PRINCE ABUBAKAR AUDU UNIVERSITY,
PMB 1008, ANYIGBA, KOGI STATE, NIGERIA

12Th INAUGURAL LECTURE

INTERCROPPING:
THAT THERE MAY BE ENOUGH FOOD

BY

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NATIONAL ANTHEM

1. Nigeria we hail thee
Our own dear native land
Though tribe and tongue may differ
In brotherhood we stand
Nigerians all are proud to serve
Our sovereign mother land

2. Our flag shall be a symbol
That truth and justice reign
In peace or battle honoured
And this we count as gain
To hand unto our children
A banner without stain

3. O God of all creation
Grant this our one request
Help us to build a nation
Where no man is oppressed
And so with peace and plenty
Nigeria shall be blessed

NATIONAL PLEDGE

I pledge to Nigeria my country
To be faithful, loyal and honest
To serve Nigeria with all my strength
To defend her unity
And uphold her honour and glory
So help me God

UDU UNIVERSITY, ANYIGBA ANTHEM

Prince Abubakar Audu University, you stand in strength and pride
Showing the way for all who yearn
Standing firm in wisdom and truth
In unity we grow

Committed in imparting knowledge, skills and learning
To all who long for excellence
Prince Abubakar Audu University, the pride of the world
We honour your virtues

DEDICATION:

To God almighty, the source of wisdom from whom all knowledge flows;

To the entire farmers' world over, who daily till the ground that there might be enough food for the sustenance of life;
To my parents of blessed memory, Mr Simon Ochalifu Attah and Mrs Rachael Attah (Nee Ochimana) for teaching me the art of hard work; May their souls rest in perfect peace with the Lord (Amen);

To my wife, Mrs Felicia Alewo Attah (Ajugu; Naata), for her support and understanding while I took on the many issues of life;,

To my children, Isaac Ileanwa Attah, Augustine Triumph Attah, Loveth Lad iAttah and Victor Ojochegbe Attah, with whom I laboured thus far, for a better today and tomorrow (Ojokichene ide me chakaa).

And lastly but not the least, to my siblings, males and females, you've been very supportive and wonderful. I appreciate you all.

Salutations:
The Vice-Chancellor
Deputy Vice-Chancellor (Administration)
Deputy Vice-Chancellor (Academic)
Registrar and other Principal Officers of the University
Deans of Postgraduate School, Faculties and Student Affairs;
Provost, College of Health Sciences and Directors of statutory Units
Professors and other Members of Senate
Head of the Department of Crop Production and other Heads of Departments
Members of Academic Staff of the University
Members of Administrative and Technical Staff of the University
My Lords, Spiritual and Temporal here present
Distinguished Invited Guests
Gentlemen of the Press
Great Kogites, our dear students
Ladies and gentlemen

Preamble:

It is with much gratitude to God that I stand here today to deliver the Twelveth (12th) Inaugural Lecture of the University. I am aware, that this event is an opportunity for me to showcase the knowledge and expertise I have acquired over the years in my area of specialisation which I daily profess. I am happy to let you know that I profess crop production, and my area of specialisation is cropping system. Vice Chancellor Ma, I want to specially thank you for this opportunity and for creating the enabling environment for me to present this lecture today. Conscious of the fact that there may be novice in this field seated here in this hall, I shall strive to be as simple as possible in order not to bore the audience.

When I picked my pen to start writing this lecture, I looked backed at life and wondered what it was that made me to go into this profession –agriculture, and I realised that my journey to becoming an agriculturist was a divine arrangement of God. This is because, when I completed my secondary education, and had to choose a course of study at the advanced level, agriculture was never on my priority list, even though it was one of my best subjects. However, in 1981 the year I would rather refer to as ‘my year of breaking forth’, I got a grant through the Bureau for External Aid Programme of the former Soviet Union (USSR) to undertake a Master’s degree program in the field of agriculture. The course, agriculture was actually given to me, not by choice, but because the people that interviewed me for the scholarship felt I could do well in it after considering my O/L results. If anything, I wanted to be an aeronautic engineer or a medical doctor, but not an agriculturist. After my appeals for a change of course to any of my darling courses fell on deaf ears, I accepted the offer reluctantly, hoping that an opportunity for a change will come in the course of the programme, but that never happened until I completed my studies.

To the glory of God, I was among the three Nigerians that graduated from the Chisinau State Agricultural University, Moldova, USSR with a Master’s Degree in Agronomy in 1987. After the mandatory one year national youth service (NYSC) in 1988, I worked briefly as an Agricultural Officer with the Benue State Local Government Service Commission before moving into the academia, starting with the Federal University of Agriculture Makurdi (FUAM) where God’s purpose for my life in this profession began to fully unfold.

Vice Chancellor Ma, ladies and gentlemen, permit me to put on record that by the time I finish this lecture, I would have become the second in the Department of Crop Production, and the fourth in the Faculty of Agriculture, to deliver inaugural lecture, since inception of this University in2000. The first lecture in the Department of crop production titled “Coroner’s Inquest: An Autopsy of the Man with the Hoe” was delivered by Professor Charles Illedun Oyewole in 2019 (Oyewole, 2019).

I have titled my lecture today ‘Intercropping: That There May be Enough Food’in recognition of the importance attached to food. Food was defined as ‘any substance that plant or animal can take into its body to maintain life (Oluwagbemi, 2018). Indeed, every endeavour of man is geared towards having what to eat and having enough of it. When food is lacking or inadequate in the quantity needed, human existence is threatened.

The relationship between the crop plant and what the man eats (food), has long been established. Food has its origin in plants and animals; all others are either by-products of the two or are synthetically made. Therefore, when a plant is deliberately grown with the intention that it will be harvested at some stage of its development for use either by man or animal, it is called a crop plant, while the art or practice of growing the crop plant is called crop production which is the major line of discuss in this lecture.

In the past, increased productivity of the major crop plants was derived from genetic improvement and from greater use of external inputs such as fertilisers, pesticides and irrigation water. It is now established that these practices have negative consequences on the environment and the quality of the products that we get. Therefore, the world is gradually moving from known agricultural systems, into highly resource-use efficient systems that are profitable, ecologically safe and socially acceptable such as organic farming, multiple cropping etc.

In this inaugural lecture, I shall be looking at one aspect of crop production known as intercropping, which is a form of multiple cropping and its contributions to sustainable food production and supply. The lecture seeks to draw attention to the very important role that this system of cropping plays, in sustainable food supply to the nations of the earth.

1.0 The Inaugural Lecture

1.1 Crop production: The God connection

Vice Chancellor Ma, ladies and gentlemen, first, let us go back to the beginning, when it all started. It is on record that when God created man, He placed everything ever created under him in the 'Garden of Eden'. '……….. and God said in the Holy Bible, 'Behold, I have given you every herb bearing seed, which is upon the face of all the earth, and every tree, in which is the fruit of a tree yielding seed; to you it shall be for meat'(Genesis 1: 29)'. From the above, it is clearly seen that God was conscious of the fact that for man to remain alive, he needed to be fed, he needed food. So, in the garden, God gave man the mandate to eat what he could lay hands on, not having to worry how the food he ate was produced; he completely depended on what God created for survival. But something went wrong that changed God's plan for mankind. In the Holy bible (Genesis 3 v 23), it is recorded that God sent man out of the Garden of Eden as a repercussion for disobedience. 'Therefore, the Lord God sent him forth from the garden of Eden, to till the ground from whence he was taken'. From this time onward, man had to spend most of his time working in the wild and searching for food. In this nomadic state, man picked up plants that appeared edible to him as food. Even though man was outside of the garden, he still did not run out of food supply; he had enough to feed and to provide for his immediate and extended family members. However, with increasing population upon the face of the earth, food became scarce, and want took over. This led man to begin to think of other means of livelihood.

Through trial and error, man discovered thatseeds dropped in the ground could yield a harvest a few months later and this led him to begin to domesticate and cultivate what hitherto, were wild plants. From this point onward, man progressed from being a food gatherer to a food producer; hunger and the desire to have enough food on sustainable basis, also forced man to invent tools to grow crops and produce animal foods.

It has to be emphasised that plants and their products formed a major proportion of man's diet in the early days, as evident from drawings in his caves, where he once lived. Records show that grains and flour used by man today, dated back twenty thousand years well into the epoch of homosapiens. Millet in Eurasia and maize in America were said to be available about this period. Indeed, most of the present day food crops were contributions of the early man who learned by trial and error to avoid poisonous plants.

Between 8000 B.C. and 6000 B.C., gardens were already being cultivated along the shores of the Caspian Sea, the Iranian Plateau, and along the Indus River to the Nile Delta (the Fertile Crescent). Cereals commonly produced at the Fertile Crescent included barley, rye, rice, oats, wheat and millet. These were followed by such vegetables as cucumber, eggplant, lettuce, onion, pea and turnip; while some of the fruits grown were apricot, date, fig, grape, lemon, melon, etc. It should equally be noted that potato, maize, lima bean, squash and tomato were native to America at this period. Many of these crops have since been dispersed to different parts of the world either consciously or unconsciously through migration, international trades, war and conquest etc.

1.2 Intercropping: What it is

Vice Chancellor Ma, ladies and gentlemen. The term 'intercropping' has been defined simply as a multiple cropping practice in which two or more crops are cultivated at the same time on the same piece of land or in the same field. These component crops do not necessarily have to be planted at the same time or be harvested at the same time, but they should be grown together for a significant period of time to be able to interact (Lithourgidis*et al*., 2011). The goal is to produce a greater yield on a given piece of land by making use of resources or ecological processes that would otherwise not be utilised by a single crop in pure stands. Mixed cropping, companion planting, relay cropping, inter-seeding, over-seeding, under-seeding, smother cropping, planting polycultures and using living mulching are all forms of intercropping (Preston, 2003).

A wide range of crops can be used for intercropping. Crop associations such as cereal-cereal, cereal-legumes, root/tuber-cereal, cereal-vegetables, perennial - arable crops etc. are very common all over the world and especially in the tropics. This system of crop production is necessary where farmers have scarcity of production resources and there is the desire to make the most efficient use of what is available (Natarajan and Willey, 1980, Francis, 1986). It is therefore not a surprise that it is common and a very important practice among peasants in developing countries where substantial contributions come from small farms. Currently, in most developing economies, realistic approaches to increasing food production have begun to incorporate more research on principles of traditional intercropping as an alternative to contemporary monoculture.

1.3 Why Farmers Practice Intercropping

There are many reasons why farmers intercrop and these have been highlighted by researchers. These include increased yield due to bio-diversity, resource utilization, improvement and maintenance of soil fertility, weed control, insect pests and diseases control, erosion control, insurance against crop failure, spread of labour and harvesting during the cropping season and production of many crops on a limited land area. I shall briefly look at each of these benefits:

a. Increased yield: Intercropping is the simplest way to increase diversity in farming systems, and more diversity in the farming system generally means more stability in the biosphere which will result in risk spreading, reduced pest and disease incidence and ultimately increased yield. When two or more crops are planted together, water, nutrients and sunlight are used more efficiently; and the combined yields of two crops grown together as intercrops can be higher than the yield of the same crops grown as pure stands (the principles for this phenomenon is discussed further under resource utilisation below).

   Greater biodiversity in intercrops also ensures yield stability which is considered an important attribute for food security. The stable yield over the growing seasons helps to ensure food availability and supply for small scale and subsistence farmers, as well as poor farmers who do not have enough purchasing capacity and tried to meet their family needs through producing food in their limited land resources. If in any growing season yield level decreases, it will throw the whole family at risk of hunger because, the market price would increase and sometimes goes beyond the poor people's purchasing capacity. Even if production is high for the specific crops, lack of storage facilities would force the farmers to sell their products at low prices.

b. Resource utilization: The main reason for higher yields in intercropping is that the component crops are able to use natural resources differently and make better overall use of natural resources than when grown separately. The efficient use of basic resources (soil nutrients, water, and sunlight) in the cropping system depends partly on the inherent efficiency of the individual crops that make up the system, and partly on complimentary effects between the crops. The partitioning of limiting resources among crop plants occurs whenever plants are grown in association. Different root and leaf systems are able to harness more light and make use of more water and nutrients than when the roots and leaves of only one species are present. When only one species is grown, all the roots tend to compete with each other, since they are all similar in their orientation and below surface depth. Similarly, the leaves of plants of the same species are directly opposite and growing at the same rates as each other, whereas the leaves of a plant of another species do not compete directly for sunlight in space and time.

Intercropping between high and low canopy crops is a common practice in tropical agriculture. To improve light interception and hence yields of the shorter crops requires that they be planted between sufficiently wider rows of the taller ones. When two morphologically dissimilar crops with different periods of maturity are intercropped, light is the vital factor that determines the yield. In areas where there is water scarcity, intercropping is the suitable cropping method. Availability of water in cropping system is vital to determine the growth of plant. Improvement of water use efficiency in intercropping leads to increases in the use of other resources. Intercrops have been identified to conserve water largely because of early high leaf area and higher leaf index.

c. Improvement and maintenance of soil fertility: Improvement and maintenance of soil fertility is realised when a cereal crop such as maize or sorghum or a tuber crop such as cassava is grown in association with a leguminous or pulse crop such as common bean (*Phaseolus vulgaris*), cowpea (*Vigna spp*.), soybean (*Glycine max*), groundnut/peanuts (*Arachis hypogea*), pigeon pea (*Cayanuscajan*) etc. Pulses or legumes are a protein rich source of food; some provide oil and may be important as cash crop. Deep rooted pulse crop such as pigeon pea, also take up nutrients from deeper soil layers, thereby recycle nutrients leached from the surface. After the intercrop is harvested, decaying roots and fallen leaves provide nitrogen and other nutrients for the next crop. This residual effect of the pulse crop on the next crop is largest when the remains of the pulse are left on the field and ploughed under after harvest. The nutrients in the crop residues can be recycled when manure is used to fertilise crops. It should be emphasized that in intercropping, nitrogen fixation by pulses or legumes is not always enough to maintain soil fertility; sometimes, it has to be augmented with inorganic fertilizer. But if inorganic nitrogen fertilizer must be used, it is not necessary to use it on the legume component; rather, it should be targeted on the associated crop(s). A basal fertiliser is generally needed for both crops in mixtures.

Fertilizers are more efficiently used in an intercropping system, due to the increased amount of humus and the different rooting system of the crops, as well as differences in the amount of nutrient uptake. Leguminous crops in intercrops do not only provide a source of nitrogen and other nutrients to the associated crops, but also increase the amount of humus in the soil due to decaying crop remains. As already established, humus helps to improve soil structure and soil fertility; it has a great capacity to hold nutrients and water for plants use (Martine and Wolfs (2010).

d. Pests and diseases control:
   Crops are susceptible to many pests and diseases, but these are often less abundant in intercrops. It is believed that one component crop in an intercropping system may act as a barrier or buffer against the spread of pests and pathogen. This is explained by the fact that if the pest or disease has a specific host, it does not spread as easily through an intercrop as it does in monocrop. Insects or other pests can also be misled by the canopy of an intercrop and not recognize the specific crop they use as host. In the same vein, substances that other crops produce may drive insects away from the main crop or natural enemies of insects may be attracted by one of the crops in the intercrop. Insect problems are less on crops grown in mixture, especially with cowpea, pigeon pea, maize and some legumes.

e. Erosion control: Intercropping controls soil erosion by preventing rain drops from hitting the bare soil where they tend to seal surface pores, prevent water from entering the soil and increase surface erosion. This happens with a good soil cover; especially when creeping pulse crops are used. For example, in maize-cowpea intercropping, cowpea will act as best cover crop and reduce soil erosion. In relay-intercropping, the pulse crop is planted sometimes after the main crop and continues growing after harvest of the main crop. This results in a more efficient use of soil water and prevents leaching and erosion, as the soil is still covered after harvest of the main crop.

f. Insurance against crop failure:When two or more crops are grown on the same field, the risk of crop failure is spread over the different crops, as they have different periods and patterns of growth, and are affected by different diseases. If one of the crops fails, maybe as a result of drought, pest or diseases infection, there will still be a harvest from the other crop in the mixture.

Other benefits of intercropping include spread of labour and harvesting during the cropping season, as well as production of many crops on a limited land area. The modern day monoculture standard is one completely reliant on agrochemicals, endless water supplies and land expansion. It leaves a waste land in its wake. It is not a surprise then that subsistence farmers in developing countries are increasingly having interest in intercropping due to the reduced management inputs that result in sustainable crop production systems more efficiently.

1.4 Important Considerations in Intercropping

a). Crop selection

It is important not to have crops competing with each other for physical space, nutrients, water or sunlight. Examples of intercropping strategy are planting a deep-rooted crop with a shallow-rooted crop or planting a tall crop with a shorter crop that requires partial shade. When crops are carefully selected, other agronomic benefits are also achieved: For instance, a lodging-prone plant may be given structural support by the companion crop, creepers can also benefit from structural support., some plants are used to suppress weed or provide nutrients. Also, light sensitive plants may be given shade or protection when intercropped with tall growing plants. Example is the tropical multi-tier system, where coconut occupies the upper tier, banana the middle tier and pineapple, ginger leguminous fodder or any other low growing crops occupy the lowest tier.

b) Spatial arrangement

When two or more morphologically different crops are growing together, each must have adequate space to maximize cooperation and minimize competition between the crops. Spatial arrangement refers to the way and manner crops are arranged on available lands. In intercropping, there are four basic forms of spatial arrangements of the component crops. They could be arranged in rows, in strips, mixed and in relays. Thus, intercropping is sometimes defined by the way and manner crops are arranged in the field such as:

- Row intercropping – involves growing two or more crops at the same time, with at least one of the crops planted in rows. It is usually encountered in intensive agriculture where the plough has replaced the machete and fire as the main tools of land preparation. The benefit of this kind of arrangement is that the interaction between the crops is maximized. A maize-bean intercrop, for example can be planted in rows with a row of maize alternated with a row of beans, or two-by one, or two by two and vice versa. This allows more light to penetrate and reach the beans or other small crops.
- Mixed intercropping – involves growing two or more crops together in no distinct row arrangement. Frequently, it is the pattern used in indigenous slash and burn or fallow agriculture of the tropics.
- Relay intercropping –involves planting a second crop into a standing crop field at a time when the standing crop is at its reproductive stage, but before harvesting. This form of intercropping may actually include the other three mentioned above as subsets, since its primary categorization variable is time.
- Strip intercropping – involves growing two or more crops together on a piece of land wide enough to permit separate crop machine production, but close enough for the crops to

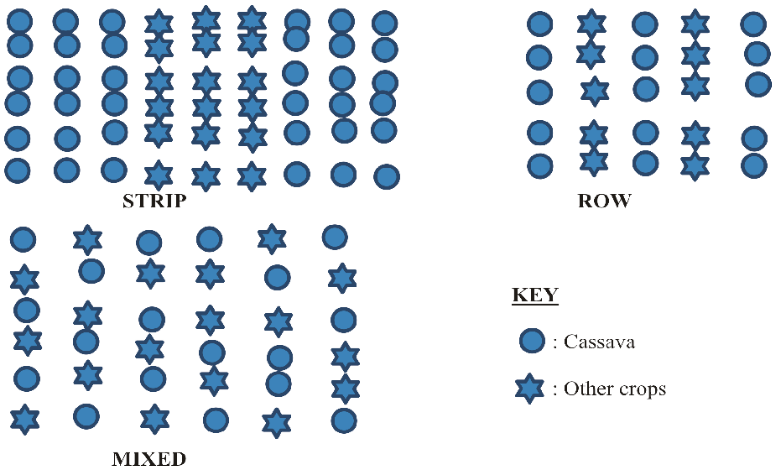
interact. It is more common in developed systems, especially where the intensive use of machinery is desired

c) Plant density.

Plant density refers to the total number of plants per unit area of land, normally one hectare or per proximate position. When component crops in intercrops are both planted at the same sole crop densities, the plant or stand density would be too high, thereby reducing yield of both crops. Therefore, plant densities need to be adjusted to maximize yield. To optimize plant density in intercrops, the seeding rate of each crop in the mixture would have to be adjusted below its full rate. If full rates of each crop were planted, neither of the two would yield well because of intense overcrowding. By reducing the seeding rates of each, the crops have a chance to yield optimally within the mixture.

The challenge to most farmers comes in knowing how much to reduce the seeding rates of the component crops. This can be done and easier, if the farmer has preference for a particular crop in the mixture. All he has to do is to drastically cut the seeding rate of the crop that is less preferred, for example, by 80% or more, leaving that of the preferred crop near normal. If the farmer wants equal yields from both crops, then the seeding rates would be adjusted to produce those equal yields, for example in the ratio of 50:50.

Fig 1: Examples of crop arrangement in mixtures



d). Maturity dates of the crops being grown

Planting intercrops that feature staggered maturity dates or development periods takes advantage of variations in peak resource demand for nutrients, water and sunlight. Having one crop mature before its companion crop lessens the competition between the two crops. An aggressive climbing bean may pull down corn or sorghum growing with it and lower the grain yield. Therefore, timing the planting of the aggressive bean may fix the problem if the corn can be harvested before the bean begins to climb.

Selecting crops or varieties with different maturity dates can also assist staggered harvesting and separation of grain commodities. In the traditional sorghum - pigeon pea intercrop, the sorghum dominates the early stages of growth and matures in about 4 months. Following harvest of the sorghum, the pigeon pea flowers and ripens. The slow-growing pigeon pea has virtually no effect on the sorghum yield.

Most grain-crop mixtures with similar ripening times cannot be machine-harvested to produce a marketable commodity – since few buyers purchase mixed grains. Because of limited harvest options with that type of intercropping, farmers are left with the options of hand harvesting, utilizing crops in the field with animals, or harvesting the mixture for on-farm animal feed. However, some intercropping schemes allow for staggered harvest dates that keep crop species separated. One example would be harvesting cereal crop that has been interplanted with a low growing leguminous crop like soybeans, which are harvested later in the season. Another example is planting harvestable strips, as in strip cropping.

Another aspect of the timing of the sowing dates of nitrogen fixing legumes is the release of nitrogen from crop remains after harvest. If the nitrogen fixing crop matures first, then the added nitrogen and phosphate already become partially available to the other crop. If it matures after the other crop, then the nitrogen and phosphate will be available to the subsequent crop. Adaptations in the planting dates of the different plants in an intercrop can help to reduce competition and to maximize yields.

e) Plant architecture.

Plant architecture is commonly used strategically to allow one member of the mix to capture sunlight that would not otherwise be available to the others. The association of low growing grain legumes with widely spaced taller cereal crops is common in traditional intercropping system (Obasi, 1986). For example, in cereal-legume mixtures involving crops like soybean, cowpea, common bean, pumpkin etc., the tall growing cereal component is usually planted in rows far enough apart to allow sunlight to reach the low growing leguminous plants. The legumes will mature earlier than the cereal component, thus there is temporal complementarity (Nintai, 1997).

1.5 Management of Intercrops:

Vice Chancellor Ma, ladies and gentlemen, as already mentioned, many combinations of crops can be grown mixed or relay intercropped on farmers' field. In various parts of the tropics cassava and corn, yam and corn, corn and groundnut, corn and cowpea, sorghum and millet, and sorghum and pigeon pea are grown together. In other regions of the world, crops like sunflowers are grown with black lentils, wheat with flax, and canola with flax. Other combinations include cucumbers, beans, celery, and chives in China; upland rice, corn, potato and cassava in Indonesia. Frequently, these cropping combinations involve a short and a tall crop, both planted at the same time. In most instances, the tall crop is harvested first. For example, corn grown with a shorter plant like peanut or sweet potato would be harvested first, then peanut or sweet potato would be harvested later. Another pattern always encountered is the growing of two tall crops with different growth rates. In relay intercrops, different planting dates are used so that one crop might mature sooner. Corn or sorghum, requiring three months to mature, can be grown with pigeon pea, requiring ten (10) months to maturation.

In all of the planting patterns or systems described above, five things are critical for the farmer to be successful. These are: detailed planning, timely planting of each crop, adequate fertilization at the optimal times, effective weed and pest control, and efficient harvesting. A brief discussion of each of these is as follows:

1. Detailed planning. Planning covers selection of crop species and appropriate cultivars, water availability; determination of plant populations and spacing, labour requirements throughout the season, tillage requirements, and predicted profitability of the intercrop. These and other parameters need to be evaluated before spending money on inputs.

2. Timely planting of each crop. As with any crop, seed germination and seedling establishment is the most critical growth phase of the entire season. Delayed planting may reduce yield since crop development many not coincide with the optimal seasonal growth periods.

3. Adequate fertilization at the optimal times. Planning fertilization regimes for intercrops can be challenging, as the full needs of both crops must be met. Generally, there is little information available on how to go about this, but one possibility would be to obtain soil test results for each crop separately, then formulate a mixture that will cover the needs of both crops to be grown. Such mixtures are generally 10% to 30% higher than rates for individual crops. As with any crop, also accounting for residual or carryover fertility from past crops saves money. Carryover fertility from intercrops may well be lower than that of pure stands because of the two crops having different root types and feeding habits.

4. Effective weed and pest control. Weed and pest control needs in intercrops will likely be different than in pure stands. Some disease incidences such as soybean or mung bean rusts may increase when aggravated with high corn populations and over fertilization. Any disease or pest that prospers under shady conditions could increase when grown under a taller crop such as corn or sunflowers. In many cases, insect pests are lower when two or more crops are grown together.

5. Efficient harvesting. Harvesting mixed intercrops is a major limitation to their adoption in mechanized farming. The farmer has the option of hand harvesting his crops if the operations cannot be mechanized. In advanced economies, some crops like flax and wheat can be harvested together and mechanically separated. Any other mechanized harvest efforts must get one crop without damaging the other.

1.6 Intercrop Productivity: Concept of Land Equivalent Ratio (LER)

One of the most important reasons why farmers grow two or more crops together is the assurance of increased productivity per unit area of land. Indeed, there will be no need to intercrop if yield advantages over sole cropping are not expected.

To evaluate the performance of intercrop components as compared to their pure stand yield, the concept of Land Equivalency Ratio (LER) is commonly used (Okigbo, 1979; Mead and Willey (1981).). LER is indicative of how much of additional land is required in pure stand, to obtain the amount of yield achieved in the intercrop. It provides a standardised basis for comparing systems under different situations and crop combinations.

To obtain LER values, yields from the pure stands and that of the component crops in the intercrop are separately measured. From these yields, an assessment of the land requirements per unit of yield can be determined. The results obtained will indicate whether the crop mixture or intercrop has yield advantages over the pure stands of the crops, or not.

To estimate LER from the above scenario for example, the intercrop yields are divided by the pure stand yields for each component crop in the intercrop, and added together. Mathematically, this is expressed as follows:

LER = $\sum_{i=1}^{n} \frac{Yj}{Yij}$ Where,

Yi = the yield of the ith component from a unit area of intercrop expressed as a fraction of the yield;

Yij = the yield of that component grown as sole crop over the same area, and 'n' is the number of crops involved

When LER is computed at uniform overall plant density of sole and intercrops, it is known as Relative Yield Total (RYT) or Partial LER. In other words, Total LER is equal to the sum of Relative Yield Totals of the component crops.

Total LER = $\frac{Ya}{Yaa} + \frac{Yb}{Ybb}$

Where, $\frac{Ya}{Yaa}$ = RYT or Partial LER of component 'a' as intercrop; $\frac{Yb}{Ybb}$ = RYT or Partial LER of component 'b' as intercrop

Y_{aa} = Yield of component 'a' as sole crop

Y_{bb} = Yield of component 'b' as sole crop

Y_a = Yield of component 'a' as intercrop grown in combination with component 'b'

Y_b = Yield of component 'b' as intercrop grown in combination with component 'a'

For example, in a maize/cowpea intercrop, LER will be computed as: (intercrop maize / pure maize) + (intercrop Cowpea / pure Cowpea)

If Total LER is less than unity (LER< 1), it is said that there is mutual inhibition (i.e there is a disadvantage to intercropping); If it is equal to unity (LER = 1), there is mutual cooperation (i.e the amount of land required for the two crops grown together is the same as that for each of the two grown in pure stand; there was no advantage to intercropping over pure stands); If LER is greater than unity (LER > 1), there is compensation (i.e there is an advantage to intercropping). For example a LER of 1.25 shows that the yield produced in the total intercrop would have required 25% more land if planted in pure stands. If the LER was 0.75, it is an indication that the intercrop yield was only 75% of that from the same amount of land that grew pure stands. Significant yield advantages of intercrops with LER values greater than unity have been reported by researchers.

In one of my works, where maize and cowpea were intercropped, cowpea was planted at three different population densities of 40,000, 66,000, and 80,000 plants per hectare, while maize being the major crop was maintained at a sole population density of 40,000 plants per hectare (100% of sole density) in all the mixtures (Attah*et al*., 2003),. Results (Table 1) show that LER ratio values were greater than unity (LER >1.0) in all the intercrop combinations. However, the best intercrop advantages were obtained at 40,000 and 80,000 plants per hectare for the local cowpea variety (ileje), 66,666 and 80,000 plants per hectare for L-25 and IAR interplanted with 40,000 maize plant per hectare, under 1:1 interrow arrangement (yield values averaged over two years). For these combinations, maize was planted at 1.0m x 0.5m at two plants per stand, while cowpea was planted 1.0m x 0.5, 1.0m x 0.25m apart between maize rows, respectively.

Table 1.0: Yields of maize and cowpea and their LER from intercrops (Attah*et al.,*2003).

Cultivar		**Treatments**			**Mean Yield**		**Partial LER**		**Total LER**
		Plant density ('000 plants/ha)		**Row Arrangement**					
Maize	**Cow pea**	**Mai ze**	Co wp ea		Maiz e	Cow pea	Maiz e	Cow pea	
MEGA 4	ILEJ E	40	40	1:1 INTRA ROW	5.68	0.39 4	1.19	0.37	1.56
		40	40	1:1 INTER ROW	5.94	1.10 1	1.25	1.02	2.24
		40	66	1:1 INTRA ROW	4.09	0.41 6	0.86	0.45	1.31
		40	66	1:1 INTER ROW	4.81	1.22 7	0.01	1.33	1.34
		40	80	1:1 INTRA ROW	4.06	0.33 6	0.85	0.45	1.30
		40	80	1:1 INTER ROW	4.06	0.96 9	0.98	1.30	2.28
MEGA4	L-25	40	40	1:1 INTRA ROW	5.16	0.22 2	1.08	0.32	1.40
		40	40	1:1 INTER ROW	5.72	0.47 6	1.20	0.66	1.86
		40	66	1:1 INTRA ROW	4.85	0.27 2	1.02	0.45	1.47
		40	66	1:1 INTER ROW	5.73	0.61 0	1.20	0.99	2.15
		40	80	1:1 INTRA ROW	5.10	0.23 4	1.07	0.56	1.63

		40	80	1:1 INTER ROW	5.09	0.511	1.07	1.23	2.25
MEGA4	L-25	40	40	1:1 INTRA ROW	4.37	0.244	0.92	1.08	2.00
		40	40	1:1 INTER ROW	5.35	0.374	1.13	1.66	2.44
		40	66	1:1 INTRA ROW	4.71	0.163	0.99	0.95	1.94
		40	66	1:1 INTER ROW	5.35	0.269	1.12	1.57	2.69
		40	80	1:1 INTRA ROW	4.30	0.178	0.90	1.05	1.95
		40	80	1:1 INTER ROW	4.93	0.256	1.03	1.51	2.54
SOLE CROPS:									
MEGA 4		40	**		4.77	**			
ILEJE		**	40		**	1.075			
		**	66		**	0.920			
		**	80		**	0.745			
L-25		**	40		**	0.727			
		**	66		**	0.611			
		**	80		**	0.416			
IAR-48		**	40		**	0.224			
		**	66		**	0.171			
		**	80		**	0.169			

1.7 Examples of Intercrop systems

a) Cereal-Legume Intercrops

Cereal-legume intercropping is currently receiving global attention because of its prime importance in World Agriculture. Usually, cereals such as maize (*Zea mays*), millet (*Pennisetumglaucum*) and sorghum (*sorghum bicolor*) are intercropped with leguminous crops like beans (*Phaseolus vulgaris*), cowpea (*Vignaunguiculata*), groundnut (*Arachishypogea*), pigeon pea (*Cajanuscajan*) and soya bean (*Glycine max*). Intercrops of maize and Soybean, maize and cowpea, millet and cowpea are common in Nigeria. This allows farmers to produce crops both for the household and for sale. Most often, the cereal components are the major crops; hence they are planted at full sole crop density, while the legumes are secondary providing bonus yields in the mixture. Both crops are planted in rows or mixed on the same row. Grown together, these crops optimize available resources. Examples:

i). Maize – Soybean

Maize and soybean are best partners under intercropping because both crops have complementary characteristics. Maize and soybean are the nitrogen- consuming C_4 and nitrogen –fixing C_3 crops, respectively, with same growing season which make them fit for the mechanized-based cultivation and harvesting. (Yang *et al*., 1999). The system provides massive advantages for small holder farmers in low input and high risky environment. Both crops can usually grow simultaneously in narrow and adjacent strips.

Maize and soybean cultivation in Nigeria has a wide scope in terms of major sources of food, economic importance and sustainability. Many of the improved soybean varieties, even though not developed for intercropping, maintained higher yield potential under intercropping conditions (Olufajo, 1991). In this example, soybean yields suffered yield reductions in mixture with maize, but it was beneficial to grow them in mixture with maize. The LER for the whole mixture was considerably higher (greater than 1.0) than any of the pure stands. Field reports show that a combination of maize

(TZESRW) with early or medium soybean varieties will be ideal under the northern guinea savannah growing condition. It was recommended that in other to reduce the competitive effect of maize on soybean in the northern part of the country, it is appropriate to establish the component maize at 35,000 plants/ha while soybean is grown at the sole crop population of 26,000 plants/ha.

ii). Millet-Cowpea mixture

Millet is a very important and widely grown cereal crop in the Sudan and Guinea savannah ecological zones of Nigeria. In this millet- based intercrop system, farmers sow millet as first crop and latter staggeredly interplant the associated secondary crop of cowpea in the form of relay-cropping.

Elemo (1983) intercropped Ex- Borno millet with ten cowpea cultivars (TVX 4659-02E, TVX 3236-01G, 339-1-2, IT 81D-1137, Kano 1696, Sampea 48, IT 81D-988, IT 82E-60, Ife Brown, TVX 1948-012F) in alternate single rows. The cowpea plants were protected with insecticides. The results show that mixed cropping with cowpea did not affect millet grain yield, and cowpea grain yields across genotypes were statistically similar in mixed crops. The land equivalent ratio of millet in all the mixtures was higher than expected, while that of cowpea varieties was lower. However, the total LER of the two crops was generally higher than the mean of the pure stand LER (i.e 1.00). He concluded that cowpea genotype TVX 4659-02E, IT 81D-1137, Kano 1696, Sampea 48 and Ife brown appeared to be well adaptable to crop mixture with millet.

b) Cereal-Cereal Intercrops

Cereal-cereal intercropping systems are gaining interest in parts of the world, but additional long term studies are needed, particularly from the tropical region where climate is more variable, to determine whether its yield is stable or not. Such studies are very important because cereal is considered as the cornerstones for global food security. If cereal-cereal intercropping shows better land-use efficiency in terms of higher yield, and more yield stability than sole crops, it could enhance greater contribution to the future global food security. Examples:

i) Maize: Sorghum mixture

Maize and sorghum mixture is one of the common cropping practices among resource-poor farmers in the guinea savannah ecological zone of Nigeria. The two crops are normally planted at the same time in alternate rows, or relay cropped with sorghum being introduced into the farm of standing maize. Elemo and Chobe (1995) intercropped maize and sorghum for two years at Samaru, Zaria using the replacement and superimposed techniques of growing the crop mixture. KSV8 variety of sorghum which is medium maturing was grown with TZESRW maize, an early maturing variety in mixture. In both years, the productivity of the mixture was influenced by the crop mixing technique. Superimposed mixture gave significantly higher productivity than the replacement mixture.

c). Strip Cropping Cereals and Legumes

In developed economies of America, Europe and Asia, farmers grow crops alternating strips of corn, soybeans, and wheat. The practice is also practicable in developing economies where there is much pressure on the land due to the land use systems.

The strips can be three to six rows wide in a ridge-till system. All the crop plantings are adapted to existing equipment widths. In this system, regular herbicide treatments can be applied using a ground sprayer of strip width. The crops are planted in a wheat-corn-soybean pattern with soybeans on the north side of the corn. This arrangement reduces the effect of corn shading often associated with a straight corn-soybean pattern, since the wheat matures before the corn has a chance to shade it. Corn gains the greatest benefit from the additional sunlight interception on the outside rows of the corn strip.

2.0 What I Have Done to Advance the Knowledge of Intercropping

Vice chancellor Ma, ladies and gentlemen, as an academic and agricultural scientist, over the years, I have devoted time to cropping systems research with a focus on crop varietal selection, cropping sequences in time and in space, and determination of optimum plant densities for multiple cropping. For over two decades now, I have been involved in the study of multiple cropping. My works and findings have been published in both local and international journals, as well as books. Some of my research findings, apart from the ones already mentioned in this lecture are summarised as follows:

a). Identification of Suitable cowpea cultivar(s) for intercropping with maize

Of all the factors that determine yield, cultivar appears to be the most important on the African continent where crop yields are low due to poor cultural practices. Cowpeas, though grown sole as a common practice, are found under various heterogeneous mixtures of crop combinations. Some of the varieties used are local, adapted to specific environments, while others are the improved types, recommended for cultivation on farmers' field.

Most of the improved cultivars are usually developed under sole cropping. For efficiency and maximum productivity in mixtures, we decided to evaluate and compare one local (Ileje) and two improved cowpea cultivars (L-25 and IAR-48) under intercropping with maize in the southern guinea savannah zone of Nigeria. The results showed that local cowpea varieties could be as high yielding as the best elite improved cultivars (Table 2). There were significant differences ($p \leq 0.05$) among the cowpea cultivars tested in number of pods per plant, pod length, number of grains per pod, grain weight and grain yield. The local variety (Ileje) exhibited yield superiority over the two improved cultivars (L-25 and IAR-48). Mean yield of Ileje was 47.4% and 66% more than the yield of L-25 and IAR-48. Differences in yield between L-25 and IAR-48 were also significant (≤ 0.05). The grain yield superiority of the local variety (Ileje) was expected in view of its overwhelming advantages in number of pods per plant, pod length and number of grains per pod.

Maize grain yield and the agronomic parameters measured in the mixtures were not affected by the intercropped cowpea cultivars, but yields were generally higher under intercropping system than in the sole cropping (Table 3); maize grain yield was highest ($P \geq 0.05$) in intercrop with L-25. The results also show that vegetative and reproductive growths of maize were accelerated under intercropping. This was attributed to the presence of cowpeas in association which may have enhanced the fertility status of the soil. Earlier studies showed that legumes in intercrops increased the availability of nitrogen to the system (Moima, 1993).

The non-significant cowpea cultivar effect for maize grain yield observed showed that the cultivars exerted similar influence on the associated maize which is an indication that any of the three cultivars could be interplanted with maize in this zone without reducing the potential yield of the associated maize. The local variety- Ileje is however preferred for intercropping with maize in this zone because of the yield superiority it exhibited.

Table 2: Yield components of cowpea as affected by cultivar in sole and intercrop with maize (Attah*et al*., 2003)

Cultivar	Number of pods per plant	Pod Length (cm)	Number of grains per pod	100 grain Weight (g)	Grain yield (Kg/ha)
Sole Cowpea					
Ileje (Local)	24.8	16.7	15.0	10.35	929.83
L-25	16.4	15.0	12.0	12.78	583.94
IAR-48	10.7	14.8	13.3	15.57	187.93
SE	3.7	0.4	0.6	0.3	88.76
LSD (P=0.05)	12.2	1.4	2.0	0.99	289.43
Maize-Cowpea					
Intercrop	21.2	16.4	15.0	10.18	740.06
MEGA-4+Ileje	13.2	15.3	13.1	12.62	388.93
MEGA-4+L-25	8.4	14.6	11.0	15.61	246.85
MEGA-4+IAR-48	1.8	0.6	0.5	0.33	48.21
SE	5.1	1.6	1.4	0.94	136.91
LSD(P=0.05)					

SE- Standard error of means

Table 3: Mean grain yield of maize (Ton/ha) in sole and intercrop with cowpea
((Attah*et al*., 2003)

Cultivar	Grain Yield T/ha		
	1998	1999	Mean
Sole Maize			
MEGA-4	4.85	4.57	4.71
Maize-Cowpea Intercrop			
MEGA-4+Ileje	4.86	4.90	4.88
MEGA-4+L-25	5.33	5.21	5.27
MEGA-4+IAR-48	4.93	4.76	4.85
SE	0.23	0.18	0.20
LSD (P=0.05)	NS	NS	NS

SE: Standard Error of Means; NS: Not Significant

b). Determination of appropriate cowpea population density for intercropping with maize

The population density of mature plants at maturity depends on a series of factors and processes which include the initial seed rates, seedling mortality as a result of predation before emergence and losses resulting from environmental stresses, pests and diseases. Such losses will be greatest at high seed rates due to intense intra-specific competition. Given a high level of crop management, about 80% establishment of sown seed could be obtained, but it is not unusual to obtain as low as 25% seedling establishment when soil conditions are unfavourable (Cowton, 1982). Therefore, it is advisable to give appropriate allowance for establishment losses to ensure realisation of yield plateau. The results of my study (Table 4) show that the two-factor interactions of cultivar and population density were not significant (P= 0.01) for cowpea grain yield.

Table 4: Mean grain yield of cowpea (Kg/ha) in sole and intercrop with maize as influenced by population density (Attah*et al*., 2004)

Plant Density (Plants/ha)	Cultivar		
	Ileje (Local) 48	L-25	IAR-
Sole Cowpea			
40,000	1075.07	726.65	
66,000	919.73	610.50	223.90
80,000	744.54	415.88	
Mean	913.11	584.34	171.08
SE= 188.32			
Maize-Cowpea			168.80
Intercrop	581.09	272.02	
40,000+40,000	654.79	329.54	187.93
40,000+66,000	501.26	279.91	
40,000+80,000	579.05	293.82	
Mean			
SE= 88.33			237.83
			166.16
			163.17
			189.23

SE: Standard Error of Means

The absence of interactions for cowpea grain yield in this study is an indication that the cultivars studied responded similarly to varied population densities. However, while there was the tendency for yield to reduce with increasing cowpea population density from 40,000 to 80,000 under sole cropping, grain yield increased with increases in population density up to 66,000 plants per hectare, under intercropping, after which it began to fall (Table 4). Irrespective of cropping system, grain yield was lowest at 80,000 cowpea plants per hectare. It is reported that there could be more flower production and fruit formation at higher plant densities, but this will not always translate to increased grain yield per unit area probably due to flower abortion enhanced by environmental stress, particularly increased inter and intra-specific competition for nutrients, moisture and light. The implication of these results is that cowpea producers in the southern guinea savannah zone of Nigeria can improve intercropped cowpea yield without sacrificing the yield of maize which is the major crop in the mixture, by altering planting densities of cowpea varieties with different growth habits. The result however shows that there would be no added yield advantage by planting Ileje, L-25 or IAR 48 above 66,000 plants per hectare.

c). Appropriate row arrangement for maize-cowpea intercropping.

Research reports have indicated that yields of the cereal components in mixture with legumes can be maintained over a wide range of spatial arrangement and that appreciable increases in yield of the associated legume can be achieved. In most cases, yields of the associated legume were more enhanced by planting them on the same row with their cereal counterpart, than in alternate rows, while the yield of the cereal component remained unaffected by row arrangement. Generally, results of field experiments on the effects of row arrangement on crop yields appeared to have been influenced greatly by crop species. In most reports, yield components were not emphasised to be able to determine their level of significance in total yield per unit area.

Results of my study show a highly significant two factor interactions of cultivar and row arrangement for grain yield (Table 5). Yields were highest for ileje (1098.71Kg/ha), L-25 (532.02Kg/ha) and IAR- 48 (299.08Kg/ha), respectively under 1:1 inter-row arrangement compared to the 1:1intra row arrangement. IAR-48 was not different across row arrangement. Among the row arrangements, cowpea grain yield was consistently higher under 1:1 inter-row system. Averaged over two years, yield was increased by 57.4% under 1:1 inter-row compared to the 1:1 intra-row arrangement. The greater yield advantage in 1:1 inter-row over 1:1 intra-row arrangement is attributed to the reduced shading effect of the taller growing maize plant under the former arrangement. It can also be said that the reduced cowpea yield under the 1:1 intra-row was due to increased competition for growth resources, especially at higher cowpea plant density. In the southern guinea savannah agro ecological zone of Nigeria, maize and cowpea are intercropped by mixing the two on the same row. This practice makes it difficult to carry out other cultural practices like fertilizer and herbicide applications. This finding showed that farmers have the potential to increase cowpea yield in intercrop with maize by adopting the 1:1 inter-row arrangements

d). Cropping system influences yield

Cropping system, according to Wikipedia, refers to the crops, crop sequences and management techniques used on a particular agricultural field. Simply put, it is the cropping pattern used on a farm and its interactions with farm resources, other farm enterprises and available technology, all of which determine their makeup. Monocropping, crop rotation, intercropping, sequential cropping and relay cropping are some of known cropping systems

Attah*et al.* (2005a) showed that cropping system influenced cowpea grain yield. In one of our trials, two out of three cowpea cultivars that we evaluated for yield produced higher grain yield in monocultures than in intercrop systems (Table 6). Percentage yield increases from monocrops were 25.64% and 50.14% for Ileje (local var.) and L-25 cultivars, respectively. On the contrary, IAR-48 cultivar yielded less (31.88%) in monoculture than in intercrop with maize, possibly due to poor adaptation to the study environment. Averaged over three cultivars and two years, grain yield was 23% higher in monocultures than in intercrops. Cowpea yield reduction in intercrop with maize was attributed to increased competition for growth resources particularly light. The study concluded that cultivation of local cowpea varieties either in monoculture or intercrop with maize can be marginally profitable.

Table 5: Yields of cowpea (Kg/ha) as affected by row arrangement and cultivar
in intercrop with maize (Attah*et al*., 2007)

Row Arrangement	Cultivar		
	Ileje	L-25	IAR-8
1:1 Intra row	381.42bc	245.87c	194.57c
1:1 Inter row	1098.71a	532.02b	299.18bc
Mean	740.07	388.95	246.88
SE		118.64	

SE – Standard error of means; Values with the same subscript letter(s) are not significantly different (DMRT, 5%)

Table 6: Grain yield of cowpea cultivars in monoculture and intercrop with maize (Attah*et al*., 2005a)

Cultivar	Monocrop Yield, Kg/ha	Intercrop Yields, Kg/ha	Difference (x) Kg/ha
Ileje	829.53	740.00	+189.77 (25.64)
L-25	583.94	388.93	+195.01 (50.14)
IAR-48	187.93	246.85	-59.92 (31.88)
Mean	567.21	458.61	-147.90 (23.00)

X: Values in parentheses are the percentage yields over (+) and or below (-) intercrop yields

Vice Chancellor Ma, ladies and gentlemen, at this juncture, I want to state that these findings are all encapsulated in a book titled 'Intercropping Maize (*Zea mays*) and Cowpea (*Vignaunguiculata* L. Walp): Effect of cultivar, stand density and row arrangement' which I wrote in 2011, and was published by LAP Lambert publishers, Germany. This book can be accessed online via https://www.amazon.com/.

2.1 My Research with other Crops:

Ladies and gentlemen, my collaborative works with students and colleagues, also included crop environment research with special focus on interrelationship among environmental factors and that of the crop plants. Results from some of those works are summarised below:

a). Plant spacing and poultry manure effect on 'egusi' melon (*Colocinthiscitrullus*) (Attah and Oyewole, 2013)

The 'egusi' melon plant (*C. citrullus* L.) is a crop that is widely cultivated in Nigeria for its seeds which are rich in protein, fats, in addition to essential vitamins and minerals. The seeds have 33.8% protein and 53.1% oil. For optimum seed production, farmers require adequate knowledge of practices such as spacing in the field and fertilizer application methods. Our study evaluated the growth and yield performance of 'egusi' melon within the range of 50 and 100cm intra-row spacing, and poultry manure application rates of 0 to 5 Tons per hectare in Anyigba. From this study, we established that spacing and poultry manure application interactions had no significant effect ($p>0.05$) on number of capsules and seed yield per hectare. The combination of 50cm intra-row spacing and 5 Tons per hectare of poultry manure gave the optimum capsule and seed yield in Anyigba area of Kogi State.

b). Green manure effect on cassava (*Manihotesculentum*) yield (Attah*et al.*, 2005b)

Leucaenaleucocephala and *Gliricidasepium*are two multipurpose leguminous trees that can be used in alley farming where they are planted in rows, while the food crops are planted in alley between them. Despite their advantages in cropping systems, the use of leguminous tree species as green manure sources, did not gain prominence due to availability of subsidised commercial inorganic fertilizers. However, they are now receiving attention in modern agriculture, because of increasing prices of fertilizers and the need to protect the environment from their adverse consequences. We conducted a 2-year field experiment, where the effect of three green manure application rates, (30 Tons pruning/ha each of *Leucaenaleucocephala* and *Gliricidasepium* and their mixture on 1:1 basis), and one rate of 15.15.15NPK inorganic fertilizer (300 Kg/ha) on the growth and root yield of cassava was evaluated. It was observed that the green manure materials enhanced both the growth and root yield of cassava comparable to the NPK fertilizer at the rates applied. They are therefore considered to be good substitutes for the 15.15.15 NPK fertilizer in the production of cassava, where the latter is not available or affordable.

c). Plant spacing and organic manure effect on eggplant (*Solanummelongena* L) (Attah*et al*., 2013).

Garden egg is predominantly produced under rain fed conditions and sufficient organic matter in the soil is needed to retain adequate moisture. It is expected that with increased organic manure in the soil, closer spacing of the crop would lead to increased fruit yield of eggplant. However, results from field trials showed varied responses of garden egg to organic manure rates. A study was carried out to evaluate the effect of plant spacing and organic manure rates on the growth and fruit yield of eggplant (*S. melongena* L.). Treatments consisted of all possible combinations of 60, 75 and 90cm intra-row spacing and three (3) organic manure rates (0, 3 and 6tons/ha). There was a significant interaction of spacing and organic manure for growth and yield parameters measured. The fruit yield of eggplant increased significantly with application of cow dung, and was highest at 3tons per hectare and intra-row spacing of 75cm).

3.0 Significance of Intercropping in Situations of Food Insecurity

Vice Chancellor Ma, ladies and gentlemen. Many people regard intercropping as a traditional way of growing crops which to them, cannot meet up to present day realities. This to me is a misconception because, results of field researches have shown that intercropping has a higher total productivity per unit land area and greater stability of yields and revenues, than monocropping. The benefit of this first and foremost, is that more land would be available to plant more crops and put into other productive sectors of the economy, like housing/estate or industrial development. Intercropping should rather be seen as a system, which could be used to fill the gap created by the problem of scarcity of land, as well as using it to improve household food insecurity.

Historically, there are instances where monoculture threatened the global food production that resulted in starvation of millions of people. For instance, the Irish potato famine which resulted in the death of millions of people, and more than two (2) million people emigrating to other countries was attributed to wide spread cultivation of potato monoculture, and the attack of late blight disease that caused 80% reduction of yield. Also, the great Bengal famine of 1943 in India, and Bangladesh famine of 1974 which caused over three (3) million deaths were due to a devastating disease that wiped out rice monoculture (Raseduzzaman, 2016)..

Global population is predicted to increase to around nine (9) billion by 2050, and with the changing dietary habit due to rising income, it is estimated that the global food production needs to be increased by 100-110 percent by 2050 (ACC, 2008., Abiwon., 2017). This is a major challenge facing the human race today. The question then is, how do we increase access to adequate food without depleting the non-renewable natural resources and causing environmental damage?

The phenomenal rapid increase of population and consequent pressure on food production as described above, demands greater agricultural intensification in most of the developing countries; not in terms of how much of external inputs into production, but in terms of the number of crops per unit area of land. To ensure food availability through increasing yield levels, current agricultural systems have to be resurgenced on the basis of sustainable agriculture through increased on-farm crop diversity. If such crop diversity through intercropping can be assembled properly in time and space, it can enhance the productivity of farming system over a wide range of environment, and the more the crop diversity in the farming system, the more the resilience to the environmental perturbations could be obtained, thus ultimately ensuring food security (Andrew and Kassam, 1976; Abiwon, 2017). There is no doubting the fact that current monoculture based agro ecosystems can put global food production in greater peril because, if any devastation in crop production happens, it will throw numerous people into food insecurity.

To say that intercropping is the future of the world, and especially the continent of Africa is an understatement. It is a fact that the conventional monocropping system is much easier to the large scale farmers who use heavy machineries, synthetic fertilizer and pesticides. but in Africa, there are about 33 million small scale farmers (representing 80% of cultivated farms in this continent) out of which over 85% have no access to the input markets, due to lack of financial capacity. For this category of farmers who grow different foods only to sustain themselves and their families, intercropping is the only way to ensure their food security and to maintain livelihood; no wonder, crop production in most of the western part of Africa is based on intercropping of cereals including maize, sorghum and pearl millet with cowpea. By following this intercropping system, farmers in Nigeria earned gross income over 300% more than the conventional monoculture, since their intercropping is over yielded.

Vice Chancellor Ma, ladies and gentlemen, food security is not only about the production or supply of enough food, but also supply of quality, nutritious food. The current global food system does not provide yet enough nutrition and calories to all the people of the planet, but intercropping can be an important mechanism that can guarantee the nutrition security, especially in the developing countries, as there are many indigenous vegetables that are characterized by high nutritional values comparable to the common vegetables like tomato, eggplant, cabbage etc. Among the indigenous vegetables, moringa (*Moringaoleifera*) is highly nutritious and widely cultivated by indigenous people in most of the tropical region of Asia, Latin America and Africa. In most of the regions, moringa is intercropped with a wide range of vegetables such as cluster bean, hot pepper, cowpea and onion. The leaves and twigs are used as livestock feed and the fruits are used as human food.

In Nigeria and most African countries, most of the rural farmers intercrop cereals with legumes and vegetable crops (pumpkins, cucumber and water melon) with a focus on nutritional and livelihood benefits (Attah*et al.*, 2009). Intercropping is of special relevance and importance in future organic farming systems, because it offers a number of significant enhancements of both the net productivity of organic farming and the ecosystems in farming regions as a result of the increased diversity of the cropping system. Organic farming is a steadily increasing production form in European agriculture. It is environmental friendly, due to low input of nutrients and no use of pesticides, and it contributes to the production of food without pesticides and antibiotic residues.

A further expansion of organic farming is needed to meet consumers worldwide having an increasing demand for products, which are healthy, safe, and of high quality and produced with consideration for animal welfare and the environment. European organic farming and research within this area are in the forefront internationally and offers the opportunity of a food production, which could strengthen the competitiveness of EU agriculture.

3.1 Intercropping Practices that Worked: Lessons of experience

i) The Machobane Farming System (MFS) in Lesotho:

In Lesotho, Southern Africa, the Machobane farming system (MFS) is an example of a redesigned intercropping system that produces multi-functional benefits **(**Thayamini and Brintha 2010). This farming system was developed in the 50s to increase productivity in the small scale farms in low mountain areas of Lesotho based on simple, low input intercropping technique and localized application of farm-yard manure and ash, and incorporating potato as cash crop in intercropping. Intercropping in this system consists of alternate rows of cereal or tuber crop with legume and vegetables. During April-May months of the year, farmers plant wheat, pea and potatoes (the MFS cash-crops) as intercropping to be harvested in following January-March, and during summer season (August to October), they intercropped maize, beans, sorghum, groundnut and possibly pumpkins and water melons to be harvested in November-December. Thus this practice ensures food supply to the household all the year round. Crop residues are left in the field for nutrient cycling and the field is ploughed once in every five years. By incorporating pumpkin in intercropping, pest incidence is reduced, thus discouraging the chemical pesticides application.

Due to the three times more productivity in MFS compared to the conventional monocropping system in this country, it is reported that MFS practices in 0.4 ha (1 acre) of land is sufficient to ensure the food security of an average family of 5 members, whereas 1.2 ha of land is required in conventional system. Besides the higher yield, due to year round production activities, MFS also has the ability to reduce soil erosion, conserve soil moisture and suppress weeds. Crop diversity in MFS makes it more drought resistance and these fields are green compared to the non-Machobane fields during drought periods.

It is also on record that between 2001 and 2005, when national yield was dramatically decreased due to severe drought, yields in the low mountain areas where the MFS was practised were quite high. For instance, maize yield was 14% high, sorghum yield, 63%, bean yield, 61% and potato yield was 294% high. Moreover, the farmers' income fluctuation over the year was substantially reduced due to low yield fluctuation of the individual crops, spreading the risk of fluctuation of yield and income among the diversified crops, and reduced dependency on external inputs like fertilizer and pesticides.

ii) Maize-Beans-Squash intercrops (milpa) in Latin America

Like in Africa, intercropping of staple crops is much popular in Latin America. More than 40% of cassava, 60% of the maize, and 80% of the beans in that region are grown in intercropping system (Francis, 1986). In this intercropping system, the productivity in terms of harvestable products per unit area is 20%-60% higher than the monocropping system.

In Mexico and Guatemala, milpa (intercropping of maize with beans, squash and other useful herbs primarily for direct household consumption) is considered as the foundation of food security for many rural communities. Intercropping of maize, beans and squash on 1 ha of land produced as much food as obtained from 1.73 ha of monocrop (Gliessman, 1998). In addition, this maize-beans-squash intercrops produced more than 4 t/ha dry matter that goes back to the soil, compared with 2 t/ha dry matter in maize monocrop. In Guatemala, 99% of the peasants considered this practice as the basic source of their family food security and livelihood.

iii) Multiple cropping in Asia

A study showed that intercropping system increased the farmers' income by 92% in Bangladesh, 83% in Nepal, and 74% in India compared to the income under monocropping (Jodha, 1979). In china, one third of total cultivated land area is used for intercropping dominated by multiple cropping and half of the total country production comes from this multiple cropping (Krantz, 1979). In Gansu province of northern China, farmers follow wheat-maize and wheat-soybean intercropping system, where wheat is 74% over yielded in wheat-maize intercrop and 53% over yielded in wheat-soybean intercrop than conventional wheat production. Yield advantages as the ones reported here are a true breakthrough for achieving food security and decent livelihood among the resource poor small-scale and subsistence farmers isolated from mainstream agricultural institutions.

iv) Perennial intercropping

Besides the annual intercropping, perennial intercropping is also a common practice in most of the tropical developing countries where mixtures of tree/fruit crops arable crops, especially at establishment stage are visible. This perennial intercropping also plays a significant role in development of smallholder's livelihood.

In Sri Lanka for example, rubber production is a traditional practice among the smallholders. More than 60% of smallholder rubber growers are fully dependent on rubber production to maintain their livelihood and to meet daily living expenses. But this sole rubber production is not enough for their subsistence. Moreover during immature stage of the plantation, farmers have no income from it, which can exist for six years or more. To overcome this problem, farmers intercrop banana in immature rubber garden to compensate the cash income. The practice of intercropping banana in rubber garden can improve the growth of both immature and mature rubber, resulting in earlier exploitation of latex. Thus rubber-banana intercropping have several advantages to the smallholder rubber growers in the region: the improved growth of rubbers reduces the length of unproductive immature period that helps the farmers to get early income, while additional income is obtained from intercrop banana and increased latex yield.

In Papua New Guinea, since 1970, due to rapid population growth, cultivable land of oil palm smallholders decreased dramatically, and due to the shortage of cultivable land area, it became difficult to maintain household food security and livelihood. From the beginning of 1990s, smallholder farmers started intercropping immature oil palm with food crops such as sweet potato, taro, yams, cassava and banana, and ensure their year round income. Through this crop intensification, smallholders have been able to reduce the requirement of per capita garden area from 0.06 to 0.04 hectare **(**Gliesman, 1998).

4.0 The Nigeria Crop Sector: So far so good?

The Nigerian economy had and still has agriculture as the dominant sector. According to Oyewole (2019), 82 million hectares of land of about 91 million hectares is arable, with about 42 percent put into agricultural production. Much of the 82 million hectares is said to be under the bush fallow, where land is left idle for varying period of time to allow for natural regeneration of soil fertility, while 18 million hectares have been classified as permanent pasture but with the potential to support crop production.

Indeed, Nigeria can benefit from the potentials that agriculture offers with the right attitude when fully developed. Nigeria is blessed with good fertile land and climatic conditions that support the cultivation of staple food crops like cassava, yam, sweet potato, corn, cocoyam, beans, cowpeas, millet, sorghum, and a great variety of fruits and vegetables, as well as livestock production (George and Jeruto, 2010).

History they say is the best teacher. Since we are considering Nigeria's crop sector, it is important to peep into the pre and post oil era of our development. It is on record that prior to the oil boom in Nigeria, agricultural sector contributed about 80 per cent of trade in value and more than 50 per cent of industrial raw materials. In the 50s and early 60s, Nigeria did not have to contend with the problem of food insecurity. The country was able to feed her population and at the same time export food items to other countries. It was then possible to identify the regions of the country with the production of one or two major crops, whether food or cash crops, and together the country was relatively self-sufficient in food production and utilization. For instance, there was the groundnut pyramid in the North, the cocoa in the West, oil palm and kernel heaps in the East and the rubber plantations in the Midwest.

However, agricultural sectorial growth has remained rather static in recent times. When oil was discovered in 1956, and exportation of it started in 1958, interest in agriculture waned and agricultural productivity drastically declined; the country blessed as it is, with abundant agro ecological resources and diversity became a major importer of staple foods which hitherto were produced locally in sub-Saharan Africa. Worthy of mention is the fact that, the price of rice which is a common staple in most homes increased by over 100 percent. It is instructive to note also that during this period, Nigeria required 2.5 million metric tons of rice annually, while local rice production was less than half a million metric tons per year. With these figures, Nigeria was short of two million tons of rice which it had to source from other countries. The story was the same for other crops. In 2008, it was estimated that Nigeria spent a whopping S2 billion dollars to import about six million tons of wheat, S750 million on rice, S700 million on sugars and S500 million on milk and other dairy products (Adesina, 2012).

4.1 Policy based Intervention Programmes of governments:

It is worthy of note that there were efforts and strategies by successive governments to address the acute food situations in the country, all which did not achieve the much desired improved agricultural practices and food production for the citizenry. Among these strategies were:

1. National Accelerated Food Production Programme (NAFPP): This programme was planned in the early 1960 by

governments to extend the production of target grain crops like maize, rice, guinea corn, millet, wheat, cassava and cowpea. These target crops are actually the major staples of Nigeria. It was therefore envisaged that if produced in large quantities will reduce hunger and other related food crises, while enhancing the farmers income. The programme was to be executed through the introduction of high yielding varieties of crops, use of proper fertiliser and allocation of credit facilities as well as creation of marketing outlets for the farmers.

2. Operation Feed the Nation: This was strategized in 1976 to address three major issues namely: the food crises, rural-urban migration and the huge food importation bill. The aim of the programme was to stimulate the general public to actively engage in agricultural production. Under this programme, government provided farmers with subsidized inputs, increased bank credits to farmers, established a commodity board and fixed prices of agricultural produce.
3. Green Revolution Programme (GRP): The programme was introduced in 1979 to replace Operation Feed the Nation Programme and was meant to bring a complete change in the Nigerian agricultural production. Under the programme, farmers received incentives to produce above the subsistence level.

There were also agency based intervention programmes that included the following:

1. Rivers Basin Development Authority (RBDA, 1973): The programme aimed to harness the abundant water resources of the country for increased agricultural productivity due to the stochastic rainfall pattern in most part of the country which has limited production to just single cropping all year round. Under the programme, irrigation facilities wer established across the designated river basins to encourage all year round cropping, thus putting more lands into cultivation

2. Agricultural Development Authority (ADP, 1976): This strategy was to integrate agriculture and rural development by providing infrastructure like good roads, schools, water supply and skills in all areas of agriculture to farmers in the rural areas. If it had worked, it would have stern the tide of rural-urban migration, reduced unemployment and increased food production. Alas, it failed.
3. National Agricultural Land Development Authority (NALDA, 1978)): It was saddled with the responsibility of reducing the problems of low utilisation of farmlands thereby increasing food production through farmland expansions. The agency was able to develop 16,000 hectares of farmlands, out of which 12,984 (81.1%) was cultivated with different crops (CBN, 1998).
4. The Directorate of Food, Roads, and Rural Infrastructure (DFRRI, 1987): This was established in 1987 to help solve the problem of under development in the rural areas of the country. DFRRI provided to some extent, accessible roads and some basic amenities for comfortable living in the rural areas. The programme hinged on the belief that the economic future of the country depended on the level of development of its rural areas. Again, the program did not last the test of time. Apart from the afore-mentioned, there was the National Fadama Development Project of 1993 and many more very recently.

4.2 Challenges of Agricultural Development in Nigeria

Ladies and gentlemen, we are all witnesses to the fact that all of the above mentioned programmes failed, because there were poorly managed. A number of challenges have been identified as inhibiting effectiveness of agricultural policies and strategies in the country. These include:

1. Unstable and inconsistent policies: There is no continuity in policy implementation in the country. New policies are initiated and old ones (whether good or bad) are disregarded as soon as there is a change in government. Moreover, there

is neglect and lack of tangible government's support in the form of political will to drive agricultural policies. This is evidenced in the low budgetary allocations and mismanagement of funds meant for agriculture by people in higher authorities. Regrettably, majority of farm workers who are small scale farmers are never consulted on policies that affect agriculture; the issue of land tenure and usage has remained pervasive (Idachaba, 2004).

2. Poor educational background of peasant farmers. This is a constraint to acquisition and adoption of modern technologies. Most of Nigeria's farming still takes place on small plots of land (a few hectares in size) by small holder farmers, who use traditional manual methods of farming, with little money to invest in fertilizer, irrigation or equipment. These farmers incidentally account for around 90% of the agricultural output in Nigeria. They are unable to produce enough food to feed Nigeria's huge, ever growing population as well as provide the much needed raw materials for the industries. The deficiency in the delivery of farm inputs is a major challenge. Low usage of agrochemicals like fertilizer greatly hampers production. It is estimated that the current use of fertilizer on crop farms is about 1,000,000 metric tonnes per annum, while the projected demand estimate is 3.7 million metric tonnes (Mustapha, 2016; Abiwon, 2017). At the end of the day, farmers are poorly remunerated for their products due to the activities of middlemen.
3. Unwillingness of young men to take to farming: Agriculture and indeed crop production in Nigeria is regarded as a vocation for the illiterates and rural dwellers who have nothing better to do. As a result, there are more young men and women graduates of agriculture in towns and cities looking for white collar jobs than are in the rural areas, willing to go into agriculture (Abiwon, 2017)
4. Corruption and associated practices: Funds meant for agricultural development are often diverted by public

officers. Also, agricultural inputs (fertilisers, agrochemicals, and farm machines etc) are grossly inadequate, and when available, those who get them are not farmers.

5. Climate change: Drought is a major driver of food insecurity, and contributes to a negative impact on nutrition. It is noteworthy that Nigeria's agriculture is mainly rain fed. Although the country has the potential to irrigate about 2.5 million hectares of arable land, it has not taken full advantage of this potential; only about 220,000 hectares or less than one percent of the total land area under crops is being irrigated. In contrast to drought, excess rain and flooding have also contributed significantly to the current food insecurity. In many riverine states, farmlands are submerged yearly, destroying yams, cassava, maize, vegetables and sugarcane farms. The monetary estimates of losses as a result are very staggering (Adesina, 2012., Sadiq, 2013., Isaac and Francis, 2019)

Vice Chancellor Ma, ladies and gentlemen, whether we agree or not, majority of Nigerians (about 65 percent) are food insecure, and it is something to worry about. Indeed, the global Index of Hunger, recently ranked Nigeria as the 20^{th} poverty stricken nation on earth. This calls for cautious efforts by all and sundry for increased food production, especially those of plant origin.

5.0 Conclusion:

Vice Chancellor Ma, the pressure of an increasing population is understood to cause increasing food demands by urban consumers and rural dwellers. It also causes the expansion of areas of cultivation, reduced fallow intervals with lack of inputs necessary to compensate, and as a result, reduced soil fertility. Expectedly, per capita and per hectare yields will decline and food will become scarce, especially for those in rural areas. The good news however is that, it is possible that an increase in population density may in fact have positive rather than negative consequences for the economy as well as the environment. This is a situation where intensification of agricultural practices takes place without the typically associated degradation. In this case, while there may exist poverty as well as people without sufficient food, there may not be a decline in crop yields due to the sustained effort of farmers to increase the production of food in an attempt to keep up with the increasing demands.

Agricultural systems (whether multi or mono cropping) must provide advantages over other available options in the eyes of the practitioners to gain acceptance. This is because, many of the impediments to adoption of new strategies or practices of diversification are sociological rather than technological.

Intercropping has been important in many countries and continues to be an important practice in developing nations. In traditional systems, intercropping evolved through many centuries of trials and error. To have persisted despite negative perceptions and much neglect, intercropping had to have merit biologically, environmentally, economically, and sociologically.

Farmers have generally regarded intercropping as a technique that reduces risks in crop production; if one crop fails, the other survives and compensates in yield to some extent, allowing the farmer an acceptable harvest. By intercropping, farmers are controlling weeds, eliminating pests, thwarting diseases and conditioning the soil. On the other hand, monocultures, encourage weeds, invite pests, breed diseases, damage the soil and rely on one crop for livelihood.

6.0 Recommendations:

a. Agriculture should be made more interesting and productive by consciously investing in the land, technology and the human elements that drive innovations in agriculture, especially at the level of the peasant farmers who constitute about 90% of the labour force in the sector, and produce the bulk of what is consumed in this country.

b. In pursuance of 1 above, Government should as a matter of priority, re-establish the commodity boards to serve as sales point for the farmers' produce. This way, the activities of middlemen will be greatly reduced, if not eliminated in the country and farmers will get fair share of their labour.
c. There should be deliberate diversification of crop intensification in small-scale production to increase yield levels and improve the nutrition status of the people. If such crop diversity through intercropping can be assembled properly in time and space, it can enhance the productivity of farming system over a wide range of environment.
d. Participation of the youths in agricultural activities should be encouraged. A lot of young people see agriculture as tiresome and a profession that gets their hands dirty. With mechanisation and intensification, more people will be attracted into the sector. This will help to reduce the problem of ageing farm workers, youth unemployment, increased food production and increased foreign exchange earnings from exports.
e. Government and other interest groups (States and Federal Ministries of Agriculture, Non-governmental Organisations, Universities, and the National Universities Commission etc) should support the training and empowerment of people who are genuinely interested in agriculture, to be future farmers in Nigeria. In doing this, our Universities and Faculties of Agriculture should set up agricultural enterprises that are business and profit oriented, and our students engaged as workers in the course of their studies.

7.0 Acknowledgement

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you as I keep building on the legacies you left behind; may your souls rest in perfect peace (Amen).

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I am most grateful to Dr ChuchuGeogory, of the Chisinau State Agricultural University in the former Soviet Union, who supervised my postgraduate work at the Masters level. He nurtured me in my early years in the University and taught me how to be a hardworking academic. In those years, I worked closely with him in his private office and learned from him how stimulating learning and research can be. I recall when I completed my MSc studies in 1987, he encouraged me to remain for my PhD studies, but I was not persuaded. The reason was that I had stayed long enough in a foreign land and it was time for me to return home, so I thought. That decision was a mistake because I realised later in life that to remain relevant in academics, I needed a doctorate degree which I eventually got after I enrolled for my PhD candidature at the Federal University of Agriculture Makurdi in 1996. That is why I am most grateful to Prof. B. A. Kalu, Prof. S. Adeyemo and Dr. S. A. Ayuba of blessed memory (May His Soul Rest in Peace) of the University of Agriculture Makurdi, who made my dream of a doctorate degree come through, through their selfless academic advice and providing the much needed moral and logistic supports when all was not well in the Nigerian educational system.

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CITATION ONPROFESSOR ENEJO SIMON ATTAH, MSC. (CHISINAU USSR), PHD. (FUAM), THE 12TH INAUGURAL LECTURER OF PRINCE ABUBAKAR AUDU UNIVERSITY, ANYIGBA.

Early life and education

Professor Eneojo Simon Attah was born a second child of late Mr Simon Ochalifu Attah and Mrs Rachael Attah (Knee Ochimana) at Ugwolawo, in Ofu Local Government Area (LGA) in the present day Kogi State. He had his primary education at the LGEA Primary School, Ugwolawo. Thereafter, he proceeded to Ochaja Secondary School Ochaja, in Dekina LGA for post primary (secondary) education in 1973. Throughout his stay at Ochaja, he maintained very high academic and moral standards until he graduated with a Division I certificate in the West African School Certificate (WASC) examinations, in 1977.

In 1978, he was admitted to do a Higher National Diploma course in metallurgy at Idah College of Technology, now Federal Polytechnic, Idah. Professor Attah was there for just three (3) months when he received another admission letter to Murtala College of Arts, Science and Technology (MUCAST) in Makurdi for basic studies, preparatory for admission into the University. He left Makurdi in 1981 for the former Soviet Union (USSR) where he studied Irrigation Agronomy for his Master's degree. He returned to Nigeria in 1987 and was posted to Ondo State for his National Youth Service where he worked in the Directorate of Food, Roads and Rural Infrastructure (DFRRI)

Career and work-life

After the mandatory National Youth Service, Prof. Attah secured appointment with the Benue State Local Government Service Commission in 1988 and worked as Agricultural officer I (Idah LGA,1988), Ofu LGA (1988), Dekina LGA (1989) and andOturkpo LGA (1990). He moved to the Federal University of Agriculture Makurdi (FUAM) in 1991 and worked to begin his academic career as an Assistant Research Fellow in the Centre for Food and Agricultural Strategies (CEFAS). He rose through the ranks to become a Research Fellow I in 2002. While there at the University of Agriculture Makurdi, he enrolled for his PhD candidature, and obtained a doctorate degree (PhD, Crop Production) in 2002.

Prof. Attah transferred his services to Prince Abubakar Audu University, formerly Kogi State University, Anyigba on 25th November 2005 as a Senior Lecturer. He became a Reader and Professor of Crop Production in 2009 and 2013, respectively. He has published several journal articles, books and chapters in books. His articles have appeared in local and international journals of crop and related sciences.

Administrative, public and community service

Prof. Attah has served in several committees and academic boards at the Federal University of Agriculture, Makurdi and Prince Abubakar Audu University, Anyigba including membership of Board of Faculties and School of Postgraduate Studies. Concurrently, He served as the Prince Abubakar Audu University Students Industrial Work Experience Scheme (SIWES) Coordinator and Head, Department of Crop Production for eight years (2008 - 2016). He was also elected Dean, Faculty of Agriculture for two consecutive terms (April 2019- May 2021) and (June 2021 - 1st June 2023), respectively. He is currently a member of Senate, Prince Abubakar Audu University, Anyigba.

Family life

Prof. Attah is married to Mrs Felicia Alewo Attah and they are blessed with four children namely: Isaac Ileanwa Attah, Augustine Triumph Attah, Loveth Ladi Attah and Victor Ojochegbe Attah.