

**UNIVERSITY OF ILORIN**



**THE NINETY-FOURTH  
INAUGURAL LECTURE**

**MAN, MACHINE AND FOOD  
INSECURITY**

**By**

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My Lords, Spiritual ad Temporal,  
Distinguished Invited Guests,  
Gentlemen of the Print and Electronic Media,  
Great Unilorites,  
Ladies and Gentlemen.

### **Introduction**

Mr. Vice-Chancellor Sir, it is my humble desire, at this meeting of town and gown, to take a cursory look at the Nigerian agriculture and find out why a nation with so much natural endowment and abundant human resources should be lagging behind in technological advancement needed to transform its agriculture to feed its teeming population. It is my desire to probe into why in a country that realises about N2.4 billion per day from the sale of its crude oil, and an abundant agricultural potential will still have millions of its citizens going to bed hungry. It is my desire to further probe into why a value chain cannot be created to minimize harvesting and processing losses of that which is being produced and convert it to wealth. It is

indeed my desire to bring to the fore the encumbrances to growing agribusiness and agro-industries that can impact positively on the Nigerian economy.

Perhaps, Mr. Vice-Chancellor, we shall at the end of this lecture be able to comprehend the limitations to creating the desired agricultural revolution through technological revolution that could bring about the much desired industrial revolution needed to grow our country's economy, and as well make the nation self-sufficient in food and fibre production.

### **Food, Hunger and Man's Wants**

Ever since pre-historic period, man's hunger drive has been basic to his existence since food determines his survival. Throughout the ages, man ate what he could get, with little understanding of how the food he ate differed. History, therefore, is a record of the progress of man's existence, his endeavours, his work, his ideas, his visions, his failures, and, indeed, his achievements (Lowenger et al., 1968).

During the golden age of science (about the 17<sup>th</sup> century), the Greeks and the Romans used knowledge of food in the treatment of diseases, even with little understanding of which foods were really helpful.

In essence, the early man was a food gatherer, spending all his life searching for food as evident from pre-historic man's record obtained from fossil animal remains found in his cave. With increasing population, food became scarce, hence want took over. Hunger forced man to invent traps and snares to capture animals for food. Plants also formed part of man's diet as evident from drawings in his cave. Grains and flour 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.

About 8000 B.C., man's greatest discovery was recorded. That is, seeds dropped in the ground could yield a harvest a few months later, marking the beginning of agriculture in the form of mixed farming. Thus man progressed from being a food gatherer to a food producer. Undoubtedly, this could very well be the beginning of human civilization. Most of the present day foods were contributions of the early man who learned by trial and error to avoid poisonous plants. When he erroneously consumed such, he paid dearly by sickness or even death. He was then the experimental animal or the guinea pig.

From 8000 B.C. to about 6000 B.C., gardens were cultivated along the shores of the Caspian Sea, the Iranian Plateau, and along the Indus River to the Nile Delta, marking the beginning of Fertile Crescent. Civilization as was then conceived dependent on man's ability to produce food efficiently. Cereals commonly produced at the Fertile Crescent included barley, rye, rice, oats, wheat and millet. These were followed by such vegetables as cucumber, egg plant, 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. The decadence of ancient civilization was largely due to inadequacy of man's tools to supply man's needs. *Food was never available without work nor abundant food without machines.*

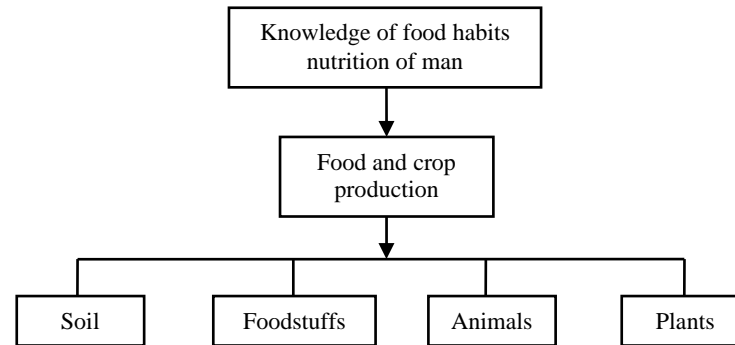


Figure 1. Schematics showing interrelationship of man to environment.

### **Hunger, Poverty and Food Insecurity**

*Hunger* is defined as the uneasy and painful sensation caused by a lack of food, and the recurrent and involuntary lack of access to food. Put in another way, hunger is the want or scarcity of food in a country. When aggregated to the world level, it becomes world hunger.

Between 1990 and 1992, the estimated undernourished people were 824 million. In 2009, an estimated 1.02 billion people were said to be undernourished. The World Food Summit target set in 1996 was to half the number of undernourished people by 2015, but the number has been increasing annually by 4 million malnourished people such that in 2010 the number of hungry people in the world was estimated at 925 million; nearly all were in developing countries where there is neglect of agriculture, significant increase in food prices and worldwide economic crisis as shown in Figure 2 (FAO, 2009; 2011). The scenario suggests a failure in realising the set target.

Ban Ki-Moon, the Secretary General of the United Nations, referred to hunger as a weapon of mass destruction. A member

of the Nigerian House of Representatives was quoted to have stated in 2005 that:

people are dying and hunger is simply unbearable. We need to tell ourselves the truth, there is hunger in the land. Our people go to bed with empty stomach.

(TELL Magazine, August 22, 2005:23)

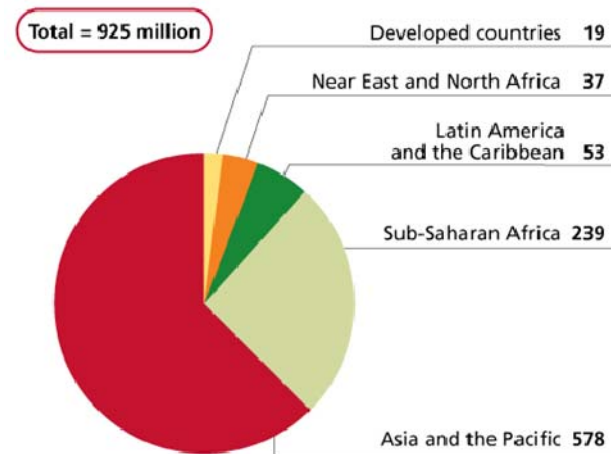


Figure 2. World hunger statistics (WHES, 2011)

The global population, according to a report (The Guardian Newspapers, March 25, 2010), will likely reach 9.0 billion by year 2050, mostly contributed by developing countries, with urban population increasing from the present 3.4 billion to 6.0 billion. The World Bank estimated in 2005 that 1.4 billion people were already living in poverty, with another 100 million people joining this rank of hungry people following the 2007 world food price increase. Hence, the Millennium Development Goal (MDG) of reducing world's hungry people by 2015 may

not be realised as a result of a steady decline in policy attention to agricultural and rural development.

Other problems militating against achieving this goal are climate change, energy crunch, financial crisis, economic uncertainty, population growth, environmental degradation and a shift in consumption pattern in emerging economies of the world. There is therefore an urgent need to transform Agricultural Research for Development in order to reach and stimulate small-scale farmers; making food production more sustainable and the system most resilient to climate and energy shocks.

*Poverty* is the principal cause of hunger. Hunger is also a cause of poverty by causing poor health, low levels of energy and mental impairment. Hence hunger limits people's ability to work and learn. In 1981, an estimated 1900 million people were said to be living in extreme poverty worldwide. Conflict is a cause of hunger and poverty; harmful economic systems are principal causes of hunger and poverty; and, climate change is also a cause of hunger and poverty. Oloyede (2011) stated that hunger and poverty are inseparable because people that are poor are people that are most often hungry.

Poverty in Nigeria is rated as absolute poverty for lack of any form of social security in place; no safety net of any sort. The incidence of poverty in Nigeria compares quite favourably with several other African countries that are not even as blessed with the kind of natural endowment that Nigeria has. The incidence of poverty in Nigeria was in 1997 put at 70 per cent, the same year that Vision 2010 established for Nigeria a poverty line of N3,290 per capita (Ifeanacho et al., 2009). Although poor people are to be found in urban areas, the incidence of poverty is more dominant in rural Nigeria.

Poverty in Northern Nigeria for example comes in different dimensions. Iwuagwu (2008) reported that poverty in some States in Northern Nigeria is as high as 95 per cent, a figure that is too high in the 21<sup>st</sup> century. Iwuagwu further gave the poverty incidence of some states in the North as depicted graphically in Figure 3.

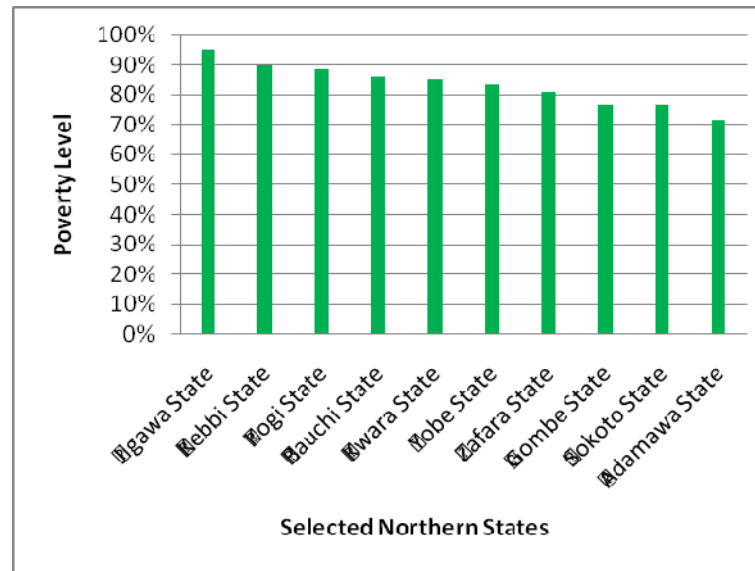


Fig. 3: Poverty Level of Selected States in Northern Nigeria

The National Economic Empowerment (NEEDS, 2004) document stated that “though revenues from crude oil have been increasing over the past decades, our people have been falling deeper and deeper into poverty. In 1980, an estimated 27 per cent of Nigerians lived in poverty. By 1999, about 70 per cent of the population had income less than US\$1.0 a day and the figure has been rising since then”.

The above situation is said to contrast what obtained in Saudi

Arabia, Iraq, Indonesia, United Arab Emirate and Kuwait which are all members of Organization of Petroleum Exporting Countries (OPEC) where per capita income averaged US\$2,000 or more (TELL Magazine, August 22, 2005:25).

Poverty index is defined for people living below the international poverty line of US\$1.25 per day which fell from 1.82 billion in 1980 to 1.37 billion in 2005. One-third of global poverty resides in India while one-quarter is located in sub-Saharan Africa (SSA). Extreme poverty in sub-Saharan Africa fell slightly from 58 per cent in 1990 to 51 per cent in 2005 (Table 1). The wealth of the new millennium tends to exacerbate incidence of urban poverty. The United Nations Development Programme (UNDP) reported in 2005 that the richest 500 people in the world earned more than the poorest 416 million people.

Poverty is inextricably linked with disappointing progress in agriculture in developing countries.

Table 1. Poverty incidence in the selected regions of the world.

Region	%US\$1.25 a day Poverty	Population (million)
East Asia and the Pacific	16.8	1,884
Latin America and the Caribbean	8.2	550
South Asia	40.4	1,476
Sub-Saharan Africa	50.9	763
Total Developing Countries	28.8	4,673
Europe and Central Asia	0.04	473
Middle East and North Africa	0.04	305
Total		5451

Source: World Hunger Education Service (WHES), 2011.

*Food insecurity*, on the other hand is the limited or uncertain availability of nutritionally adequate and safe foods, or the limited or uncertain ability to acquire acceptable foods in a socially acceptable way. The opposite of food insecurity is food security.

Food insecurity was a topical issue discussed at the World Food Summit held in Rome in 1996. A nation is said to be food secure when their food system operates in a way that removes fear that there will not be enough food to eat.

A survey conducted between 2002 and 2004 showed that about 11 per cent of USA households were food insecure while only 4 per cent were food insecure with hunger (MCH, 2006).

The International Federation of Red Cross and Red Crescent Societies, in their year 2000 special focus on health, defined food security as existing when all people at all times have physical and economical access to sufficient, safe and nutritious food for a healthy and active life. These organizations have been responding to food insecurity in Africa since the major famine of the mid-1980s. Hence, food security became a committed strategy at the Pan African Conference held in Ouagadougou in September 2006. The organizations opined that food insecurity was directly linked to such other root causes as poverty, HIV/AIDS pandemic, worsening debt crisis and global armed conflict.

The impact of global food crisis is potentially politically explosive, particularly in developing countries. This brings to mind the resulting riots in parts of the eastern and southern Africa due to scarcity and/or increase in prices of maize and bread in the last decade (Collier, 2008). The world food prices jumped 83 per cent in 2005 resulting by 2008 in global economic crisis.

In rural Africa, the subsistence farmers are, by and large, food sufficient selling and buying food needs at unregulated rural markets which are shielded against global markets. However, the urban poor living in crowded slumps spend about 60 to 70 per cent of their meagre income on food purchased from integrated urban markets where prices are highly regulated, with severely regressive effects on their income.

Collier affirmed that in Africa, policies that promote scientific and commercial agriculture must be promoted much against promotion of small-scale farming. Global food crisis must be rapidly brought down through increased world food supply. Innovative commercial agriculture is the way forward since food imports are projected to double over the next 25 years, more so as innovation is hard to generate through peasant farming. The encumbrances or limitations have to be removed. These include land ownership, energy demand and political challenges.

Oriola (2009), in agreeing with the submission of Akanmidu (2004) on the ethical and political dimension of poverty stated that “achieving food security and reducing poverty is not an issue of right policies or right programmes, rather that of a strong political will and absolute patriotism on the part of the people at the helm of affairs, who are to implement the policies and execute the programmes”. He defined poverty on the basis of income level. He asserted that majority of Nigerians do not have access to the quantity and quality of food needed for healthy living and are therefore living below poverty line.

World Bank (2003) reported that over 60 per cent of Nigerians were living below poverty line of US\$1.0 per day. Oguntola (2008) in Oriola (2009) reported that Nigeria ranked 20 on the 2006 Global Hunger Index (GHI). Similarly, the nation ranked 152<sup>nd</sup> out of 175 countries on Human Development Index

(HDI) which is a measure of the nation's access to basic social services, further attesting to the food insecurity situation and hence poverty level of the country.

Bishop Oyedepo, Chancellor of the newly approved Landmark University, OmuAran, at the commissioning of the university stated that “no country can achieve sustainable economic growth if it cannot guarantee food security for its citizenry, as agriculture revolution is the springboard for industrial revival”. He stated further that Nigeria cannot continue to rely on imported foods if it truly wanted to revolutionize its industrial sector.

According to Bishop Oyedepo, the incontrovertible contribution of agriculture to industrial revolution in the United States of America was the ever-increasing need for more and better farm machinery.

Bishop Oyedepo further stated that:

our poor rating in technological development cannot be dissociated from our straying away from technological and industrial revolution, which is through an agricultural revolution.

### **Food Insecurity and Climate Change**

The effects of climate change on food insecurity have in recent times become topical discourse. Agriculture and climate change are uniquely interrelated, viz: agriculture is a victim of climate change. Agriculture is the most important source of greenhouse gas emission contributing more than any other industry to global warming. Climate change affects agriculture in a number of ways. Carbon dioxide is a plant fertilizer which acts to stimulate plant growth (von Witzke, 2008).

Bio-energy production, unless otherwise from manure and/or straw or based on sugar cane production, has to be subsidized

to stimulate domestic production in order to diversify energy sources. Growing bio-energy production allocates agricultural land and other inputs away from food production. Hence, price of food rises further, further aggravating the global problem of hunger and malnutrition. It also acts to increase incentive for the rural poor of developing countries to burn forests to claim additional land for food production. Thus negating the very essence (environmental effects) of increased bio-energy production.

Currently, deforestation is the second most important source of greenhouse gas emission in the world, contributing about 18 per cent to the anthropogenic global warming. About 14 per cent results from farming at the present scale of hectareage, thus making agriculture by far the single most important source of greenhouse emission. This may not be discountenanced in any climate policy. Hence, it becomes obvious that there is need for agricultural climate policy. Tropical and sub-tropical regions' agricultural production will suffer most due to continued global warming, the regions where hunger and malnutrition are already prevalent, thus exacerbating food imports.

Whatever the approach or instrument employed for the reduction of agricultural greenhouse emission, food production will become more expensive thus reducing global supply of food, and thus contributing to even higher food prices. With such a major source of greenhouse gas emission as agriculture, an absence of agricultural climate policy will also act to increase food prices because global warming will be more pronounced, and therefore food production will decline. In essence, agricultural climate policy will increase food insecurity globally; but no climate policy will also do the same. This indeed is a paradox!

Joaquim Alberto Chissano, the former President of the

Republic of Mozambique, in his contribution to the CABI Global Summit in 2009 stated that there was need to devise new approaches or strategies in order to create conditions to avoid predictable catastrophe that humanity may face in the coming years when 9 billion people would be yearning for food in quantity and in quality. He stated further that the efforts of small-holder farmers must be supported by the efforts of commercial farmers who should also master more and more the methods and techniques to increase production and quality of products while preserving or improving the quality of the soil being utilized.

Climate change also contributes to soil degradation through erosion, increased salination and desertification, thus decreasing amount of land available for agricultural activities.

As at 2007, Chissano claimed that more than half of the world population (approximately 3.3 billion) lived in urban areas. Hence, any disruption to farm food supplies may precipitate a uniquely urban food crisis in relatively short time.

### **Agricultural Mechanization and the Nigerian Agriculture**

The Nigerian economy has agriculture as the dominant sector generating up to 50 per cent of the nation's gross domestic product (GDP). Prior to the oil boom, agricultural sector contributed about 80 per cent of trade in value and more than 50 per cent of industrial raw materials.

However, agricultural sectorial growth has remained rather static in recent times. Yield of cereals, maize in particular, is about one-third of that achieved in Asia and Latin America (Table 2). The level of mechanization makes the difference. Asia and Latin America have success stories to tell on mechanization, particularly in the use of draught animals and tractors as sources of power.

In sub-Saharan Africa, there were, in 1980, only 2 tractors per 1000 hectares whereas Asia and Latin America had 7.8 tractors. In 2003, the number for sub-Saharan Africa shrunk to 1.3 tractors while that for Asia and Latin America increased to 14.9 tractors. In 1960, Kenya, Uganda and Tanzania each had more tractors in use than India. However, by 2005, India had 100 times more tractors than all the three countries combined! The situation in the sub-Saharan Africa in the last decade has become quite worrisome. Human muscle remains the greatest source of power on the farm. The above scenario probably explains why some development practitioners believe that farming conditions in sub-Saharan Africa do not justify investment in mechanization (FAO and UNIDO, 2008).

Table 2. Performance of agricultural activities in selected regions.

Region	Cereal yield kg/ha	Fertilizer use kg/ha	Irrigation % of arable land	Tractors per 1000ha
Africa*	1,040	13	5	28
Ave. of 9 selected countries**	3,348	208	38	241

Source: FAO and UNIDO (2008)

\* Africa less Egypt and Mauritius

\*\* Bangladesh, Brazil, China, India, Pakistan, Philippines, Republic of Korea, Thailand, Vietnam.

### **Handhoe Farming in Nigeria**

Between 1997 and 1999, seventy per cent of farm activities in the West African sub-region was by human muscle using traditional hand tools, while the use of draught animals

accounted for 22 per cent and the use of tractors a mere 8 per cent. This contrasted observations in Northern Nigeria where the percentages were 86 per cent for human muscle, 6 per cent for animal draught power and 8 per cent for tractor, respectively. Although Southern Nigeria has no history of draught animal farming, the other two percentages can very well be projected for the whole country about this time. This scenario is slightly different for Central Africa where the percentages for the same period were 85 per cent for human power, 11 per cent for animal draught power and 4 per cent for tractor power respectively. In Southern Africa, these ratios were 54 per cent for human muscle, 21 per cent for animal draught power and 25 per cent for tractor power respectively, showing greater levels of animal traction farming and tractorization. In East Africa, about this period, the percentages were 50 per cent for human muscle, 32 per cent for animal draught power, and 18 per cent for tractor power. The projections for sub-Saharan Africa for the period under consideration (1997 – 1999) were 65 per cent for human muscle, 25 per cent for animal draught power and 10 per cent for tractor power, with a further projection for 2030 of 45 per cent for human muscle, 30 per cent for animal draught power and 25 per cent for tractor power respectively, a target hardly achievable under the current economic and energy climates (IFPRI, 2010).

The above can only be mitigated by adopting the Asian and South American investment strategies in agricultural mechanization.

Handhoe farming is predominant in Nigeria in particular and sub-Saharan Africa in general. Hoe cultivation according to FAO (2005) results in smaller cropped area, reduced total output, reduced cash cropping, increased food insecurity,

reduced farm incomes and increased incidence of poverty.

The Nigerian agriculture is often referred to as the hoe and cutlass farming (Oni, 2011). At the beginning of the 20<sup>th</sup> century, tools made from steel (hoes, machetes, axes) were introduced and supported by development of local blacksmithing business. By early 1950s, communities began settling down to sedentary agriculture in several parts of sub-Saharan Africa including Nigeria; and handhoes with metal blades began to replace traditional implements made from wood and even ribs of animals. In a study conducted by FAO (2005) in Ojo, Nigeria, a community predominantly dominated by hand tool farming, there were diverse range of hand tools, as was the case in most other parts of the country due to socio-cultural diversity. Observations by Ajibola and Sinkaiye at Ojo revealed 3 different types of handhoes and 3 different types of cutlass (large-size cutlass for tree felling, medium-size cutlass for weeding and small-size cutlass for harvesting). Figure 4 is a photograph of a farmer weeding with a medium-size cutlass while Figure 5 shows a farmer making heaps with short-handled hoe.



Figure 4. A farmer weeding his farm with medium-size cutlass. (After FAO, 2005).



Figure 5. A farmer making heaps with short-handled hoe. (After FAO, 2005).

The negative effects of the use of handhoe for farming were summed up by the consultants in their study of another Nigerian community (Sanchitagi) thus:

our postures and palms are different from others. We can no longer stand up straight. Our palms always have sores and our fingers are curved instead of straight. There are aches and pains in our backs and using handhoes causes pain and fatigue. Those of us using the hoe age faster than those using tractors. We can only work a little land at a time, hence we remain poor.

(FAO, 2005)

The Nigerian handhoe has not undergone any dramatic structural changes although cultural diversities govern the hoe type, such that the hoe type of the Southern Nigeria is structurally different from those of the North. The traditional farming hoe is a major handtool in Nigerian agriculture (Bassi, 1997; Oluka and Akubuo, 1997). Oluka and Akubuo (1997) gave an estimated number of handhoes in Nigeria as 100 million units, far more than any other implement or equipment type on Nigerian farms, thus the description of the Nigerian farmer as “hoe and cutlass” farmer.

Limited research work has been carried out to improve on the existing form of the Nigerian handhoe. Documented studies by Nwuba and Kaul (1986), Bassi (1992; 1997), and, Oluka and Akubuo (1997) were more on their ergonomic considerations than their design considerations.

The Second National Development Plan (1970 – 1974) stated inter alia:

No realistic change can be expected from the present nature of Nigerian agriculture due to the drudgery attached to it until the farmer finds an alternative to the hoe and cutlass technique of production. The clearing of bush, preparation of land, the sowing of seeds, the various post-planting operations are all processes in which the farmer's present tools can do little for high productivity per man day or per acre.

Asoegwu and Asoegwu (2007) stated that over reliance on handtool technology for agricultural production is one of the greatest technological problems facing the present generation of Nigerian farmers, resulting in low work rate efficiency of less than 10 per cent in the humid tropics. The use of hand power (human muscle) is arduous and inefficient, and can hardly produce enough food to feed the farm family (Figure 6).

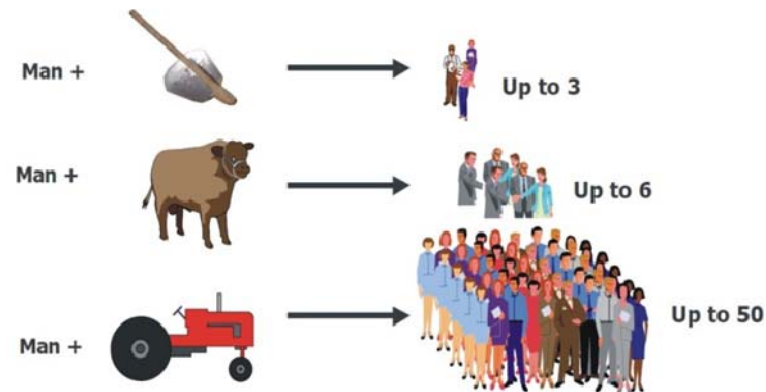


Figure 6. Contribution of farm power sources to food production. (After Clarke, 2008).

### **Animal Draught Power Farming in Nigeria**

The employment of domesticated animals for farm work or transport is known as animal traction. But the term readily connotes the “pulling” work of animals. Commonly employed domestic animals all over the world include cattle, buffaloes, horses, camels, donkeys, elephants, etc. However, cattle are the major work animals worldwide. The most common working cattle are the castrated bulls known as oxen or bullocks.

History of animal power in Africa started about the 6<sup>th</sup> Millennium BC in Egypt with the first drawings of oxen and ‘ard’ plough (scratch plough) occurring in the 3<sup>rd</sup> Dynasty (Starkey, 1989). This plough consisted of a frame holding a vertical wooden stick that was dragged through the top soil. Domestication of oxen in Mesopotamia and by its contemporary Indus valley civilization provided mankind with the pulling power needed for simple scratch plough (Figures 7 and 8).

When agriculture first developed, simple hand-held digging sticks would have been used in highly fertile areas such as the banks of the Nile where annual flood rejuvenated the soil, to create furrows wherein seeds could be sown. To grow crops regularly in less fertile areas, the soil must be turned to bring nutrients to the surface.



Figure 7. Ancient Egyptian plough, circa 1200 BC.

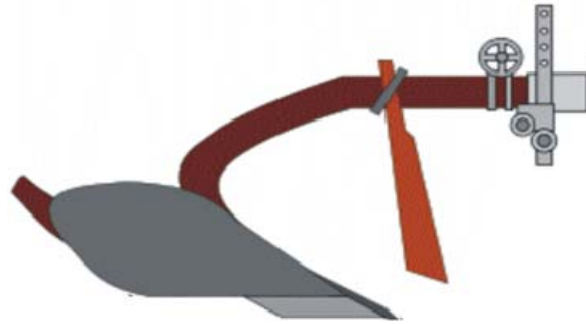


Figure 8. Image of a contemporary ox-drawn plough.  
(Source: <http://en.wikipedia.org/wiki/plough.htm>)

Animal-drawn implements are employed predominantly in the Northern parts of Nigeria where socio-cultural conditions favour their employment. The limited duration of work per day (3 to 4 hours), coupled with feed requirements to maintain them, particularly in dry season, tend to make their choice an unfavourable economic proposition.

In Nigeria, Emcot plough and Emcot ridger are the most prominent tillage equipment. They are well accepted by farmers in Northern Nigeria. The range of animal draught powered equipment in use in Nigeria is a measure of their level of adoption.

Animal draught powered seeders and planters have also been imported from India and elsewhere but are seldomly used. Inter-row and intra-row rolling cultivators have been developed at the Institute for Agricultural Research of the Ahmadu Bello University, Zaria (Oni, 1985). These animal-drawn weeding equipment were ideal for weeding cereal and legume crops, particularly at early stages of growth.

### **Impact of Tractors on Nigerian Agriculture**

Where ever agricultural mechanization is discussed, what readily comes to mind, and rightly too, is tractor and its impact on agricultural productivity. From earlier discussions in this lecture, it has been shown that farm activities in Nigeria in particular, and the sub-Saharan Africa in general, rely overwhelmingly on the human muscle power based on operations that depend on the “hoe and other handtools”, with implicit limitations in terms of required energy on the farm (Makanjuola, 1990).

Curiously, animal and tractor power have both declined in African agriculture in the last few years, further making agriculture more reliant on manual methods as shown in Tables 3 and 4.

Table 3. Farm power sources (percentages)

Region	Hand, %	Animal, %	Engine, %
Sub-Saharan Africa	65	25	10
3 other Developing Regions*	25	25	50

Source: FAO (2005).

\* Asia, Near East and North Africa, Latin America and Caribbean.

The growth of tractors in these regions is amply shown by Table 4 below.

Table 4. Growth of tractor numbers between 1961 and 2000.

Region	Increase, %
Asia	500
Latin American and Caribbean	469
North Africa and Near East	1,350
Sub-Saharan Africa	28

Source: FAO and UNIDO (2008).

Two tractor assembly plants were established in Nigeria in the 1970s. These were the Nigeria Truck Manufacturers (NTM), assemblers of Fiat tractors as well as Fiat trucks; and Steyr Nigeria Ltd., assemblers of Steyr tractors and Steyr trucks. It is rather disheartening that both assembly plants folded up within ten years of their establishment. Even while in operation, both companies complemented their sales with imported implements and equipment. Besides, government policy that a minimum of 30 per cent local content be incorporated into their production was never adhered to.

The above scenario therefore explains the excitement that welcomed the plan of an Indian tractor manufacturer, the *Mahindra and Mahindra Company Ltd*, to build an assembly plant for its tractors in Ibadan, Nigeria in 2005, with a multiplier effect of increased agricultural productivity, greater field efficiency, job creation, conservation of foreign exchange, and greater human capacity building. I was privileged to present a paper at the commissioning titled: Socio-economic impact of tractor assembly plants in Nigeria (Oni, 2005).

However, considering the fragmented nature of smallholder farmlands, the purchasing power of subsistence farmers and the limited annual usage of tractors for farm operations, it was

thought realistic to consider tractor power within the range of 22 kW to 45 kW (30 hp to 60 hp) for assembly. Mahindra tractors were in the range of 29 kW to 45 kW (39 hp to 60 hp) which were subjected to extensive field evaluation and subsequent certification by the National Centre for Agricultural Mechanization (NCAM), along with some other tractor makes imported into the country. Figures 9 to 15 show the process of field evaluation of agricultural tractors to determine their suitability for Nigerian agriculture.



Figure 9. Disc ploughing during field testing of a tractor.



Figure 10. Slippage determination during field evaluation of a tractor.



Figure 11. Field Efficiency determination of a tractor.



Figure 12. Measurement of implement depth-of-cut during field evaluation of a tractor.



Figure 13. Measurement of tractor draught using a 20 kN Strain gauged dynamometer.



Figure 14. Coupling of the dynamometer for draught force determination.



Figure 15. An array of imported tractors for testing and certification.

The Nigerian government, in its effort to encourage large-scale farming, imported hundreds of tractors for distribution to farmers, through cooperative groups under subsidy schemes. Farmers still consider cost of private ownership of tractors prohibitive. Although tractorization is suitable for large-scale farming, the complement of implements and equipment are in short supply.

Nigeria is said to have about 30,000 functional tractors but the minister of agriculture in a press release stated that the nation still required about 1.5 million tractor units to fully boost its food production efforts (Daily Independent Newspaper, 03 May, 2010).

Agricultural mechanization therefore is the application of mechanical technology and increased power to agriculture, largely as a means to enhance the productivity of human labour and often to achieve results well beyond the capacity of human labour. This includes the use of tractors of various types, as well as animal powered implements and tools, and internal combustion engines, etc.

Many agricultural tasks are less arduous and much quicker to accomplish when tractors are used (Oni, 1988; Oni et al., 1988). These include planting, herbicides and pesticides applications, weeding and harvesting.

The level of mechanization varies from one country of the world to another and from region to region. It is only through mechanization that farmers would be able to feed not only themselves but also the burgeoning urban population (as amply shown in Figure 6).

The history of development of farm mechanization also varies among industrialized countries of the world. By 1950, a high

level of mechanization was observed in the USA, while Western Europe (with the exception of United Kingdom) and Japan were still saddled with animal draught power farming. A dynamic growth in the number of tractors and farm implements occurred in Western Europe during the 1950s and the 1960s, while the same observation was recorded for Japan between 1960s and 1970s.

In 2007, there were just 626,000 tractors in Africa (FAO and UNIDO, 2008). South Africa and Sudan, each with more than 60,000 tractors in 2007 were easily the best equipped countries far ahead of Nigeria and Zimbabwe. There are a few lessons to learn if mechanization is considered an essential pre-requisite for achieving food self sufficiency. These include the issue of insecure land tenure system, fragmented farm holdings, finance, weak credit system, lack or inadequate training and lack of organized cooperatives.

### **Investments in Agricultural Mechanization in sub-Saharan Africa**

Investment in agricultural mechanization will bring added benefits and sustained food self sufficiency. For example in Benin Republic, a system of cooperatives for pooling agricultural machinery was launched in 1995. By 2009, a sizeable number were already highly active. Similarly, several billion CFA francs were invested in purchasing machinery from China, India and Libya, which were subsequently sold to farmers and other service providers. In the Cameroon, common interest groups (CIGs) were formed to engender larger plots so as to take advantage of tractors and other equipment. Additionally, several drivers and mechanics were in 2000 trained on the fringe of an assembly plants at Ebolowa in the southern part of the country. In the Congo, the Congolese government was at this period subsidizing the training of young

people to drive vehicles and help to provide technical assistance. In Madagascar, the Agricultural Machinery Centre at Antsirabe set up a higher institute for training engineers in agricultural mechanization. An agricultural machinery training programme in Papua New Guinea also allowed students to choose from a number of careers to become machine designers, developers, inspectors, distributors and sales personnel.

Until recently, little or no agricultural machinery was manufactured or assembled in Africa apart from southern part of Africa. However, in 2009, Mali opened an assembly plant for tractors and accessories at Samanko, in partnership with an Indian company. At the end of 2009, an industrial plant for assembling tractors started operations in N'Djamena, Chad. In Cameroon, an assembly line for tractors, motor pumps, shellers and combine harvesters was being planned to open at Ebolowa, again in partnership with an Indian company. The localization was aimed at lowering prices (as against importation), and as well reassure users regarding availability of spare parts.

In an effort to boost irrigation farming in Ghana, the government imported huge quantities of Asian and Czech-built tractors which were then sold to farmers who pay half of the cost upfront and stagger the rest over a 3-year period.

In their joint report of 2008, experts from FAO and UNIDO stated that if agricultural mechanization efforts are to succeed in Africa, there was an urgent need for all concerned, be they farmers, supporters, planners or policy-makers, to understand and contribute to agricultural mechanization efforts across the entire farming system and with value chain perspective. The success of agricultural mechanization strategies therefore lies in participatory approach. Experts now believe that it is up to the private sector -manufacturers, importers, suppliers, mechanical service providers- to fulfil this role.

### **Investment in Agricultural Mechanization to Power Nigerian Agriculture and Agro-industry**

Nigeria is blessed with a land mass to about 98 million hectares out of which about 83.0 million is considered suitable for agriculture but with not more than 30.0 million currently under cultivation (Oni, 1996; F.M.A, 2001). In spite of this great natural endowment, the concern and efforts towards evolving appropriate mechanization technologies for agriculture in Nigeria, coupled with the required huge investments, the Nigerian small-holder farmers remain impoverished and the Nigerian agriculture sector remains an industry of perpetual toilage and indignity plagued with drudgery, aged and ageing farming population.

For Nigerians to create wealth through agriculture sector, mechanization of its agriculture must of necessity assume a centre-stage through application of appropriate level of agricultural mechanization technology that is potent enough to modernize, energize and revitalize the agriculture industry.

Agricultural mechanization embraces the manufacture, distribution and operation of all types of tools, implements and equipment for agricultural land development, farm production, crop harvesting and primary processing.

The most viable approach is to evolve an integrated, *need-based, home-grown* appropriate agricultural mechanization technology. Essentially, this will involve research and development (R & D) in high priority areas. There are problem areas of agricultural mechanization that presently constitute bottlenecks in the development of agriculture in the country. Such areas include: land clearing, weeding, harvesting, crop processing and storage, irrigation and drainage, erosion control, use of small-equipment and hand-tools, and the use of draught animal power.

Oni (1994; 1996) and Oni and Obiakor (2002a&b) asserted that the major inadequacy identified in agricultural mechanization in Nigeria is the tendency to supply agricultural machinery and equipment without due consideration to local maintenance and support capability and equipment appropriateness. Other problems include fragmented farm holdings which hinder efficient use of agricultural machines and equipment, lack of data and information on the suitability, adaptability and performance of commercially available prototypes as related to types and conditions of crops, inadequate repair and maintenance facilities, difficulties in obtaining spare parts, lack of trained machinery/equipment operators, poor credit facilities, inadequate research and development programme, absence of indigenous design and manufacture of agricultural machines and equipment, and inadequate engineering infrastructure (water, electricity, workshop) for installation, application and operation of machines and equipment (Oni, 2001a&b).

### **Mechanization and the promotion of private sector investment opportunities in Nigeria**

It has become rather difficult to understand why the bountiful natural assets and endowments have not translated to greater agricultural productivity and high level of entrepreneurship (agri-business) in Nigeria.

The encumbrances often highlighted as constituting major impediments (Oni, 2008) include subsistence nature of the Nigerian agriculture; land tenurial system; lack of appropriate mechanization technologies; production and management constraints; lack of initiatives to start a business; inadequate technology information; lack of effective policies; ineffective industrial liaison services; poor funding mechanism; lack of market information.

### **Agro-industrialization for national food security**

Nigeria's farming population is estimated to be between 60 per cent and 70 per cent of the entire population, contributing about 41.5 per cent of the nation's gross domestic product (GDP). This view is further reaffirmed by Lemo (2011). Lemo claimed that if you grow gross domestic product (GDP), you grow the economy through agriculture. He defined GDP as the summation of all economic activities.

However, the agro-industrial sector remains rudimentary, underdeveloped and largely without significant institutional, technical and financial support. It may thus be instructive to re-examine some of the problems and constraints which have continued to militate against this very important sector of our growing economy.

#### **(i) Availability of raw materials:**

It is highly questionable as to whether the present state of the agro-processing sector in Nigeria is due to lack of suitable indigenous raw materials.

In addition to yam, cassava, palm fruits, maize, groundnut, soyabean etc., Nigeria is endowed with a wide variety of primary agro-commodities, much of which have been used in the agro-processing sector with excellent results. Other commonly used materials include herbs, spices, legumes and vegetables. It has however been advanced that very few of these commodities are available in the required quantities throughout the year and thus a viable agro-processing sector cannot be sustained.

#### **(ii) Environmental regulations:**

Most agro-related industries are affected increasingly by environmental regulations and the need to introduce

monitoring and bench marking systems. Waste reduction and the safe disposal of unwanted and often hazardous by-products of processing pose continual problems to enterprises and threaten existing potential employment. This applies particularly to cassava processing.

**(iii) Research, technology and technical support for agro-industrial development:**

The technology utilized in the small-scale processing sector has remained relatively static and traditional. Other crucial constraints to the development of the agro-processing sector are the lack of proper utilization of research and development results and outcomes, lack of trained personnel, inadequate technical, managerial and marketing support. Both the public and the private agro-processing sectors have not invested in the development of the most effective research, nor have they readily embraced and adopted the most appropriate and current technologies. These problems are even more serious in the case of smallholder farmers since they generally do not have the financial resources or credit facilities at their disposal to invest in new processes, human resources, management or technological innovations.

**(iv) Absence of good management and non-existence of market development strategy:**

Most small-scale agro-industries in Nigeria are either owned by an individual or a family. As a result, most of the time, management of these industries falls into the hands of incompetent persons. This often results to the closure of the industries.

**(v) Seasonality of crops:**

Most times, the crops used by the agro-industries in Nigeria are seasonal. Agro-industries are automatically out of business within the periods these crops are out of season. A few example that readily comes to mind are crops like orange, pineapple, cashew, etc. However, the antidote to this seasonality of crops is appropriate and functional storage systems, which from all indications are lacking probably because of the high investment cost.

**(vi) Inappropriate or obsolete processing and ancillary equipment:**

Most agro-based industries in Nigeria are equipped with inappropriate or obsolete processing and ancillary machines and equipment. These affect their production rate and impact negatively on the quality of processed products.

**(vii) Mitigating Food Insecurity Through Equipment Development:**

Agricultural mechanization in Nigeria envisages the development of *home grown* or indigenous tools and equipment to improve agricultural production and productivity by relieving the continuous increasing labour constraints, enhancing farmers income and reducing food shortages, and hence food imports.

A number of agricultural labour saving equipment developed by the National Centre for Agricultural Mechanization (NCAM) found relevance during the presidential initiatives instituted by the Obasanjo administration between 2002 and 2005. The NCAM under my leadership then was specially challenged to develop tools and equipment which could be used particularly at the farm gate level to add value to crop products obtained from cassava and rice. During this period, cassava

production and processing was stepped up, with government's ambitious plan of generating N5.0 billion annually from cassava products.

Cassava crop, hitherto a famine-reserve commodity, is commonly produced by the smallholder farmers on a total land area of 3.5 million hectares and a yield of 36.75 million tonnes per annum. Cassava root production has been stepped up for its starch content for home and industrial uses. The crop thrives on impoverished soils. Production constraints include partial mechanization, bulkiness and highly perishable root, high transport cost, inadequate harvesting equipment, high production labour cost, inadequate credit to farmers, inadequate support for research, extension and capacity building.

Planting and processing equipment are now available at farm-gate and village levels for the empowerment of small-scale producers. These include prototype planter, manual lifter and mechanical harvester, root peeler (manual and mechanical), peeled root washer, peeled root chipper, peeled root grater, mash dewaterer, batch dryer, horizontal (hot air) dryer and hammer mill. Some of these equipment are illustrated by Figures 16 to 29.



Figure 16. (a) NCAM-developed semi-automated cassava planter; (b) in operation.



(a)

Fig. 17. Manual Cassava lifter.



(b)

Fig. 18. Tractor-drawn cassava harvester.



(a)



(b)

Fig. 19. (a) Manual cassava peeler; (b) in operation.



Figure 20. Motorized mechanical peeler.  
(NCAM collaboration with a fabricator).



(a)



(b)

Fig. 21. (a) Manually operated peeled cassava root washer; (b) in operation.

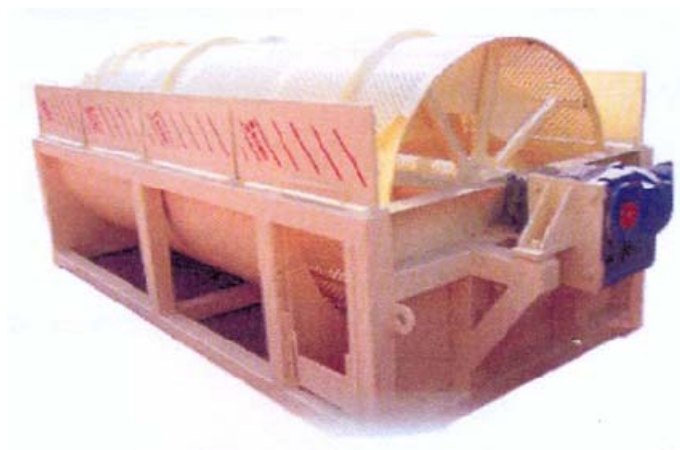


Fig. 22. Motorized cassava root washer. (Adapted: Technol Equip. Plc., 2006).



(a)



(b)

Fig. 23(a). Motorized cassava root grater; (b) in operation.



(a)



(b)

Fig. 24(a). Manual cassava root chipper; (b) in operation.



(a)



(b)

Fig. 25(a). Motorized cassava root chipper; (b) in operation.



(a)



(b)

Fig. 26(a). Cassava mash dewatering press; (b) in operation.



(a)



(b)

Fig. 27(a). Batch dryer for drying cassava chips; (b) In operation.

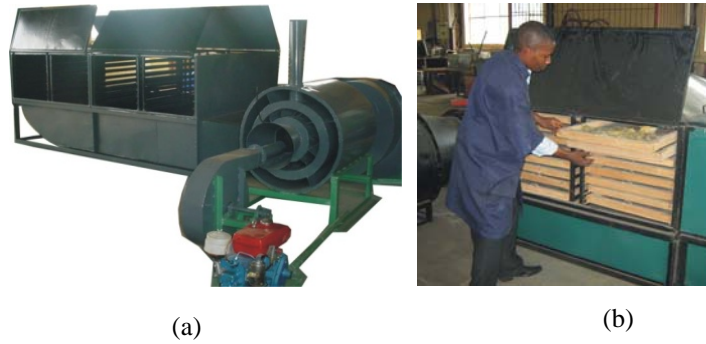


Fig. 28(a). Horizontal hot-air dryer; (b) in operation.

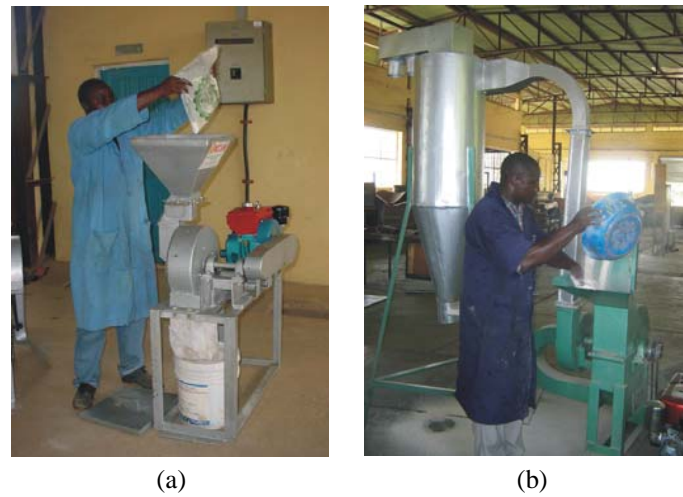


Fig. 29(a). Motorized hammer mill; (b) Motorized hammer mill with cyclone.

## **MY OTHER CONTRIBUTIONS TO AGRICULTURE THROUGH AGRICULTURAL MECHANIZATION**

### **Mechanization of Tillage Operations**

There were two major occurrences in this regard. First, my postgraduate research work centred principally on investigating tillage tools that could alleviate the tedium of weed control while at the same time protecting the rather fragile soils of northern Nigeria which are prone to wind erosion. Cultivation processes on such soils had to be minimal. The major problem was how to combat weeds on the farm without excessive soil cutting and pulverization. This led me to investigate various designs of under cutter tillage tool and to provide mathematical basis for their design and fabrication.

The experimental investigation was carried out using an indoor facility called soil bin (Oni, 1983). The advantage of the soil bin was to enable investigations of various tool designs under a controlled environment which would have otherwise been difficult in the field because of rapidly changing soil conditions resulting from the influence of soil moisture, soil temperature and even soil structure.

Interestingly, the design parameters and the resulting model equations agreed with what was obtained by a manufacturer of the tillage implement in Canada known as Noble Plough but which I was oblivious to at the time of my investigation. A representative of the company subsequently visited my laboratory to ascertain the resulting outcome and confirmed the correspondence of my design parameters with theirs.

Mr. Vice-Chancellor Sir, the facilities at my disposal were awesome. Every part and component required for the

instrumentation were received from the suppliers within 24 hours of the order, and this was as far back as 1980. The construction and arrangement of experimental equipment and associated instrumentation are as shown in Figures 30 to 33.

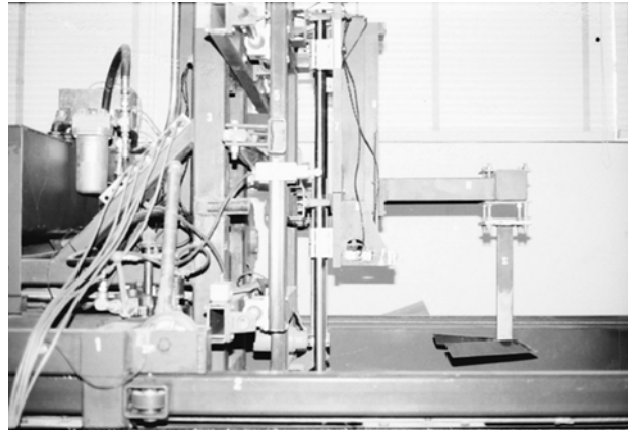


Figure 30. Side view tillage tool dynamometer.

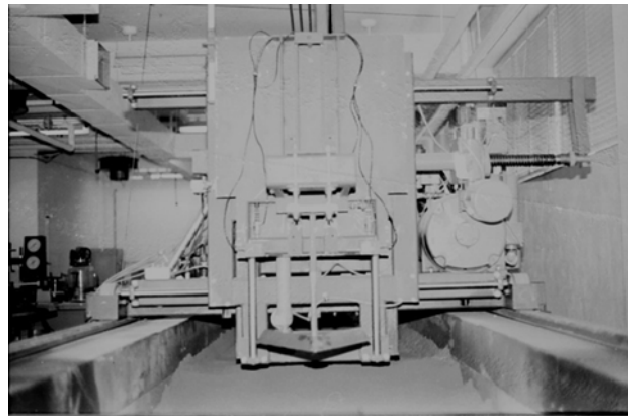


Figure 31. Front view tillage tool dynamometer.

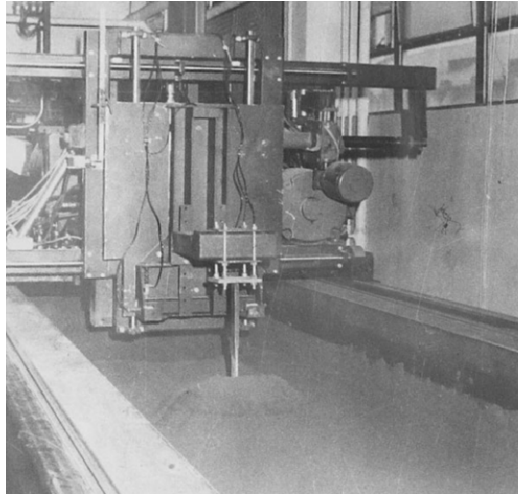


Figure 32. Bulldozing effect of model tool.



Figure 33. Laboratory data acquisition system.

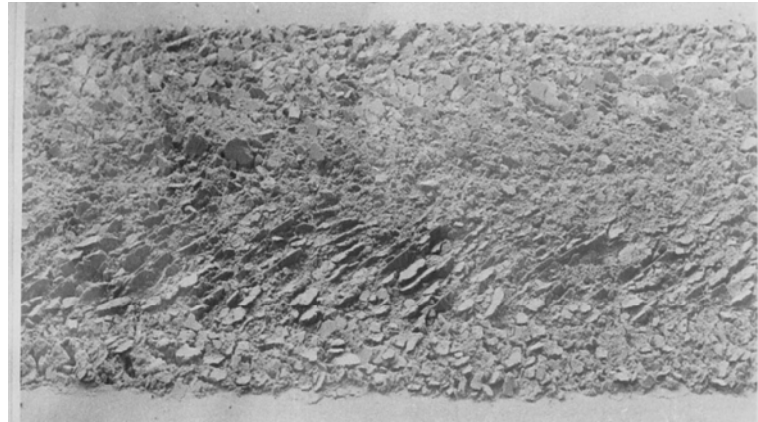


Figure 34. Desired soil surface profile after passage of under cutting tool.

Back in Nigeria in 1981, I was confronted with similar problem but in a different dimension. My employer then, the Institute for Agricultural Research(IAR) of the Ahmadu Bello University Zaria saw me as a “local expert” in tillage machinery development for weed control on cropped farmland; and therefore requested that I developed a weed control tool that could be powered by draught animals, within the context of *home-grown, appropriate technology equipment development*. Draught animal power farming research was a prominent programme at IAR because of the potential of draught animals as a source of power for farming in the north as earlier discussed.

Taking cognisance of common draught animal powered implements in use, I developed and incorporated a weeding attachment to the Emcot ridger. This *inter-row rotary weeder* consisted of a pair of rotary hoe aligned with the side slope of adjacent ridges as shown in Figures 35 to 37.



Figure 35. *Inter-row rotary weeder* weeding maize crop at early stage of growth.



Figure 36. *Inter-row rotary weeder* weeding maize crop at later stage of growth.



Figure 37. *Inter-row rotary weeder* showing proper alignment with the side slopes of adjacent ridges.

While weeding efficiency of this *inter-row weeder* was very high, the drudgery was equally high since the operator had to walk the entire length of the field behind the draught animal, guiding both the work bulls and the weeding equipment (Oni, 1985).

A 'Mark II' rotary weeder was therefore developed in order to eliminate the drudgery associated with the employment of the rotary weeder. This was called *straddle-row rotary weeder*, which as the name implies was designed to straddle a ridge at each pass, and with a provision for a riding sit attachment to the tool frame (Oni, 1989). By this arrangement, a ridge was completely weeded at each pass of the weeder as shown in Figures 38 and 39.



Figure 38. *Straddle-row rotary weeder* in operation in a maize field.



Figure 39. *Straddle-row rotary weeder* in operation in a groundnut field.

There was a peculiar research problem in 1996 on how to come up with a tillage tool that would create a groove or furrow in a vertisol for the planting of dry season sorghum known as Masakwa. This crop commonly grown at the Lake Chad basin is high yielding with a growing period of about 4 months. The crop uses residual soil moisture because it does not require rainfall and is seldom irrigated and is raised in a nursery prior to being transplanted into specially dug holes using wooden dibbles (Figure 40). About 20 ml of water is introduced into the dug hole at the time of transplanting to start off the seedlings since top soil (0 to 10 cm) are already dry. The crop is highly resistant to draught.



Figure 40. Photograph showing farmers holding local dibble and crop seedlings.

In the course of this research work carried out by a Ph.D. student, under my supervision, several tillage tool designs were investigated and the one that achieved our research objective was further investigated in the laboratory soil bin constructed for the purpose at the Department of Agricultural and Biosystems Engineering of this university. The vertisol soil was brought from Lake Chad Basin and modified for use in the soil bin. The instrumentation and data acquisition arrangements for this investigation posed a special challenge. There were no load cells as used in the investigation earlier described, hence strain gauges were linearized and mounted on the tool bar to sense forces acting on each of the designed model tools during test running in the soil bin. The arrangements are as shown in Figures 41 to 43. The results were analyzed statistically in order to come up with the best tool design that would achieve the objectives of the investigation (Mamman and Oni, 2005).

Mr. Vice Chancellor sir, the student involved in this research was the first to obtain a Ph.D. degree from the Department of Agricultural and Biosystems Engineering of this University in 2002. The equipment and the instrumentation for the investigation were constructed locally, further demonstrating the potentiality of Unilorin research students in conducting complex research investigations. It also underscores the modest contribution of the University of Ilorin to the training of staff of sister institutions.

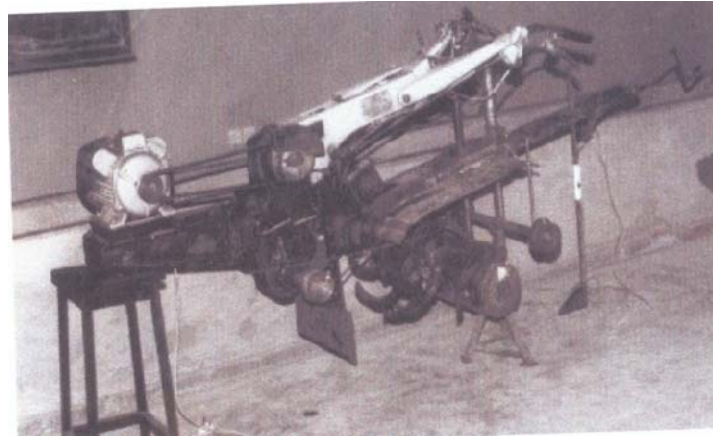
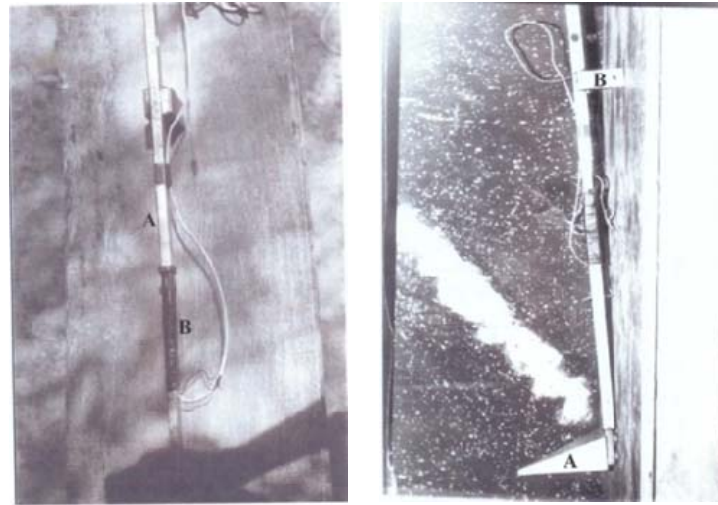


Figure 41. Equipment arrangement showing the prime mover, soil processing carriage and instrumented tool bar for the investigation.



(a) (b)  
Figure 42. Views of the strain-gauged tool bar with model tool attached.

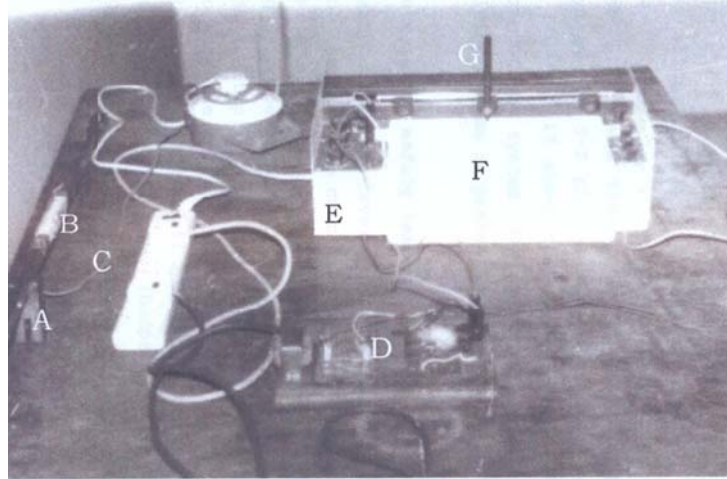


Figure 43. Assembly of instrumentation and data acquisition system.

### **Recommendations**

From this lecture, the following recommendations become germane.

### **Partnership with the private sector**

Agro-industries, as in other economic sectors, can only be competitive and thrive when supported by an enabling environment. The cooperation between the public and the private sectors is one of the ways of promoting agro-industrial development. In Kwara state, the government partnered with white farmers who relocated from Zimbabwe to settle in Tsonga area of the state; these commercial farmers have in their short stay in the state, put close to three thousand hectares of farmland under cultivation.

The success of the enterprise is hinged on the fact that the farmers were encouraged through access to loans and other

infrastructural facilities which were put in place to facilitate their agricultural production activities. Other state governments could borrow a leaf from the cooperation between the Zimbabwean farmers and the Kwara State Government, as a public-private sector (PPS) strategy for alleviating the food crisis in the country.

### **Enabling environment for agricultural development**

In Nigeria, rural infrastructural development should be the responsibility of all tiers of government. The provision of basic infrastructures to rural communities would drastically reduce migration to the urban centres. However, such infrastructural developments should be holistic, that is, it should include land demarcation and development, road development, electricity and water supply, market development, etc.

### **Sustainable agricultural raw materials production**

The lack of a clear policy framework regarding the production and utilization of these commodities would perhaps be the most critical constraint that needs to be resolved. The national agricultural policy should be up-dated to set the framework for the structural transformation of primary production in line with current realities.

### **Research and development support for agro-industries**

Lack of appropriate technologies and equipment has been identified as major bottlenecks in the development of agro-industries in the rural areas. This is more pronounced in the women-led enterprises which contribute more than 65 per cent of the labour resources in agricultural production, processing and storage.

There are large arrays of machines and equipment available to agro-industry. These machines are found in the processing enterprises for rice, cassava, maize, oil palm, soybeans, fruits and vegetables. Most of these machines and equipment are locally fabricated while a few are imported. Unfortunately, a good number of the machines that are manufactured locally are substandard and break-down easily. The imported machines, which come largely from Asia do not fare better.

To address these problems and increase the supply of relevant agro-processing machines and equipment, it is hereby recommended that the research and development family should carry out the following:

***Collation and analysis of shelf sitting machines and equipment***

The research and development institutions carry out machines and equipment design and prototype development. Very little linkage exists between the R&D institutions and agro-industries with regards to dissemination of developed technologies. The agro-industries, as a result of the disconnection between them and the universities, polytechnics and R&D institutions, do not benefit directly from this array of machines. Rather, the fabricators, who are closer to the industries and identify with some of their problems, go to the R&D institutions and steal the designs. Most of the time, the prototypes are not fully developed and the machines that result from those designs are defective and ineffective.

***Pilot testing of identified machines and equipment***

Machines and equipment prototypes are workshop specimens only and need to be properly tested in the field to ensure that they meet all the performance parameters. This is essential to eliminate dumping of unsuitable machines and equipment on

the agro-industries. Pilot testing is also a veritable vehicle for awareness creation on the potentials and performance of the identified prototypes.

### ***Machines and equipment standardization***

A good number of machines and equipment targeted at the agro-industries are sub-standard and breakdown frequently. This is more evident with shafts, worms, bearings, brackets, sieves, etc., which are fabricated with materials that are not hardened, and therefore suffer rapid wears and failures.

The Standards Organization of Nigeria (SON) has the statutory responsibility to create, monitor and enforce standards and should be more alert to this aspect of its mandate.

### ***Product development***

Most agro-industries set up their enterprise with little understanding of product development and quality. Their lack of knowledge of process flow and precise unit operations to achieve high quality products is obvious. They also compromise on certain quality imperatives to cut cost at the expense of their consumers. This limits, considerably, their access to very lucrative markets.

Efforts should be made to develop strategies for raw materials supply both in quality and quantity. Methods of achieving high quality products and provision of appropriate packaging systems should be emphasized.

### ***Machines and equipment certification***

Most machines and equipment manufacturers lay bogus claims to high performance of their products. This creates problems for process design as machines hardly conform to the manufacturers indicated ratings.

Technologies and equipment therefore need to go through the process of evaluation to conform with the specifications

claimed by the manufactures. The testing and certification would eventually protect the ultimate user/consumer in order for them to optimally utilize the machinery/equipment purchased.

More support should be given to NCAM, which has the national mandate to certify all imported or locally produced machines, to ensure certification of machines and equipment destined to the agro-industries.

### ***Component specialization and equipment manufacturing***

The fabricators constitute a very important resource pool in machines and equipment manufacture. They supply most of the needed machines and equipment to the agro-industries. The process is laborious, time consuming, inefficient and very unproductive. Replacement parts development under this process is practically impossible as attention to details is always compromised and capacities are too low to produce the parts in the required quantities and qualities.

Component specialization appears to be the only answer to this ineffective production process.

### ***Machines and equipment commercialization***

The commercialization of machines and equipment appears to be non-existent in Nigeria. This has made it difficult for production of machine and equipment to be in such quantities that will encourage their display on market shelves. Except for the pepper grinder, all other machines have to be ordered before they are fabricated.

Support should be given to RMRDC, NCAM, NASENI, etc., to develop a viable strategy that would facilitate the commercialization of some viable agro-industrial machines and equipment.

### ***Fabrication improvements***

Many fabricators exist but only very few of them obtained formal training in fabrication. Many of them started off as apprentices to welders and have the knowledge of welding only. Most of them do not know how to read and interpret drawings and this limits their scope considerably.

There is, therefore, the need to up-grade and increase the number, spread and effectiveness of the fabricators. Support should be given to NCAM, whereby the fabricators would be tutored in theory and practical works, and conclude the training with industrial attachment with selected well established fabricating workshops. This will enable the qualified fabricators give quality back-stopping to the agro-industries.

### ***Agro-industries technology value chain analysis***

Several inefficiencies exist in the production, supply, marketing and utilization of machines and equipment. These inefficiencies distort the production process of the agro-industries and limit their chances of maximizing their potentials. It is, therefore, necessary that all the cost centres are properly analyzed to expose and strengthen the weak points along the value chain.

Support should be given to NCAM to carry out value chain analysis in terms of design, prototyping, field testing, production, machines and equipment availability, marketing, dissemination and appropriate linkages that will ensure free flow of machines and equipment from R&D to the agro-industries.

### ***Servicing and maintenance back-up***

One of the major problems facing the agro-industries is inadequate access to servicing and maintenance back-up in the rural areas.

Support should be given to facilitate the creation of a network of servicing and maintenance artisans within the rural areas.

### **Conclusion**

Mr. Vice-Chancellor Sir, in concluding this lecture which you will agree with me is a comprehensive review of the state of mechanized agriculture in Nigeria and the failure of agricultural policies, I stand here to concur with the view of Chissano (2009) who stated that:

the most direct and effective means of raising standard of living and alleviating poverty, hunger and malnutrition is through increasing the productivity and incomes of small-holder farmers. Transformation of the rural economy should therefore be through the development of rural based agro-industry and the rural based private sector participation, only achievable through greater participation of farmers in commercial agriculture coupled with effective agrarian land reforms.

The above view was also corroborated by Bishop Oyedepo who advocated for agricultural revolution which he said would engender technological and industrial revolution. The Bible says that from the mouth of two or three witnesses the truth shall be established. The third group of witnesses are the August guests at this lecture. The book of proverbs chapter 13 verse 23 of the Holy Bible says:

much food is in the tillage of the poor; but there is that is destroyed for want of judgement.

This lecture has discussed extensively, the problems and challenges of food security in Nigeria, and the issues which impugn directly and otherwise on its resolution. Our country possesses the fundamental human, material and institutional resources required to achieve national food security. Agro-industrialization is a potent and particularly appropriate tool for Nigeria to sustainably achieve and maintain national food security. We are of course beset by many constraints but they are miniscule and insignificant when compared with our potentials and possibilities.

Applying the strategy of agro-industrialization for national food security will not only ensure adequate supply of our nutritional needs, but central to the successful diversification of the economy and income base of the nation. It will also significantly facilitate the sustainable and environmentally responsible exploitation of our vast renewable agricultural resources.

## **Acknowledgements**

Mr. Vice-Chancellor Sir, as far back as the mid-1960s, it was 'pardonable' for young students of my age from my town, Egbe in Kogi State, to dream big of becoming either doctors or engineers due to the influence of the white missionaries in the community then. Incidentally, my father of blessed memory who for his foresight was convinced, and strongly too, that agriculture was the profession of the future, and the way for me to go. I humbly dedicate my modest achievements in life and indeed this lecture to his memory. My late mother assumed full parenthood of guiding us her children through life after the demise of my father. She was one mother in a million who sacrificed all at her disposal to see that her children succeed in life. She is pleasantly remembered today. My wife, Mrs. Lois Olubukola, was very much a part of me as I was growing professionally. She gave me all the support and encouragement particularly during my postgraduate studies at Kansas State University even though she too was pursuing her Master's degree programme then. She has remained a pillar of support for me and our children. I am sure that our children home and abroad would join me in saying a big thank you and well done to her for her love and dedication to our family.

Dr. B. S. Oloruntoba, a retired Federal Permanent Secretary in the Federal Ministry of Agriculture and the first Nigerian to be appointed Director of Federal Department of Agriculture, contributed in no small way towards my being able to undertake my undergraduate studies at the Ahmadu Bello University as an in-service trainee (on full school certificate salary!) through his recommendation as the then Chief Agricultural Officer of Kwara State Ministry of Agriculture and Natural Resources. So also were the contributions of Chief M. S. Ayimodu, former General Manager of Niger River Basin

Development Authority, and Alhaji M. S. Koro, former Head of Service to Kwara State Government, who then were principal and senior agricultural officers, respectively, in the ministry. We all looked up to them, as overseas trained agriculturists, for guidance. I will like to say a big thank you to them for mentoring many of us.

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