ANTS BEARING THE BURDEN OF ELEPHANTS: THE PARADOX

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ANTS BEARING THE BURDEN OF ELEPHANTS: THE PARADOX

PROFESSOR EDET JOSHUA UDOH

Thursday, 29th March, 2018

Edet Joshua UDOH
B. Agric., M.Sc, Ph.D
Professor of Agricultural Economics

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Dedication

Almighty God, the Father of our Lord Jesus Christ,

The Memory of my late father, Elder Joshua Udo Inyang
and

Struggling Small Farming Households in Nigeria

CITATION ON PROFESSOR EDET JOSHUA UDOH
BY
Aniekan Brown, Ph.D.

Protocols and Preamble

I feel highly honoured, and elated to have been found worthy and invited to present this citation on a young man who though still budding has reached the zenith/acme of his chosen career and is flawlessly regarded as an academic *par excellence*. I am indeed privileged. Therefore, today of all days, I have the honour of standing on this platform in this capacity to pen-portrait a friend, colleague, and one full of promise.

May I at this early moment forewarn us that today's Inaugural Lecturer is a rare personality who in spite of a very rich curriculum vitae which spans over fifty pages (when presented in the Time New Roman, font 13.5, single line spacing fashion) is not a Curriculum Vitae-excited academic. As such through a "finest-hour"-induced concession, we had agreed within the video space not to be flowery and verbose, but to be brief, concise, and simple in this presentation. I must confess to having a horrendous experience in my bid to adhere to the gentleman's agreement.

I, therefore, hope that this presentation would not be hackneyed but would be unusual and distinct. A rare opportunity is thus available to me to request the Inaugural Lecturer for today to please stand and remain standing until directed otherwise.

The Citation

You, Professor Edet Joshua Udoh, a native of Ibiaku Ikot Usen (Ibiono Ibom), were born on October 18, 1971, in Calabar, Cross River State, Nigeria to late Elder Joshua Udo Inyang (your father) and Deaconess Ekpoanwan J. U. Inyang (your mother) as their 5th child (last born). Your birth signaled the beginning of intellectual renaissance in the family. You have grown to occupy a pride of place in the academic, administrative, social, political, and international spheres.

Beyond the primary source(s) of socialization, you cut your first western education tooth at the Qua Iboe Group School, Nto Omum, Nto Edino, Obot Akara Local Government Area from where you proceeded to enroll into Community Secondary School, Ibiaku Ibiono Western, Ibiono Ibom L.G.A in 1983 where you passed your School Certificate Examination in flying colours in 1988.

Without a break, you gained admission into the University of Calabar, Calabar, Cross River State to read for, and which you successfully completed a Bachelor's Degree of Agriculture in Agricultural Economics and Extension with a Second Class (Upper Division) in 1994. Your Master of Sciences (M.Sc.) Degree in Agricultural Economics came in 1997 from the University of Ibadan. And after successfully defending your Doctor of Philosophy (Ph.D) Thesis titled: "Land Management and Resource Use Efficiency among Farmers in Southeastern Nigeria" which was adjudged the best research on Land

Management in Africa by RICS, you bagged your terminal degree in Agricultural Economics in that magical year – 2000AD. I must emphasize that you were awarded the distinction, winning the Best Paper Prize by the African Real Estate Society and RICS Foundation in London in Land Management in Africa in 2001. It is interesting to note that you completed your Ph.D at the age of 28 years, and became a Professor ten years later.

Armed with the requisite skills as informed by an excellent experience through all the strata of western education, you have contributed very immensely and impeccably to global manpower development in the areas of teaching Microeconomics, Macroeconomics, Econometrics, Production Economics, Agribusiness, Resource Economics, Agricultural Marketing, Operation Research Method, Mathematics for Agricultural Economics as well as Farm Management and Accounting.

You have also successfully supervised over 100 B. Agric, 20 M.Sc and 10 Ph.D students and in the course of time mentored many of the students you have taught. It should be noted that you supervised the first ever Ph.D product of your Department in the University of Uyo; and many other of your Ph.D and M.Sc supervisees are now teaching in the University of Uyo and other tertiary institutions.

In terms of scholarship, you are/and have been the following:

- **Member/ Associate editor:** Nigerian Journal of

Agriculture, Food and Environment**,** Faculty of Agriculture, University of Uyo.

- **Associate Reviewer**
  i. Journal of Social Sciences (JSS), Krepublishers, New Delhi, India
  ii. Nigerian Journal of Agriculture, Food and Environment, University of Uyo
  iii. Journal of African Studies and Development (JASD), www.academicjournals.org
  iv. African Journal of Agricultural Research (AJAR),www.academicjournal.org/ajar
  v. Global Journal of Pure and Applied Sciences, University of Calabar
  vi. Journal of Sustainable Tropical Agricultural Research, University of Uyo
  vii. British Journal of Economics, Management and Trade, Science domain, London, W1B3HH
  viii. Asian Journal of Agricultural Extension, Economics and Sociology, New Delhi, India
  ix. Science Domain International Group of Journals
- **Associate Editor**: World Journal of Agricultural Science, Idosi publication, Pakistan
- **External Examiner:** Department of Agricultural Economics University of Calabar and Michael Okpara University of Agriculture, Umudike (Undergraduate and Graduate Level) **2011 –Date**

It is on record that you have served the University of Uyo in various capacities since your assumption of duties. Mr.

Vice Chancellor, Sir, permit me to remind this erudite professor that he has been:

- **Ag. Head of Department,** Department of Agricultural Economics and Extension, University of Uyo**, March 08, 2004- January 14, 2008**
- **Vice Dean:** Faculty of Agriculture, University of Uyo, **October 2006-Feburay, 2008**
- **Ag. Director:** Center for Skill Acquisition and Rural Development (CSARD), University of Uyo (June, **2008 – May, 2011**)
- **Editor:** Nigerian Journal of Agriculture, Food and Environment (NJAFE), Faculty of Agriculture, University of Uyo (**2008-2016**)
- **Membership:** Several committees of Department of Agricultural Economics and Extension, Faculty of Agriculture, Senate, management and Council in the University of Uyo.
- **Member:** Senate of University of Uyo**, 2003-Date**
- **Member:** University of Uyo Management, **April, 2014-Date**
- **Director:** School of Continuing Education, University of Uyo, **April, 2014-Date**
- **Chairman:** University of Uyo Student Disciplinary Committee. June 2017-Date
- **Member:** University of Uyo 8th Governing Council (Representative of the Senate). **May, 2017-Date**

Despite your deep involvement in the University administration, you have not neglected the sacred duty of

your Union having served the ASUU-UUB to the admiration of the Congress as:

- **Investment Secretary:** Academic Staff Union of Universities, ASUU, University of Uyo, **April, 2006-May, 2011 (Pioneer Investment Secretary whose major achievement was the formation of UAMCOS)**
- **Secretary:** Board of Trustee, Uniuyo Academic staff multi-purpose Cooperative society limited (UAMCOS), **August, 2009 –May, 2011**

With regards to National and Community engagements, you have also participated actively as Consultant, National Expert, Field Assistant, and Team Member in various Environmental Impact Assessment Teams spanning the whole of the Niger Delta Region and some parts of Nigeria; with the Shell Petroleum Development Company (SPDC), Akwa Ibom State Ministry of Women Affairs and Social Welfare, Ministry of Agriculture and Food Sufficiency, UNIDO, Indorama Eleme Petrochemicals Limited OBOB, World Bank, FADAMA III, NEST, International Institute for Tropical agriculture (IITA), Exxon Mobil, some Nigerian Universities, to mention but a few.

Also, you have served as:

- **Facilitator:** National Population Commission during the Nigerian National Population and Housing Census, 2006,
- **LGA Collating/Returning Officer:** 2015 INEC General Election

- **Chairman:** Parent Teacher Association, Tropicana International Schools, Afaha Oku, Uyo, Akwa Ibom State, **February, 2010 – Date**
- **Chairman:** Board of Directors, Unique Ambassadors Nursery/primary School, Inim Etuk Akpan Lane/ Umoren Street, Uyo, **Dec., 2013-Date**
- **Chairman:** The Apostolic Church Bible College Governing Council, Obot Idim Nsit, Uyo Field, Akwa Ibom State. **Oct., 2016-Date**

On the strength of your academic, professional and managerial experiences, His Excellency, the governor of Akwa Ibom State, Mr. Udom Emmanuel on assumption of Office appointed you as a Chairman of Technical Committee on Agriculture and Food Sufficiency to work with him in actualizing his vision of making Akwa Ibom State to be self sufficient in food production. This speaks volumes as a golden fish has no hiding place.

All these experiences have harbingered many published articles, reports and works totaling: ninety-five (95) articles in local and international outfits, and nine (9) conference presentations.

You, Professor Edet Joshua Udoh, belong to many professional bodies, four of which are:

- Nigerian Economic society (NES)
- Nigerian Association of Agricultural Economists (NAAE)

- Africa Policy Research and Advocacy Group (APRAG) at WARDA, Cotounu, Benin Republic
- Agricultural Society of Nigeria (ASN)

You have also attended many Leadership and Management courses, principal of which are:

1. Master Class in Anti Corruption Compliance Monitoring; and Projects Monitoring and Evaluation for Corruption Prevention and Control Organized by African Diaspora Initiative in conjunction with ICPC, November 5-7, 2013, UK Bello Centre, Minna Niger State.
2. Capacity Building Training Retreat on Responsibility of Leadership for Akwa Ibom State Executive Council members organized by Institute for National Transformation, May 12-13, 2017, Eko Signature Hotels, Lagos.

Your hard work saw you grow from a Lecturer II (2000) to the rank of a Professor (2010) in a ten-year period.

You are married to the beautiful Julie and your union has been blessed with three wonderful children namely: Lemuel, Zemirah and Jerusha. You, an ordained Elder of The Apostolic Church, Nigeria, have had the honour of being vouched for by not a few in quality and quantity.

In spite of the several formal, non-formal and informal commitments and responsibilities, you redeem time in terms of hobbies, to be in good speaking terms

with the Holy Bible and indulge in raising Godly, hardworking, and upwardly mobile young men and women.

Mr. Vice-Chancellor and Chairman, Prof. Enefiok E. Essien (SAN), distinguished academics, ladies and gentlemen, from the foregoing, I do not entertain any hesitation whatsoever in presenting to you, a briskly natured academic and socialite, a husband to one and father of three, a Christian and an inspiration to many, an investor in the sustainable development project, and a Nigerian of distinguished academic competence who with modesty, humility, diligence, hard-work, commitment, dedication, and discipline has written his name in gold for the presentation of the 59th Inaugural Lecture of the University of Uyo titled: "ANTS Bearing the Burden of Elephants: The Paradox" I am referring to, the one and only irrepressible (in the positive sense) and inimitable Professor Edet Joshua Udoh.

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ACKNOWLEDGEMENT

I am beholden to express my sincere appreciation and say words of gratitude to persons whom God placed in my life in the course of my academic pursuit. I am most profoundly grateful to my teachers beginning from the primary level to the tertiary level. I had the privilege to be taught by selfless teachers at Qua Iboe Group School, Nto Omum, Nto Edino, Obot Akara LGA. They include Late Mr. James Akwa (my first Headmaster), Late Chief Sam Imo-Owo (later became Village Head of Ikot Ide), Elder Jumbo Ubeng, Mr. Sambo Ubeng, Mrs. Grace Isidore Akpan, Mr. Nkopuruk, Late Dec. Grace Sunday Akpan-Udo and Late Mr. Ekpemefe. These men and women laid a strong and solid academic and moral foundation in my life on which others have built upon. Also, I have fond memories of the discipline and instructions of my teachers in the secondary school days that contributed in fashioning my academic and moral perspective. I appreciate Late Mr. Offiong Etim Akpan (My first principal), Mr. Jackson Udo, Mr. Edet J. Akra, Mr. Clement Simon Asanga, Late Mr. Ekpenyong, Mr. Ini Iwok Uyire, Mr. I. E. Okon, Mr. N. S. Offiong, Mr. Solomon Enebong Okon, Mr. Ime Ekpo, Mr. S. J. Umoren and Mr. Sunday Umoren etc. Their voices still echo in my mind with good feelings of reminiscences

Getting to the University of Calabar and being taught by lecturers rather than teachers was a new experience that confronted me. The usual affectionate disposition that characterized teachers at both primary and secondary

school levels was not there. Most of our lecturers only come in to use their credit hours and cared less about the students. Mr. Vice Chancellor Sir, I want to confess that I was shocked, flabbergasted and totally discouraged and wanted to drop out until I came across some teacher figures like Prof. A. I. Essien, Prof O.O. Ukoha (my B.Agric Project Supervisor), Dr. E. Ele and Late Dr. Daniel Udom. These men and a few others actually demystified lecturing and added glamour and simplicity such that a village boy like me could have hope of graduating and even nurse thoughts of becoming a lecturer. I sincerely register my deepest appreciation to them, and other lecturers, who though were not *teachers*, but contributed in building this academic colossus.

How on earth can I forget to specially mention the finest agricultural economists who taught and mentored me at the University of Ibadan during my graduate programs? They include Dr. J. O. Akintola, Prof. J. K. Olayemi , Prof. A. Ikpi, Prof. A. J. Adegeye, late Prof. R. O. Adegboye (Baale), Prof. A. O. Falusi, Late Prof. S.G. Nwoko, Late Dr. J. T. Atobatele Prof. (Mrs.) T. O. Adekanye, Prof. J. A. Akinwumi and Prof. F. Y. Okunmadewa. My academic prowess is a combination of their excellent traits that I coveted. I vividly remember the massive red inks on every page of the proposals submitted to Prof. A. Ikpi (my M.Sc Supervisor), Dr. J. O. Akintola (my Ph.D. supervisor) and Prof. J. K. Olayemi (my Co-supervisor, Ph.D), and their candid remarks. I can say I received the proverbial baptism of fire

from their tutelage and came out more refined to handle research issues. I want to say a big thank you to each and everyone of them. To Prof. B. T. Omonona, Prof. S. Yusuf, Dr. Wale Oni, Prof. Justice I. Onu, Prof. Paul Amaza and others who I associated with during my graduate program, your assistance cannot go unnoticed.

On my assumption of duties at the University of Uyo, I had the opportunity to associate with wonderful colleagues and have gained from them. Many have played vital roles in making me fit into the university system. In this regard I deeply appreciate the contribution of Prof. Trenchard O. Ibia, Prof. Etuk Ekanem, Prof. G. S. Umoh, Prof. (Mrs.) I.P. Solomon, Dr. S. O. Edem, Prof. N. U. Ndaeyo (Dean of Agriculture), Dr. Uduak C. Udoinyang (Hon. Comm. of Agriculture and Food Sufficiency), and others too numerous to mention, I say thank you. On a special note, I salute my colleagues at the Faculty of Agriculture, especially those of the Department of Agricultural Economics and Extension. They are Dr. Nsikak-Abasi Etim, Dr. Ubong Asa, Dr. Glory Edet (Hon. Comm. of Women Affairs and Social welfare), Dr. Jude Obi, Dr. Effiong Etim (Ag. Head of Department) and all the teaching and non-teaching staff. A big thank you to my students including those who are currently in the school and those who have graduated. My interactions with everyone of you have left good, bad and ugly lessons in my life and I am very grateful that you accepted me to teach you

Prof. Akpan H. Ekpo employed me and appointed me to head the Department of Agricultural Economics and Extension barely three years after my appointment as Lecturer II. I still cannot understand why he had to take such unimaginable risk. I recollect the rapt attention when permitted to speak on the floor of the Senate and sometimes he will address me as little Professor. I want to register my deepest gratitude to him for believing in me even when he did not know me.

Prof. Akaneren I. Essien taught me at the University of Calabar, and actually muted the idea of me becoming an academia and encouraged me to proceed to University of Ibadan for further studies. He believed in me then and when he assumed as the Vice Chancellor of the University of Uyo, he continued the work of mentorship and gave me the opportunity to serve the University at a higher capacity. I remain grateful to him.

Prof. (Mrs). Comfort M. Ekpo's tenure as the Vice Chancellor of the University of Uyo will remain evergreen in my heart. Apart from ensuring my appointment into the exclusive class of Professorship, she gave me a great opportunity to serve the University as Director of School of Continuing Education, and on the University Management team. I am yet to understand why she chose the least among the greatest when she did not know me.

Prof. Enefiok E. Essien (SAN), the incumbent Vice Chancellor deserves special appreciation for his show and

demonstration of love to me. He has continued to entrust in me the responsibility of leadership. Working with him has been quite rewarding as I am learning to imbibe good leadership traits that are inherent in him; remaining unperturbed in the midst of furore. Thank you for the privilege of sitting with you on the exalted tables of University Management and Governing Council. I am standing here as the 'headmaster' to deliver the 59th inaugural lecture that you and your entire Principal Officers have permitted.

I acknowledge the warm comradeship of Prof. Godfrey Udo (DVC, Administration), Prof. (Mrs.) Inyang Udofot (DVC, Academics), the indefatigable Registrar, Mr. Aniedi Udofia and the entire Management team. I have enjoyed working with them in moving the University system forward. I also appreciate the roles Dr. Effiong Inyang, Mrs. Edak Umondak (immediate past Registrar), Dr. Ashong Ashong, Prof. Udo Etuk, Dr. Aniekan Brown and Dr. Happiness Uduk, have played in my life since I joined the University of Uyo. I deeply appreciate all the staff of the School of Continuing Education for their cooperation and goodwill.

In the course of carrying out my research works, I have the privilege of working closely with some of my professional colleagues and I must admit that they have been quite interesting persons to collaborate with. They include Prof. B. T. Omonona, Dr. S. B. Akpan, Dr. NsikakAbasi Etim,

Ekaette Udoh, Nkoyo Etim, Dr. D. O. Akpan, Prof. Idiong C. Idiong Emem Inyang and others. I sincerely respect their individual invaluable contributions toward our publications. Again, I appreciate the brotherly disposition of Prof. M.K. Yahaya, Mr. Festus Erewele, Dr. Patrick Komarwa, Elder Imo Udosen, Hon. Ebong Okon and others who have severally proven themselves friends, and have touched my life in different ways. Prof. M. K. Yahaya deserves special mention for not only encouraging me to pursue an M.Sc program in the University of Ibadan, but taking the extra step of securing the PG application form for me at his own expense.

His Excellency, the governor of Akwa Ibom State, Mr. Udom Emmanuel did the unthinkable in the political realm by appointing me the Chairman, Technical Committee on Agriculture and Food Sufficiency when he had never seen or known me. Working with him in this capacity has been quite revealing and rewarding. He has introduced me to another plane of leadership and management of human resources. I am deeply grateful to him and his wife, the First Lady of Akwa Ibom State, Her Excellency, Mrs. Martha Udom Emmanuel for reposing such confidence in me to join him in the march toward making Akwa Ibom a food self-sufficient State.

Also, I salute the acceptance of the Deputy Governor of Akwa Ibom State, Mr. Moses Ekpo, MFR, Secretary to the State Government (SSG), Dr. Emmanuel Ekuwem,

immediate past SSG, Sir Etekamba Umoren, Head of Civil Service, Mr. Ekerobong Akpan and the entire members of AKS Executive Council. These are men and women of goodwill of which I am appreciative. I have enjoyed good working relationship with Mr. Udom Inoyo (Vice Chairman), Hon. (Pst.) Sunny Ibuot (Secretary), Mr Gabriel Nkannang, Barr. (Mrs.) Nkoyo Amana and other members of the Technical Committee of Agriculture and Food Sufficiency.

I respectfully acknowledge the prayers and words of encouragement I have received from the Ministers of Gospel and other brethren in the Body of Jesus Christ across the various Church denominations. On several occasions, when the storms of life bawled, you were there for me, watching over me in prayers and intercessions. Most specifically, I thank the Apostles, Pastors, Elders, Officers and the entire members of The Apostolic Church of (TACN) Nigeria for their spiritual support and encouragements. Worthy of note are Apostle I. N. George, PhD (Uyo Field Superintendent), Apostle G. E. Akpan, (Uyo Field Secretary), Apostle S. A. Isaiah, PhD, Apostle A. J. Umana, Apostle B. E. Usanga, Pastor J. Nsubo and all the Elders in TAC, Uyo District.

The Almighty God rightly destined my birth into the wonderful family of late Elder Joshua Udo Ekanem Inyang. I sincerely acknowledge the contribution of my late father towards my academic attainment. I have fond memories

of his deep interest in my education and the vow to sponsor me to any level of study I wished to attain. He laid a strong foundation for my siblings and me for success in our individual endeavours. I wish he is sitting in this audience listening to his 'Landlord' speak English language that he was denied the opportunity to learn. May his soul continue to rest in peace! Amen.

I want to give much accolade to my dear mother, Deaconess (Mrs.) Ekpoanwan J. U. Inyang, for her love, care, trust, spiritual and financial supports. Her motherhood has been a blessing from God to me. My siblings, Elder Bassey. J. Inyang, Barr. Etim J. Inyang, Elder Efiong J. Inyang, Mrs. Nkoyo Iwatt and their spouses have been wonderful and caring. Their individual contributions are highly appreciated. Also worth acknowledging are my parents-in-laws, Elder and Mrs. Sunday Ekanem, Uncles, Aunties, Cousins, Nephews, Nieces whose prayers and support contributed in placing me on the podium of success.

There is a girl who believed and cherished my strength and had the audacity to accept my weaknesses in the presence of witnesses. She bears the pains for others to enjoy the gains. She corrects my mistakes for others to applaud my achievements. She became my wife since 2003, and has remained committed to the making of the man standing in the presence of everyone here. From her womb came out three heirs of my kingdom, namely

Lemuel (the King), Zemirah (my Sweetheart) and Jerusha (the Professor). Her name is Mrs. Julie Edet Udoh. She and the children have been wonderful and sources of inspiration. I appreciate them for their love.

Finally, I thank the **Aba nsi nsi** for making my name to be known as other names of the great men and women of stature. Great are the works of His Hands and Faithful is He. As the Psalmist enunciates in verses 5 and 6 of chapter 16, "He has made boundary lines to fall into pleasant places for me and has given me a delightful inheritance". If anyone of you knew my beginning and follow my life through from birth to now, you will agree with me that **I am what I am by His benevolent grace.** My gratitude to Him is encapsulated in the Song written by **ROBERT SEYMOUR BRIDGES (1899),** which is incidentally my Family song. I request everyone to join me in singing this song to the glory of His name alone. Amen.

EFIK VERSION

1. Ami nyetoro Abasi mi
kʼofuri odudu mi kʼisɔn;
Kʼenyɔn nyekwɔ enem akan;
Itoro idikureke
Adaⁿa nte nnyenede
Odudu nditoro Enye

2. O yak owo ekededi,
Emi esinde idem
kʼubɔk
Abasi nnyin, adat esit;
Enye edi Ɔbong enyɔⁿ,
Onyun akara mi kʼisɔn,
Anam se Enye ɔnwɔnɔde.

3. Kʼusiere emi nkɔm Enye,
Ndopke ke uwemeyo;
Nyekwɔ ikwɔ ke okoneyo,
Ye ke ini ekededi.
Uwem mi amabe Kʼisoⁿ
Nyebuanʼ uyo yʼmbon enyɔn.

ENGLISH VERSION

1. Thee will I praise my God and King
With all my strength on earth I'll sing,
In Heaven the sweeter praise shall be,
Thy praise that ever more shall be.
As long as I live, I will praise
Thy praise shall never, never cease.

2. O happy, Happy is the man
Who puts his trust in Jesus' hand,
O let him have full confidence,
He is the Lord of confidence.
He reigns on earth and sky and sea
He is faithful to His promise.

3. In early morning I will praise
At noon I will not stop His praise,
I'll sing to Him even at night,
Or at any time in my life.
When my life here on earth is past
I'll join with heav'nly hosts who past

INTRODUCTION

I was very fortunate as an MSc student of the University of Ibadan to witness an erudite Professor of Agricultural Economics, Professor Abiodun Falusi present his inaugural lecture on 18th June 1996 at the University of Ibadan. The title of his lecture was, ***'March towards hunger, can it be halted?'*** As I sat in the audience watching with keen interest this colossal agricultural economist per excellence tell the world his contributions to knowledge and the very reasons he is a professor, I was lost in thought and literally envisioned myself standing behind that Lectern. At the end of his presentation, a fertile seed was planted in me; deeply motivated to begin a journey toward reaching the same destination that this acclaimed Agricultural Economist had reached. I walked out from that auditorium much more determined to create an academic niche for myself in the field of Agricultural Economics. I remembered telling my colleague and friend, Mr. Festus Erewele that I will one day stand as the revered Professor to present an inaugural lecture as long as Christ tarries. To God be the Glory who has made that possible twenty two years after!

Mr. Vice Chancellor, Sir and distinguished audience, I am an Agricultural Economist, trained to know and also training others the principles and practice of agricultural economics. Agricultural Economics is simply a discipline of making use of economic principles, statistical and mathematical tools to evaluate, analyse, determine and

explain agricultural issues as they relate to farms and farming households. If there is any discipline that can qualify to fits into the popular maxim of *"jack of all trade but master of all"* it is agricultural economics. From the cradle to the zest of academic training, an agricultural economist is wired to investigate actions, processes and workings of economic system of farms and farming households within the demand and supply nexus. He/she is a trained agriculturist who learns the theories and practices of crop and animal production, marketing and consumption yet fixing his gaze at some predetermined but consistent and rational objective functions as defined by economic theories, statistical inferences and positive sided mathematical hypotheses. As a matter of fact, a trained agricultural economist can easily explain the economic, biogenic and psychogenic reasons producers and consumers engage in any economic activities. It is therefore a common practice to see an agricultural economist engage his/her time, resources and talent towards exploring the socio-economic phenomena and the inter relativities of consuming and producing farm(ing) units. He/she evaluates the economy more at a micro level and prefers a positive economic analysis framework. He/she navigates from the real economic situation to economic abstractions and vice versa within the farm and farming household *x-y* space. Essentially, an agricultural economist studies and analyses the economic behaviour

of either farms or farming households or both and their relation to other economic units.

The march towards becoming a professor of agricultural economics was more or less a journey that I consciously undertook after the initial interaction with Prof. O. O. Ukoha, who was my undergraduate supervisor in the University of Calabar. In the process of choosing a project topic, he awoke the academic curiosity in me and literally introduced me to the subject of farming household economy. Can you imagine how I felt when my supervisor told me to research on the economics of waterleaf production when actually I was having interest in topics that would require me collecting data from commercial banks? Horrible! I couldn't imagine myself going around waterleaf farming households to ask questions about them and their economic activities in the name of collecting primary data. Being faced with the obligatory task of "partial fulfilment of the requirements for the award of Bachelor degree in Agriculture (Agricultural Economics and Extension)"I had no alternative but to embark on the study. Since then, it has been an exciting and a mind blowing expedition: exploring the world of the farming households.

THE METAPHORICAL ANTS

Has it ever crossed anyone's mind how basic staple foods are made available in the rural and urban markets across Nigeria? Who are those who fill the ever widening gap

between domestic food demand and food import? Perhaps some would inadvertently give credit to the organised commercial farms and wholly disregard the unorganized and uncoordinated small farming households. The much that is known about the farming households is that they are small scale farmers who are scattered around the country, producing over 85% of locally produced staple foods. However, information about their anatomy, actions, and processes in carrying out their economic and livelihood activities are largely ignored. Apparently, it is the lack of adequate knowledge about them that would make government and other development partners to initiate and implement plans, policies, projects and programs that usually fail and the benefits accruing to unintended beneficiaries (Idachaba, 1998).

Farming households are basic socio-economic units that make production, consumption and other economic decisions within the context of maximizing objective functions as constrained by the household characteristics. Shaner, Philipp and Schmehl (1982) noted farming households as productive resources managers who provide purpose, direction, objectives and management to the whole-farm system, with the goal of attempting to optimize the farm component of the system in terms of whatever mix of socio-cultural, religious, traditional and material goals that are relevant to the household. In terms of farm operating objectives, farming households skewed

more towards household sustenance on subsistence-oriented farms and less toward profit maximization on market-oriented farms (Collinson, 1983). In this case, unless they relate significantly to production management, interfaces of a purely social, religious or political nature between the farm-household and its environment can be ignored (Dillon, 1992).In essence, farming households operate more of livelihood oriented system and less of economic/financial oriented system. It is on this premise that Clayton (1983) noted that beyond the priority objectives of ensuring sufficient food and cash for the household, subsistence and semi-subsistence farmers (farming households) generally have a number of secondary objectives. These are likely to include such things as having security in their livelihood, having the opportunity to observe socio-cultural customs and obligations, and having a satisfactory amount of social capital resources.

In Nigeria, farming households are the major operators of the informal (third) economy. From dawn to dusk, they toil under the sun and rain to provide social, cultural and economic goods and services. They are without strength yet accomplish significant feats; they are small yet walk in rank and file to bear their livelihood burdens; resource poor working with raw energies to provide economic goods and services to the elegant but lazy consumers and bottle-fed agro allied firms. They are devoid of glamour though seen everywhere and often times are not invited

to economic discourses. **They are ANTS and their households**

The Ant, here they come!

Mr. Vice Chancellor Sir, Nigeria is having food problem because of lack of total understanding of this set of economic gladiators. Too long have we ignored making deliberate research into their nature and how they operate. As it stands, farming households are the only economic units that have survived both internal and external threats to perform their primitive and modern roles. They possess the allegory of the cat with nine lives. As a nation, we can only build a food self-sufficient economy if the survival of these **ANTS** is taken seriously by both the government and organised private sector.

Mr. Chairman, Sir, to fully understand the farming households, it requires having an understanding of the biblical description of the ants. The book of Proverbs 30: 25 states, inter alia: '' ***the ants are a people not strong, yet they prepare their meat in the summer***''. I believe the ants that King Solomon is referring to in this scripture are the peasANT farmers. Characteristically, farming households' life sustaining activities revolve around providing foods to the members of their households through farming and livelihood related activities. Members of the households operate farm holdings as welfare and income generating ventures under the leadership of the household heads, who are usually the

reference persons. In their nature, they undertake economic decisions primarily after taking stock of the total resource available within the household and how those decisions would translate into the livelihood sustenance of the households. In this regard, farming households are generally known to operate peasantry agriculture with the primary goal of producing more of social (i.e. un-tradable) goods for the household benefit and less of economic (i.e. tradable) goods for the markets, but the aggregation of these fragmented economic goods from their scattered small farm holdings consistently constitutes the source of over 91% of the domestic food production. However, as the aphorism goes, economic goods follow money but social goods follow poverty, hence high poverty incidence among the farming households. This is the reality of Nigerian farming households (peasant farmers), who are involved in production without much consideration of the neoclassical marginal criterion of economic optimality rather basing production decisions on the imperatives of survival (subsistence). This is what I term eating from hand to mouth. Walking on this pathway for many generations sustainably keeps them within the narrow life-dependent conveyor belt. Thus, they usually do not operate within the economically defined rational zone of production, and this naturally fuels intergenerational poverty and deprivation (Udoh and Omonona, 2002). They are economic units with over 70 percent of the household members frictionally unemployed but having a global

unemployment rate of about 24 percent (Udoh, Omonona and Ukpe, 2006). They have considerable entrepreneurial competencies to successfully operate small scale agro-based enterprises (Udoh, Inyang & Oguzie, 2017).

As earlier stipulated, farming households are unique socio economic groups that are defined by their personal and institutional asset structures. It is a common practice for any researcher who collects data from the farming households to describe the households as a *prima facia* requirement using some measurable socio economic constructs. Table 1 presents some of the important constructs that have been used severally to explain the farming households.

Table 1: Farming Household socioeconomic variables

Descriptive constructs	**2000**	**2017**	**Remarks**
Gender (male dominance)	71.33	51.67	Decreasing
Age of the household head	41.35	58.81	Increasing
Household size	6.09	6.71	Constant
Educational level of household head	5.01	5.87	Constant
Educational level of household members	6.34	8.5	Increasing
Predominant land ownership mode	Family land	Purchased	Increased access

Descriptive constructs	2000	2017	Remarks
Farm size	2.87ha	1.23ha	Declining
Extension service contact	51%	13%	Declining
Access to credit	25.5%	17.4%	Declining
Household income ₦	37,970.00	30,245.70	Declining

Sources: Based on several studies of the author and others

Distribution of the above listed personal and institutional constructs have influence on the decision making process of the farming households. As shown in Table 1, there are changes in the constructs, which reveal a paradigm shift in the nature and structure of the farming households between 2000 and 2017. Gender inclusiveness, contrary to the popularly held opinion, has increased over the period with decreasing male dominance. This implies that more female are having control and ownership status in the rural farming households. To buttress this point, Udoh (2005) revealed about 0.73 control index for the credit demanded by women in rice producing households. Per capita farm holdings as well as household income have been found to be declining; indication of continuous constrained land availability and worsening household purchasing power. Obviously too, the mean age of the household heads has increased, an indication of aging farmers taking production and consumption decisions. Literacy level of the reference persons have remained almost unchanged but the average level of literacy for the

entire household has increased. In terms of contact with agricultural extension officers, there is a sharp decline in the numbers of farmers who have access to extension services. This may not be unconnected to the withdrawal of World Bank from financing the ADP system, which according to Oladele (2004), had serious implications on the performance of the extension services in terms of funding and number of extension visits.

THE ANTS AND THEIR ECONOMY

The Ants are economic entities who do not operate in isolation but create, exchange and distribute goods and services with other economic units. In the process, they contribute to the nation's Gross Domestic Product (GDP) through the framework of circular flow of income and expenditure. They actively contribute to sustaining the injection and withdrawal of the macroeconomic elements through production, consumption, demand, saving and investment decisions taken at their respective micro levels. The processes, nature, structure and the workings of these inter-related socio-economic activities that aid in determining how scarce resources are allocated by the ANTS explains their economy. Mr. Vice Chancellor Sir, the most appropriate way agricultural economists usually explain this economy is to specify behavioural micro simulation models using data that are sourced from the farming households.

Farming household micro simulation/modelling, either static or dynamic, is typically a mechanism of abstracting and presenting either in reduced or structured form the incidence of some predetermined socio-economic factors changes on the farming household's production, utility and welfare decisions. Therefore, besides making production decision, farming households also take other consistent socio-economic decisions as defined by their budget and resource endowment. In essence, they are individual micro economic units whose collective action defines the market (industrial) supply and demand functions. It is common to empirically simulate and describe the behaviour of the farming households with respect to consumable and reproducible goods and services. This involves specification of production, consumption, demand; saving and investment functions. I will proceed to enunciate some of my contributions.

The Ant, Production System and the Profit Walk

- ***Production function***

A pure economist understands a production function within the narrow range of a vector of only conventional resources (factors of production) mapping a predetermined outcome by a given state of technical knowledge. According to Kassier (1966), such a function expresses the relationship between inputs and outputs, and provides a method to determine the resource use efficiency and any re-allocation of resources that may be necessary for maximum returns. Following the seminal

work of Samuelson (1961), a symbolic form of a production function may be stated as:

$Y = f(K, L, N)^t$.....(1)

where: Y = output, f = some function of …, K = capital, L = labour, N = natural resources (Land), and t = time.

In essence, the above stated function expresses the economics of firms (farms), which is largely used for basic and advanced analysis of firm optimization problem.

Mr. Vice Chancellor Sir, by either default or lack of adequate understanding, many scholars have tried to assume a production function of such for farming households; analyses that I have found to be a total misspecification. Farming households' optimization problems are not solely constrained by the conventional resources, as in the case of firms (farms), but there are also vectors of non-monetary variables that contribute to defining the sign, slope and curvature of the production function. These are the household and institutional related variables whose omission from farming household production function specification results in serious econometric problems thereby invalidating the predictive power of the estimators. These are corollaries of management variable in a farm production function, for which Heady (1948) noted that the differences in the managerial skills of farm managers would be reflected in the output levels. A more plausible production function that would produce parsimonious estimators for

describing the farming household's production system is usually specified as follows:

$Y = f(K, L, N, Z_i, Z_j)^t$ .....(2);

Where Z_i are the vectors of farming households characteristics, like age of the household head (age), educational level (edu), gender (sex), household size (hhs), etc. and Z_j are the vector of institutional related factors such as access to extension services (ext), access to credit (cre), access to market infrastructures (mrk), etc. Instructively therefore, a classical farming household production function could be represented as:

$Y = f(K, L, N, age, sex, edu, hhs, ext, cre, mrk, \infty, e)$.....(3)

Where ∞ represents a set of plausible household and institutional related variables that can be included based on theoretical, mathematical and statistical convenience; and e is the usual disturbance term.

It should be noted that such a specification is not known to affect the mechanics and properties of the functional forms that the data are fitted, though there may be limitations in the estimation of some productivity measures. For instance, Cobb-Douglas production function has been known to fit farm data perfectly for ease of estimation of average and marginal physical product and value productivities of the conventional inputs, but this may not be the case for some of the farming households' socio-economic and institutional

non-monetary inputs. Example, it is not possible to estimate average and marginal physical product and value productivities of sex, marital status, and other binary variables, etc.

Farming household production function in the eyes of neoclassical production function

Mr. Vice Chancellor, Sir, elementary agricultural economist students will agree with me that the fundamental optimality problem of production decision is usually evaluated following the neoclassical hypothesis that is, identifying the technically and economically feasible production region from factor-product and factor-factor analyses. Though the overall objective function of farming household is sustenance rather than profit maximization, the peasANT farmers still walk the tight rope of neoclassical ideology. As a cat full of curiosity, I and some of my colleagues have engaged our time and resources to answer the question: Is it really possible to empirically validate the existence of typical production function for farming households? The answer to this question lies in estimating the fundamental concepts inherently derivable from equations 1 and 2. A typical conventional production function developed for farming households is as presented in Table 2.

Table 2: Productivity estimates from a farm business production function

Resource	Elasticity	MPP	APP
Land (Ha)	0.0382	0.7148	18.7126
Fertilizer	0.4290	0.93	2.17
Labour (Mandays)	0.6021	0.1745	0.2897
Capital (N:K)	0.00314	1.84E04	0.0586

Table 3 presents a typical farming household production function that is specified to capture other unconventional (non-monetary) variables that are very important in describing their production system.

Table 3: Productivity estimates from farm household production function

Resource	Elasticity	MPP	APP
Land (Ha)	0.315	1.95	6.19
Planting material	0.068	0.127	1.86
Fertilizer	0.339	2.01	5.93
Labour (Mandays)	0.104	0.0345	0.331
Capital (N:K)	-0.021	-0.0032	0.152
Age	-0.0062	-0.0019	0.306
Sex (Dummy)	-0.0066	NA	NA
Education	0.0051	0.043	8.431
Hhs	0.866	0.076	0.087
Extention (Dummy)	0.584	NA	NA
Credit (Dummmy)	0.128	NA	NA

The results from both tables reveal the presence of constant return to scale in crop production that is caused by the use of labour intensive technology. In essence, the use of simple tools does not increase the productivity of labour and other complementary inputs when capital input is increased. That is, the benefits of technical economies of scale are not usually realisable in peasantry production system. Further, the presence of constant returns to scale marks the point of long run production equilibrium where total farm output produced by the farming households is just exhausted as each factor of production receives its marginal product. Therefore, as long as long run production equilibrium exists, then the peasANTS are operating at stage II of the production process. This is the point where, the marginal physical productivities of the inputs, that are less than the average physical productivities, have fulfilled the requirement of monotonicity as they are non-decreasing and greater than zero.

With respect to factor inputs, apart from capital, all other conventional inputs and non-monetary inputs have some degree of influence on the total physical product of farming households. Their use in the production process have been estimated to be at stage two since the inputs are experiencing decreasing returns to scale (Udoh, 1999; Udoh, 2000; Udoh & Faleke, 2006).

- ***Profit walk***

Although, farming household's primary objective function does not focus on profit making, their production system have inherent capacity to generate profit. Many empirical studies have shown that farm households can generate substantial revenue sufficient to ensure food security and better financial status if proper financial management is practised. Farm household level analyses using repeated cross sectional data usually reveal some positive margin of farm revenue accruable to the farming households as farm profit.

Table 4 presents a summary of profitability analyses from typical farming household production processes.

Table 4: Profitable ratios of farm household production system

Profitable ratios	Mean values	Remarks
Benefit cost ratio	1.23	Profitable
Gross ratio	0.30	Viable enterprises
Rate of returns	1.83	Moderate loan repayment capacity
Expenses structure ratio	0.06	Less level of fixed capital involvement

Source: *Compiled from different works of the author and others*

As indicated on the table above, the peasANT farmers have abilities to transform the market driven inputs into

surplus marketable outputs to the extent that every 30 kobo spent would generate revenue of at least 1 naira under a production system with very negligible fixed capital requirement. In case of investment, a return of over 180% on every naira invested by farm households clearly shows that the farming household can repay loans sourced from credit providers with high interest rates although studies have shown high levels of strategic and portfolio defaults among beneficiaries of agricultural loan (Udoh, 2006; Akpan, Udoh & Akpan 2014).

Therefore, in the event that the scale of operation is increased, coupled with right marketing strategies, farming households can operate within the paradigm of commercial oriented farms irrespective of their poor resource endowment and can be seen to cover their production cost as well as equate marginal revenue with marginal cost. Building on the profit maximization criteria, it is possible to estimate normalized profit function and factor share equation to explain the major drivers of profit at farming household based farms. As indicated in Udoh and Idiong (2000), the profit level of peasANTs has inverse relationship with variable inputs, but positive relationship with fixed inputs. Also, the factor share function estimation reveals that family labour has the highest share in profit function and that the farm's demand for the variable inputs is inelastic.

Up the hill the ants go yet not losing much energies

Mr. Vice Chancellor, Sir, we operate in an economic system where everyone desires to maximise some conceivable objectives; that is to obtain greater values with less efforts (inputs). That is what you may say "aiming at the star". One of the compelling questions that drives my interest in studying farming households is that of finding out if this set of economic players obey the basic neoclassical law of producing at the frontier given their poor resource endowment. In other words, since there are several impediments to large scale production, one pertinent question has been whether the small-scale farmers could attain optimum production level or not? This question constituted the fundamental research issue of my doctoral work; that is, how efficient are the peasant farmers in resource use? In essence, can we truly agree with the assertion Schumacher made in 1973 that small is beautiful within the framework of sustainable land use and management? The answer to the research question lies in measuring the efficiency of resource allocation and use among farming households. This puzzle has been investigated among small scale farming households in a bid to ascertain the level of their resource use and productivity.

As in other sectors of the economy, the absolute measurement of efficiency and productivity is of great importance in the agricultural sector. If threshold efficiency has not been reached in agricultural production,

detection and correction of the sources of failure would minimize the potential economic loss. For agricultural businesses to achieve sustainability in food production, it is imperative to determine their efficiency level and factors affecting efficiency. Factor productivity growth of input-output relations shows that small scale farmers can operate on the frontiers of the production and cost functions, and one way peasant farmers can raise the productivity of their farms is to improve efficiency within the limits of the existing resource base and available technology (Udoh and Akintola, 2001).

The term efficiency of a firm can be defined as its ability to provide the largest possible quantity of output from a given set of inputs or producing the same quantity of output at the lowest cost. The modern theory of efficiency dates back to the pioneering work of Farell (1957) who proposed that the efficiency of a firm consists of technical and allocative components, and the combination of these two components provide a measure of total economic efficiency. Technical efficiency of a farm measures how well inputs are transformed into a set of outputs based on a given set of technology and economic factors (Aigner *et al*. 1977; Kumbhakar, 1994). Technical efficiency can be measured either as input conserving oriented or output expanding oriented, which according to Jondrow *et al*, (1982) and Ali (1996), is the ratio of observed to maximum feasible output, conditional on technical and observed input usage.

The basis of efficiency analysis for any farm lies on evaluating the relative position on the production frontier. The term frontier involves the concept of maximality in which the function sets a limit to the range of possible observations (Foresound *et al.*, 1980). It is therefore possible to observe points below the production frontier for firms producing below maximum possible output, but there cannot be any point above the production frontier given the available technology. Deviations from the frontier are attributed to inefficiency. The need to measure inefficiency effects is the major motivation for the study of frontiers.

Frontier studies grouped these methods into two broad categories viz parametric and non-parametric methods. For the parametric methods, it can be deterministic, programming and stochastic depending on how the frontier model is specified. Many researchers including Schmidt (1976) have argued that efficiency measures from deterministic models are affected by statistical noise. This, however, led to the alternative methodology involving the use of the stochastic production frontier models. Aigner *et al.* (1977) and Meeusen and Vander Broek (1977) independently proposed the idea of stochastic measurement. The major feature of the stochastic production frontier is that the disturbance term is a composite error consisting of two components, one symmetric, the other one-sided. The symmetric component, Ui, captures the random effects due to

measurement error, statistical noise and other influences outside the control of the firm and is assumed to be normally distributed. The one-sided component V_i, captures randomness under the control of the firm, which gives the deviation from the frontier attributed to inefficiency. It is assumed to be half-normally distributed or exponential. The major weakness of the stochastic frontier model, however, is its failure to provide an explicit distribution assumption for the inefficiency term (Sharma *et al* 1999).

By definition and following the seminal work of Battese and Coelli (1995), stochastic frontier production function is as follows:

$Y_j = f(X_j - \beta)exp(V_j - U_j)$ j = 1,2,..., n..... (4)

Where Y_j is the output of the i^{th} firm, X_i is the corresponding (MxZ) vector of inputs, β is a vector of unknown parameter to be estimated F(.) denotes an appropriate functional form; V_j is the symmetric error component that accounts for random effects and exogenous shock; while Uj < 0 is a one sided error component that measures technical inefficiency.

Technical efficiency model

Technical efficiency (TE) of a firm using SPF is given as:

$$TE = \frac{Y_i}{Y_i^*} = \frac{Observed\ output}{Frontier\ output} = \frac{f(X_j - \beta)exp(V_j - U_j)}{f(X_j - \beta)exp(V_j)}$$
$$= exp(-U_j) \dots\dots\dots\dots\dots (5)$$

In recent times, econometric modelling based on either Cobb-Douglas or restricted transcendental production function or cost function of stochastic parametric frontier form with a composite error term has been an important aspect of efficiency estimation. By means of maximum likelihood estimation, asymptotically consistent and efficient estimators are obtained together with inefficiency determinants. Both time series and cross-sectional data have been variously used by many authors to measure efficiency indices among farms and farming households (Bagi and Hunag, 1993; Bagi,1984; Apeziteguia and Garate, 1997; Yao and Lui, 1998).

Against the risk of indulgence in many mathematical and statistical jargons, let me present the general forms of Cobb-Douglas and restricted transcendental production functions that different data sets have been fitted:
Cobb-Douglas production function:

Explicitly, it is shown as:

$$LogCAO = \delta_0 + \delta_1 LogLAN + \delta_2 LogHHL + \delta_3 LogHIL + \delta_4 LogFER + \delta_5 LogCAS + \delta_6 LogCAP + \delta_7 LogMAN + (V_1 - U_1) \ldots\ldots\ldots\ldots\ldots (6)$$

Where, CAO = Output of cassava measured in (kg); LAN = Land size of farmer measured in hectare; HHL = Household labour (man-days); HIL = Hired labour (man - days); FER = Quantity of Fertilizer (Kg); CAS = Cassava Stem cutting, (kg); CAP = Depreciation value of farm asset

as proxy of farm capital (Naira); MAN = Quantity of Manure measure in kg; ($V_i - U_i$) = Composite error term.

The stochastic frontier production specified in equation (6) is used to generate indices of technical inefficiency and determinants of technical inefficiency simultaneously through maximum likelihood estimation procedure. Explicitly also, the determinants of technical inefficiency are specified as thus:

$$TIE = \beta_0 + \beta_1 AGE + \beta_2 EDU + \beta_3 HHS + \beta_4 SOC + \beta_5 EXP + \beta_6 POV + \beta_7 CR + \beta_8 FAS + \beta_9 ICS + \beta_{10} GEN + u_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Where, TIE = Technical inefficiency; AGE = Age of the farmers (years); EDU = Education level of the farmer in years; GEN = Gender (dummy 1 for female farmers and 0 for male farmers); EXP = Farming experience (years); HHS = Household size (Number); FAS = Farm size (ha); SOC = Membership in a social organization (Number of years); POV = Poverty status of household head (income below poverty line of the respondents).

Restricted transcendental logarithm (translog) production function: $lnQ_j = a_0 + \sum_{i=1}^{n} a_i lnX_{ij} + {}^{1}/_{2} \sum_{i=1}^{n} \sum_{g=1}^{n} b_{ig}(lnX_{ij} lnX_{ij}) + \sum_{k=1}^{o} c_k R_{kj} + \sum_{t=1}^{m} d_t lnC_{tj} + \sum_{i=1}^{n} b_{ii}(lnX_{ii})^2 + {}^{1}/_{2} \sum_{i=1}^{n} \sum_{r=1}^{p} f_{ir}(lnX_{ij} lnI_{rj}) + \sum_{r=1}^{p} e_r\, lnI_{rj} + {}^{1}/_{2} \sum_{i=1}^{n} \sum_{t=1}^{m} h_{it}(lnX_{ij} lnC_{tj}) + {}^{1}/_{2} \sum_{r=1}^{p} \sum_{r=1}^{p} j_{rr}(lnI_{rj} x lnI_{rj}) + {}^{1}/_{2} \sum_{k=1}^{q} \sum_{0 \neq k}^{q} r_{ko}(R_{kj} R_{oj}) + {}^{1}/_{2} \sum_{t=1}^{m} \sum_{k=1}^{q} w_{tk}(lnC_{ij} R_{kj}) + {}^{1}/_{2} \sum_{t=1}^{m} \sum_{r=1}^{o} s_{tr}(lnC_{tj} lnI_{rj}) + U_j + V_j \ldots\ldots (8)$

Where Q_j, = output of crops measured as grain equivalent (kg/ha); X = vector of physical inputs (unit/ha), R = land quality variable, measured as dummy variable, L = vector of land use variables measured as indices, eg, diversification index, and C= vector of land management practised. a_0, a_1, b_{ig}, c_k, d_t, b_{ii}, f_{ir}, j_{rr}, e_r, h_{it}, r_{ko}, w_k, and s_{tr} are the parameters of interest to be estimated.

Chairman, Sir, leaning on empirical literatures, I and my research colleagues have worked with several farming households to evaluate how technically efficient they are in the use of productive inputs, principally to measure the household level efficiency indices and the determinants of efficiency beginning with my PhD research work. The findings are documented in the following published works: Udoh (2000), Udoh and Akintola (2001a) (2001b); Udoh (2005); Etim *et al*. (2005), Etim and Udoh (2006); Udoh (2006); Udoh and Etim (2006a-b); Udoh and Faleke (2006); Udoh and Akpan (2007); Udoh and Etim (2007);

Udoh and Etim (2008); Udoh and Etim (2009); Amaza, Udoh et al.(2010); Udohand Etim (2010); Etim and Udoh (2014).

Technical Efficiency indices

With respect to technical efficiency indices, over the years, our findings have been consistent and persistently point to one fact: that, resource use has not reached the technical or efficiency frontier as shown on Table 5. Specific farm households operate at different levels of efficiency in the use of their productive resources.

Table 5: Distribution of farm-specific technical efficiency

Efficiency Class	Percentage
0.40-0.49	9.17
0.50-0.59	7.50
0.60-0.69	15.83
0.70-0.79	26.66
0.80-089	31.77
0.90-1.00	9.17
Mean Value = 73.19	
Minimum Value = 0.40	
Maximum Value = 0.99	

Source: (Udoh and Faleke, 2006)

Specifically, Figure 1 shows the trend in technical efficiency measurement of the farming households for the past 17 years. The trend reveals a varied picture as the

range of average efficiency was 65-82 percent; that is, with the farming households existing technology, there is still room for a 18-36 percent increase in production. This is an indication that the farmers did not utilize the available productive inputs optimally and hence did not reach the production frontiers. Though the farming households are producing above median level, there are appreciable levels of waste of productive inputs recorded; that is substantial portion of outputs and farm level profits have not been achieved by majority of the peasANT farmers.

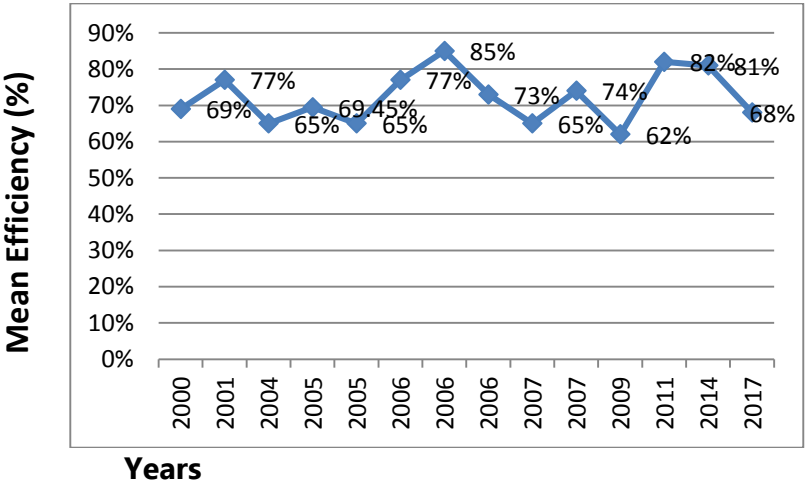

Figure 1: Trend in Technical Efficiency Measurement

Small as they appear, Mr. Vice Chancellor, our farming households are literally moving up the hill without losing much energies! In essence, *small body no be sickness:* they have shown considerable evidence that they are

rational economic units and are potential agents who can drive agricultural development agenda of government.

Determinants of Technical Efficiency

The determination of factors affecting efficiency is important as well as the measurement of efficiency indices. Many factors influence the efficiency of farming households, and some of these factors that have consistently appeared significant in many of my research works include land (farm size), age, education, farming experience, extension contact, sex, household size, membership of social organization, credit, market.

Economic Efficiency Model (Profit Efficiency)

We have also employed the Farrell model (efficient unit isoquant) to investigate the economic efficiency of farming households as shown in the following model: (Akpan, Udoh and Adah, 2017).

The general model is presented as:

$$\pi/p = f(q_i; Z)exp(V_j - U_j) \ldots\ldots\ldots\ldots\ldots\ldots (9).$$

Where; π = profit of ith farmer; q_i = vector of variable inputs; Z = vector of fixed inputs; p = output price; exp ($V_j - U_j$) = composite error term.

The element V accounts for random variations in profit attributed to factors outside the farmer's control. A one-sided component U ≤ 0 reflects economic efficiency relative to the frontier. Thus, when U = 0, it implies that farm profit lies on the efficiency frontier (i.e. 100% economic efficiency) and when U < 0, it implies that the

farm profit lies below the efficiency frontier. Both V and U are assumed to be independently and normally distributed with zero means and constant variances. The estimation of equation (9) is based on the assumption of constant returns to scale, varying factor proportions, varying factor prices among farms, the same technology and a homothetic production function.

Thus, economic efficiency of an individual farmer is derived in terms of the ratio of the observed profit to the corresponding frontier profit given the price of variable inputs and the level of fixed factors of production of farmers.

$$EE = \frac{\pi_i}{\pi_i^*} = \frac{Observed\ farm\ profit\ of\ a\ farmer}{Frontier\ profit} = \frac{f(q_i; Z)exp(V_j - U_j)}{f(q_i; Z)exp(V_j)} = exp(-U_j) \dots\dots (10)$$

Explicitly, it is shown as thus:

$$Log\pi = \vartheta_0 + \vartheta_1 LogLAN + \vartheta_2 LogFLP + \delta\vartheta_3 LogFEP + \delta\vartheta_4 LogCSP + \delta\vartheta_5 LogCAP + \delta\vartheta_6 LogHIP + \delta\vartheta_7 LogMAP + (V_1 - U_1) \dots\dots\dots (11)$$

Where, π =Normalized profit of a farmer; LAN = Land size of a farmer measured in hectare; FLP = Normalized wage rate of household labour (man-days); HIP = Normalized wage rate of hired labour (man - days); FEP = Normalized price of Fertilizer (Naira/Kg); CSP = Normalized price of

cassava Stem cutting, (N/kg); CAP = Value of farm capital (Naira/Kg); MAP = Normalized price of manure measure in Naira/kg; ($V_i - U_i$) = Composite error term. Note that all monetary variables were normalized using output price.

The determinant of economic efficiency of cassava farmers is specified as follows:

$$\mu = \beta_0 + \beta_1 AGE + \beta_2 GEN + \beta_3 INV + \beta_4 EDU + \beta_5 CRE + \beta_6 EXP + \beta_7 HHS + \beta_8 SMG + \beta_9 EXT + \beta_{10} FAS + V_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

Where, μ = Economic efficiency index of ith farm; AGE = farmer's age (year); GEN = Gender (dummy 1 for female farmers and 0 for male farmers); INV = level of involvement in farming (0 for part time, 1 for full-time); EDU = level of education (year); EXP = farming experience (years); HHS = household size (number); SMG = soil Management technique (1 for tillage, 0 for zero tillage); FSI = farm size (ha); Vi = stochastic error term. Table (6) presents economic efficiency indices of farming households.

Table 6: Distribution of farm-specific economic efficiency

Economic Efficiency range	Percentage
0.01-0.20	19.00
0.21-0.40	17.00
0.41-0.60	46.00
0.61-0.80	10.00
0.81-1.00	8.00
Total	100.00
Mean	0.57268
Minimum	0.11000
Maximum	0.85435

Source: Akpan *et al* 2017

As indicated on Table 6, only very few farm households attain higher level of economic efficiency close to the efficiency frontier. No farmer's profit reached the frontier profit efficiency. However, the least profit efficient farm household needs an efficiency gain of about 104% (i.e., 1.00 – 0.110/0.854)100 in the use of specified farm resources if such household is to attain the maximum economic efficiency level. For an average efficient farm household, they will need an efficiency gain of about 50.0% (i.e., 1.00 – 0.573/0.854)100 to attain the maximum profit efficient level while the most economic efficient farm household needs about 14.57% gains in economic efficiency to be on the frontier efficiency. The degree of variation in profit efficiency observed could be attributed

to variation in prices of specified farm variable resources and quantity of fixed factors used as well as the output price. To be precise, about 42.70% of profit is not earned by the farm households. The observed economic inefficiency gap is persistently affected by the level of farming involvement, farmers' education; farming experience, household size, soil management technique adopted and farm size, among other factors.

Farming Household Utility Function Specification

Farming households are utility maximizing socio-economic units; thus it is possible to specify welfare functions (demand, consumption and adoption functions) based on available data. Consumers' welfare is important for agricultural production to have a complete cycle. It is pertinent to emphasize the importance of consumers in agricultural production system, because it is the magnitude of consumption that decides the energy invested in agricultural production.

- ***Demand functions***

Microeconomic theorists have conceptualised consumer's ordinary demand function to capture both substitution and income effects (Varian, 2014). Specification of farming household demand function therefore involves building functional equation that shows the direction and magnitude of change in the demand frontier as influenced by the substitution and income effects variables. In this regards, we specified different ordinary demand functions for the purpose of estimating and isolating the elasticities

of income, prices and household characteristics variables with respect to necessity and luxury goods and services demanded by farming households. Some of the models developed are as presented:

i. Demand for health services

Specifically, we have developed a multinomial logit model that isolates the factors that determine the choice of or demand for medical treatment sources among farming/fishing households, given that the households can access medical treatment from four sources, namely self medication, modern health services, traditional means and divine intervention (Udoh, Omonona and Bassey, 2008). Accordingly, the probabilities of choosing any of these alternatives can be shown as:

$$C_i = P(L_i = 1) = \frac{Exp(V_i)}{1+Exp(V_j)+Exp(V_k)+Exp(V_l)} \dots\dots\dots\dots\dots\dots (13);$$

where *i, j, k, and l* could be either 1, 2, 3, or 4 based on the choice preference of the household that the household presumes to have highest utility. In order to dichotomize the choice in relation to determining demand shifters, the explicit model is as given:

$$LnU_j = \beta_{jo} + \sum_{i=1}^{k} \beta_{ji} X_i + \alpha_1 S + \alpha_2 \ln(Y - P_j) + \alpha_3 \ln(Y - P_j)(Y - P_j) \dots\dots (14)$$

Where U_j could be any of the probabilities of choice; X_j are the demographic and socio economic factors; S is the type

of service consulted; Y is the income of the household and P_j is the consultation/treatment fees of the sources.

The result of the major finding is presented on Table (7). In the estimation, seeking of divine intervention as a treatment source was taken as the base for normalisation. The effects of changes in the independent variables on the predicted probability of choosing a particular treatment source is also estimated and presented on Table 8.

Table 7: Multinomial Logit Estimates for Determinants of the Probability of Treatment Preference given other options

Variable	Self-medication	Modern services	Traditional means
Age	-0.0594 -1.3286	0.0716* 1.8680	0.1809* 1.8288
Sex	4.8736* 1.7697	-3.4970*** -1.9759	0.0328*** 10.6383
Education	0.3972* 0.1870	0.1651*** 2.9540	-0.7624*** -11.5925
Marital Status	-0.4256 -1.0836	0.5415* 0.1870	0.4315 1.1316
Number of Children	2.1023*** 4.2053	-0.2465*** -4.4539	-3.7413* -1.8141
Number of Adult	0.6142*** 4.7897	0.6925 1.5885	0.0362* 1.8234
Household Income	0.1206** 2.0596	1.2736*** 7.6916	-0.8307* 1.8325

Variable	Self-medication	Modern services	Traditional means
Consultation fee	-0.0325*** -4.0663	-0.3128*** -4.2956	-0.1212 -1.0138
Transport cost	0.0738 0.2353	-3.1562*** -5.6014	-0.0176 1.1675
Ownership status of fishing gears	0.7911** 1.8908	1.8112*** 9.3734	-0.2018 -0.4985
Lr chi_2 L- Livelihood	461.5217 -329.5129		

*, **, and *** indicate significance Significant @ 10%, 5% and 1% respectively (culled from Udoh *et al* 2008)

Table 8: Marginal Effects of Covariates on Probability of outcomes

Variable	Self-medication	Modern services	Traditional means
Age	-0.0675	0.0457	0.0382
Sex	-0.0381	-0.0032	0.0172
Education	0.0846	-0.0021	-0.0057
Marital Status	-0.0377	0.0592	0.0119
Number of Children	0.0114	0.2310	0.3210
Number of Adult	-0.0098	0.0041	0.0124
Household Income	0.0612	0.0741	-0.0081

Variable	Self-medication	Modern services	Traditional means
Consultation fee	-0.0091	0.0012	0.0219
Transport cost	0.0751	0.0521	-0.0014
Ownership status of fishing gears	0.0590	-0.0061	0.0519

Source: Udoh *et al* 2008

As expected, the households demanded less of modern health services but more of self medication and herbal/traditional means. Also, the determinants of seeking treatment differ for the different options, suggesting that there is heterogeneity in treatment sources. For instance, age, sex of the household heads, educational level, dependency ratio and household income affected the choice of healthcare services. Specifically, the positive significant coefficient on age for both modern service providers and traditional means suggests increase in patronage for these sources among older persons. This corroborates the findings of Kacou *et al* (1999) and Meyerhoefer *et al* (2003) that as an individual becomes older, he/she utilizes the hospital more. Furthermore, the choice of traditional means, which involves taking of herbs, is revealed to be prevalent among older household heads; a suggestion of strong belief system among the aged. Female headed households' preference gradient skewed toward modern

healthcare services and divine intervention (faith based) treatment sources while male headed households aligned their treatment options toward self-medication and herbal treatment. Accessing medical attention via modern healthcare is income elastic as against income inelastic with respect to self medication. Access cost to the user of treatment sources, defined as consultation/medical fees, negatively affected the probability of choices, especially for the conventional healthcare services.

ii. Demand for animal protein

It is common knowledge that animal protein source is considered as luxury food for resources poor farming households; as the level of demand and consumption among them has been questionably and progressively low. Using beef as a widely demanded and relatively cheaper source of animal protein, we tried to explain the demand behaviour of households by specifying ordinary Marshallian demand function (equation15) as shown in (Udoh and Akintola, 2003):

$$Q_b = f(P_b, \prod_{k=1}^{n} P_k, Z_i, Y, T, e) \ldots\ldots\ldots\ldots (15),$$

where Q_b is the quantity of beef demanded, P_b is the own price of beef, P_k are the prices of the competing products, Z_i is vector of plausible demographic variables, Y is disposable income, T is the trend/policy element, and e is the usual noise term.

After fitting secondary data into the model, parsimonus estimators were identified that clearly showed that households react negatively to changes in own price, but positively to the substitute prices (fresh fish and goat meat), and that there was less than proportionate demand for beef as income level increased.

iii. Demand for staple food

Farming households have to budget their meagre income for the purchase of different foodstuffs to prepare meal. Characteristically, a flexible demand function is imperative for estimating demand system that can handle optimal allocation of household expenditure profiling among broad household need groups; thus the applicability of the Linearized Approximate Almost Ideal Demand System Model (LA/AIDS). According to Deaton and Muellbauer (1980),the acceptability of AIDS model in estimating the elasticities of the major staples demanded by consuming households is predicated on the axioms of order, aggregates over consumers without invoking parallel Engel curves and consistent with budget constraints. Typical AIDS demand function for all classes of food based on theoretical and statistical plausibility was developed for the consuming farming households as indicated in equation (16) and presented on Tables 9a-c (Udoh, *et al.*, 2013).

$$W_i = \alpha_i + \sum_j^n \gamma_{ij} Ln\, P_j + \beta_i (LnX - \sum_{i=1}^n W^* Ln\, P_i) + \sum \varphi V + \mu_i \text{.....(16)}$$

Where;α_i = average value of the budget share of food items, β_i = effect of real income on the budget share of the food items, γ_{ij} = effect of the prices of items in group i^{th} on the budget share of item i^{th}, and φ = coefficients of household socio-economic variables.

Table (9a): AIDS Model for Household demand for Food

Variables	Coefficient	t-value
Budget share for starchy food		
Constant	0.006	0.207
Sex	0.005	1.016
Age	0.001	1.383
Marital Status	0.000	-0.097
Education	0.001	0.945
Household Size	0.093	2.909**
Household Income	-0.024e-08	-2.735***
Effect of Real Income (β_i)	-0.047e-05	-5.000***
Weighted Unit price Starchy Food (Y_{ii})	0.084	4.353***
R^2	0.768	
F Statistics	8.701***	
Budget Share for Plant Protein Food		
Constant	-0.064	-1.725*
Sex	0.002	0.273
Age	-9.814e-05	0.147

Variables	Coefficient	t-value
Marital Status	0.014	2.752***
Education	0.013	1.391
Household Size	0.006	4.214***
Household Income	0.028e-08	2.968***
Effect of Real Income (β_i)	0.009	3.625***
Weighted Unit price Starchy Food (Y_{ii})	0.000	12.707***
R^2	0.924	
F Statistics	31.703***	
Budget Share for Animal Protein Food		
Constant	-0.194	-1.392
Sex	0.035	1.024
Age	0.000	0.099
Marital Status	0.008	0.457
Education	0.016	2.779***
Household Size	-0.084	-5.971***
Household Income	0.126e-07	1.865*
Effect of Real Income (β_i)	-0.002	-1.738
Weighted Unit price Starchy Food (Y_{ii})	0.036e-05	3.374***
R^2	0.569	
F Statistics	3.470***	
Budget Share for fatty-Food		
Constant	-0.059	-0.667
Sex	0.004	0.209

Variables	Coefficient	t-value
Age	0.000	-0.167
Marital Status	0.004	0.354
Education	0.049	2.348**
Household Size	-0.003	0.336
Household Income	-7.750e-08	-0.619
Effect of Real Income (β_i)	0.047	4.203***
Weighted Unit price Starchy Food (Y_{ii})	0.173	3.833***
R^2	0.669	
F Statistics	5.302***	

Table 9b: Household Expenditure Elasticities for Food Classes

Food Subgroup	Elasticity	Own-Price Elasticity
Starchy	0.117	-1.047
Animal Protein	0.987	-1.002
Plant Protein	1.207	-0.991
Fat and Oil	2.042	-1.048

Table 9c: Household Cross-Price Elasticity for Food Classes

Food Classes	Starchy	Animal Protein	Plant Protein	Fat and Oil
Starchy	0.000	0.001	-0.009	-0.044
Animal	0.176	0.000	-0.003	-0.031

Food Classes	Starchy	Animal Protein	Plant Protein	Fat and Oil
Protein				
Plant Protein	0.048	0.001	0.000	-0.008
Fat and Oil	0.048	0.001	-0.009	0.000

Source: Udoh *et al* 2013

In line with *a priori* expectation, the expenditure elasticity coefficients of starchy and animal protein food stuffs as shown on the Tables above are inelastic which implies that they are "necessity" goods; while that of plant protein and fat food items are elastic, hence "luxuries". The result also confirmed that, the cross price elasticity of most staples is complementary in nature.

- ***Consumption function for potable water***

Farming households are the major consumers of goods and services produced within an economic system and based on their disposable income and some demographic factors. It is possible to empirically specify consumption functions for various expenditure items. On this premise, efforts have been made to estimate the domestic water consumption function for farming households (Udoh & Etim, 2007; 2004).

Assuming consumption functions that are homogenous in the exogenous variables, best *goodness of fit* equations have been developed that consistently revealed that

household size, household income, storage facility, multiple usage, distance to water sources and body mass index are major potable water consumption shifters with estimated coefficients less than unity. In essence, the marginal propensity to consume water with respect to the regressants is fairly inelastic.

- ***Adoption model***

The need to maximize economic returns and improve the general welfare has been a driving force behind technology adoption by farming households. In many developing economies, considerable public and private resources have been devoted to providing new agricultural technologies to rural farming households that are predominantly poor. From the adoption of tractor power and hybrid seeds, fertilizer and pesticides to the reliance on biotechnology to ensure higher yield and lower cost of production , farmers have been induced to adopt new production practices (Anderson *et al.*, 1999). The most compatible of these technologies to the resource-poor farmers are those termed operating innovations (e.g., improved seed varieties) that impact most directly annual variable costs and possibly production levels.

The decision to adopt a given technology is based on utility maximization concept (Jamison and Lau, 1982; Voh,1982; Kebede et al., 1985). Adoption decision is adequately integrated to the theory of the threshold that

explains and predicts dichotomous decisions and behaviour, and this creates a sensitive response in the decision variables (farmer specific factors, farm specific factors, institution specific and technology specific factors) that can be observed only in the segment between the two extremes. Within these extremes, technology is either preferred or not as explained by either the innovation-diffusion theory, the economic-constraints theory and/or the technology characteristic-users context theory (Roger, 1983; Negatu and Parikh, 1999). We therefore expect functional relationship of the threshold decision model with a normal sigmoid function, which is probabilistic in nature (Yamane, 1960). Therefore, the probability that a farming household adopts a new technology is a function of the expected utility (benefits) derivable from the decision to adopt. But there is a functional relationship between expected utility of a technology and farmer, farm, institutional and technology characteristics. Formally, this is expressed as:

$$YN = 1 \; if \; E(UN) > E(UT) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (17)$$

Where YN =1 is adoption of new technology and 0 is non adoption; E(UN) =expected utility of new technology (i.e. expected benefits farmer would derived by deciding to adopt a new technology); E(UT) = expected utility of old technology (i.e. the benefit from old technology, which the farmer would sacrifice by adopting a new technology). From equation (17), the probability of a farming

household adopting a new technology, P(YN), given the old technology is given as:

$$P(YN) = f\left\{\frac{E(UN)}{E(UT)}\right\} \dots\dots\dots\dots (18)$$

But E(UN) depends on certain conceivable factors as shown in the following equation:

$$E(UN) = f(Tc, Fh, Fa, In) \dots\dots\dots\dots\dots\dots\dots (19)$$

Where Tc = technology-specific characteristics, Fh = farming household-specific characteristics, Fa = farm-specific characteristics, In = institution-specific characteristics.

Usually, developing adoption model for farming household involves hypothesizing multivariate threshold decision model of either standard cumulative distribution function (Probit), or the logistic distribution function (Logit) or a hybrid of discrete and continuous function (Tobit). As in the case of multivariate dichotomous function, an aggregate variable, say ***A*** is assumed such that ***A*** is a linear combination of the adoption-induced variables, with A* as threshold playing the role of disturbance force. With this, the disturbance term is therefore homoscedastic in any of the model specified. Empirically therefore, the multivariate Probit model involves this relationship:

$$Let\ Y_i = \begin{cases} 0, if\ A_i < A^* \\ 1, if\ A_i \geq A^* \end{cases} for\ all\ i, i = 1,2, \ldots n\ observations$$

Where Y_i is the probability that the farming household chooses to adopt the technology; and

$A_i = \sum_{i=1}^{n} \beta_i X_i + e_i$..... (20)

A^* = the threshold level (latent variable), which is not mathematically observable. But A_1 equals 1 for farming households that adopt and 0 for non-adopters.

The Logit model is as follows:

$$Y_i = {}^{1}/_{1 + e^{-f(A_i)}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (21)$$

Where Y_i and A_i as defined in equation (20)

Following close association of both Probit and Logit models, the change in the probability that the farming household will adopt new technology into his/her farm given a change in any one of the adoption induced variables can be computed as:

$${}^{\delta Y_i}/_{\delta A_i} = f(w_i)^{\beta} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (22),$$

where $f(w_i)$ is the standard normal density function. Selection of the 'best' or most appropriate model between Probit and Logit is usually dependent upon the evaluation of the statistical significance of the estimated coefficients.

The Tobit model is used to determine both the likelihood and the intensity of adoption simultaneously. The choice of Tobit model over Probit or Logit models is based on the fact that there are differentials in the level of adoption of an innovation by adopters.

Tobit model is expressed as;

$$Y_i = \begin{cases} y_i = \beta X_i + u_i, if\ y_i^* > 0 \\ 0 = \beta X_i + u_i, if\ y_i^* < 0 \end{cases} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(23), Yi}$$

is discrete if the farming household does not adopt and continuous if adopts, y_i^* is the level of adoption and $y_i^* > 0$ implies y_i^* is observed whereas the reverse is the case when $y_i^* < 0$. X_i is the vector of explanatory variables that are known to influence the decision of the farming household to adopt new technology. Following the decomposition framework suggested by McDonald and Mofitt (1980),the Tobit model can further be disintegrated to determine the effect of a change in the variable or change in the probability of adopting the new technology (likelihood of adoption) and the depth (intensity)of adoption. These are expressed in the form of elasticity as follows:

Elasticity of probability of adoption

$$eP_r - adton = \frac{\beta_j f(z)}{\sigma} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (24)$$

The elasticity of probability of adoption measures the change in the probability of adopting a technology as each factor changes.

Elasticity of intensity of adoption

$$eIn - adton = \beta_j\{1 - \frac{zf(z)}{F(z)} - f(\frac{z)^2}{F(z)^2\}} \dots\dots\dots. (25)$$

The change in intensity of adoption with respect to a change in each factor among the adopters is measured by the elasticity of intensity of adoption.

Elasticity of total change

$$eTc - adton = F(z)\beta_j \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (26)$$

Total changes show the marginal effect of a factor on the expected value of integrating a technology in the farming system of the farming households.

Chairman, Sir, having understood new technology as a panacea for sustainable productivity growth, I engaged myself in specifying adoption models that could typify the behaviour of farming household with respect to adopting agricultural innovations (Udoh and Kormawa, 2007; Udoh and Omonona, 2008; Udoh, 2011).

A typical adoption model for farming households is as presented on Table (10), which shows the significant importance of household size, farming experience,

educational attainment, farm size, access to credit, extension services, access to augmented input, reasons of food security, land and protein source in explaining the decision to adopt a technology. These are the technology-specific factors, farming household-specific factors, farm-specific factors and institution-specific factors known to determine the likelihood of farming households adopting new technology. Table (11) presents the estimates of elasticity of probability of adoption, elasticity of intensity of adoption and total change. In aggregate, the elasticity of probability of adoption, elasticity of intensity of adoption and total change are 0.40, 0.25 and 0.51 respectively. Specifically, the intensity of adoption is low, thus the extent of diffusion of technology among farming households is relatively slow; having more laggards than early adopters.

Table 10: Determinants of Adoption (Tobit Model)

Variable	**ML Estimate**	**Standard Error**	**t-value**
Farmer Characteristics			
Household size	0.02292**	0.011059	2.07252
Experience	-0.025991**	0.004669	-5.5667
Age	0.00054	0.00146	0.1174
Education	0.003587***	0.00326	11.0030
Farmer Characteristics			
Labour	0.049761	0.75358	0.66033

Variable	ML Estimate	Standard Error	t-value
Extension Contact	0.116418**	0.043377	2.68386
Total Farm Size	0.12552***	0.022142	5.66887
Access to Credit	0.0183***	0.00492	3.71950
Augmented Input	0.0652	0.01680	3.88091
Technology Characteristics			
Food Security	0.09266**	0.047133	1.96591
Land	0.10029**	0.046191	2.17120
Protein	0.38935**	0.165714	2.34952

Sigma (δ) = 0.5718***
Source: Udoh, 2011

Table 11: Elasticity of Probability of Adoption, Elasticity of Intensity of Adoption and Total Change

Variable	ML Estimates	EPr-adton	EIn-adton	Total Change
Farmer Characteristics				
Household	0.02292	0.013213	0.08286	0.016736
size	-0.025991	-0.01498	0.0094	-0.01897
Experience	0.00054	0.00031	0.000195	0.000394
Age	0.03587	0.020678	0.012967	0.026185
Farmer Characteristics	0.049761	0.028686	0.017989	0.036326

Variable	ML Estimates	EPr-adton	EIn-adton	Total Change
Labour Extension Contact	0.116418	0.067112	0.042085	0.084985
Total Farm Size	0.142552	0.072359	0.045376	0.09163
Access to Credit	0.0183	0.010549	0.06615	0.013359
Augmented Input	0.0652	0.037586	0.02357	0.047596
Technology Characteristics				
Food Security	0.09266	0.053416	0.033497	0.067642
Land	0.10029	0.057814	0.036255	0.073212
Protein	0.38935	0.05703	0.03576	0.07222

Note: f(z) = 0,49; F(z) = 0.73; σ = 0.85; Z = 0.37
Source: Udoh, 2011

- ***Farming household and Saving function specification***

Theoretically, the concept of saving is closely related to the concept of consumption; thus, saving function is derived from the consumption function. The centrality of household income mapping both saving and consumption underscores the use of simultaneous equation modelling

technique to specify saving determinants among agro-based farming households. (Akpan, Udoh and Aya, 2011).

Simultaneous equation saving model

On the premise that some variables that affect saving also affect consumption of the households, we specified a structural simultaneous equation model as follows:

$$\left\{\begin{array}{l} SAV = f(INC, TAX, AGE, EXP, EDU, MOA, HHS) \ldots\ldots\ldots\ldots\ldots\ldots\ldots (27) \\ CON = F(INC, TAX, EXP, EDU, NFE, HHS, FMI, VFO) \ldots\ldots\ldots\ldots (28) \\ INC = SAV + CON) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (29) \end{array}\right\}$$

Where, SAV = Households saving defined as (INC – CON) measured in Naira; INC= Income of i^{th} of the farm household defined as Salary + Allowance + farm income + off- job income (₦); CON = Household consumption expenditure (Con = Inc Sav) (₦). TAX= Tax defined as ($Tax = t_0 + t_1 INC^*$). where Tax is a predicted value of tax in (₦) and INC* is the salary + allowance of i^{th} farm worker; AGE = Age of i^{th}farming household head in years; EXP = Experience on job measure in years. EDU = Educational qualification of the household head in years; HHS = Household size in number; FMI= Income of other family members (₦); NFE = Expenditure, defined as Household non-food expenditure (₦); VFO = Value of Farm output of household in (₦); MOA = Membership of *etibe* Association in Years (A local contribution group among workers).

Having resolved the identification problem and showing that the disturbance terms are contemporaneously independent, we proceeded to estimate the system of

equations using a 2-stage least square method and arrived at a consistent classical model for saving behaviour of farming households as shown on Table 12.

Table 12: Two-stage least squares estimates of saving equation

Variables	Estimates
Income	0.584*** (7.451)
Tax	-3.527** (-2.422)
Age	16.359 (0.250)
Experience	11.117*** (3.142)
Education	21.637** (2.214)
Membership of credit group	34.146** (2.503)
Household size	-0.69* (-1.878)
Constant	-2204.773*** (-3.209)
R^2	0.873
R^2-Adjusted	0.828
F-stat	17.433***

Source: Akpan, Udoh and Aya, 2011

My research findings agree with Keynesian and Friedman Permanent Income Hypothesis postulations that relate income positively to saving; thus, a fairly inelastic marginal propensity to save that is approaching unity. The negative sign on tax coefficient indicates that as tax rate increases, the disposable income is lowered thereby resulting in increase in the consumption expenditure and a corresponding decrease in saving. Further, the positive sign on slope coefficient of experience agreed with Ando and Modigliani (1963) that older farm workers have higher tendencies to save than those that are new on the job. Farming households with larger family size would likely save less and consume more. Membership of local credit/thrift association is a major saving shifter, which could be attributed to the social capital accumulation derivable from being member of such social groups and also social networking that can generate additional income to members.

- ***Investment function (Economic replacement model)***

The decision to cultivate tree crops by farming households could be considered as accumulation of fixed assets that will generate streams of income for a considerable period. As other fixed assets that experience wear and tear, tree crops undergo depreciation in yield level over the years and if old trees are not felled down and new ones planted, there will be disinvestment in the farm and the capital stock and streams of revenue will decrease. Therefore, for

increase in the real capital stock, replacement of old trees must exceed depreciation.

Over the years, the revenue derived from tree crop sub sector has declined steadily due to aging trees and poor maintenance of existing plantations. Adoption of such management technique that would ensure sustained productivity of the tree crops is necessary. In this wise, it is imperative to determine the optimum replacement period for major tree crops grown by farming households. Using rubber as a case study, we determined the economic replacement period through both cost minimization and profit maximization routes. (Udoh & Akpan, 2009 ; 2010).

Following the cost minimization replacement principle, the implication is that the value of anticipated maintenance cost must be more than the amortized present values in the preceding years (Olayemi *et al.*, 1999). Mathematically, $R_{n+1} > P_n\left(\frac{1-V}{1-V^n}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (30)$, where

R_{n+1} = marginal net revenue in year n+1, $P_n\left(\frac{1-V}{1-V^n}\right) = a_i$, which is the amortized present value of accumulated cost;

And, $P_n = C + \sum_{t=1}^{n} {R_t}/{(1+r)^{t-1}} \ldots\ldots\ldots\ldots (31)$, where P_n= accumulated present value of maintenance cost, r= discount rate, n= optimum replacement period, t= years i.e. 1,2,3… n, $(1-V)/(1-V^n)$= amortization factor, V= $1/(1+r)^t$**.** The amortized present value or annuity of cumulated maintenance cost is the annual amount which if saved

yearly in the course of rubber production in each plantation for 'n' years will be the same in discounted value to cumulated present value of stream of unequal maintenance cost in the same 'n' number of years for each plantation. The average lending rate of 18% for the year 2008 was used as a discounting rate for the previous stream of maintenance costs over the years. Total maintenance cost consists of the annual labour cost (wages and salaries), annual equipment cost (i.e. wires, cups, tapping knives, containers, measuring shed and other equipment), and the annual maintenance cost (i.e. cost of chemicals used on rubber tree, casual labour cost and logistic costs) and depreciation cost.

Figure 2 shows an exact optimum replacement period for rubber in the farming household plantation. The exact optimum replacement time in years is the point of intersection of the amortized present value of maintenance cost curve and the anticipated maintenance cost curve, drawn to touch the X-axis. The exact time of replacement of the rubber trees comes before the 25th year.

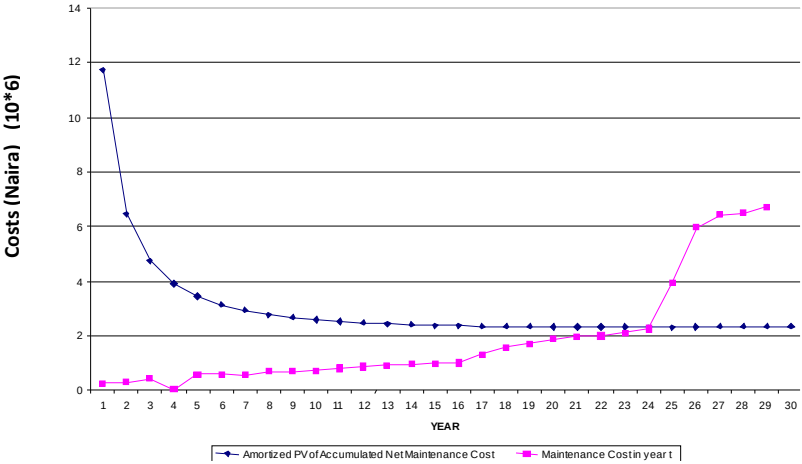

Figure 2: Economic replacement period for rubber tree (cost minimization replacement principle)

Source: Udoh and Akpan, 2010

To further verify the economic optimum replacement period, we also estimated an investment model using the profit maximization criterion. Mathematically,

$$P_n \frac{(1-V)}{(1-V^n)} > MNR_{n+1} \ldots\ldots\ldots\ldots (32),$$

$$P_n \frac{(1-V)}{(1-V^n)} = a_i =$$

$$amortized\ present\ value\ of\ accumulated\ net\ revenu,$$

$$MNR_{n+1} = Marginal\ net\ revenue\ in\ year\ n+1,$$

$$P_n = C + \sum_{t=1}^{n} MNR_t / (1+r)^{t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (33)$$

P_n= accumulated present value of net revenue, r= discount rate, n= optimum replacement period, t= years i.e. 1,2,3,..., n, (1-V)/(1-V^n)= amortization factor

V= 1/(1+r)^t. The amortized present value of cumulated net revenue is the annual amount which if earned yearly in the course of rubber production in each farm for *n* years would have the same accumulated present value as a stream of unequal net revenues earned in the same *n* number of years.

The result showed an optimal replanting period of 24 years after field establishment as presented in Figure 3. This implies that given the stream of income generated and cost in the production of rubber, the economic period for replacing the rubber trees is 24 years from the first year of production.

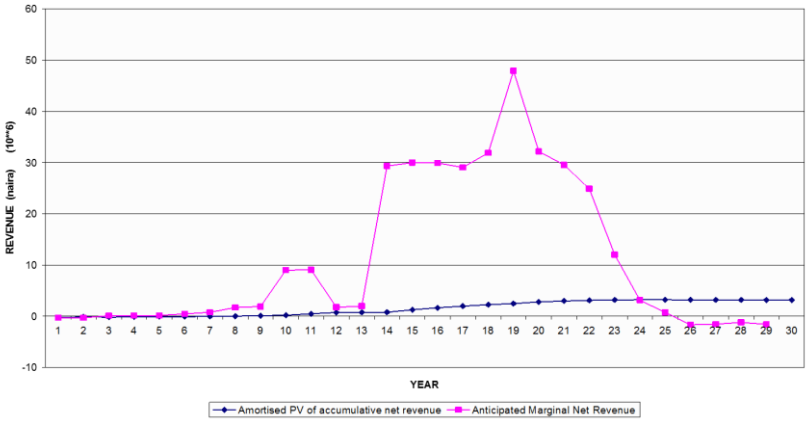

Figure 3: Economic replacement period for rubber tree (profit maximization replacement principle)
Source: Udoh, Akpan and Aya 2008

In essence, to ensure that farming households derive optimal economic benefits from rubber plantation, old trees should be replaced with new trees after 24 to 25 years of field establishment. This is the window for investment for optimum gain.

ANTS' WELLBEING

Poverty Issues

Mr. Vice Chancellor, Sir, developing economies are grappling with the challenge of poverty, which is widespread and pronounced even though these economies are naturally well endowed with abundant natural and human resources. As noted by World Bank

(1996), this is actually a paradox of experiencing poverty in the midst of plenty. Clearly, farming households experience much of poverty, thus it has been a major task among researchers to understand the concept, dimension, profiles and determinants of poverty at the global, national, community, household and individual levels.

Conceptually, poverty is a complex and multi-dimensional phenomenon for which precise definition has remained elusive. It is variously perceived, defined and understood yet the symptoms and features are quite visible and easily recognized (Udoh & Omonona, 2002). Hence poverty, like humpty-dumpty or elephant is more easily recognized than defined. Most of the poor reside in the rural areas and derive their livelihood from farming. Besides the nature of the income/expenditure dimension of poverty, other obvious dimensions are essential for the description of poverty. These include physical, moral, social and even psychological (Omonona, Udoh and Owoicho, 2001).

Therefore, while economist would consider poverty from the view point of wants, needs and effective demand, psychologist may look at it from the standpoint of deprivation, esteem and ego. In the same vein, while a nutritionist may view poverty as inability to meet basic nutritional needs, a social health worker may view poverty as a function of life expectancy, child mortality etc. (Ojiha, 1970, Reutlinger and Selowsky, 1976, Singer, 1975 and Sen, 1983).Also, characterization of poverty with respect to

the cause-impact analysis differs markedly depending on social group and geographical context (Udoh and Omonona, 2002) as shown in the following schema (Figures 4a-d):

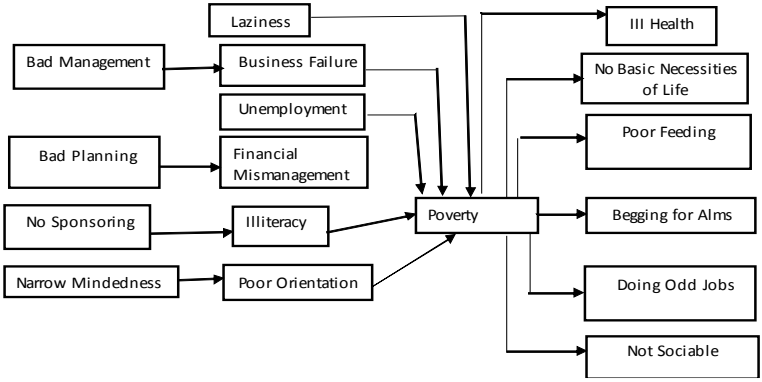

Figure 4a: Cause-Impact Analysis as given by adult males

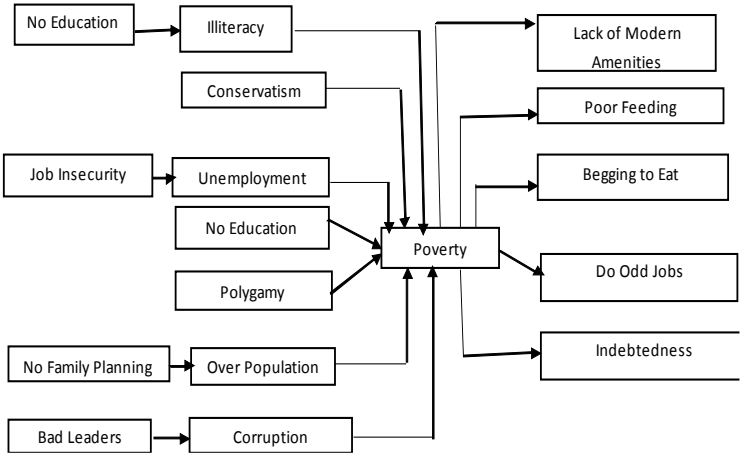

Figure 4b: Impacts Analysis as given adult females

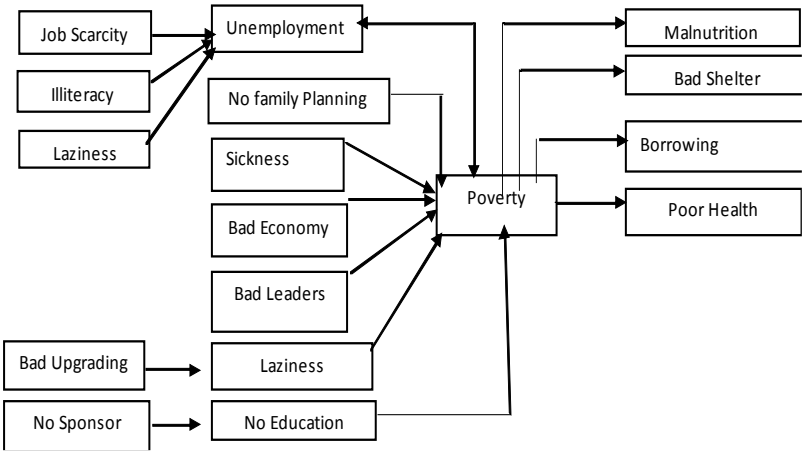

Figure 4c: Cause-Impact Analysis as given by young males

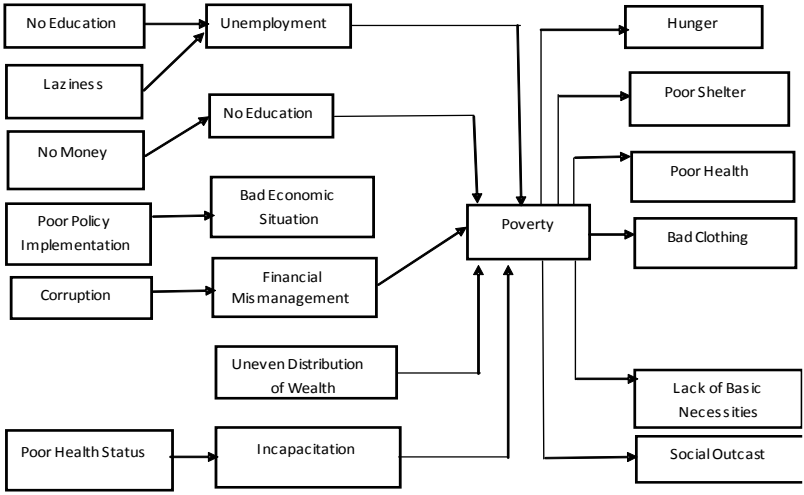

Figure 4d: Cause-Impact Analysis as given by young females

- ***Measures of poverty***

Based on different perspectives, poverty has been measured, quantified and profiled differently by scholars. The first attempts to measure poverty were made more than a century ago by Booth, 1889; Rowntree, 1901 and Naoroji, 1901). While Booth's and Rowntree's studies were focused on the urban cities of London and New York, Naoroji's was directed at estimating the extent of poverty in the whole of India. These first attempts were intended to identify poverty lines, hence it was only later that poverty profiles and indicators were introduced into the debate by Sen (1976).

Many indices have been designed and developed to measure poverty and well-being. These comprise of Sen index (1976); Foster-Greer-Thorbecke (FGT) poverty index (1984); UNDP, (1990), Integrated poverty index (IPI), Basic needs on balanced diet index, the physical quality of life index (PQLI) (Morris, 1994), Relative Welfare index (IFAD, 1983), Index of Social Progress (Estes, 1984), Index of Quality of life"in nations (Slottje's 1991); Index of life in metropolitan areas (Liu's 1977). Out of these listed measures, Sen index and FGT index have been used severally to profile poverty status of farming households.

Sen index: The Sen index is attributed to Sen (1976), and it reflects not only the number of the poor but also both the extent of immiseration and the distribution of income among the poor. It is able to accomplish this by

incorporating the headcount index, the income gap, and the Gini coefficient.
The Sen poverty index (S) is symbolically shown as:

$S = [I + (1 +) GP]$..... (34)

Where $I = \sum_{i=1}^{q} \frac{z - y_i}{q_z}$..... (35)

Where I = the average income short fall as a percentage of the poverty line; Yi = income of the i^{th} poor household;Z= poverty line; q_z = number of households with income < z; h = q/n; headcount ratio; n = total number of households; and Gp = Gini coefficient among the poor = $0 \leq Gp \leq 1$

We note that S is an increasing function of the headcount index and an increasing function of the income shortfall. Given that the Gp ranges from zero to one, S is also an increasing function of Gp:

$$\frac{\delta S}{\delta H} > 0; \frac{\delta S}{\delta I} > 0; \frac{\delta S}{\delta Gp} > 0$$

The Sen index has a major drawback; that is, it is more responsive to improvements in the headcount than it is to reductions in the income gap or to improvements in the distribution of income among the poor. That is, the index indicates that the efficient way to reduce poverty is to help the least needy first and the most needy last. This is antithetical to egalitarianism, thus it is unpopular in evaluating poverty status among farming households.

Foster-Greer- Thorbecke's (FGT's) weighted poverty: This is the most widely used method in poverty assessment based on income/expenditure approach. It was introduced by Foster, Greer and Thorbecke in 1984. The FGT poverty index, which shows the class of additively decomposable poverty measure, is generally expressed as:

$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{Z-Y_i}{Z}\right)^\alpha$ ..... **(**36**)**

Where: n = total number of households in population; q = the number of poor households; Z = the poverty line for the household; Y_i = Per capita household income for i^{th} farmer; α = poverty aversion parameter, which takes on value 0, 1 and 2; $\left(\frac{Z-Y_i}{Z}\right)$= proportion shortfall in income below the poverty line. The poverty line mostly used is based on income/expenditure of the households. Two-thirds of the mean per capita expenditure (2/3MPCHE) is referred to as the moderate poverty line whereas one-third of the mean is taken as the line for extreme poverty. Specifically, those that spend <1/3 of MPCHE and <2/3 of MPCHE are considered to be extremely poor and moderately poor respectively, whereas those spending greater than or equal to 2/3 of MPCHE are considered to be non-poor farming households.

If the sample population is continuous, the FGT's measure can be expressed as

$P\propto = \int_0^2 \frac{[z-xi]\alpha}{z}$ f(y) δy..... (37);

Where f(y) is income or expenditure distribution function (Kakwani, 1993).

When α =0, $P_0 = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{Z-Y_i}{Z}\right)^0 = \frac{q}{n}$ ..... (38). This equation measures the poverty incidence or head count;

When α=1, $P_1 = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{Z-Y_i}{Z}\right)^1$ ..... (39). This is a measure of poverty gap or depth.

When α=2, $P_2 = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{Z-Y_i}{Z}\right)^2$ ..... (40). This is a measure of poverty severity.

- ***Determinants of Poverty***

Welfare regression (OLS estimation) and limited dependent (ML estimation) poverty models have been severally used to determine factors that drive poverty among households based on the respective strength and weakness of the two approaches (Ravallion, 1996; Omonona, Udoh and Eegunjobi, 2006; Omonona, Udoh and Adeniran, 2008). The limited dependent models frequently used include Probit, Logit and Tobit model to reflect the probability of household below poverty line or above. However, Tobit model is the most popular as it measures both the likelihood of household being poor and the intensity of poverty. In addition, all poor are not equally poor; some poor are poorer than some others.

The implicit form of Tobit model can further be expressed as:

$$Y_i = \begin{cases} Y_i = X_i\beta + V_i, & if Y_i^* < \text{K}, where\ V_i \sim i.i.d.N(0,\delta^2) \\ 0 = X_i\beta + V_i, & if Y_i^* > \text{K}, where\ V_i \sim i.i.d.N(0,\delta^2) \end{cases} \quad \text{.....(41)}$$

Y_i is the dependent variable, which is observed and a continuous variable when a rural household per capita income is below the poverty line. Y_i* is the rural household per capita income, X_i is a vector of explanatory variables, β is a vector of unknown coefficient or parameter and V_i is an independently distributed error term. The marginal effect on the latent dependent variable Y* is expressed as follows:

$$\frac{\delta Y^*}{\delta X_i} = \frac{\delta E|Y^*|}{\delta X_i} = \beta_i \text{..... (42)}$$

Using the FGT measure and Tobit model, I and my colleagues have tried to profile the poverty level of farming households based on the demographic and human capital characteristics (Omonona, Udoh and Eegunjobi, 2006; Udoh and Omonona, 2008; Omonona, Udoh and Adeniran, 2008; Etim and Udoh, 2013; Etim and Udoh, 2015). Table (13) shows the general poverty profile by some basic demographic and human capital variables of farming households while Table (14) presents the parameter estimate of these factors that determine household probability of being poor.

Table (13): Poverty profile by demographic and human capital variables of farming households

Demographic Variables		Poverty Incidence	Poverty Depth	Poverty Severity
Sex of Household Head	Male	0.46	0.20	0.10
	Female	0.40	0.09	0.05
Age of Household Head	≤40	0.45	0.16	0.07
	≥40	0.43	0.18	0.10
Marital Status of Household Head	Married	0.45	0.16	0.09
	Single	0.42	0.17	0.08
Household Size	1-5	0.30	0.08	0.03
	6-10	0.45	0.17	0.09
	≥10	0.80	0.38	0.20
Human Capital Variable				
Educational Level of Household head	No Formal Edu.	0.86	0.45	0.14
	Pri. Edu	0.56	0.23	0.13
	Sec. Edu	0.35	0.13	0.06

Demographic Variables		Poverty Incidence	Poverty Depth	Poverty Severity
	Tertiary Education	**0.33**	**0.12**	**0.04**

Source: Omonona, Udoh and Adeniran 2008

As shown on Table (13), poverty incidence, depth and severity are highest among farming households that are male headed, have large household size, aged household heads and with less number of members with formal education. These factors with others shown on Table (14) define the farming household poverty behaviour model.

Table 14: Parameter estimates of the determinants of poverty using Tobit model

Variable	Parameter Value	T-Ratio
Household Size	0.0414***	2.729
Sex	0.0023	1.087
Education	-0.0875**	-2.063
Age	-0.0113**	-1.993
Primary Occupation	0.0211	1.221

Variable	Parameter Value	T-Ratio
Farm Size	*0.0041*	0.050
Access to Credit	-0.0076**	-2.090
Commercialization Extent	-0.0317***	-3.009
Adoption	-0.2191**	-1.989
Intercept	-0.1295**	-2.213
Sigma (δ)	0.7452***	9.1543

= Significant @ 5%; and *= Significant @ 1%
Source: Udoh and Omonona 2008

Largely, the poverty profiles generated for farming households in Nigeria are in consonance with the findings of Hemmer (1994), World Bank (1996); FOS (1999). Education improves welfare and reduces the likelihood of experiencing poverty and hunger through getting a better-paying and safer job; understanding the extension information. Further, land plays a major and significant role in the livelihoods of farming households crossing the poverty line. Empirical studies have shown that increasing the size of cultivable land by rural farmers has resulted in significant welfare improvements. Credit is a key player in the improvement of welfare of farmers in most rural economies. The inability of poor households to acquire land and other productive assets can be explained by their lack of access to credit and savings. Credit capitalizes

farmers and entrepreneurs to expand scope of production and also helps smoothen consumption. Rural farmers in Nigeria have limited access to productive resources due to many factors including gender, education and lack of collateral. In a nutshell, negative drivers of rural farming household poverty identified were household head farming experience, years in social organization, level of formal education, farm and non-farm income, while positive drivers include; household head's age, household size, structure of land ownership and gender composition.

Livelihood issues

Livelihood sustainability is an evolving issue especially in developing economies given the increasing level of poverty, hunger, starvation, economic backwardness and poor agricultural system prevalent in the region (Ashley, 2000; Bauman, 2000; Turton, 2000 and Nicol, 2000). Following the scholarly work of Krantz (2001), a livelihood comprises of the capabilities, assets (stores, resources, claims and access) and activities required for a means of living including income earned. Livelihood is sustainable when it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term. Hence, a livelihood constitutes of adequate stocks and flows of food and cash to meet basic needs of

life and it comprises people, their capabilities and means of living including income and assets.

Given a strong correlation between wellbeing and assets owned, extensive evaluation of the asset structure of farming households have been carried out and documented in Udoh *et al*. (2017). Assets contribute or enhance the situation of farming household by responding to shocks and stress as they adjust to overcome them and stay sustainable over a period of time. Assets could be tangible or intangible. Tangible assets are physical resources while intangible assets are claims and access (Stephen, Nora and Moses 2009).

The five pillars of asset as proposed by Scoones (1998) include natural, human, financial, physical and social capitals. The natural capital consists of resource stocks such as soil, water, air, genetic resources used to support livelihood activities of households. Also, environmental services such as shade, pollution sinks, and hydrological cycles among others are included in this category. By definition, human capital represents the skills, knowledge, experience and ability of human labour or other intangible assets of individuals that can be used to create economic value for the individuals, families, employers, communities, societies and nations. At a household level, human capital represents the amount and quality of household labour available. This varies according to household size, skill level, leadership potential, health status among others. Human capital appears in the generic framework as a

building block or means of achieving livelihood outcomes. In a similar vein, social capital in the context of sustainable livelihood means the social resources upon which people build and pursuit their livelihood objectives. These are developed through networks and connectedness, membership of more formalized groups and relationship of trust, reciprocity and exchange. In addition, within the context of household livelihood, physical capital comprises the basic infrastructures and producer goods needed to support livelihoods. They are items of economic, commercial or exchange value that have a tangible or material existence. For instance, household's cash, farm tools and equipment, family inventory and other properties owned by members of the family. Another important form of sustainable capital is financial capital. This refers to the financial resources such as cash, liquid assets, pension, remittances and the like (Scoones, 1998). Financial capital denotes resources that people use to achieve their livelihood objectives. Some of these capitals are straight forward i.e. buildings, machinery, land, cash etc., while some are less immediately obvious such as social networks, knowledge and good health (Morse *et al.*, 2009).

The asset capacity structure of farming households represents the intensity of each category of asset among the five categories of the assets owned by the households. Table 15 presents the estimated capacity index of the farming households for each of the category of asset s.

The capacity index was greater for the physical asset compared to the rest of the categories. This index for the natural, financial and human assets as well as the social asset revealed the order of importance of these categories of household assets.

Table 15: The asset capacity structure of farming households

S/No	Asset	Capacity index
1	Physical asset	3.0998
2	Natural asset	3.0041
3	Social asset	2.9045
4	Financial asset	2.8701
5	Human asset	2.8147

Source: Udoh , Akpan and Uko, 2017

Figure 5 is a pentagon, which further shows the capacity structure of typical farming households. The pentagon gives information about people's assets presented visually, thereby bringing to life important inter-relationships among various assets. From the diagram, it can be observed that the capacity is skewed and does not form a perfect pentagon; a show of an unsustainable livelihood asset structure. The asset with the highest capacity is the physical asset followed by natural asset, social asset, financial assets and human asset. The human asset has the least capacity index compared to others. This implies that households have more of physical assets, natural assets and social assets while they have less of financial asset

and least of human assets. The high capacity of physical asset however implies that it can generate multiple benefits to households in the very short run. Households with access to land (natural capital) are also well-endowed with financial capital, as they are able to use the land not only for direct productive activities, but also as collateral for loans. Similarly, livestock may generate social capital (prestige and connectedness to the community) for owners while at the same time being used as productive physical capital

Figure 5: Asset Capacity Structure of farming Households

CAUGHT IN THE WEB

Mr. Vice Chancellor, Sir, an economic system which farming households operate is an environment inundated with many economic forces; and often times the PeasANT farmers' economic capabilities are influenced by these forces. In essence, they are usually caught in the web produced by the *spiders* operating in the economic system. It is a known fact that the actions and activities of the government and other economic actors in the supply chain have both direct and indirect socio-economic consequences on the farming households to the extent of either enhancing or distorting their welfare and production systems in the form of increasing cost and worsening output price. In this lecture, I will proceed to discuss how the ANTs are caught in the web of macroeconomic fundamentals, price fluctuation, income volatility and climate change.

The ANTs and the Macroeconomic Fundamentals

It is true that farming households vis-a-vis agricultural sector do not exist in total isolation; they are integral part of the economy. In other words, there are established reversible causal-effect relationships between the behaviour of farming households and certain macroeconomic phenomena, and by extension domestic and international policy variables. Hence, in an attempt to establish the causal relationships between the performance or productivity of farming households and some key macroeconomic variables in Nigeria; certain

time dependent models such as: autoregressive model, autoregressive –distributed lag model, vector autoregressive, cointegration and error correction models, etc. have been specified (Udoh and Akpan, 2007; Akpan and Udoh, 2009; Akpan and Udoh, 2009; Akpan,Udoh and Umoren, 2012,Udoh, *et al*., 2012; Akpan, Udoh and Patrick, 2015; Akpan, Udoh and Umoren, 2017, Ojo *et al*., 2017). I will proceed to present some of the specifications

- ***Farming household Export Supply and Macroeconomic variables***

Chairman, Sir, farming today is seen beyond mere producing food for domestic consumption. The export component in recent times has become one of the propelling forces that induce farm production. It is the prevailing exchange rate and the extent of its volatility over time that detects the participatory behaviour of farming households in export markets. Since agricultural production is one of the key components of the economic system that dominate the non-oil sector in the country's export market, working with my colleagues, we have explored the relationship between some basic macroeconomic fundamentals and non-oil export market proficiency indicator in Nigeria. The essence was to develop a policy package that would promote farming household export orientation.

Specific model developed is presented as:

$$Vol_t = \delta_0 + \delta_1 TIM_t + \delta_2 EXR_t + \delta_3 PGDP_t + \delta_4 CUR_t + \delta_5 INF_t + +\delta_6 AGRI_t + \delta_7 EXD_t + \delta_8 INTER_t + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots (43)$$

Vol_t = Exchange rate volatility, Tim_t= real value of total import, EXRt = external reserves, $PGDP_t$ =-real per capita GDP as a proxy of aggregate demand shock (Nm/person), CUR_t = industry's capacity utilization rate (%), EXD_t= external debt as a ratio of GDP, AGRI = index of agricultural production; INTERt = interest rate (lending rate); D = dummy variable which takes the value 1 during liberalization period (1986-2010), and 0 otherwise (1970-1985), U_t= stochastic error term

Exchange rate volatility is found to be affected by total import, industrial capacity utilization rate, lending rate of commercial Banks, foreign private investment and liberalization policy period. The result has direct bearing on farming households' export drive since a robust farm credit policy for rural farmers would trigger export of agricultural commodities in Nigeria.

- ***Agricultural intensification and Macroeconomic Fundamentals***

Since agricultural intensification is whirled by increase activities at the farm level, there is the overwhelming need to establish its relationship with macroeconomic variables. The macroeconomic environment consists of the fiscal, monetary, exchange rate regimes and trade policies that tend to regulate production activities in the real sectors and other sectors including the agricultural sector. Sound macroeconomic policies are important to achieve national development targets through agricultural development.

Macroeconomic variables have serious economic and developmental implications for the sustenance of agricultural production and stimulation of export. Therefore, the country's quest for sustainable agricultural intensification in the face of emerging liberal and competitive environment is vital to the long-term economic growth. Hence, understanding the relationship between the agricultural intensification and macroeconomic variables in the economy will fine-tune the path for sound policies on economic growth in the country. Such a relationship is crucial and will be one of the reliable tools needed to accelerate productivity in the agricultural sector, sustain the environment as well as improve farmers' wellbeing in the country.

To determine the long run relationship between Agricultural intensification Index and selected macroeconomic variables in Nigeria, a time dependent regression model was specified at the level of variables. The model is specified as follows:

$$LnACI_t = \gamma_0 + \gamma_1 \sum_{i=1}^{n} LnCOP_t + \gamma_2 \sum_{i=1}^{n} LnPCG_t + \gamma_3 \sum_{i=1}^{n} LnINF_t + \gamma_4 \sum_{i=1}^{n} LnFDI_t + \gamma_5 \sum_{i=1}^{n} LnUEM_t + \gamma_6 \sum_{i=1}^{n} LnIEC_t + \gamma_7 \sum_{i=1}^{n} LnIMP_t + \gamma_8 \sum_{i=1}^{n} LnLEN_t + + \gamma_9 \sum_{i=1}^{n} LnCAS_t + \gamma_{10} \sum_{i=1}^{n} LnEXD_t + \gamma_{11} \sum_{i=1}^{n} LnEXR_t + \gamma_{12} \sum_{i=1}^{n} LnNOI_t + U_t \quad (44)$$

Where; ACI_t = various measures of agricultural intensification Index (HCI, OCI and ECI) ; COP_t = annual crude oil price per barrel (₦); PCG_t = annual per capita GDP (₦/Person); INF_t = annual Inflation rate (%); FDI_t = foreign direct investment in Agricultural sector (₦m); UEM_t = annual unemployment rate in Nigeria (%); IEC_t = index of energy consumption (1985 =100) (%); IMP_t = annual Index of manufacturing production (1990 =100) (%); LEN_t = average annual lending rate of commercial Bank (%); CASt = credit to agricultural sector/GDP
EXD_t = external debt/GDP; EXR_t = external reserve/GDP; NOI_t = value of non-oil import/GDP; U_t= Stochastic error term and U_t~ IID (0, δ^2_U).

The general specification of the Error Correction Model for the agricultural intensification index equation in Nigeria is represented as:

$$\Delta \mathrm{LnADI}_t = \beta_0 + \gamma_1 \sum_{i=1}^{n} \Delta LnACI_{t-1} + \beta_2 \sum_{i=1}^{n} \Delta \mathrm{LnX}_{t-i} + \beta_3 ECM_{t-1} + U_t \ldots (45)$$

The variables are as defined previously in equation 6 and coefficients (β_3) of the ECM_t ($-1 < \beta_3 < 0$) measures the deviation from the long-run equilibrium in period ($_{t-1}$).
Following the estimation the relevant equations, we found out that in the long run, inflation, industrial output, external reserves, per capita income, and energy consumption were negative drivers of agricultural intensification; whereas crude oil prices, lending rate of bank, foreign capital in agriculture and non-oil import

works in opposite direction. However, in the short run, inflation, external reserves and industrial output retards agricultural intensification; while lending rate of banks and crude oil price were stimulants.

Based on these results, there is urgent need for policy makers to re-align their macroeconomic policies to achieve stability in inflation rate, external reserves, industrial production, electricity consumption, agricultural credit institution to achieve sustainable agricultural intensification in the short and long runs

- ***Foreign Direct Investment and Agricultural Productivity***

In developing economies, experts have asserted that, foreign capital inflow supplements investible funds in the recipient country thereby stimulating domestic capital formation. Inward FDI can also increase the host country's export capacity causing it to increase its foreign exchange earnings. In line with the current increase volatility in crude oil prices, Nigeria needs additional source of funding to stimulate growth in a critical sector such as agriculture. The agricultural sector is one important area FDI has proven effective in tackling the fundamental issues.

Given the critical role played by FDI, there was need to assess the contribution of FDI to agricultural productivity in Nigeria and this led to the specification of bilateral Granger causality tests. The Granger causality test is a

statistical hypothesis test for determining whether one time series is useful in forecasting another. The primary model in Vector Autoregressive Regression form is represented as thus:

$$\left\{\begin{array}{l} Y_t = \beta_0 + \beta_1 \sum_{i=1}^{n} Y_{t-j} + \beta_2 \sum_{i=1}^{n} X_{t-j} + U_t \ldots\ldots\ldots\ldots\ldots\ldots (46) \\ X_t = \delta_0 + \delta_1 \sum_{i=1}^{n} X_{t-j} + \delta_2 \sum_{i=1}^{n} Y_{t-j} + V_t \ldots\ldots\ldots\ldots\ldots\ldots (47) \end{array}\right\}$$

Following the result of the unit root test, and an attempt to avoid the tendency of having spurious regression, a time dependent double log multiple regression model representing the long run model and meant to capture the dynamic nature of dependent variables were specified at level for variables used in the models. The model is expressed explicitly as thus:

$$LnTAG_t = \gamma_0 + \gamma_1 \sum_{i=1}^{n} LnFDI_t + \gamma_2 \sum_{i=1}^{n} LnCRD_t + \gamma_4 \sum_{i=1}^{n} LnUEM_t + \gamma_5 \sum_{i=1}^{n} LnPPI_t + U_t \ldots\ldots\ldots\ldots\ldots\ldots (48)$$

Where the dependent variable is defined as either LSG_t = Livestock sub-sector's productivity (%), FRG_t = Forestry sub-sector's productivity (%), FSG_t = Fishery sub-sector's productivity (%),or TAGt = agricultural sector's productivity (%). The independent variables included in themodel are FDI_t = Foreign direct investment as a ratio of

total GDP (%); CRD_t = Credit to Agricultural sector as a ratio of total credit to economy (%); UEM_t = Unemployment rate as a proxy of nature of insecurity (%); PPI_t = Per capita income (Total GDP/Population) as a proxy of demand capacity Ln = Natural logarithm; U_t= Stochastic error term and U_t~ IID (0, δ^2_U).

The general specification of the Error Correction Model for the sub sectoral and agricultural sector productivity equation is shown below:

$$\Delta \mathrm{LnTAG}_t = \beta_0 + \gamma_1 \sum_{i=1}^{n} \Delta LnTAG_{t-1} + \beta_2 \sum_{i=1}^{n} \Delta \mathrm{LnX}_{t-i} + \beta_3 ECM_{t-1} + U_t \ldots (49)$$

The empirical result showed that crop sub sector's productivity has a significant positive relationship with FDI in the long run; while livestock sub sector productivity showed a negative relationship. There was no significant relationship between FDI and fishery as well as forestry sub-sector's productivity. The result also revealed a significant positive relationship between agricultural sector productivity and FDI both in the short and long run periods. Furthermore, the volume of credit to agricultural sector, unemployment rate and demand capacity impacted significantly on the sub sectorial productivities and the overall agricultural sector's productivity .in a nutshell, there is a significant positive relationship between the agricultural sector productivity and FDI both in the short and long run periods.

The Ant and the Agricultural Price Volatility Game

Rational and consistent economic agents react differently to both input and output prices under different market systems. Decision to acquire inputs and dispose outputs depend to a large extent on these choice indicators. In a perfectly competitive market system where farming household operates, control over the prices is almost non-existent. In essence, farming households literally demand productive inputs and supply farm products based on prevailing market prices. Incidentally, agricultural output prices are known to exhibit variations occasioned by seasons, locations and inherent risk elements. In these circumstances therefore, the farming households are literally caught in the web of price dynamics and have to carry out their socio economic activities and maintain their livelihood as defined by the prevailing prices.

Mr. Vice Chancellor, Sir, modelling the nature, mechanics and effects of price volatility on farming households and the factors affecting the variation became a concern to me and my colleagues. I vividly remember a telephone conversation I had with Dr. Sunday B. Akpan one morning and the *eureka* excitement in his voice about a set of raw weekly agricultural data in the archive of Akwa Ibom State Agricultural Development Project (AKADEP). I could not help but get infected with the same excitement when possible research problem issues started building up on my mind. If I may borrow the exact words of Prof. Gabriel Sunday Umoh, I started having "brain waves" and

concomitant research topics. In the evening of that day, I and Dr. S. B. Akpan held a two man boardroom meeting to marshal out plans of giving life to the newly discovered data. So far, we have made some modest contributions by studying the mechanics of price transmission of some agricultural commodities on the assumption of symmetric and asymmetric adjustments in the long run and how macroeconomic variables influence relative price volatility (Udoh & Akpan, 2007; Akpan, Udoh &Udo, 2014; Akpan, *et al*, 2014; Akpan, Udoh & Umoren, 2012; Akpan & Udoh,2009a-b; Akpan, Udoh & Inimfon, 2016a-b).

- ***Mechanic of price volatility***

Possible cointegration between two prices from separated markets have been examined following the methodologies of threshold autoregressive (TAR) and Momentum-threshold autoregressive (M-TAR) cointegration models expressed below:

$$\Delta\varepsilon_t = \rho\varepsilon_{t-1} + v_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (50)$$

$$\Delta\varepsilon_t = M_t\rho_1\varepsilon_{t-1} + (1 - M_t)\rho_2\varepsilon_{t-1} + \sum_{i=1}^{k}\delta_i\Delta\varepsilon_{t-i} + V_t \dots (51)$$

Where $\rho_2, \rho_2 \, and \delta_i$ are coefficients, ε_t is a white noise disturbance, k is the number of lags and M_t is an indicator function such that:

$$M_t = \begin{cases} 1 \; if \, \varepsilon_{t-1} \geq 0 \\ 0 \; if \, \varepsilon_{t-1} < 0 \end{cases} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (52)$$

A model consisting of equations 50, 51 and 52 is called Threshold Autoregressive (TAR) cointegration model. The modified version is based on the change in ε_{t-1} in the previous period as shown in equation (53);

$$Z_t = \begin{cases} 1 \; if \, \Delta\varepsilon_{t-1} \geq 0 \\ 0 \; if \, \Delta\varepsilon_{t-1} < 0 \end{cases} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (53)$$

Hence, a model consisting of equations 50, 51 and 53 is called Momentum-Threshold Autoregressive (M-TAR) cointegration model. The asymmetric cointegration between two prices using TAR and M-TAR models was determined by testing the null hypothesis of no cointegration. The summary of the results is as presented on Table (16)

Table 16: Price Relationship of Agricultural commodities in Urban and Rural Markets

Agricultural Commodity	**Nature of price movement**
Staple Crops	
Cowpea (Beans)	Symmetric/integrated
Maize (dry grain)	Symmetric/integrated
Fish/aquatic products	
Fresh Fish (High quality)	Symmetric/integrated
Fresh Fish (Low quality)	Symmetric/integrated

Agricultural Commodity	Nature of price movement
Dry Fish (High quality)	Symmetric/integrated
Dry Fish (Low quality)	Symmetric/integrated
Imported Fish	Symmetric/integrated
Dry Bonga Fish *(Ethmalosafimbriata)*	Symmetric/integrated
Periwinkle	Asymmetric
Cockle	Asymmetric
Dry Cray Fish	Symmetric/integrated
Oil Crops	
Palm oil	Integrated market
Palm kernel	Asymmetric
Groundnut oil	Integrated market
Shell Groundnut oil	Integrated market
Meats	
Pork	Symmetric/integrated
Goat (chevon)	Symmetric/integrated
Beef	Symmetric/integrated
Exotic chicken	Symmetric/integrated
Local chicken	Symmetric/integrated
Snail	Symmetric/integrated

Source: Compiled from authors works

Mr. Vice Chancellor, Sir, our findings have revealed that symmetric market information flows between the rural and urban markets for several staples (e.g. maize and beans) and meats (beef, poultry) in the farming household

economy. There is an evidence of short and long runs market integration between the rural and urban prices of most staples produced by farming households. This implies that, there is an insignificant price differential between most staples sold in rural and urban markets where these staples are traded.

The results further confirmed significant short and long run integrations between the upstream and downstream market prices of palm oil, groundnut oil and shell groundnut, though there was no evidence of long run stability in the palm kernel oil market. Also, there was no evidence of asymmetric price transmission in these commodities. The symmetric price adjustment, however, was not instantaneous, while the coefficient of market integration showed consistent positive effect in both short and long runs.

We also found that fish prices in the source markets followed asymmetric adjustments with respect to urban prices in cockle and periwinkle market in the long run; whereas symmetric adjustments were obtained with respect to prices of low quality fresh fish; high quality fresh fish; low quality dry fish; high quality dry fish; imported fish; dry Bonga fish; and dry cray fish. The symmetric price adjustment was not instantaneous, while the asymmetric price relationship showed persistent positive shock in the long run. This implies that government intervention in this sub-sector might not yield

the needed response due to obstruction imposed by unnecessary intermediaries in the marketing chain.

- ***Macroeconomic drivers of Relative Price Volatility***

The basic model specified to establish the functional relationship between price volatility and some theoretically accepted macroeconomic variables is as presented in the following equations:

$$ADFtest = \Delta X_t = \alpha_0 + \alpha_{1t} + \alpha_2 X_{t-1} + \sum_{i=1}^{k} \delta \Delta X_{t-i} + \varepsilon_t \ldots . (54)$$

$$Vol_t = \delta + \alpha \sum e_{t-1}^2 + \beta \sum h_{t-1} \ldots \ldots . (55)$$

$$V_t = f(Inflation, SAP, MSAP, CSAP, ACGSF, Ha, D) \ldots (56),$$

Where equation 54 was used to ascertain the stability of data used, while equation 55 captured the GARCH generating process from which respective output price volatilities were derived. V_t = Estimated crop price volatility; SAP = Period of structural adjustment programme, whereas MSAP and CSAP represented the military and Civilian SAP periods respectively, ACGSF = Agricultural credit guarantee scheme fund, Ha = hectarage of land used for cultivation).

The results from the estimation of the models revealed that fluctuations in macroeconomic fundamentals

constitute one of the major inducing factors to volatility in grain price in Nigeria. It is established that Inflation has a positive impact on price volatility of major staple crops grown by farming households in Nigeria. Agricultural policies during SAP and civilian post-SAP regimes tend to increase inflation in the country; thus eroding the purchasing power of the farming households. The civilian SAP policy package has positive impact on price volatility of most staple crops in Nigeria. This result implies that, during the CSAP, most farming households re-allocated production resources to more rewarding sectors in order to augment family income. Per capita real GDP, loan guaranteed by ACGSF in the food crop sub sector, harvested area of land for food crop and liberalization policy era have mixed influences on food crop output volatility of farming households both in the short and long run periods.

Generally, the results have been consistent and indicate conspicuous price variability across several agricultural commodities produced by farming households. The implication of the continuous price volatility in agricultural produce has been; the uncertainty in production at the farm level, poor resource combinations and increase rural households' poverty among others.

ANTs and Income Volatility

Mr. Chairman, Sir, farming households earn income from multiple livelihood sources but the distribution of the

income earned varied with time and location. Variation in the income is considered to be one major factor that enhances persistent and intergenerational poverty among the farming households. Recent review of the global welfare measures reveals that, Nigeria is one of the most unequal nations in Africa in terms of income distribution with the highest income inequality peaking at over 0.54 for the self-employed (predominantly farmers), and 0.44 for the employed-salary paid/wage earners, (UNDP, 2012)

Having critically examined the asset structure of farming households, we have identified great and conspicuous imbalance in asset structure among farming households as shown in figure 5. This imbalance in asset structure of farming households is stem from income inequality and volatility prevalence among farm households. Income volatility has assumed undulated pattern across farm households and between on and off seasons. The size of peasant farmer's income is among the major determinants of it size of asset accumulation. Hence, the fluctuation in household income is affirmed to translate to the imbalance in the asset structure of faming households in Nigeria and this is one major web that has caught the farming households. Premised on above fact, we assessed the nature of income volatility among farming households during on and off seasons by employing generalized autoregressive conditional heteroskadaticity (GARCH) and coefficient of variation (CV) models to measure and compared farming household income volatility (Akpan

and Udoh, 2016). The GARCH system of equations is as specified:

$$Log(Y_t) = \delta_0 + \delta_1 \Delta log(Y_{t-1}) + V_t \dots\dots\dots\dots\dots (57)$$

$$VI_t = \gamma_0 + \gamma_1 \sum \varepsilon_{t-1}^2 + \beta \sum h_{t-1} \dots\dots\dots\dots\dots (58)$$

$$VI_t = \gamma_0 + \gamma_1 \sum |\varepsilon_{1-1}^2| + \beta \sum h_{t-1} \dots\dots\dots\dots\dots\dots (59)$$

Equations 57 to 59 captured the GARCH generating process from which household income volatility is derived. Our findings have shown varying degrees of income volatility across farming households from on season to off-season periods. Generally, the income volatility indices from both GARCH and CV methodologies employed showed highly skewed income distribution with majority clustering around the index of 0.5 to 0.7 for both on season and off season periods. However, with respect to precision of measurement, the GARCH approach of measuring income volatility gives a better result as compared with coefficient of variation in both seasons. The CV measure from the mean score shows an explosive result while the GARCH measure shows persistency. Due to the conspicuous income volatility discovered among peasANT farmers, we recommend among others the intra-diversification within crop and livestock production which will enhance relative stability in farming household's income

The ANTs and the Climate Change

The farming households practise agrarian agriculture and subsist primarily on natural environmental resources like land, water, forest and wildlife. Studies have shown that the use of these resources by farmers have not been within the sustainability framework resulting in incidences of environmental pollution and degradation. There are reported cases of overfishing, deforestation, bush burning, and most importantly contributing to the problem of climate change.

Mr. Chairman, Sir, the environment has the tendency of keeping wrongs done to it and will wait to pay back in good measure, pressing down unto the bosom of its offenders. Incidentally, farming households are known to be one of the major offenders through their economic and anthropometric activities, and this has culminated into the global nightmare called "climate change". This, itself is a strong web that has debilitating effect on the farming household production and welfare decisions.

The impacts of climate change are cross cutting, with severe direct effects on agriculture, water resources and vegetation and indirect impacts on human health, the economy and institutions (Umoh, *et al.*,2013;Solomon *et al.*, 2015). In many farming/fishing communities, the effects are visible.

Figure 6: Debris of brick building destroyed by sea level rise in Ibaka, Mbo LGA, Akwa Ibom State (Culled from Umoh *et al*, 2013)

Climate change has brought about drought, flood, sea level rise and erosion. These have adversely impacted on farm households in various ways including loss of farmland and farm produce, displacement of residents and loss of property including residential buildings and fishing gadgets. Other adverse impacts include health problems, conflict, increased expenditure, poor yield and loss of income.

THE ANTS, LAND EQUATION AND SUSTAINABILITY WALK

Land Utilization

Mr. Vice Chancellor, Sir, following the wise saying of the Scripture, I can attest to the fact that ants live, move and have their being (existence) on land. In this same wise,

farming households have undeniable affiliation with land with respect to their production and welfare. Therefore, the modes, processes, and practices of land acquisition, allocation, utilization and management effectively define the ownership and accessibility of land by farming households. Apparently, the interest of resource economists and other planners in land as a factor of production is to devise means of either resolving conflicts or pragmatic allocation amongst alternative competitive uses, and to ensure optimal socio-economic level of its utilization. More often, in peasant agriculture, the farmer's resources endowment and management capacity is quite limited and sometimes, land is unsustainably allocated, used and managed. In other words, using land within the paradigm of social, cultural, economic and environmental dimensions has a visible question mark (Udoh, Idiong and Ekpe, 1999).

The demand for land for both agricultural and non-agricultural purposes is ever increasing. The challenges posed by such increasing demand therefore require efficient allocation, use and management, especially under peasant settings. Where there exist unwise land uses, ignorance or lack of reproductive investment, the degradation of land resources become more evident and may culminate in the potential causes of land use problems, especially in a situation where land users are exploiting the resources today without investing for tomorrow (Udoh, 1998).

Farming system mostly practised by the farming households has influence on the pattern of allocation, use and management of their agricultural land. Ordinarily, the adoption of farming system relevant to the sustainable land use and management must be within the framework of equity, optimality and productivity to ensure that conflicts are minimized and resolved, soil cum crop types marching ensured and sustainable yield guaranteed. Incidentally, the farming households have not been operating effectively within the three-fold framework (NEST, 1990, Udoh, 2000).

Several studies have documented incidences of inter and intra communal land conflicts among farming households and pastoralists that have resulted into severe human and resource loss (Conroy, 2014, Muhammed, 2015). As noted by Alawode, 2013, land conflicts cause serious dislocations, suspend or destroy income opportunities, create food insecurity, damage the environment, and frequently result in the loss of lives and properties. Poor households bear the heaviest burdens of land-related conflicts for the simple reason that their daily needs and livelihoods are directly tied to their property rights, that is, the use of land.

With respect to land allocation and utilization, the farming households are involved in different levels of land intensification practices that have consequences on the financial and food security status of the households and

also on the health and productivity of the soil. Table (17) shows some of the land allocation and use indices that are typical of peasant farming households.

Table (17): Land allocation and use indicators

Descriptions	Mean value	Maximum value
Index of crop diversification	0.28	1.00
Index of nutrient intake	3.6	5.00
Rutherberg-value index	0.325	
Fertilizer use index	0.13	1.00

Source: *Compiled from different works of the author*

The mean values of diversification and nutrient intake indices indicate the risk of competition among crops usually grown by farming households for available soil nutrients. In other words, on average, majority of farming households combined crops that have greater tendencies to deplete soil nutrients, and in situations where the fallow period is increasingly reduced (as shown in Rutherberg value of 0.325), soil fertility is greatly compromised resulting in poor crop yield and meagre financial benefits to the farming households (Udoh, 2006, Udoh & Akaeme, 2006). The poor soil fertility is further worsened by the obvious low use level of fertilizer among the farming households and general dismal fertilizer supply situation in the country. As indicated in Udoh, Etim & Idiong (2003), fertilizer is procured in larger quantities after period of

intense demand, an indication of poor procurement efficiency. Also observed is the increasing price disparity between official price and black market price of fertilizer that is decreasing distributive efficiency and higher instability and negative growth rate in the supply of NPK and Urea fertilizer. It calls to question how sustainable have the farming households been using and managing their farmlands.

Sustainability

Mr. Vice Chancellor, Sir, as earlier noted in this lecture, one basic fundamental research question that guided my doctoral research work was: how efficient are the peasant farmers in resource use given their land allocation, use and management practices? In essence, if the conventional input use productivities are high and the farmers are efficient in the use of these inputs, can land use and management practices of the farmers be capable of maintaining the economic benefits over subsequent years? Also, are the land use and management practices adequate to improve the state variables and enhance sustainable production in every planting cycle?

Essentially, sustainable production should address the simultaneous issues of neoclassical conventional input optimization and natural resource conservation. Therefore, evaluating how sustainable peasant farmers' production activities with respect to the use and management of farmlands involve modelling eco-economic conditions at

specific farm levels. This involves the estimation of both farm specific inefficiency index (RUI) and farm specific index of sustainable land use and management (ISM). The summation of both indices gives a measure of short-run sustainability index (SRSI). RUI had been previously defined in equation (5) and is estimated after controlling for the sustainability effect of land use and management practices. ISM is given as:

$$ISM = \sum_{t=1} d_t + \sum_{r=1} e_r + {}^1/_2 \sum_{t=1} \sum_{r=1} s_{tr} + {}^1/_2 \sum_{i=1} \sum_{r=1} f_{ir} \left(lnX_{ij}\right) + {}^1/_2 \sum_{i=1} \sum_{t=1} h_{it} \left(lnX_{ji}\right) + {}^1/_2 \sum_{t=1} \sum_{k=1} w_{tk} \left(R_{kj}\right) \ldots\ldots\ldots (60)$$

All notations are as previously defined in equation (8). ISM is estimated with respect to all agronomic practices carried out by each farming household (i.e. land use and management practices), evaluated at different levels of input use and land resource quality

SRSI equation is expressed as follows: $SRSI = 1 - [(X_i.p)(X_a.p)^{-1}] + \sum_{t=1} d_t + \sum_{r=1} e_r + {}^1/_2 \sum_{t=1} \sum_{r=1} s_{tr} + {}^1/_2 \sum_{i=1} \sum_{r=1} f_{ir} \left(lnX_{ij}\right) + {}^1/_2 \sum_{i=1} \sum_{t=1} h_{it} \left(lnX_{ji}\right) + {}^1/_2 \sum_{t=1} \sum_{k=1} w_{tk} \left(R_{kj}\right) \ldots\ldots (61)$

Following Udoh (2000) and Udoh (2006), these two indices depend on stochastic frontier specification that is transcendental logarithmic in form. SRSI equation is estimated by maximizing the log-likelihood of equation (5) and is evaluated at different levels of output and

resource quality. Inferentially, if the value of SRSI is zero, the land use and management practices give no change in land quality, if it is positive, then there has been improvement in the use and management of the land; and if it is negative, then land use and management practices have adverse effects on the land resources. The indices are presented on Table (18)

Table 18: Distribution of Short run Sustainability Indices

Class interval	Percentage
(3.3-2.8)	0.33
(2.7-2.2)	1.00
(2.1-1.6)	1.67
(1.5-1.0)	8.33
(0.9-0.4)	14.00
(0.3-0.07)	22.67
(0.06-0.01)	25.00
0.01-0.06	14.67
0.07-0.3	8.00
0.4-0.9	1.67
1.0-1.5	2.00
1.6-2.2	0.67

Source: Udoh, 2000

The distribution of the SRSI on Table 18 clearly indicates that over 73 percent of the farming households' land productivities declined owing to the net balance effect of the resource use inefficiency and effect of land use and

management practices. On the contrary, about 27 percent of the farmers improved their land productivities, that is, undertook sustainable production processes.

Apparently, the distribution of SRSI may not be unconnected to the prime reasons the peasANTs prefer crops to be grown. As reported in Udoh (2000), food security goal predominated the farmer's choice of crops grown followed by income generation goal with land management goal being the least reason. Specifically, on the scale of 1, the relative preference weight of 0.54, 0.19, 0.16, 0.06 and 0.04 were reported for household food security, income generation, risk management, ease of cultivation and land management reasons respectively. This is in line with the finding of Ogunkunle and Eghaghara (1992) that under peasant agriculture land use and crop choice are rarely closely associated with soil type.

BEARING THE BURDEN OF ELEPHANT

Mr. Vice Chancellor, Sir, without contradiction, we all agree that Nigeria is grappling with the problem of food crisis; as the population increases exponentially while domestic food production increases in arithmetic progression. This is a situation Malthus described as the point of misery/crisis that warrants increased food importation to fill the ever widening food deficit gap as shown on Figure (7).

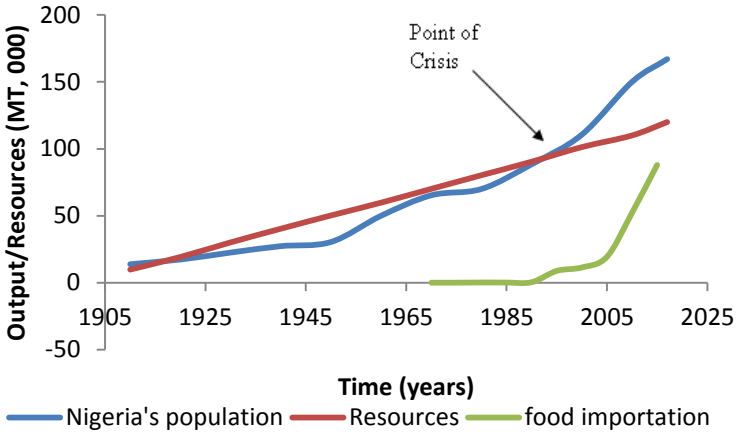

Figure 7: Nigeria population, Resources and Food Importation

Source: Oladimeji (2017)

As revealed in Udoh and Akintola (2003) and Udoh *et al*. (2013) income-elasticities of demand for various food stuffs often exceed unity, indicating that an increase in income leads to a more-than-proportionate increase in the demand for food in Nigeria. These elasticities, according to Zhou and Staatz (2016) when combined with strong per capita income, changing dietary pattern, urbanization and population growth, imply strong increases in food demand. This strong demand is also reflected in increasing food imports, which have consistently shown negative balance of trade.

Based on the statistics released by the Federal Ministry of Agriculture and Rural Development (FMARD, 2016), there

exist substantial demand-supply gaps for both staple and industrial agricultural products in Nigeria as shown on Table (19).

Table (19: Gaps in Nigeria Demand & Supply across Key Crops and Activities (2016 Estimate)

Crop	Demand (tons)	Supply (tons)	Remark
Rice	6.3 million	2.3 million	Insufficient supply chain integration remains issue
Wheat	4.7 million	0.06 million	Driven by demand for various types of wheat (white, hard, durum), etc. for bread, biscuits and semovita
Maize/Corn	7.5 million	7.0 million	Limited imports required but can shift due to feed demand
Soya Beans	0.75 million	0.6 million	Animal feed andplant protein source. driving demand
Chickens	200 million birds	140 million	Gap filled by illegal imports that enter market at lower price point than domestic producers; gap also a moving target based on fast food demand
Fish	2.7 million	0.8 million	Decliningocean catch and weakness in aquaculture yields due to high cost of fish feed
Milk / Dairy	2.0 million	0.6 million	Driven by insufficient milking cows and low yields (~1525 liters/day versus norm of 35–40 liters inUS)
Tomato	2.2 million	0.8 million	Actual production is 1.5 million tons but 0.7M ton is lost post harvest

Yams	39 million	37 million	Limited gap but volumes expected to rise
Oil Palm	8.0 million	4.5 million	Refers to fresh fruit bunch (FFB) from which oil is extracted at a 10%– 15% efficiency rate
Cocoa	3.6 million	0.25 million	Demand is global which is expected to rise to 4.5M by 2020
Cotton	0.7 million	0.2 million	Demand is for seed cotton and could rise to 1.0– 1.5 million tons subject to textile sector revival
Sorghum	7.0 million	6.2 million	Demand will rise further as use in feed grows in 2016- 2020. Import of malt extracts and glucose syrup is currently used to manage gap

Source: (FMARD, Agriculture Promotion Policy Document, 2016)

As shown on table 19, there exists a considerable supply deficit in the domestic food, animal feed and industrial agro raw materials in the country. This suggests a burden on the farming households in bridging the gaps. Unfortunately, policy makers often assume that the most acceptable way to resolve Nigeria's food insecurity problem is through large-scale commercial agriculture whereas the key to resolving the country's ongoing food crisis is through small-scale farming. Nigeria's agriculture is predominantly small-scales and is carried out on farms averaging 0.1–2.0 ha, mostly on a subsistence basis. Small-scale operations account for over 80% of agricultural

gross domestic product and meet about 90% of the national food demand. Therefore, the most important reason for supporting small-scale farming is its critical role in achieving food security and supporting industrial and manufacturing sector. This clearly shows that the farming households are currently overburdened with the responsibility of feeding the ever growing population.

Peasant farming is the moral fibre of agriculture and food security in Nigeria because it is the predominant source of supply of staple foods. It guarantees both income and job creation to virtually all rural households and catalyses the growth of rural businesses, particularly in the sector of micro and small enterprises. As the demand for food is growing and the foreign earning capacity of the nation is dwindling, rural and urban consumers are increasingly relying on farming households to secure their supply of agricultural commodities.

AGRICULTURAL REVOLUTION IN AKWA IBOM STATE: UDOM ACTION'S PLANS

Mr. Vice Chancellor, Sir, as I am getting to the end of my presentation, I will love to take out few minutes of your time and this wonderful audience to present the efforts of the present administration in Akwa Ibom State towards reinvigorating and repositioning the economies of peasANT farmers in the State. The agricultural vision of His Excellency, Mr. Udom Emmanuel is predicated on developing a framework for strong public and private

sectors participation in agricultural revolution in Akwa Ibom State. This involves a new paradigm shift and action plan for moving from the culture of farming to the business of farming. Walking within the pathway of sustainable agriculture and ensuring food self-sufficient State requires adopting the evergreen revolution strategies (pro-nature, pro-poor, pro-women and pro-employment/livelihood oriented eco-agriculture) that would ensure achieving productivity in perpetuity. This involves institutionalization of strategies that are known to drive and sustain agriculture as a business. The agricultural strategies adopted are meant to align with the 5-points developmental agenda of the governor.

The road map therefore involves stimulating value chain *imperatives* for competitive and sustainable agricultural systems in Akwa Ibom State. In a nutshell, I can boldly say that the Executive governor of the State has charted a Green Revolution pathway for the farming households as a template for attaining sustained agricultural development in the State. His Excellency has a strong belief that a State that is self sufficient in food production will become respected (not taken as a charity case) and will be operating from the position of strength. In other words, he agrees to the assertion of Fine (1998) that food carries enormous social, cultural, political symbolic and nutritional significance for all societies, and that Akwa Ibomites biological, spiritual and ethical health depends on food in complex ways. Therefore, it is on this

imperativeness that the development of agriculture has always been a priority of His government.

The Green Revolution signalled the government´s reaffirmation of developing food sufficient State, establishing a directive for the transformation of an essentially subsistence agriculture into commercial agriculture. In this perspective, government commitment, is made clear by the actions already taken to increase both farmers and investors confidence (public and private), and intensifying and diversifying farming and livestock production. The primary objectives of the State Agricultural Revolution are therefore to;

- stimulate growth in small producer production and productivity,
- Increasing the supply of food in a competitive and sustainable way.

Taking into account the recurrent constraints to the development of the agricultural sector, the Agricultural Revolution´s implementation strategy of the State government is consciously guided by the following strategic pillars:

1) Food security;
2) Commercialization potential;
3) Employment generation/training;
4) Competitive advantage;
5) Capital flight buffering; and
6) Protecting State investment.

Achieving the proposed outcomes involves adopting an integrated production and value chain approach, together with the involvement of all actors from both public and private sectors and civil society organisations

KEEPING THE ANTS ALIVE

Mr. Vice Chancellor, Sir, I have no doubt that the avid listeners in this audience will accepts the undisputable truth that the farming households (ANTs) are really a people not socio-economically strong individually, but their importance in the food equation cannot be ignored collectively. The structure and the fabric of Nigerian economy is largely linked with their productivity and welfare levels; thus, efforts toward keeping them alive hinged totally on initiating and sustaining a complete paradigm shift in their productivity and welfare imperative nexus. No matter how glamorous and laudable actions of government and development partners may be, if the outcome indicators do not lead to an outward shift in the productivity and welfare curves of the peasANT farmers it would amount to a situations of fetching water with baskets.

Having studied farming households closely for close to two decades now and also having been giving the opportunity by His Excellency, Mr. Udom Emmanuel, the executive governor of Akwa Ibom State to serve as Chairman, Technical Committee on Agriculture and Food Sufficiency, I will like to specifically mention some

recommendations on how to keep the farming households alive.

1. Cooperative Agriculture

This involves land consolidation, social capital formation and economic/political inclusion to guarantee large scale farms. The strong socio-cultural affinity attached to land and continued fragmentations have adverse effect on accessibility to farmland. Therefore, the pathway towards commercial agriculture is land consolidation and this can only be possible through formation of economically viable cooperative farmer groups. This is one of the fundamental agricultural strategies of Mr. Udom Emmanuel, the Executive governor of Akwa Ibom State and through this, over 3,500 cassava producing and processing groups/clusters have been formed and over 2000 ha of cassava farms have been cultivated. This measure has push the on-farm yield level from 16MT to 28MT yield level.

2. ***Agribusiness model***

Developing and strengthening commodity value chain and value addition is central to moving the farming households from the culture of farming into the business of farming for profit making. In this regards, no intervention project and program should be initiated if a complete value chain is not stimulated. For instance, action toward expansion of production should adequately handle input supply, processing and off taking capacities.

3. **Market driven input supply program**

For so long, government have erroneously treated agricultural inputs as political and social resources and in most cases this has resulted in wrongful targeting of the intended beneficiaries and racketeering by the privileged unintended beneficiaries. Agricultural credits and land augmenting inputs like fertilizer should be handled as productive inputs rather than social resources. Incentivizing farming by government either as input or output subsidy should not be on 'hand-out' poverty reduction program but should be based on acceptable financial and economic performance indicators.

4. ***Outgrower scheme***

Rent seeking in form of demanding for compensation has been the usual practice when land is acquired from land owners. Beside the social conflict that characterized the sharing of the amount paid, the one off payment results in outright denial of the future generation access to land thereby encouraging intergenerational poverty. To ensure sustained and generational benefits, out grower scheme arrangement should be provided for the hitherto landowners. This guarantees buy-in and transfer of technology to small scale farmers for sustained increase in input productivity. It also confers some sense of ownership and security of investment.

5. Economic corridor

This involves creating access to market for rural farmers and providing necessary infrastructures at the rural

communities for the sale of their agricultural outputs. This will increase the level of production and productivity as farmers are known to be price responsive (Omonona, *et al*, 2004*)*.

6. ***Public private partnership model***

This involves identifying and mainstreaming notable international investors to operate commercial farms under a mutually beneficial memorandum of understanding that will ensure sustained financial benefits and employment generation to the host communities. That is, collaborating with large scale agro-allied firms and integrating the peasANT farmers into the arrangement as contract farmers

7. **Research and Development of High technologies**

Though many still consider agriculture the epitome of low-technology, they are mistaken. Borrowing from the Israel experience in evolving an economic miracle, when they discovered that the land was infertile and the water insufficient, they turned to invention and technology for solution. As noted by Senor and Singer 2009, technology was 95 percent of the secret of Israel's prodigious agricultural productivity. Efficiency of the peasant farmers can only be enhanced through the introduction and adoption of cost effective farm machines.

8. Tailor made Agricultural development policy direction

Mr Vice Chancellor, sir, I cannot fail to agree with the postulation of Meier(1976) that many distinguished economists would be impatient with any attempt to blindly adapt economic models built on the empirical and theoretical frameworks of developed economies to understudy the working and behaviour of economic operators in the developing economies. As already enunciated in this lecture, farming household economy has some distinguishing features that are different from the conventional firm economy. As such, policy that would enhance public resource efficient allocation and increase private sector participation in up scaling farm level productivity and household level welfare enhancement should be pursued.

9. Extension Service

Delivery of timely and adequate critical agricultural information is necessary to promote input productivity growth and better livelihood among farming households. It is a known fact that agricultural extension agents play crucial roles in gathering and disseminating the innovations thus the importance of strengthening the agricultural extension service.

10. Improved budgetary allocation

It is on the premise of critical importance of public agricultural expenditure in agricultural transformation that led to the *Maputo* declaration that each African country

should spend at least 10 percent of annual budget on agricultural sector. Yet, in Nigeria the national and sub-national budgetary allocations to agriculture consistently remains less than 10 percent in spite of the sector's huge potential for wealth creation, employment generation, and poverty reduction. (Olomola, *et al*, 2014). Policy of sustained injection of at least 10 percent of annual budgeted public funds into agricultural sector should be pursued.

CONCLUDING REMARKS

Mr. Vice Chancellor, Sir, I am about to let down the anchor at the shore having been in charge of this audience for the past 60 minutes or so. One thing I can't be sure of is if everyone found the sailing interesting. Thanks heaven, the tradition of inaugural lecture has insulated me from having to respond to any antithesis complain and question that are brewing in inquisitive minds of many eggheads seated here. As the University of Uyo 59th inaugural presenter, I have led this audience through a labyrinth of my teaching and research adventure and trying to justify my appointment as a Professor of Agricultural Economics. Studying the economics of farming households over the past years have been an academic exercise that I have found very rewarding. I have also realised that I still have much to learn and disseminate about these economic gladiators.

I have strong conviction that the ace of sustained agricultural development in Nigeria is the **ANTS**.

Enhancement of their production capacities and welfare will certainly guarantee increased productivity, which will literally translates into more food entering the marketplace at affordable food prices for the **ELEPHANTS** in the economy to feed on. Moreover, it means, these poor farmers, will be able to earn a living that allows them to reinvest in their farms and feed their households, other domestic consumers, agro allied industries and the export market. In essence, increased small-scale agricultural production supports the livelihoods of people on both ends of the food value chain.

Mr. Chairman, Sir, Distinguished guests, Ladies and Gentlemen, thank you for allowing me the privilege of your time and getting to know how **ANTS** are bearing the burden of **ELEPHANTS** in Nigeria.

Thank You.

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