, P. 2017. Women's empowerment in Indian agriculture: does market orientation of farming systems matter? *Food security*, *9*(6), 1447-1463.

Gurara, D., Klyuev, V., Mwase, N., &Presbitero, A. F. 2018. Trends and challenges in infrastructure investment in developing countries. *International Development Policy| Revue internationale de politique de développement*, (10.1).

Han, S., & Lee, S. 2019. Estimation in a generalization of bivariate probit models with dummy endogenous regressors. *Journal of Applied Econometrics*, *34*(6), 994-1015.

Hassanzadeh, J., Moradi, N., Esmailnasab, N., Rezaeian, S., Bagheri, P., &Armanmehr, V. (2014). The correlation between gender inequalities and their health-related factors in world countries: a global cross-sectional study. *Epidemiology Research International*, *2014*.

Independent Evaluation Group (IEG)2017. Women's Empowerment in Rural Community-Driven Development Projects.

Islam, A., Muzi, S., & Amin, M. 2019. Unequal laws and the disempowerment of women in the labour market: evidence from firm-level data. *The Journal of Development Studies*, *55*(5), 822-844.

Jane, K. M., Wambugu, A., &Musau, S. 2011. *Multidimensional poverty in Kenya: Analysis of maternal and child wellbeing* (No. 164626). Partnership for Economic Policy (PEP).

Jerumeh, T. R. 2019. *Gender Analysis of Healthcare Expenditures in Rural Nigeria* (Doctoral dissertation).

John, K. M., &Seini, W. 2013. Technical efficiency analysis of maize farmers in the Eastern Region of Ghana. *Journal of Social and Development Sciences*, *4*(2), 84-99.

Kabeer, N. 2017. Economic pathways to women's empowerment and active citizenship: What does the evidence from Bangladesh tell us? *The Journal of Development Studies*, 53(5), 649–663.

Keane, M. P., & Neal, T. 2021. A New Perspective on Weak Instruments.

Keberuka, D., 2011. Boosting infrastructure investments in Africa. *World Economics*, 2(2), pp. 7-24.

Kemi, A. O., &Jenyo, O. G. 2016. Gender equality and the empowerment of women and girls in Nigeria: the way forward to national security. *Open Journal of Social Sciences*, *4*(07), 230.

Kilic, T., Palacios-Lopez, A., & Goldstein, M. 2015. Caught in a productivity trap: A distributional perspective on gender differences in Malawian agriculture. *World Development*, *70*, 416-463.

Kiprono, P., & Matsumoto, T. 2014, March. Roads and farming: The effect of infrastructure improvement on agricultural input use, farm productivity and market participation in Kenya. In *CSAE conference* (pp. 23-25).

Kossymbayeva, S. I., Nukesheva, A. Z., Kirbassova, L. G., &Saubetova, B. S. 2019. Analysing the Efficiency of Managing the Rural Social Infrastructure in the Region. *Space and Culture, India*, *7*(3), 204-214.

Koolwal, G., & Van de Walle, D. 2013. Access to water, women's work, and child outcomes. *Economic Development and Cultural Change*, *61*(2), 369-405.

Kozak, M., Krzanowski, W., &Tartanus, M. 2012. Use of the correlation coefficient in agricultural sciences: problems, pitfalls and how to deal with them. *Anais da Academia Brasileira de Ciências*, *84*(4), 1147-1156.

Kozak, N. I. 2015. Access to infrastructure. *The International Encyclopedia of Digital Communication and Society*, 1-7.

Kurbatova, S. M., Aisner, L. Y., &Naumov, O. D.2020. Labor resource as a factor of modern agricultural production. In *E3S Web of Conferences* (Vol. 161, p. 01088). EDP Sciences.

Lan, C. W., &Tavrow, P. 2017. Composite measures of women's empowerment and their association with maternal mortality in low-income countries. *BMC pregnancy and childbirth*, *17*(2), 1-11.

Leder, S. 2016. Linking women's empowerment and their resilience. *International Water Management Institute-Nepal*.

Letsara, N., Saidi, S., &Lufumpa, C. L. 2013. The Africa infrastructure development index (AIDI). *Infrastructure in Africa: Lessons for Future Development*, 25.

Llanto, G. M. 2012. *The impact of infrastructure on agricultural productivity* (No. 2012-12). PIDS Discussion Paper Series.

Li, Z., & Liu, X. 2009. *The effects of rural infrastructure development on agricultural production technical efficiency: evidence from the data of Second National Agricultural Census of China* (No. 1005-2016-78948).

Llewelyn, R. V., & Williams, J. R. 1996. Nonparametric analysis of technical, pure technical, and scale efficiencies for food crop production in East Java, Indonesia. *Agricultural Economics*, *15*(2), 113-126.

Makama G.A 2013. Patriarchy and Gender Inequality in Nigeria: The Way Forward. *European Scientific Journal*, 9(17).

Malapit, H. J., Sproule, K., Kovarik, C., Meinzen-Dick, R. S., Quisumbing, A. R., Ramzan, F., &Alkire, S. 2014. *Measuring progress toward empowerment:*

Women's empowerment in agriculture index: Baseline report. Intl Food Policy Res Inst.

Mandal, K. C. 2013, May. Concept and Types of Women Empowerment. In *International Forum of Teaching & Studies* (Vol. 9, No. 2).

Manoj, K., Tauqueer, A., Anil, R., & Sahoo, P. M. 2013. Methodology for construction of composite index. *International Journal of Agricultural and Statistical Sciences*, *9*(2), 639-647.

Mariyono, J. 2018. Profitability and determinants of smallholder commercial vegetable production. *International Journal of Vegetable Science*, *24*(3), 274-288.

Merter M. 2021. Economic growth under Solow-neutrality. Economic Research-Ekonomska.

Mohun, R., Biswas, S., Jacobson, J., & Sajjad, F. 2016. Infrastructure: A Game Changer for Women's Economic Empowerment. *Background Paper. UN Secretary-General's High-Level Panel on Women's Economic Empowerment*.

Moore, C. 2013. An introduction to logistic and probit regression models. *Lecture Notes, University of Texas, Austin*.

Musa, B. A. 2011. *Women Participation in Agriculture: The Role And Impact Of Agricultural Development Project (AADP) in Kogi State* (Doctoral dissertation).

Mwuese, A. M., &Okorji, E. C. 2015. Determinants of Productivity among Women in Development Activity: A Case Study of the Cassava Women Farmers of Benue Agricultural Development Project, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*, 158-165.

Nadeem, N., Mushtaq, K., &Javed, M. I. 2011. Impact of social and physical infrastructure on agricultural productivity in Punjab, Pakistan-A production function approach. *Pakistan Journal of life and social sciences*, *9*(2), 153-158.

Nayak, C. 2014. Rural Infrastructure in Odisha: An Inter-District Analysis. *PRAGATI: Journal of Indian Economy*, *1*(1), 17-38.

Nchuchuwe, F. F., &Adejuwon, K. D. 2012. The challenges of agriculture and rural development in Africa: the case of Nigeria. *International Journal of Academic Research in Progressive Education and Development*, *1*(3), 45-61.

Njuki, J., Kruger, E., & Starr, L. 2013. Increasing the productivity and empowerment of women smallholder farmers results of a baseline assessment from six countries in Africa and Asia. *Atlanta: CARE< http://www. care. org/sites/default/files/documents/pathways-global-baselinereport-2013. pdf>[accessed 7 August 2016]*.

Nouman, M., Siddiqi, M., Asim, S., & Hussain, Z. 2013. Impact of socio-economic characteristics of farmers on access to agricultural credit. *Sarhad Journal of Agriculture*, *29*(3), 469-476.

Nzomoi, J. N., Byaruhanga, J. K., Maritim, H. K., &Omboto, P. I. 2007. Determinants of technology adoption in the production of horticultural export produce in Kenya.

Obayelu, A. E., Olarewaju, T. O., &Oyelami, N. L. 2014. Effect of rural infrastructure on profitability and productivity of cassava-based farms in Odogbolu local government area, Ogun state, Nigeria. *Journal of Agricultural Sciences, Belgrade*, *59*(2), 187-200.

Obayelu, O. A., & Chime, A. C. 2020. Dimensions and drivers of women's empowerment in rural Nigeria. *International Journal of Social Economics.* 47(3),315-333 https://doi.org/10.1108/IJSE-07-2019-0455

Odeny, M. 2013. Improving Access to Land and strengthening Women's land rights in Africa. In *World Bank Conference on Land and poverty, Washington, DC*.

O'Donnell, C. J. 2010. Measuring and decomposing agricultural productivity and profitability change. *Australian Journal of Agricultural and Resource Economics*, *54*(4), 527-560.

Odurukwe, S. N., Matthews-Njoku, E. C., &Ejiogu-Okereke, N. 2006. Impacts of the women-in-agriculture (WIA) extension programme on women's lives, implications for subsistence agricultural production of women in Imo State, Nigeria. *Livestock Research for Rural Development*, *18*(2), 47-61.

Ofuoku, A. U., &Agbamu, J. U. (2016). Maize contract farming experience in Delta State, Nigeria. *Journal of Northeast Agricultural University (English Edition)*, *23*(1), 65-73.

Ogato, G. S., Boon, E. K., & Subramani, J. 2009. Improving access to productive resources and agricultural services through gender empowerment: A case study of three rural communities in Ambo District, Ethiopia. *Journal of human Ecology*, *27*(2), 85-100.

Ogbalubi, L. N., &Wokocha, C. C. 2013. Agricultural development and employment generation: The Nigeria experience. *Journal of Agriculture and Veterinary Science*, *2*(2), 60-69.

Ogunlela, Y. I., & Mukhtar, A. A. 2009. Gender issues in agriculture and rural development in Nigeria: The role of women. *Humanity & social sciences Journal*, *4*(1), 19-30.

Ogunmakinde, O. E., Oladokun, S. D., &Oke, O. E. 2015. Rural-urban migration in Southwestern Nigeria: A menace to national development. *Civil and Environmental Research*, *7*(5), 42-47.

Ojo, C. O., Bila, C. Y., & Iheanacho, A. C. 2012. Agricultural resource access and the influence of socio-economic characteristics among rural women in Borno State, Nigeria. *Agris on-line Papers in Economics and Informatics*, *4*(665-2016-44887), 27-33.

Okhankhuele, O. T., &Opafunso, O. Z. 2013. Causes and consequences of rural-urban migration Nigeria: A case study of Ogun Waterside local Government area of Ogun State, Nigeria. *British Journal of Arts and Social Sciences*, *16*(1), 185-194.

Oladokun, Y. O. M., &Adenegan, K. O. 2019. Asset Ownership and Welfare Deprivation of Women in rural Nigeria: A bi-causal relationship. *Journal of Economics, Management and Trade*, 1-16.

Olajide, B. R. 2011. Assessment of farmers' access to agricultural information on selected food crops in Iddo District of Oyo State, Nigeria. *Journal of Agricultural & Food Information*, *12*(3-4), 354-363.

Olaore, G. O., Adejare, B. O., &Udofia, E. E. 2021. The gains and pains of small and medium-scale enterprises (SMEs): the way forward for entrepreneurship development in Nigeria. *Rajagiri Management Journal*.

Olarinre, A. A., &Omonona, B. T. 2018. Effect of Land Fragmentation on the Productivity of Rice Farmers in Osun Study area. Applied Tropical Agriculture, 23(1), 105– 111. https://doi.org/10.13140/RG.2.2.11854.31049

Olaseni, M., &Alade, W. 2012. Vision 20: 2020 and the challenges of infrastructural development in Nigeria. *Journal of Sustainable Development*, *5*(2), 63.

Olomola, P. A., &Osinubi, T. T. 2018. Determinants of total factor productivity in Mexico, Indonesia, Nigeria, and Turkey (1980–2014). *Emerging Economy Studies*, *4*(2), 192-217.

Olorunfemi, S. O. 2020. Rural Road Infrastructural Challenges: An Impediment to Agricultural Development in Idanre Local Government Area of Ondo State, Nigeria. *Ghana Journal of Geography*, *12*(2), 108-124.

Olukunle, O. T. 2013. Challenges and prospects of agriculture in Nigeria: the way forward. *Journal of Economics and Sustainable Development*, *4*(16), 37-45.

Oluwagbamila, O., & Samson, A. A. 2017. Analysis of socio-economic characteristics and utilization of healthcare facilities in Owo Local Government Area of Ondo State, Nigeria. *European Scientific Journal*, *13*(23), 377-391.

Ondiege, P.,Moyo, J. M., &Verdier-Chouchane, A. 2013. Developing Africa's infrastructure for enhanced competitiveness. In *World Economic Forum, the African Competitiveness Report* (Vol. 2013, pp. 69-92).

Onokala, P. C. 2015. Transportation Development in Nigeria: The Journey so far and the way forward. *The 97th Inaugural Lecture. University of Nigeria, Nsukka*.

Onuoha C. 2019. Improving Nigeria's Electricity Supply industry through public education. 2, (25).

Ovharhe, O. J., Okpara, O., &Asedegbega, C. 2020. Assessment of stakeholders' contributions to livestock development in Delta State, Nigeria: Rural infrastructure intervention. *Open Agriculture*, *5*(1), 656-668.

Oyedepo, S. O., Babalola, P. O., Nwanya, S., Kilanko, O. O., Leramo, R. O., Aworinde, A. K., &Agberegha, O. L. 2018. Towards a sustainable electricity supply in Nigeria: the role of decentralized renewable energy system. *European Journal of Sustainable Development Research*, *2*(4).

Patra, A. K., & Acharya, A. 2011. Regional disparity, infrastructure development and economic growth: An inter-state analysis. *Research and Practice in Social Sciences*, *6*(2), 17-30. IDI

Plag, I. 2020. Productivity. *The handbook of English linguistics*, 483-499.

Quisumbing, A. R., Meinzen-Dick, R., Raney, T. L., Croppenstedt, A., Behrman, J. A., & Peterman, A. 2014. Gender in agriculture. *Springer*, *102072*, 444.

Rahji, M. A. Y. 2007, September. Rural infrastructure, farm output and productivity nexus in a multi-crop economy, the case of Oyo State, Nigeria. In *Proceedings of the 21st Annual national conference of farm management association of Nigeria* (pp. 3-6).

Rahman, S. 2014. Impact of rural infrastructure on farm and non-farm enterprise choice and income in Bangladesh. *The Journal of Developing Areas*, 275-290.

Rana, I. A., Bhatti, S. S., & e Saqib, S. 2017. The spatial and temporal dynamics of infrastructure development disparity–From assessment to analyses. *Cities*, *63*, 20-32.

Raney, T. 2011. The state of food and agriculture. *Women in Agriculture: Closing the Gap for Development*, *2*.

Resnick, D., Diao, X., & Tadesse, G. 2020. *2020 Annual trends and outlook report: Sustaining Africa's agrifood system transformation: The role of public policies: Synopsis*. Intl Food Policy Res Inst.

Reza Anik, A., Rahman, S., &Sarker, J. R. 2020. Five Decades of Productivity and Efficiency Changes in World Agriculture (1969–2013). *Agriculture*, *10*(6), 200.

Salman, K. K., Salawu, M. B., Oni, O. A., & Obi-Egbedi, O. 2020. Does Maternal Autonomy Influence Child Nutrition in Rural Nigeria? *Journal of Hunger & Environmental Nutrition*, 1-20.

Sander, G., & Keller, N. J. (2021). 11. McKinsey Gender Parity Report. *Handbook on Diversity and Inclusion Indices: A Research Compendium*, 164.

Seber, G. A., & Lee, A. J. (2012). *Linear regression analysis* (Vol. 329). John Wiley & Sons.

Shang, Q., & Lee, L. F. 2011. Two-step estimation of endogenous and exogenous group effects. *Econometric Reviews*, *30*(2), 173-207.

Sharaunga, S., Mudhara, M., &, A. 2019. Conceptualisation and measurement of women's empowerment revisited. *Journal of Human Development and Capabilities*, *20*(1), 1-25.

Sharma, C., & Sehgal, S. 2010. Impact of infrastructure on output, productivity and efficiency. *Indian Growth and Development Review*.

Sulaiman, J., Azman, A., & Khan, Z. 2014. Re-modeling urban poverty: A multidimensional approach. *International Journal of Social Work and Human Services Practice*, *2*(2), 64-72.

Tanko, Y., Kang, C. Y., & Islam, R. 2019. Impact of Rural Infrastructure on Rice Productivity in Kano State, Nigeria. *European Academic Journal*, *7*(1), 286-311.

Tanko, Y., Islam, R., Cheah, Y. K., & Abidin, I. S. Z. 2020. Effect of physical and institutional infrastructures on efficiency of rice farmers. *International Journal of Management*, *11*(4).

Ukoha, O. O., Okoye, B. C., &Emetu, J. 2010. Analysis of the Determinants of Total Factor Productivity among Small-Holder Cassava Farmers in Ohafia LGA of Abia State.

Uyang, F. A., Ejeje, J. A., &Aniah, E. A. 2016. Gender inequality and women empowerment in Warri South Local Government area of Delta State, Nigeria. *European Journal of Research in Social Sciences Vol*, *4*(6).

Wang, S. L., Heisey, P., Schimmelpfennig, D., & Ball, V. E. 2015. Agricultural productivity growth in the United States: Measurement, trends, and drivers. *Economic Research Service, Paper No. Err-189*.

Wiklander, J. 2010. Determinants of women's empowerment in rural India: an intra-household study.

Wooldridge, J. M. (2015). *Introductory econometrics: A modern approach*. Cengage learning.

World Bank 2010: ‘Making infrastructure work for women and men: A review of World Bank Infrastructure projects (1995-2009)’

World Bank. 2018. *The World Bank Annual Report 2018*. The World Bank.

Wouterse, F. 2016. Empowerment and agricultural production: Evidence from rural households in Niger.

Yount, K. M., Cheong, Y. F., Maxwell, L., Heckert, J., Martinez, E. M., & Seymour, G. 2019. Measurement Properties of the project-level Women's Empowerment in Agriculture Index. *World development*, *124*, 104639.

Yusuf, T. M., Okunmadewa, F. Y., Adenegan, K. O., &Oyekale, A. S. 2010. Productivity of women farmers in the derived savannah zone of Nigeria: Panacea to food crisis.

Yusuf, O. R., &Ukoje, J. A. 2011, February. The imperative of "Eco-supportive" infrastructure for sustainable rural livelihood in a changing climate. In *Proceedings of the 52nd Annual Conference of the Association of Nigerian Geographers (ANG), UsumanDanfodiyo University, Sokoto, Nigeria* (pp. 14-18).

APPENDIX

APPENDIX 1: Table of Analysis of Objectives

Objectives	**Data requirements**	**Analytical tools**
Determine the level of farmers' access to infrastructure in the study area	Socio-economic variables, details of rural infrastructure such as road, electricity, health facilities, water, market, school, storage, and telecommunications.	Descriptive statistics, mean, / mode, frequency, tabulation, composite score measure.
Examine the factors affecting women farmers' access to infrastructure in the study area	Age, Age square, Household size, Farming Experience, Occupation, Household head, Education, Marital Status, Type of Farming, Wage employment, Access to credit	Truncated tobit Regression

Determine the effect of access to infrastructure on Productivity in the study area.	Age, Education, Household Size, Farming experience, Farm size, Household head, Marital Status, Primary occupation, Distance to Extension office, Number of plots, Credit access, Infrastructural index, Household member on farm, Membership of association, Distance to the market.	Total Factor Productivity, and OLS
Assess the status of women empowerment in the study area	Variables of the five agricultural domains namely, Resources, Production, Income, leadership and time	5DE score of Women's Empowerment in Agriculture Index (WEAI).
Examine the effect of infrastructure access on women empowerment.	Infrastructure index, Productivity, Age, Secondary Occupation, distance to nearest Market, Ownership of GSM, Type of household, Age square, household labour size, Wage employment.	IV Probit regression model.

Source: Author's compilation

APPENDIX 2: Composite Access Indicators across Eight Infrastructure Elements

Infrastructure Component	Access Indicators
	Improved water source
Water	Distance to the nearest water source
	Network access/coverage
Telecommunication	Ownership of a mobile telephone
Electricity	Access to public power supply
	Hours of supply of power
Transport	Access to tarred road

	Distance to the nearest road
Education	Access to available education facility
	Contact with education facility in the last 1 year
Health	Access to functional health facility
	Distance to the nearest health facility
Market	Access to market
	Type of market patronized
Storage	Access to modern storage
	Contact with modern storage in the last 1 year

Adapted from:Letsara*et al.,* (2013), AFDB, (2013), Manoj, (2013), Baptista, (2014)

APPENDIX 3: Production Variables

Production Variables	Average(N)
LandCost	31,824.21
Seedling Cost	8,542.40
PlantingCost	8,180.75
WeedingCost	14,890.86
Irrigation Cost	13,750.17
PestCost	6,730.61
Fertilizer Cost	7,329.48
HarvestCost	6,100.40
TransportCost	7,287.74
Family Labour Cost	3,200.60
Hired labour Cost	64,248.37
Other Cost	60,000.00
Feeds Cost	30,615.00
Vaccine Cost	10,000.00

Logistics Cost	2,000.00
TotalOutput	327,486.30

Source: Field Survey 2018

APPENDIX 4: Percentage Contribution of Each Infrastructure Components

Infrastructure Component	Sub Index	Percentage %
Water	0.35	7.17
Telecommunication	0.95	19.43
Education	0.66	13.48
Health	0.58	11.92
Power	0.93	19.05
Market	0.72	14.78
Storage	0.03	0.62
Road	0.66	13.55

RESEARCH QUESTIONNAIRE

AGRICULTURAL ECONOMICS DEPARTMENT, UNIVERSITY OF IBADAN

This questionnaire seeks to establish the **EFFECT OF ACCESS TO INFRASTRUCTURE ON PRODUCTIVITY ANDEMPOWERMENT OF RURAL WOMEN FARMERS IN SOUTHWESTERN NIGERIA.** Questions will be asked to capture respondents' Profile, Access to Infrastructure, Empowerment, and Productivity as they relate to the study objectives.

- You are not required to fill in your names.
- All questions are intended for academic research purpose ONLY.
- All information given will be treated with utmost confidentiality.

SECTION A: PROFILE DEMOGRAPHIC AND SOCIO-ECONOMIC INFORMATION

- Kindly answer all questions correctly, ticking or answering as appropriate.

S/N	Item	Options	Responses
1	Household Identification		
2	Questionnaire No		
3	Name of Zone		
4	Name of community		
5	Gender	(i)=Female	
6	Household Type	(i)=2 Adults (Man & Woman) (ii)=1 adult only (Woman)	
7	Are you the household head?	(i)=Yes (ii)=No	
8	Marital status	(i)=Single (ii)=Married (iii)=Divorced (iv)=Widowed	
9	Age (yrs)		
10	Years of Education		
11	Household size		
12	How many people in your household work with you on the farm?		
13	Primary occupation	(i)=Farming only (ii)=Farming + others	
14	What is your secondary occupation?	(i)=Farming only (ii)=Trading (iii)=Artisan (iv)=Civil servant (v)=Others (specify)	
15	How long have you been farming?		
16	Scale of operation	(i)=Small (ii)=Medium (iii)=Large	
17	What type of farming do you practice?	(i)=Crop farming (ii)=Animal husbandry (iii)= Mixed Farming (iv)=Others (specify)	
18	What do you produce?	(i)=Cash crop (ii)= Food crop (iii)= Both i& ii (iv)=Livestock (v)=Fish (vi)= Others (specify)	
19	Income (month)		
20	How long have you lived in your current location? (yrs.)		
21	What is the ownership status of your house?	(i)=Owned (ii)= Rented (iii)= Leased	

SECTION B: INFRASTRUCTURAL FACILITIES.Please provide answers as appropriate			
S/N	**Item**	**Options**	**Responses**
	1. COMMERCIAL MARKET		
22	What type of apartment do you live in?	i)=Room self-contained (ii)= Face me I face you (iii)= Flat (iv)=Others (specify)	

23	What type of market do you have in this community?	(i)=Daily (ii)=Periodic (iii)=None	
24	Do you patronize any of these markets?	(i)=Yes (ii)=No, why?	
25	What type of market infrastructure exists in this community?	(i)=Open Market (ii)=Covered stalls (iii)=Partitioned stalls	
26	What is the distance to the nearest market in km?		
27	What is the transportation cost to the market weekly?		
28	In what ways have you benefitted from the market? Tick as appropriate	(i)=Major source of income i) Yes ii) No (ii)=Creates contact/social gathering i) Yes ii) No (iii)=keeps me up to date with market trend i) Yes ii) No (iv)=Acts as agent of innovation/message diffusion (v)=Any other, specify……..	
	2. WATER FACILTY		
29	What are the sources of water in this community?	(i)=River/stream (ii)=Open well (iii)=Closed well (iv)=Borehole (v)=Tap water (vi)=None (vii)=Others, (specify)	
30	What is the distance to the water source in km?		
31	How much does it cost you to access/provide water on a daily basis?		
32	Is the water source in your community sufficient	(i)=Yes (ii)=No	
33	Who provides water in your community? Please tick as appropriate.		

SOURCES	**PROVIDER**	**PROVIDER**	**PROVIDER**	**PROVIDER**
	GOVT	COMMUNITY	NGO	SELF
i. Tap water				
ii. Borehole				
iii. Well				

34	What is your main source of drinking water?	(i)=River/stream (ii)=Open well (iii)=Closed well (iv)=Borehole (iii)=Tap water	

		(iv)=Rainwater	
35	What benefits are derived from the water sources? Tick as appropriate	(i)=Reduced time/distance in getting water for use. i) Yes ii) No (ii)=facilitates irrigation i) Yes ii) No (iii)=reduction in water borne diseases i) Yes ii) No (iv)=its availability has increased usage i) Yes ii) No (v)=Any other, specify.....	
	3. ELECTRICITY		
36	Do you have public power supply in this community?	((i)=Yes (ii)=No	
37	Who provides electricity in your community?	(i)=Government (ii)=Community (iii)= NGO/RELIGIOUS ORG. (iv)=Others, (specify)	
38	Is PHCN your main source of power?	((i)=Yes (ii)=No	
39	On the average, how many hours of PHCN power do you have in 24hrs?		
40	How much does it cost you to have power in a month?		
41	What benefits have you derived from the use of electricity? Tick as appropriate	(i)=Better standard of living i) Yes ii) No (ii)=Boost's business/services i) Yes ii) No (iii)=Illuminates surrounding for safety. i) Yes ii) No (iv)=keeps one updated in terms of current events/news etc. i) Yes ii) No (v)=Makes domestic work easier. i) Yes ii) No (vi)=Any other, specify.....	
	4. HEALTH FACILITY		
42	Do you have any health facility in this community?	((i)=Yes (ii)=No	
43	What types of health facilities are available in this community?	(i)=General Hospital (ii)=Private Hospital (iii)=Primary healthcare centre (iv)=Pharmacy (v)=Patent medicine store (vi)=Any other, specify	
44	What is the distance to the nearest health facility in Km?		
45	What is the cost of transportation to the nearest health facility?		
46	Where do you access health care?	(i)=Self medication (ii)= Hospital (iii)=Traditional herbalist (iv)= Patent medicine store /Pharmacy (v)=Church/Mosque	

		(vi)=Any other, specify	
47	Please state why you picked the answer above?	(i)=Proximity to facility (ii)= Cost of access (iii)=Availability (iv)= Convenience/Belief (v)=Any other, specify	
48	What are the benefits that you have derived from the health facilities?	i)=Immunization and vaccination i) Yes ii) No (ii)= anti/post-natal/delivery services i) Yes ii) No(iii)=Administration of drugs& injection. i) Yes ii) No (iv)= General diagnosis i) Yes ii) No (v)=Any other, specify.....	
49	What can you say about the general condition of available facility?		

FACILITY	CONDITION	
i. Staffing	Adequate	Inadequate
ii. Attention of staff to patients	Good	Bad
iii. Availability of drugs	Adequate	Inadequate
iv. Availability of space for patients	Adequate	Inadequate
v. Cleanliness of the hospital/clinic	Good	Bad

5. TRANSPORT FACILITY			
50	What type of road network is available in your community?	(i)=Tarred Road (ii)= Untarred Road (iii)=No road network	
51	Available transport facilities?	(i)=Motorable road (ii)= Motor park (iii)=boat/ferry system (iv)=Railway system (v)= Others, (specify)	
52	What means of transportation do you own?	(i)=Bicycle (ii)= Motor Cycle (iii)=Car (iv)=Truck (v)= Others, (specify)	
53	What is the distance to any motorable road in km?		
54	Averagely, how much do you spend on transportation weekly?		
55	Averagely, how much do you spend on transportation to and fro the farm daily?		
56	How much does it cost you to get to the state capital?		
57	What is your main means of transportation?	(i)=Self owned means (ii)= Public transport (iii)= Others, (specify)	

58	What are the possible benefits that you have derived from available transport facilities in this community?	i)=Reduced travel time i) Yes ii) No (ii)= lower commodity price i) Yes ii) No (iii)=increased mobility i) Yes ii) No (iv)= lower prices of hauling produce to the market i) Yes ii) No (v)=Any other, specify.....	
	6. COMMUNICATION FACILITY		
59	Do you have network access in this community?	(i)=Yes (ii)=No	
60	What are the available networks in this community?	(i)=MTN (ii)= Airtel (iii)=GLO (iv)= 9 mobile (v)=Any other, specify	
61	Do you own any of the available networks?	(i)=Yes (ii)=No	
62	If No, why?	(i)=High cost of acquisition i) Yes ii) No (ii)= High cost of maintenance i) Yes ii) No (iii)= Not needed i) Yes ii) No (iv)= Any other, specify.....	
63	If yes, which one(s)?	(i)=MTN i) Yes ii) No (ii)= Airtel i) Yes ii) No (iii)=GLO i) Yes ii) No (iv)= 9 mobile i) Yes ii) No (v)=Any other, specify.....	
64	What is your main means of communication/dissemination of information?	(i)=Personal GSM (ii)= Face to Face (iii)=Business call centre (iv)= Media (v)= Town crier (vi)=Extension agents (vii)=Any other, specify	
65	How much on the average do you spend on calls weekly?		
66	What is the distance to the nearest extension office?		
67	How as GSM improved your life? (i)=Enhanced businesses and business contacts. (i) Yes (ii) No (ii)= Reduced frequency of travel (i) Yes (ii) No (iii)=Reduced price dispersion (i) Yes (ii) No (iv)= Reduced middlemen exploitation (i) Yes (ii) No (v)= Provides employment opportunities (i) Yes (ii) No (vi)=Reduced information gaps (i) Yes (ii) No (vii)=Instant means of communication (i) Yes (ii) No (viii)= Enhanced market price check (i) Yes (ii) No (ix)=Improved family ties (i) Yes (ii) No (x)=Any other, specify (i) Yes (ii) No		
	7.EDUCATIONAL FACILITY		

68	Available Educational facilities	(i)=None (ii)= Primary School (iii)=Secondary School (iv)= Tertiary (v)= Adult Education (vi)=Skills acquisition centre (vii)=Library (viii)=Any other, specify	
69	Have you used any of these facilities in the last one year?	(i)=Yes (ii)=No	
70	If yes, why?	(i)=To attend a class (ii)=for my child/ward (iii)= Others, (specify)	
71	Who provides Education facility in your community?	(i)=Government (ii)=Private (iii)=Others, (specify)	
72	What is the distance to the nearest education facility km?		
73	How much do you or your ward spend weekly to get to the education facility?		
74	What are the possible benefits that you have derived from schooling that is now helping in your daily farm activities? I. Ability to communicate in more than one language (i) Yes (ii) No II. Ability to do calculation with ease (i) Yes (ii) No III. Acquired agricultural skills/vocational training (i) Yes (ii) No IV. Ability to learn new skills easily outside of school (i) Yes (ii) No VI. Ability to socialized more easily (i) Yes (ii) No VII. Any other (specify).....		
	8. STORAGE FACILITY		
75	What type of storage facility exist in your community?	(i)=None (ii)=Traditional (iii)=Modern, (specify)	
76	Have you used any type of storage facility in the last 6 months?	(i)=Yes (ii)=No	
77	If No, Why?	(i)=No reason to (ii)=Lack of funds (iii)=Facility not available (iv)= Facility not accessible (v) Specify	
78	How do you store your produce?	(i)=Storage sack/basket (ii)=Underground pit (iii)=Roof top (iv)=Steel bins (v)= Brick wall silo (vi)=reinforced silo	

		(vii)=Others, (specify)	
79	What is the distance to the nearest storage facility in KM?		
80	How much do you spend to use/access storage facility?		
81	What do you think are the main infrastructural problem in general? I. Non availability (i) Yes (ii) No II. High cost of access (i) Yes (ii) No III. Insufficient Facilities (i) Yes (ii) No IV. Long distance (i) Yes (ii) No VI. Dilapidated facility (i) Yes (ii) No VII. Any other (specify).....		

SECTION C: PRODUCTIVITY

Please provide answers as appropriate

S/N	Item	Options	Response
82	Farm size in (Plots, acres, Ha) ?		
83	What is the status of your farm land	(i)=Grains (ii)=Tuber (iii)=Vegetables (iv)=Tree crops (v)=Others, (specify)	
84	What crops do you grow?	(i)=Grains (ii)=Tuber (iii)=Vegetables (iv)=Tree crops (v)=Others, (specify)	
85	What kind of animals do you rear?	(i)=Live stock (ii)=Birds (iii)=Fish (iv)=Others (Specify)	
86	**COST OF PRODUCTION**		

S/N	**CROP PRODUCTION**			**ANIMAL HUSBANDRY**		
	Input	**Qty(KG)/Amt(Nos)/ litres**	**Production cost (N)/ha**	**Input**	**Qty (KG)**	**Production cost (N)/ 100 animals**
1	Land preparation			Farm House		
2	Seedling			Chicks/fingerlings		
3	planting			Brooding		

4	Weeding			Feeding		
5	Irrigation			Vaccination		
6	Pesticide			Harvesting		
7	Fertilizer			Transportation		
8	Harvesting			Labour		
9	Transportation			Cost of land		
10	Family Labour			Others		
11	Hired labour					
12	Others					

87	**OUTPUT/REVENUE**							
	CROP PRODUCTION/ month				**ANIMAL HUSBANDRY/month**			
S/N	**OUTPUT ITEM**	**QTY (KG, NOS, LTRS etc)**	**PRICE (N)**	**REVENUE (N)**	**OUTPUT ITEM**	**QTY (Nos)**	**PRICE (N)**	**REVENUE (N)**
1	Cassava				Chicken			
2	Yam				Egg			
3	Cocoyam				Rabbit			
4	Maize				Goat			
5	Millet				Sheep			
6	Soyabean				Ram			
7	Millet				Cow			
8	Cowpea				Fish			
9	Rice				Others			
10	Cocoa							
11	Cashew							
12	Plantain							

13	Vegetables							
14	Others							
88	Do you have any other source of income?			(i)=Yes (ii)=No				
89	If yes, state the amount from this source(s) monthly?							
90	How much is your monthly revenue from all farm activities?							

SECTION D: WOMEN EMPOWERMENT

Decision-making capability inincome and production

PARTICIPATION- TASK		Self-participation in the past 12 months in the task / activity	Extent of input in making decisions about the task	Extent of input in making decisions about the income generated from task
S/N	**Task Description**	**01**	**02**	**03**
A	**Crop farming (1):**Forcrops produced mainly for household use, i.e food crops	Yes (i) No (2)→IF NO move to next task	1. I had no input or few indecisions ..... (i) 2. I had input in somedecisions .....(ii) 3. I had input in most or all decisions .....(iii) 4. I was not involved in decision making at all...move to next	
B	**Crop farming (2):**For crops produced mainly for sale in markets,i.e. cash crops	Yes (i) No (2)→IF NO move to next task		
C	**Livestock farming**	Yes (i) No (2)→IF NO move to next task		
D	**Non-farm economicactivities:**Like buying and selling, self-employment or small business	Yes (i) No (2)→IF NO move to next task		
E	**Other form of** employment**:** here you earn wage or salary in cash or kind	Yes (i) No (2)→IF NO move to next task		
F	**Fishing Farming**	Yes (i) No (2)→IF NO move to next task		

3.Access toIncome generating Resources/Items- Households Ownership of income generating items

		Ownership of item within the household?	Number of the item owned within the household?	Who is the owner of the item? CIRCLE ALL APPLICABLE	If you want to sell the item, who will always decide. CIRCLE	If you want to give away the item, who will always decide. CIRCLE	If you want to rent out the item, who will always decide? CIRCLE ALL APPLICABLE	If you want to buy a new item who will always decide
PRODUCTIVE CAPITAL[1]								
1	Land	YES..1 NO…2→ If No Skip	☐☐☐	a. Just me.....1 b. My Partner....2 c. My family member …….3 d. My Housemate.4 e. Joint Ownership….5 f. NotApplicable…				
2	Big Animals like cattle	1 YES 2 NO→ If No skip	☐☐☐					
3	Smaller animals like goats, pigs, sheep	1 YES 2 NO→ If No skip	☐☐☐					
4	Birds like Duck, chicken	1 YES 2 NO→ If No skip	☐☐☐					
5	Fish farming (pond or equipment)	1 YES 2 NO→ If No skip	☐☐☐					
6	Small Farm equipment like hand tools	1 YES 2 NO→ If No skip	☐☐☐					
7	Large Farm equipment like tractor	1 YES 2 NO→ If No skip	☐☐☐					
8	Other equipment not used for farming.	1 YES 2NO→ If No skip	☐☐☐					
9	House or Building or other property	1 YES 2 NO→ If No skip	☐☐☐					
10	Big Household appliances	1 YES 2 NO→ If No skip	☐☐☐					

		Ownership of item within the household?	Number of the item owned within the household?	Who is the owner of the item? CIRCLE ALL APPLICABLE	If you want to sell the item, who will always decide. CIRCLE	If you want to give away the item, who will always decide. CIRCLE	If you want to rent out the item, who will always decide? CIRCLE ALL APPLICABLE	If you want to buy a new item who will always decide
PRODUCTIVE CAPITAL[1]								
	like Fridge, TV, sofa)							
11	Small household appliances like radio,utensils	1 YES 2 NO→ If No skip	☐☐☐					
15	Mobile phone	1 YES 2 NO→ If No skip	☐☐☐					
16	Land and other properties not used for farming	1 YES 2 NO→ If No skip	☐☐☐					
17	Mobilitymeans like Tricycle, motorcycle, car, bicycle,)	YES..1 NO…2→ MOVE TO 3B	☐☐☐					

3(B): CREDIT EXPERIENCE (Funding)

Questions about your household's involvement with getting funds or other items within the last one year.

SOURCES OF FUNDS	Have you or anyone in your house taken any loan or item within the last one year from the sources below?		Whose idea was it go and source for money? **CIRCLE ALL APPLICABLE***	After you get the loan or item, who decides what do with it? *
S/N	**Lender 03**		**G3.08**	**G3.09**
1	Not for governmentorganization (NGO)	We got Cash.....1 We got In-Kind.....2 Yes, both 1&2 above3 No.....4 If No move on No idea 5	Just me……1 My Partner.....2 My family member……3 My Neighbour/friend...4 Joint Decision……5 Not Applicable.....6	Just me……1 My Partner.....2 My family member……3 My Neighbour/friend...4 Joint decision……5 Not Applicable.....6
2	Coop society and other local associations			

3	Banks and other formal organized money lenders			
4	Informal source from my pairs and family			

G4: Role in Leadership within your community as an individual

Questions about your ability to talk in a public gathering with ease and contribute to positive decision making

S/N	Question	Answer
1	Are you able to talk in public without being shy or intimated to help in decision making about infrastructure (clinics, well, borehole etc) provision in your locality?	**No, If No move to next** **Yes, but with struggle .....2** **Yes, without any issue.....3**
2	Are you able to talk in public without being shy or intimated when it comes to ensuring women are paid adequately for work done?	
3	Can you participate in rallies or protest to challenge leaders or nonperforming elected officials?	
4	Can you speak up at farmer's meetings in your neighborhood?	
5	Can you speak ill treatment of fellow women?	

MODULE G4 continued: GROUP MEMBERSHIP

Questions about the different formal and informal group in your community

Membership categories		State the availability of the groups below in your community?	Do you belong to this group actively?
	Categories	**Answer**	**Answer**
A	Farmers (crop & livestock faming) and marketing groups	Yes 1 No 2move to the next No Idea 3	Yes 1 No 2
B	Women farmers association		
C	Cooperative group		
D	Mutual group (ajo/esusuetc)		
E	Trade and business association		
F	Community or charity groups		

G	Religious group	—	
H	Other (specify)_____		

MODULE G5: DECISION MAKING

"Questions about your decision-making ability generally

		Regarding activity (AC 1-7) who is responsible for decision making? Note- If self is the answer do not ask AC 200	If you are to make these decisionssolely on AC 1-7, what extent are you able to?
	ACTIVITY (AC)	**AC. 01**	**AC.02**
1	Sourcing inputs for farming activities	**Myself…….1** **My Partner.....2** **Family Member……3** **Neighbour/Friend....4** **Joint Decision……...5** **Not Applicable 6→Move on**	**Never.....1** **Few times .....2** **Most times.....3** **Always.....4**
2	What to grow		
3	Going to the market with crops produce (or not)		
4	Rearing of animals		
5	Personal funds, like salary or wages from employment		
6	Major household expenseslike buying large appliances like freezer, fridge		
7	Minor household expenses (like food consumed daily and other small needs		

G6: TIME DISTRIBUTION

What activities have you been involved in within the last 24 hours till the current day.

ACTIVITY	Hours used for activity **Morning** **Afternoon** **Evening** **Night**
ACTIVITY	**Response**
Sleeping and resting	
Farming/Livestock/Fishing	
Domestic work; sweeping, washing etc.	
Cooking	
Social activities and hobbies	

ACTIVITY	Hours used for activity **Morning** **Afternoon** **Evening** **Night**	
Personal care		
Care for children/husband/elderly		
Eating & Drinking		
Religious activities		
Using TV/ radio/Reading		
Traveling / commuting		
Others (specify)		

S/N	QUESTION	ANSWERS
1	Where did you carry out most of your work within the last 24 hours,at home or outside?	More at home…….1 Same for both……2 More outside…….3
2	Are you satisfied with your leisure time, enjoyable things like visitation,listening to radio and television, partying, travelling. On a scale of 1 to 10 1.... not satisfied 10 .... very satisfied. 5..... neither satisfied nor dissatisfied,	RATING ☐

THANK YOU