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Inaugural Lecture Series 183

TECHNOLOGY, LIFE AND LIVING

By

M.O. Faborode
Professor of Agricultural Engineering

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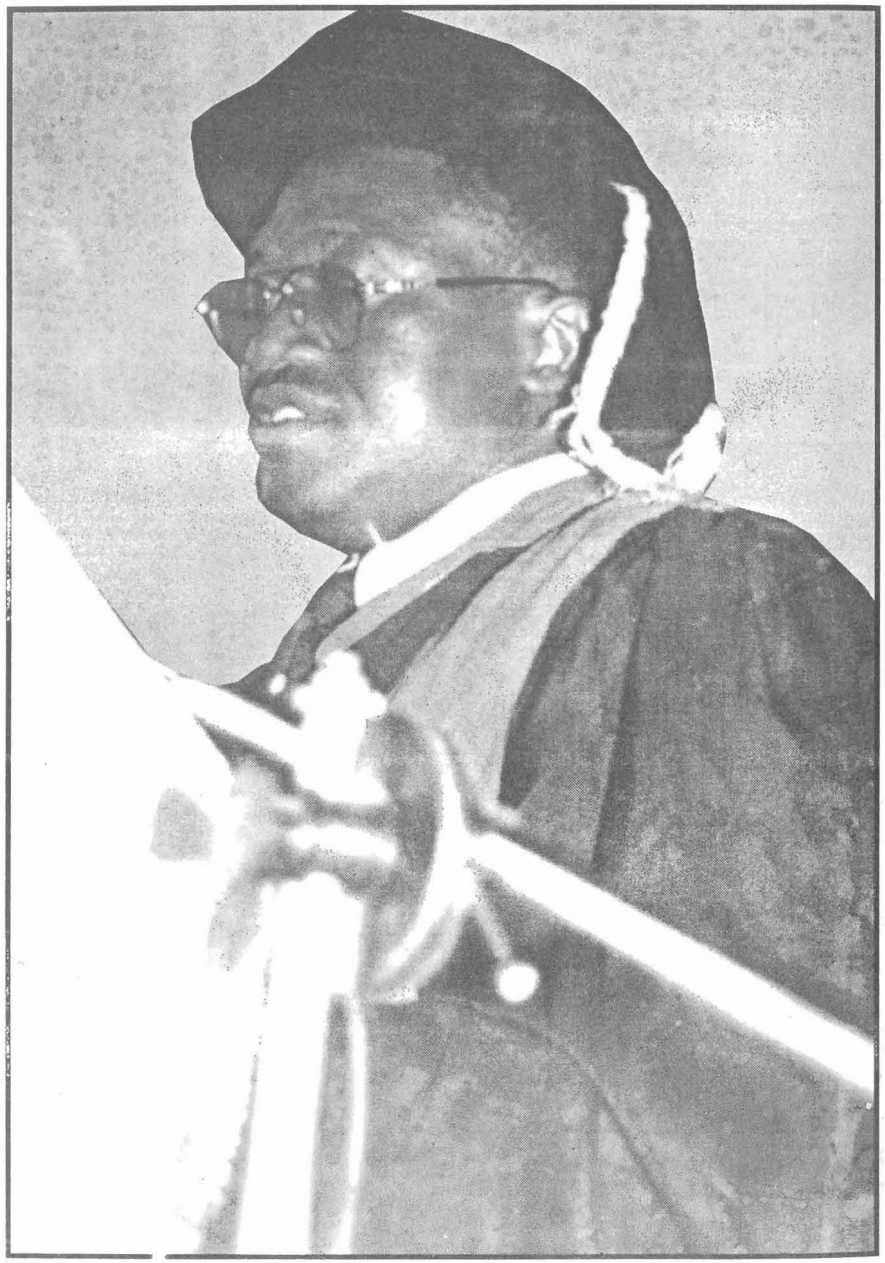

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PROLOGUE

Professor Mojola of the Department of Mechanical Engineering of this University, in his inaugural treatise of 1988, noted that "the ivory tower ritual of delivering an inaugural lecture originated in Britain, precisely at the University of Oxford in about 1623 when Digory Whear mounted the rostrum to deliver his *oratio uaspicalis* in the *Schola Grammaticae* which was regarded as a semblance of the modern Inaugural Lecture" The tradition eventually became formalised and took root, with the lecturer or celebrant having the academic freedom to prepare the "intellectual feast" according to his own recipe. It was at his inaugural lecture in 1913 that Mr Albert Einstein elucidated his theory of relativity, as one of the classical cases when a clearly formulated principle led to conclusions that were completely outside the domain of facts that were then accessible to experience, and recommended protracted experimental research to unravel whether or not the theoretical principles corresponded to reality. For an academic, the inaugural lecture comes but once, hence John Emerich Acton, a distinguished British Historian of the early 20th century had remarked that "I shall never again enjoy the opportunity of speaking my thoughts to such an audience as this, and on so privileged an occasion, a lecturer may well be tempted to bethink himself whether he knows of any neglected truth, any cardinal proposition, that might serve as his selected epigraph, as a last signal, perhaps even as a target". To some, the inaugural may well represent the first draft of a professor's autobiography, while some regard it as the turning point to set a new agenda for future engagement.

In this celebration of the Chair of Agricultural Engineering which was established for me in 1996, and which is the fifth of such in Agricultural Engineering in this University, I have chosen to explore the place and contribution of technology, particularly my own field of Agricultural Technology, to human livelihood. In so doing, I intend to re-establish in our consciousness the acceptance of technology as the basis of life and the shaper of life or better still, the determinant

of the trajectory of human development or underdevelopment. Greatness of nations no longer depends on sheer size or the extent of natural endowment, but on their level of technological development. Technology now rules the world. Technology is power, the power of wise nations!

I will be more concerned, understandably, with the theatre of the agricultural engineer, the rural interface, including the peri-urban domain, where majority of our people live and die unsung.

TECHNOLOGY AND DEVELOPMENT

Technology, as a term, means many things to several people and this may well depend on the setting or the context. Adopting a broad term definition, technology implies "any practical art which utilises scientific knowledge". The object is usually in the positive, to advance and enhance human society and conditions. However, indeliberately and sometimes deliberately, technology may lead to unintended and undesirable consequences. Sometimes we mistake engineering for technology, simply because technology evolves from engineering activities. Engineering technology is essentially a subset of technology, making us professional engineers to talk of the engineering family comprising of technologists, technicians and craftsmen. Even then, there is more to technology than engineering as more unconventional frontiers of technological conquest, the so called new technologies – infotech and biotech - unfold.

I find myself in total agreement with the sentiments of a past President of the Nigerian Society of Engineers, Engr. Dr. U.J.S. Uujahman, who once said "anytime I think of ***life***, I wonder whether I am biased in saying that technology is its essence, that engineering technology is about creating, planning, executing, sustaining, about making changes". He was also deeply fascinated watching "a figment of the imagination emerge through the aid of science to a plan on paper, moving into realisation on stone, metal, wood or energy, bringing jobs, homes and joy to mankind, elevating the standard of ***living*** and

adding to the comfort of ***life.*** He related this to the great achievements of the world, which would not have been possible without some engineering, namely:

- The creation of man in the image and likeness of God
- The writing of the Holy Books
- The seven wonders of the ***old*** world - ***the pyramid of Giza, the hanging garden of Babylon, the statue of Zeus at Olympia, the temple of Artemis at Ephesus, the mausoleum of Halicarnassus, the colossus of Rhodes and the Pharos of Alexandria.***
- The era of thinkers, philosophers and geometry
- The European civilisation
- The scientific revolution – spanning through the jet and new information age.

The words of Dyson (1989) put the place of engineering in life more philosophically thus:

> Next to the **gift of life is technology, for it is the greatest** of God's gifts **as it offers the poor of the earth, a short** cut to greatness **and wealth, a way of getting rich by** cleverness **rather than a back-breaking labour**

Little wonder that the 31st President of the United States of America (1929-1933), Herbert Hoover, was reported to have referred to engineering as "a great profession", noting further the burden of the engineer thus:

> **The great liability of the engineer compared to men of other professions is that his works are out in the open where all can see them. His acts, step by step, are in hard substance. He can not bury his mistakes in the grave like doctors. He cannot argue them**

into thin air or blame the judges like the lawyers. He cannot, like the architect, cover his failures with trees and vines. He cannot like the politicians, screen his shortcoming by blaming his opponent and hope the people will forget. The engineer cannot simply deny he did it. If his work does not work he is damned. On the other hand, unlike the doctor, his life is not a life among the weak. Unlike the soldier, destruction is not his purpose. Unlike the lawyer, quarrels are not his daily bread. To the engineer falls the job of clothing the bare bone of science with life, comfort and hope. No doubt, as the years go by, the people will forget which engineer did it, even if they knew. Or some politician puts his name on it. Or they credit it to some promoter who used other people's money. But the engineer himself looks back at the unending stream of goodness which flow from his successes with satisfaction that a few professionals may know. And the verdict of his fellow professionals is all the accolade he wants.

Talking of the proverbial seven wonders in relation to the significance of technology, I had earlier deliberately used the word "old world", for indeed those wonders belong to the past. In the view of V.S.O. Olunloyo, a previous winner of the Nigerian National Order of Merit, the influence of science and technology, particularly the unfolding convergence of time and space, causing change to occur in a rather dizzy speed has led to the emergence of what can be regarded as seven-day or indeed seven-second wonders!, namely the Internet and other micro electronic gadgets, satellites and the space station, cloned products (Dolly), nano-materials, genetically modified agricultural products, robots and the atomic bomb as indicated in the Table below:

Table 1: The (Seven) Possible **Technological Wonders of the New** World

S/No	Possible Candidates	**Area of Technology**
1.	The Internet, Supercomputers & Lap/Palmtops, the Microprocessor and Microchip	Information and Communication Technology
2.	Satellites; the International Space Station, the Space Shuttle, Space Walk and Products of microgravity manufacturing	Space Technology
3.	Dolly, the Sheep and other products of cloning, Artificial Organs, etc	Genetic Engineering
4.	Nano and Micro electronic materials	Nanotechnology
5.	Genetically Modified Products in Agriculture, etc.	Biotechnology (A second genesis)
6.	Robots	Artificial Intelligence & Robotics
7.	The Atomic Bomb	Nuclear Engineering

Source: Adapted and modified from V.S.O.Olunloyo (2001)

Almost all the technologies involved in the technological feats of the new and also to a great extent the old wonders depend on knowledge-based engineering technology. It is thus obvious that for the foreseeable future, the destiny of man shall, to a significant extent, be dependent on the role of the engineer in society. In other words, engineers and engineering technology will continue to shape the trajectory of human development for a long time to come, indeed to the end of times.

... the foregoing, I have alluded to the universa... y of engineering and its anchorage on science or knowledge, for there cannot be engineering technology without science. In the surprising words of a famous Nigerian Economist, Dr Pius Okigbo in 1996 whilst admonishing Nigeria on the merits of science and technology, said "we must learn the language of the new age, which is technology and its grammar, which is science, for science is to technology, as grammar is to language", and that countries that do not prepare themselves fully for the future by mastering their language and its grammar will be left behind". Indeed for engineers to remain useful to society, they must be involved in all aspects of human activities (Olunloyo, 1997). Professor Hardy Cross in his book *Engineers and Ivory Towers* noted as follows:

> **It is customary to think of engineering as part of a trilogy, pure science, applied science and engineering. It needs emphasis that this trilogy is only one of a triad of trilogies into which engineering fits. The first is pure science, applied science, engineering; the second is economic theory, finance and engineering; and the third is social relation, industrial relations, and engineering. Many engineering problems are as closely allied to social problems as they are to pure science.**

That scientific knowledge is critical to engineering practice is further elaborated in the view that it increases society's confidence in the system of technology creation and that the more the application of science, the higher the level of confidence in the products and services of technology. While this interrelatedness of the arduous, but somewhat obscure, labours of science and the outcome/product of engineering technology that make life easy and immensely more pleasurable for the population can easily be appreciated in modern scientific societies, the connection is not appreciated in more traditional or under developed societies. Hence, the assertion of

Olunloyo (... 01) that "in such societies, it is patently ...fficult to persuade the people and their governments to expend resources on such labours especially when the benefits are not immediately in view!" This is the dilemma of basic and even applied science in Nigeria, as "this traditional mindset has been a major hurdle for the appreciation of the scientist and the engineering profession by either the largely undedicated, parasitic and foolishly corrupt political elite or the bureaucratic civil service in Nigeria and many African countries. Herein hides the myth of the inexplicable under-funding of education and research, which are otherwise critical success factors in the march towards a truly technological society in which knowledge and enterprise drive development.

LIFE, KNOWLEDGE AND EMPIRICISM

In 1986 after completing my PhD studies at the University of Newcastle upon Tyne, I had a sense of accomplishment, though as a not too young man at 30. I had been married and was expecting my second child. I had worked on the compression of fibrous biomaterials to high densities in order to enhance their use as briquettes in biofuel energy applications, a subject on which many eminent researchers before me, as far back as the 19th century, had had a kick, coming up with a myriad of empirical propositions relating the dominant process parameters – compression pressure and volume/density change. The basic ideas of a non-empirical compression ratio model, the classical output of the endeavour, had appeared in the prestigious *Journal of Agricultural Engineering Research* now known as the *Euro-AgENG Journal of Biosystems Engineering*. More explanations and extension of the basic idea were to follow later in the same medium. The sense of accomplishment had to do with the simplicity of elucidating an otherwise complex problem as a basic and classical stress-strain problem, the basic concept of which is very fundamental to all of engineering material analysis and had been there all along. In the words of M. J. O'Dogherty of Cranfield University in the United Kingdom in 1989, a leading authority in the field, "identification of

the compression ratio model represents a p...found elucidation of the mechanics of biomaterials' compression/compaction". The work brought out the shortcomings of empiricism and empirical relations - they only exist when we fall short of identifying the underlying theory of a fundamental concept.

I have come a long way from then to respect the idea of life and its image of processes being ordered or ordained. Not much in life is accidental. Even from the beginning of creation God ordained order, He created everything, and man in his own image, they were beautiful to behold and he was happy. He proceeded to put everything else "at the beck and call of mankind to rule over the seas and the land", thereby distinguishing us from the beasts of the wild and the owls of the night, and other inorganic matter. He gave us life, and enthroned ***living*** – good livelihood. Man derailed and fell short of His grace. Since then we have been living in the empirical realm, striving ceaselessly for perfection, the elusive fundamental theory of our lives. So we must realise the inadequacies of empiricism and always strive to unravel the fundamental theories of all human processes – physical, biological, economic and indeed social. Albert Einstein puts this more succinctly in his inaugural treatise of 1913 when he asserted:

> **to establish the principles which can serve as the basis of a researcher's deductions, there is no learnable, systematic applicable method which would lead him to that objective. The researcher must rather eavesdrop on nature to become privy to these general principles, by recognising in larger sets of experimental facts certain traits that can then be strictly and precisely formulated. Once this formulation is achieved, a chain of conclusions sets in, often with unforeseen connections, far transcends the domain of the facts from which the principle has been wrested. However, as long as the principles that must serve as the basis for the deductions remain undiscovered, the individual experimental fact is of no help to the theoretician. In fact, he cannot even do much with individual empirically established general laws. Instead, he must rather remain in a state of helplessness vis-à-vis the individual results of empirical research until principles reveal themselves to him so that he can make them the basis of deductive developments.**

I equally find distinguished support for this position in the writing of Louis Pasteur, the inventor of *penicillin*, who said "without theory, practice is but the routine of habit", and defined theory as "when you understand everything but nothing works", whereas practice is "when it works and but nobody understands why, and that theory and practice is when nothing works and nobody knows why". In reality, we do need a blend of both theory and practice, but theory is the basis of successful practice. This reminds me of the other dimension of this dichotomy as elucidated in 1999 by Ziman, a Professor of Work Study at the Imperial College of Science and Technology, London, who refers to ***"a scientist as one who knows more and more about less and less until he knows everything about nothing, in contrast to a philosopher, who knows less and less about more and more until he knows nothing about everything"***.

Our pioneering theorisation then became a prelude to a career in biomaterial properties and bioprocess engineering, back here at Ife, just as this variant of Agricultural Engineering that had emerged in North America in the early eighties started gaining global prominence, and became the new fad until today. I shall expound more on the compression ratio model, its extensions to juice dewatering and oil expression, and application to the design of agricultural process machinery in the course of this lecture.

IMPERATIVES OF RURAL DEVELOPMENT IN AFRICA

Africa remains a rural society largely dependent on agriculture and pastoralism. Even in our dear oil-rich country, Nigeria, Agriculture can still be the mainstay of the economy and a potential major producer

o. national income. Eighty percent of Africans live in the rural areas and produce almost four-fifths of national food output. Yet their needs together with the opportunity to build a strong rural economy have been by-passed. Instead, governments have given priority to the demands of the 20% urban elite in the cities. By focusing resources on urban and industrial development, many governments have placated urban concentrations of population, who might otherwise have proved de-stabilising politically, but the consequences overall are now all too apparent – economic stagnation or regression.

At independence, Africa largely fed itself and was a leading exporter of palm oil (75% of world trade during World War II), coffee and cotton, and also timber, tea and groundnuts. Now Malaysia and Indonesia between them, control over 80% of world trade in palm oil, producing more than the whole of West Africa put together. Indonesia, which was an insignificant coffee exporter 30 years ago, now exports more than either Cote d' Ivoire or Uganda, Africa's two principal producers. Food production has fallen so far behind population growth and the continent has been reduced to dependence on imported food. Some of the food required is provided as food aid but much has to be purchased either with scarce foreign exchange or borrowed funds, at astronomical interest rates. It has been estimated by FAO that by 2010, Africa would need US$28.7 billion to import food to supplement regional production. Yet it will be receiving less than US$12 billion from the export of its agricultural products. No doubt, Africa faces the double problem of an increasing need for food imports and declining ability to afford them. Even if Africa could afford them and even if Africa could afford to pay for the increasing quantity of food it will need, or if other countries could give the food free, the continent lacks the transport infrastructure- docks, roads and railways- to distribute such a huge quantity of goods.

As I speak, the world's agonising spotlight is once again on Africa, the land of famine and man-made disasters. There is famine in Niger, just up north from here, and people, children, are dying in their

hundreds. The international news networks are again agog with pictures and footages of miserable, helpless and dying Africans. Food aid is being organised, airlifted and rushed to the sahel. Thank God Nigeria is in a position now to contribute to food supplies, and a Committee has been set up, under the leadership of House Speaker Aminu Masari, to coordinate this and further response from the Nigerian public. Very soon we may be hearing of mismanagement of the aid or infighting to control and misappropriate the supplies in Niger – the pitiable analogy of '*eni ri nkan he...*' While Israel has turned her desserts into agricultural fertile and productive lands, and the Netherlands boast of highly productive reclaimed lands, which enable the country to dominate the European flower and ornamental markets, drought and food shortage rule the land in the sahel.

One Feasible Option

To survive economically, African countries have a feasible option of investing in mobilising and developing the rural sector. This is one of the messages of the British Commission for Africa's "*Our Common Interest*". One of the declarations in the report summarises the plight of the African poor thus "the Commission for Africa finds the condition of the ***lives*** of the majority of Africans to be intolerable and an affront to the dignity of all mankind. We insist upon an alteration of these conditions through a change of policy in favour of the week. Ironically in the past, many African governments had given commitments to do this. As long ago as 1980, the Lagos Plan of Action for Economic Development of Africa, which was approved by the special session of the Assembly of Heads of State and Government of the OAU, affirmed the need "for an effective agricultural revolution in Africa". The Assembly insisted that policies had to emphasise consistently the need not only to improve the ***living*** condition of the farmers, but also to increase real farmer income as a means of making agriculture more attractive and remunerative. In effect, African policy makers recognised that the road to effective agricultural development is through rural development. Then, in 1986

at the meeting to discuss the African Priority Programme for Economic Recovery (APPER), Heads of State agreed that 25% of national budgets be directed to the agricultural sector. Similar commitments were made at the Popular Participation declaration in Arusha in 1989, and at the African Heads of State meeting in Addis Ababa in 1990. Yet no African government has ever committed such a proportion of its funds to rural development. In contrast, India had consistently directed a substantial part of the national budget to rural development peaking at 30% under Indira Gandhi in her first term in office (CTA, 1994). Almost everywhere in the world, a firm foundation of rural development has been an essential precursor to industrial growth and urban employment (exceptions are city states such as Hong Kong and Singapore and the oil-based economies of Saudi Arabia and the Gulf States).

The most important, though not the only, economic rural activity is agriculture and a healthy agriculture provides food self-sufficiency, employment and a surplus for export. It also forms the basis for small scale industrialisation based on agricultural service industries including agro-processing, manufacture and repair of farm implements, transport and financial infrastructure for banking and credit. As successful small businesses grow, experience and resources are available for investment in new ventures. Meanwhile the rural population, provided with employment opportunities both in agriculture and its supporting services and industries can remain, for the most parts, in their hometowns and villages, which in turn grow and develop. Mass migration to a few cities is avoided, together with the strain on urban services that unplanned settlements invariably cause.

Planning a Better Future through the Participatory Livelihoods Approach

Failures in rural development go beyond lack of sufficient investment for much of the investment that has been committed to rural development has not achieved expected targets. Causes of the failure

include inappropriate design and implementation of projects and ineffective support services, and endemic corruption. Rural people are central to development projects, yet seldom has project planning been based on the participatory bottoms-up approach, which involves establishing needs and priorities as perceived by the people who will be involved in the projects. When asked, their priorities are usually different from those imagined by expatriate planners or government officials. When local people are consulted in the preliminary stages, not only is their local/indigenous knowledge utilised, they themselves also feel involved. Indeed, if they are provided with meaningful roles within the project they come to view it as "their project" and are more likely to commit themselves as individuals and as a community. This helps to ensure a sustainability that may otherwise be lacking. This is the fundamental underpinning of the livelihoods approaches, which all derive their origin from the work of Chambers and Conway in the early 1990s.

In contrast to this concept, when projects are imposed on rural people, they may appear cooperative during the project's life but as the project comes to an end and members of staff are withdrawn, there is neither the management experience nor the interest among local inhabitants to maintain momentum. It is now being realised that if local people are trained to do so they can take over day-to-day management when project staff depart and, in many situations, there is no need for civil servant to be employed on a long term basis. This thus provides sustainability and considerable savings in salaries.

Finance is the lubricant if not the fuel of commerce and, if agriculture is to develop beyond subsistence and bartering, government funding organisation and commercial banks will have to be more forthcoming with the credit facilities required. There is risk and there is cost in administering small loans to large numbers of farmers. There is also frequently a lack of collateral. But experience in Asia and Africa has shown that lending very small amounts to individuals can result in both very high returns and excellent repayment. Functional numeracy

and literacy go hand-in-hand with money management and all three contribute to the development of individuals and communities. On the other hand, education raises expectation, one of which is the aspiration to do more than manual work. Agro-processing using small-scale equipment offers both an alternative employment to agriculture and an opportunity to add value to local produce. Currently the majority of agricultural products leave rural areas to be processed either centrally in the country of origin or in an importing country. This results in a loss of employment and wealth to the rural sector.

Certainly there are economies of scale in centralised processing of grain, manufacturing fruit and vegetables into conserves and relishes, crushing oilseed, compounding animal feeds, making dairy products such as cheese, and packaging herbs and spices. But to be efficient, large centralised facilities require a constant and high volume of throughput, which is difficult to maintain. Dispersed local processing on a smaller scale is usually more-intensive, requires less investment in sophisticated, modern plants, is closer to the source of supply, produces a smaller volume of higher value products which are easy to transport, and leaves residues in rural areas where they have a better chance of being utilised rather than in urban areas where they are at best a nuisance and at worst a pollutant.

The Sustainable Livelihoods Approach

Chambers and Conway, define "a *livelihood* as comprising of the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood (SL) opportunities for the next generations; and which contributes net benefits to other livelihoods at the local and global levels and in the long and short term" There are six basic principles underlying the sustainable livelihoods approach. The activities should be: people-centred, responsive and participatory, multi-level, conducted in partnership with both the public and private sector, sustainable

economically, institutionally, socially and environmentally, must be dynamic, and should be informed by an underlying commitment to poverty eradication. There is great emphasis on capital assets of which five categories were identified as follows: natural, social, human, physical and financial, while the need to maintain an 'outcome focus' was stressed, thinking about how development activity impacts upon people's livelihoods, and not only about immediate project outputs. One is taken aback why most of these elaborate development frameworks failed to stand out technology as a key asset rather than viewing it as a means of contributing to human capital.

Integrated Rural Development versus the Sustainable Livelihoods Approach

One of the early 'criticisms' that has been levelled at the livelihoods approach is that it is too similar to the failed integrated rural development (IRD) approach of the 1970s. It is easy to see where this reflection is coming from as the two approaches share much in common. But the sustainable livelihoods approach endeavours to build upon the strength of IRD (especially the recognition of the need for broad-based support in rural areas) without falling into the traps that caused IRD's downfall. In particular, the livelihoods approach does not aim to establish integrated programmes in rural areas. While recognising the importance to rural poverty reduction of a wide range of factors it targets just a few core areas (with the help of thorough analysis of existing livelihoods and a bottom-up participatory planning process) so that activities remain manageable. The livelihoods approach also addresses macro-level and institutional factors where these are major constraints. IRD, by contrast, was forced to operate within a hostile micro-economic and institutional environment, dominated and often heavily distorted by government.

T. .e 2: Sustainable Livelihoods Approach Compar. vith Integrated Rural Development

	Integrated Rural Development (1970s)	Sustainable Livelihoods (late 1990s)
Starting point	Structures, areas strengths and constraints	People and their existing
Conceptions of Poverty	Holistic, multi-dimensional; Recommendation domains suggest uniformity (an operational simplification)	Multi-dimensional complex, local; embraces the concepts of risk and vulnerability
Problem Analysis	Undertaken by planning unit in short period of time, viewed as conclusive	Inclusive process, iterative and incomplete
Sectoral Scope	Multi-sectoral, single plan; Sector involvement established at the outset	Multi-sectoral, many plans; Small number of entry points; Sectoral involvement evolves with project
Level of Operation	Local, area-based	Both policy and field level, clear links between the two
Partner Organization	National and local governments	Local and national governments, NGOs, civil society organizations, private sector
Project Management Structure	Dedicated project management unit, external to government	Project within partner organizations
Co-ordination between Sectors	Integrated execution (donor driven)	Driven by shared objectives, benefits of co-ordination identified by those involved
Sustainability	Not explicitly considered	Multiple dimensions; Core concerns

Source: DFID (2001): Sustainable Livelihoods Guidance Sheets

POVERT . IN NIGERIA

The socia! conditions in Nigeria present a startling paradox; her robust endowment in natural and human resources, the level of poverty of our people stands in contrast to the country's vast wealth. For decades, the country has struggled with the issue of socio-economic development, which has remained in decline in the face of increasing revenue from crude oil. The deepening incidence and dynamics of poverty in Nigeria have stratified and polarised the Nigerian society between the haves and have-nots, between the north and the south, between the educated and uneducated; poor parents beget poor off-springs (creating a kind of dynasty of the poor). The resulting tensions and social conflicts have eroded the fabric that held society together. The resulting challenge of development is not only the need to reform the economy for enhanced economic growth, but also how to empower the citizenry as a means of revitalising the weakened social pillar. This calls for the human rights approach to development planning, which places human beings at the centre of development efforts. The added value provided by this approach is that the norms and values enshrined in it have the potential to empower the poor, since it is now widely recognised that effective poverty reduction is not possible without the empowerment of the poor.

Poverty reduction is the most difficult challenge facing Nigeria and its citizens. It is also the major hurdle that must be overcome in the pursuit of sustainable socio-economic growth. Available statistics (Table 3) indicate that the poverty rate of the population increased from 27% in 1980 to about 70% by 1996. By 1999, it was estimated that more than 70% of Nigerians lived in poverty. Among other indicators, the gender composition of primary school enrolment in Nigeria showed little or no change during the decade of the 1990s, with the female share being consistently below 50% though a modest improvement emerged in the year 2000. Life expectancy is unsatisfactorily low at 54 years. Infant mortality at 77 per 1000 and

maternal mortality at 7.04 per 1,000 live births are among the highest in the world. Other available indicators show the following unsatisfactory picture:

- Only about 10 % of Nigerians in 1999 had access to essential drugs;
- Physicians per 100,000 people were fewer than 30;
- Over 5 million adult Nigerians have been estimated to be living with HIV/AIDS; a number that may be currently exceeded;
- Of the children under 5 years of age in 1999, close to 30% were classified as underweight;
- The proportion of children fully immunised had dropped from 30% in 1990 to 17% in 1999 and almost 40 % of the children in the latter year had never received any vaccination;
- Access to safe drinking water in 1999 was limited to about 50% of the population, and less than 40% of the rural population had access to safe drinking water, as against about 80% in urban areas;
- Some 29% of the total population live at risk from annual floods;
- Over 90% of the rural population depend on the forest for livelihood and domestic energy;
- Up to 1.5 hours a day on average are spent by rural households to collect water and fuel wood, with household members walking an average of one kilometer a day to collect water and fuel wood;

Qualitatively, poverty in Nigeria has many manifestations and dimensions, including joblessness, over-indebtedness, economic dependence at adult age, lack of freedom, and inability to provide the basic needs of life for self and family. Other characteristics include

lack of access to land and credit, and inability to save on own assets. The poor tend to live in dirty localities that exert significant pressures on the physical environment, thereby contributing, however inadvertently, to environmental degradation. The poor, especially peasants, perceive their general economic circumstances to be excessively fraught with uncertainty, including those relating to the behaviour of primary commodity prices, the volume of rainfall, pest attacks, fire outbreaks, changes in soil conditions and social conflicts. However, lack of food is the most critical dimension of poverty, which is reflected in the popular saying that "when hunger is excised from poverty, the burden of poverty is light" (*bi ebi ba kuro ninu ise, ise buse*). We also pray that "may God not inflict hunger on us in the twilight of our life" (*ki Oluwa ma fi ebi ale pa wa, Amin*).

Table 3: Nigeria - Poverty Incidence Indicators, 1980-96
(The poor as a percentage of the total in the specified groups)

	1980	1985	1992	1996
National	28.1	46.3	42.7	65.6
Geo-Political Zones				
(i) North East	35.6	54.9	54	70.1
(ii) North West	37.7	52.1	36.5	77.2
(iii) North Central	32.2	50.8	46	64.3
(iv) South East	12.9	30.4	41	53.5
(v) South West	13.4	38.6	43.1	60.9
(vi) South South	13.2	45.7	40.8	58.2
Sector				
Urban	17.2	37.8	37.5	58.2
Rural	28.3	51.4	46	69.3

Gender of Head of Household				
Male	29.2	47.[illegible]	45.1	66.4
Female	26.9	38.6	39.9	58.5
Size of Household				
1 Person	2	7	29	13.1
2-4 Persons	8.8	19.3	19.3	59.3
5-9 Persons	30	50.5	51.5	74.8
10-20 Persons	51	71.3	66.1	88.5
20+	80.9	74.9	93.3	93.6
Education of Head of Household				
No Education	30.2	51.3	46.4	72.6
Primary	21.3	40.6	43.3	54.4
Secondary	7.6	27.2	30.3	52
Post-Secondary	24.3	24.4	25.8	49.2
Age of Head of Household				
15-24 Years	16.2	25.3	28.7	37.4
25-34 Years	17.8	33.4	28.5	52.7
35-44 Years	26.7	46	42.1	64.6
45-54 Years	27.1	49.7	45.7	71.3
55-64 Years	39.7	55.7	48.2	69.9
65+ Years	28.8	49.1	49.5	68

Source: Federal Office of Statistics. Note: A recent nation-wide household survey by FOS will provide up to date statistics on the state of poverty in Nigeria.

NIGERIA'S NATIONAL ECONOMIC EMPOWERMENT AND DEVELOPMENT STRATEGY (NEEDS)

Nigeria now envisions a 21st century that is Africa's century, and with Nigeria among the leading nations. The most recent articulation of this vision as embodied in the 2001 Kuru Declaration is as follows:

> **To build a truly great African democratic country, politically united, integrated and stable, economically prosperous, socially organized, with equal opportunity for all, and responsibility from all, to become the catalyst of (African) Renaissance, and making adequate all-embracing contributions, sub-regionally, regionally and globally.**

From the NEEDS document, "the Mission of President Obasanjo's Government is to use the instrumentality of the National Economic Empowerment and Development Strategy (NEEDS) as a nationally coordinated framework of action in close collaboration with the State governments and other stakeholders to consolidate the achievements of 1999-2003, and build a solid foundation for the attainment of this long-term vision. Over the medium term, NEEDS would lay the foundation and achieve significant progress in the areas of wealth creation, employment generation and poverty reduction. It is to initiate a process of national self-rediscovery and advocacy of strong values based upon:

- Enterprise, competition and efficiency at all levels
- Equity and care for the weak and vulnerable
- Moral rectitude, respect for traditional values and extolling our culture
- A value system for public service that makes for efficient and effective service delivery to the citizens
- Discipline at all levels of leadership

Reading the NEEDS document, very deeply and dispassionately, one can discern its central hallmark: "***NEEDS is about people, their welfare, their health, education, employment, empowerment, security and participation". It is about poverty-reduction, and its overarching ultimate goal is to lead to an enhancement of the life, livelihoods and good living or wellness of the people.*** To this extent, then, it accords with the "Fundamental Objectives and Directive Principles of State Policy" in the 1999 Constitution of the Federal Republic of Nigeria, which mandates as follows: that "the security and welfare of the people shall be the primary purpose of government; that the state shall direct its policy towards ensuring, among other things, that suitable and adequate shelter, suitable and adequate food, reasonable national minimum living wage, old age care and pensions, and unemployment, sick benefits and welfare of the disabled are provided for all citizens".

Thus, in NEEDS, a key strategy of the social charter is **inclusiveness and empowerment,** not just on the economic front, but deliberate programmes to give voice to the weak and the vulnerable groups through increased participation in decision-making and implementation, and laws and programmes to empower women, children, the handicapped, and the elderly. In NEEDS, education is seen as the most important bridge to the future and a powerful instrument of empowerment. In NEEDS, the HIV/AIDS epidemic is regarded not as just as a social problem, but a major threat to productivity and hence the economy. Industry, especially the SMEs, is expected to provide a boost to employment, particularly to the urban labour force. In NEEDS, priority to agriculture (especially to improve the productivity of peasant farmers) is a key element of the poverty reduction strategy since over 50 percent of the poor are in agriculture. The continuing investment in water resources not only provides a key social service, i.e. water to the people, it also provides water for irrigation to enhance agricultural productivity. An ***integrated rural development programme*** was to be the major strategy to stem the hugely discomforting rural-urban migration.

I looked back in time to the articles establishing the subsisting Poverty Alleviation Programme (PAP), the Family Economic Empowerment and Advancement Programme (FEAP), which preceded it, the Directorate of Food, Roads and Rural Infrastructures (DFRRI), Operation Feed the Nation (OFN) of qld, the River Basins Development Authorities (RBDAs), National Accelerated Food Production Programme (NAFPP), etc, as well as at the VISION 2010 document. I looked back in time to the elements of the 1st, 2nd and 3rd National Development Plans (1970-74, 1975-1980, and 1980-1985), and I also looked back into the African Lagos Plan of Action of 1970. I looked back in time to the programmes of the late Sage Chief Obafemi Awolowo, and his later counsels after he had been conspiratorially denied ascension to the national centre stage. I find not much significant addition to what he had preached, or what some serious components of the other documents had enunciated.

So the problem would seem really not to be in our stars or our brains, but in our hands and our hearts. The problem has, to a large extent, not been in the fine details of the plans and development papers but in their practical implementation and the lack of commitment to our collective existence, which corruption implies. Perhaps then, NEEDS has one essential difference because it agrees with this contention and so has this to say: ***"Over the years, ineffective implementation of plans has been a major issue. NEEDS is poised to be different: it is a plan on the ground. A key element of the implementation relates to a system of collaboration and coordination between the Federal and State Governments, donor agencies (through more effective donor coordination), the private sector, civil society, NGOs and other stakeholders".*** It continues, ***"Ultimately, the acid test of NEEDS is the implementation, and the President and his team are determined to make a fundamental difference. The President personally chairs a weekly (90 minutes) meeting of the Economic Management Team, designed to monitor and coordinate implementation among key agencies and ministries. The agenda also is focused and selective,***

and there are aspects of it to be implemented by the private sector, NGOs and donor agencies". The States, Local Governments and Wards are to formulate their own versions of the strategy with assistance from the central coordinating office, so that invariably we shall have States Economic Empowerment and Development Strategy (SEEDS), Local Governments Economic Empowerment and Development Strategy (LEEDS), Wards Economic Empowerment and Development Strategy (WEEDS) and indeed Nigerians (as sharp as always) are already contemplating weird extensions to these as follows (see The PUNCH of Sept 3, 2004, p.44 for advert on MBO Economic Summit, by the MBO Local Government of Akwa Ibom State): Village (or Community) Economic Empowerment and Development Strategy (VEEDS), Family Economic Empowerment and Development Strategy (FEEDS) and Personal Economic Empowerment and Development Strategy (PEEDS).

Also, and as a most significant departure from the past, the strategy acknowledges that "corruption and fraud need to be fought ruthlessly (a whole chapter of the document – Chapter 6 is devoted to the issue of combating corruption – analysis of its genesis, dynamics, impact and mitigative measures); infrastructure decay needs to be reversed and the private sector empowered to become competitive and lead the growth process; and the weak and vulnerable groups need to be lifted up". A key aspect of the institutional reforms is to fight corruption, ensure greater transparency, promote the rule of law and stricter enforcement of contracts. Notably too, though yet on paper, "an explicit Service Delivery Programme to re-orientate government agencies towards effective delivery of services to the people is being introduced in government for the first time". In summary, "the goal is to make government and public institutions serve the people: to make government play a developmental role, rather than a haven for corruption and rent-seeking, under a regime of predictable and sustainable macroeconomic framework, especially through a sustainable fiscal policy framework".

One other major aspect of NEEDS, which complements its anti-corruption and anti-rent seeking stance, is the design to shrink the domain or role of the government to becoming a facilitator "providing the enabling environment for private sector to invest and operate in a free market system", with less bureaucracy and less obstacles to investment. The document states:

> **The strategic intent of government is to diversify the productive base of the economy away from oil and foster a market-oriented private sector driven economic development with strong local participation. The overarching goal is to develop, in the process, an indigenous entrepreneurial class capable of competing in a global market where technology and skills play dominant role. As government continues to redefine its role, resources will be freed up and hence government is better focused to take up its primary role of providing basic infrastructure, security, defence, and other social services, which are necessary for creating a competitive environment and for private-sector driven wealth creation and employment generation, on a sustainable basis. The private sector on its part will be encouraged to commit to genuine and responsible investment, good corporate governance and citizenship, subscribing to internationally acceptable standards of quality, business ethics and practices. It must also commit to transparent partnership with the public sector especially in the promotion and development of Small and Medium Enterprises.**

Agriculture under NEEDS

As earlier noted, under NEEDS programme, agricultural development is to be pursued vigorously with the aim of achieving food security

and poverty reduction. The major constraints which hitherto inhibited private sector participation in the transformation of agricultural production were identified to include:

a. The rapid shift of population from rural to urban areas and the perceptible shift in consumption patterns from local to imported food items – rice, poultry, etc;

b. Lack of funds, inadequate processing and storage facilities as well as inefficiencies in input supply and distribution;

c. Oil boom, policy inconsistency and decline in political commitment to agricultural and rural development;

d. Inadequate incentive framework and pervasive distortions in the macro-economy. Absence of price support mechanism and pervasive distortions in macroeconomic and sectoral policies including misaligned exchange rates, heavy explicit taxation of agricultural exports;

e. Continued dependence on rain-fed agriculture and the absence of economy of scale;

f. Land tenure system that inhibits the acquisition of land for mechanized farming;

g. Inadequate Agricultural Extension Services and lack of indigenous capacity or technologies responsive to local conditions.

Policy Thrust

Investment in food and agricultural production is to be increased with the following as the cardinal policy thrust:

a. Providing the right policy environment and vigorously targeted incentives for private sector investment in the sectors (Government will implement a new agricultural and rural development policy aimed at addressing the foregoing constraints);

b. Fostering effective linkage with industry to achieve maximum value addition/processing for export;

c. Creating more agricultural and rural employment opportunities to increase the income of farmers and rural dwellers through the modernization of production and creation of an agricultural sector that is responsive to the demands and realities of the Nigerian economy;

d. Reversing the trend in food import (which stood at 14.5% of total imports at the end of 2001), through a progressive programme for agricultural expansion. (Government is committed to reducing the growing food import bill to stem the rising trade imbalance as well as diversify the foreign exchange earning base of the economy);

e. Striving towards food security and generating surplus for the export market.

Targets

The objective of NEEDS is stated to include restoring agriculture to its former status as a leading sector in the economy in terms of its contribution to GDP, supply of raw materials, employment generation, source of export, local consumption and hence food security. Agricultural policy under NEEDS therefore, has the following targets:

1 Achieving minimum annual growth rate of 6% per annum in agriculture;

2 Achieving $3 billion in agricultural exports, a major component of which will be through cassava export, by 2007;

3 Drastically reducing food imports from 14.5% of total imports to 5% by 2007;

4 Developing and implementing a scheme of land preparation services to increase cultivable arable land by 10% annually and foster private sector participation through incentive schemes.

Strategies

The following strategies were to be employed:

1 Vigorous implementation of the Presidential Initiatives on cassava, rice, vegetable oil, sugar, livestock, tree crops and cereals;

2 Taking advantage of the various concessionary arrangements within the WTO, EU-ACP, and the AGOA, NEPAD and the huge market in the West African Sub-region;

3 Strengthening of agricultural research and revitalisation of agricultural training and streamlining the extension delivery system including the involvement of non-governmental organisations (NGOs) and opinion leaders in extension delivery through *capacity building and promotion of improved technologies that are appropriate to the needs of farmers;*

4 A review of the agricultural input supply and distribution system with a view to developing effective and sustainable private sector-led input supply and distribution system;

5 Promotion of integrated rural development involving agricultural and non-agricultural activities and including the provision of physical infrastructure such as feeder roads, rural water supply, rural communications etc;

6 Encouraging states to develop projects of model rural communities and farm settlements adequately provided with feeder roads, boreholes, vocational training, simple farm tools and equipment, alternative energy source and communication centers for a wholesome life to reduce rural-urban drift;

7 Adequate capitalisation of the Nigerian Agricultural, Cooperative and Rural Development Bank (NACRDB) to provide soft agricultural credit and rural finance (the NACRDB has been restructured and its mandate expanded to include full financial intermediation);

8 Refurbishment of the eight functional silo complexes and phased completion of the remaining ones to improve and increase the capacity of the food reserve programme as a step to food security. These would be leased out to farmers either on individual or group basis;

9 Promotion of joint-venture private sector managed multi-commodity development and marketing companies to guarantee remunerative prices for farmers, stabilise consumer prices and provide alternative markets for farm produce through buyer-of-last-resort mechanism; and

10 Promotion of all-season farming through rain-fed and irrigated farming with emphasis on fadama agriculture as well as implementation of the programme for the massive production of tree crop seedlings.

Can NEEDS Work?

While I agree with NEEDS in general terms on these sentiments, and commend some of its radically bold initiatives, particularly the need to fight corruption and enthrone transparency and eradicate rent-seeking, we need to look very closely at the adoption of an integrated rural development (IRD) strategy to address poverty reduction at the rural interface. Though IRD, which was basically the cornerstone of DFRRI, has had its time in development history, it is now a dead concept as I had enunciated in the immediate preceding section (See Table 2).

One of the forefathers of agricultural engineering, Professor Fola Aboaba, formerly of the University of Ibadan, who has now equally made his mark in the corporate world of business, agreed that NEEDS appears to be a good plan on paper, but expressed many concerns as to some of its underpinning concepts and its implementation plan. For example, he wondered if "the Nigerian private sector has enough economic backing and knowledge to handle the gigantic

responsibility" being literally trusted on its shoulder. He then made the following suggestions to support and rescue NEEDS:

1. Breaking down the big picture, i.e. detailing activities to the lowest level of implementation;
2. The need for massive education/enlightenment. (Many Nigerians do not know about NEEDS, neither do even many elites, scholars and students/youths (tomorrow's leaders!) have access to its guiding philosophy...., its documents. The degree of value re-orientation required to enshrine its new tenets in our psyche should not be underestimated);
3. Identifying our strengths (existing knowledge and capabilities) and comparative advantages and converting them into value;
4. Creating an environment where new ideas can find expression, by designing incentives/rewards and protection for creativity and intellectual property.

I agree entirely with these suggestions, which indicate that government is not matching the enormity of the task of the necessary transformation with adequate implementation activities. The anticipated sector-wide coordination (intra- and inter- governmental) and national-state-LG coordination of NEEDS, SEEDS, LEEDS and WEEDS are not evolving at a pace that inspires hope and confidence, yet the programme is almost midway for its initiating administration and the drums for their exit in 2007 are already beating loudly! It will be vary sad if an otherwise seemingly very promising programme is made to suffer the political haemorrhage that usually attends changes in political leadership, which has been the hallmark of Nigeria's instability, and hence the non-sustainability of previous plans and programmes as lamented earlier on.

Apart from the foreseen problems of implementation, there are other concerns that need to be addressed.

- Why the low allocation to agriculture in the financial provisions and indeed the first NEEDS budget in spite of the high expectations and the grand standing on the place of agriculture in the narratives?
- What is the cost of implementing NEEDS in its totality, at its various levels and sectors, in order to allow the various stakeholders anticipate the enormity of tasks designed for them? For example, what level of investment is required by the private sector, and by the States, LGs, Wards etc, not just by the Federal Government alone?
- How shall sectoral planning be coordinated and harmonised? For example (only one example!), integrating land and water resources planning for agriculture and rural development – transportation, energy, electricity, communication, water supply, etc in an economically and environmentally sustainable way, which though is the global best-practice, is not apparent in the strategy document.
- Lastly and most importantly, technology. Is there a technological base for NEEDS? If not, is one being created?

On this last point, there is the need to make a few more remarks. Critiques of NEEDS abound in the print press, but my reading is that many of these are hasty, lazy and non- cerebral. While NEEDS cannot (and should not) lay claim to perfection, it is a strategy that has a lot of potentials, at least on paper. However, I find myself strongly in agreement with Bala Usman, though on a different pedestal: if NEEDS fails, as he predicted it is bound to do, it will not be due to its advocacy of the market economy with a strong private sector involvement, rather it will be because it ignores and despises technology – the new power of development. NEEDS has not made "technology" and its critical success ingredients – education and research - the centre piece of the strategy for development", and I consider this omission to be fatally flawed, considering what one technology alone, ICT, has done to

space and time, and hence human livelihoods. Can NEEDS inspire and sustain internal technological creativity? What are the boundary conditions (a.k.a constraints) to national technological creativity? In this age of technology, NEEDS should rather be a **technological advancement and transformation strategy**, rather than just an economic empowerment and development strategy. The difference is fundamental and non-trivial. Technological transformation is the bedrock of modern development. Paying econometric lip service to it is like shooting oneself in the leg. It may amount to "*the proverbial cyclic dance of fools*". Nigeria has done enough of this to date and that is why we are where we are today. '**Without technology, all that labour for development do so in vain'.** This is the thesis of this inaugural lecture. My fear then, and I am known to be an incurable optimist, always dreaming and never giving up on possibilities, is that NEEDS may in the end, like many other programmes preceding it, end up as a catalogue of *"inane economic precepts and homilies"* that will once again take Nigeria back to square one, where hopes and aspirations are ruptured to failure. Let's pray then that some usually clever Nigerians will not dub it '**National Empowerment Eradication Disaster Strategy or Syndrome'.**

OBAFEMI AWOLOWO UNIVERSITY'S CONTRIBUTION TO NATIONAL DEVELOPMENT THROUGH AGRICULTURAL ENGINEERING

At the time the Faculty of Technology at Ife came into existence in 1970, the University set itself the goal of developing areas of engineering and technology that were not adequately covered by existing University programmes in the country. This was why it started by first developing programmes in Agricultural Engineering, Chemical Engineering, Computer Science, Electronic Engineering and Food Science and Technology. By 1974, the Technology Planning and Development Unit (TPDU) was established primarily to conduct policy research on how to harness Science and Technology for Economic Development, working in close collaboration with the

Departments in the Faculty. Its establishment underscored the critical need for research capability and advisory capacity to assist government and other policy-making bodies in reaching decisions about the allocation and monitoring of resources for the development of scientific and technological capabilities in Nigeria and in other less developed countries. It was however realised from the beginning that by the time the programme in Agricultural Engineering is fully developed, considerable amount of equipment would have been accumulated for teaching the science and practice of Civil and Mechanical Engineering. Thus, it became clear that these traditional areas of engineering needed to be developed, and the University decided in 1977 to nurture Civil Engineering in the Department of Agricultural Engineering and Mechanical Engineering in the Department of Chemical Engineering. The evolution of the Faculty and its attainments over the years has always been a source of pride to the University and its teeming Alumni, who now occupy strategic places in the national economy.

The Departments of the Faculty, which today number up to eight plus the TPDU, have collectively made significant contributions to the development of indigenous technology in the country. In particular, in the areas of agricultural mechanization and crop/food process technology, the Department of Agricultural Engineering has produced some landmark innovations including the most popular of them all and the only one so far commercialised, the yam pounding machine (Fig. 1), now manufactured and marketed by ADDIS Engineering Nig. Ltd, a leading agricultural machinery manufacturing company in the country. This machine, in its laboratory and commercial versions (Fig. 2) provides for us a model not only for teaching students the rudiments and intricacies of machine commercialisation but also for explaining to potential investors and anyone who cares the wide gap between the two versions in order to emphasise the huge challenge facing us in our quest for technological transformation. Perhaps people will be more appreciative and sympathetic to design engineers who

suffer the double tragedy of being unrewarded and unfulfilled because the labour of a designed machine that fails to hit the market and impact on human livelihoods is labour lost.

Other machines, in the early life of the Department include the semi-automated cassava stem planter, melon sheller, kenaf decorticator, maize, cowpea, soybean shellers, different types of planters and many others. These machines and indeed the overall achievement of the Department stand as a good testimony to the good foundation of excellence laid by the pioneering staff of the Department and those who joined them in the early years to firmly establish the Department nationally and in the global domain. The name of (now Emeritus) Professor Gabriel Ayodele Makanjuola, who was later to supervise my M.Sc thesis and also mentored me to proceed to the University of Newcastle upon Tyne to obtain my Ph.D, like he did eight years before me, bestrides these annals. By not fully exploiting the immense potentials and capabilities of this colossus, and extraordinary machine designer and many of his ilk (some present at this lecture), Nigeria is the loser.

I must also mention Professor M. T. Ige, who supervised my B.Sc project work in 1977/78 and with whom I wrote my first ever technical article, Professor Fola Lasisi, a consummate and passionate professional civil/structural engineer, former Vice Chancellor of the University of Uyo and Professors Sola Ogedengbe and O.O Mojola, who were later to pioneer the development of Civil and Mechanical Engineering Departments respectively. There were several others, including expatriates, who stayed a while and left. In good time the second generation of staff, mainly alumni and beneficiaries of the then dedicated staff development programme came on board in the early eighties. Many of them today are distinguished professors, including Professors O.O Ajibola, L.O. Adekoya and last but not the least, Henry Fapohunda, who helped to nurture the Soil and Water Engineering option earlier developed by Drs Abiodun, Ogedengbe and Co., but passed on to eternity in 2001 while serving as Head of Department.

Fig. 1: The Yam **Pounding Machine, developed at OAU, Ile-Ife by** Prof. G. A. Ma**kanjuola (Commercial version, manufactured by** ADDIS Engineering, **Lagos)**

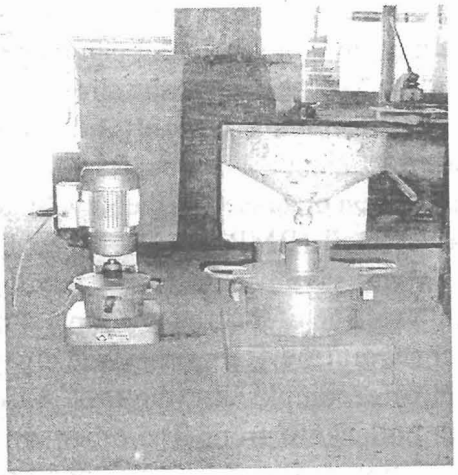

Fig. 2: The Yam Pounding **Machine: Lab prototype (right),** Commercial **version (left)**

In recent times working with younger colleagues and our students, we have developed more gadgets for processing a variety of tropical crops especially cassava, oil palm fruit

and palm kernel. The **IFESIFTA** (Fig. 3), a machine for sifting pressed cassava mash, in place of the tedious and inappropriate traditional woven raffia sieve, *won a national innovation award* in a 2002 exhibition by the National Office of Technology Acquisition and Promotion (NOTAP). An improved version of the machine which now combines gari frying (**the automated OAU cassava sifter and fryer** – Fig. 4) won the University and the designers (Engr L. A. Sanni and I) the outstanding contribution award at the 1st Nigerian Universities Research and Development Fair, at which OAU also placed 2nd overall in November 2004. It is noteworthy that the University has now employed the graduate who first worked on this machine, as his final year project, as an Engineer in the Central Technological Laboratories and Workshops (CTLW). Even though he finished with a Pass Degree academically, he now walks tall as an accomplished OAU design engineer. Our most recent machine prototypes include machine for separating palm kernels from fibre, machine for dehulling cowpea, plantain slicer and the Specific **Gravity System for Producing Export Quality Palm** Kernels (Fig.5) , which placed 4th at the 1st National Raw Material Processing Plants Design Competition organised by the Raw Materials Research and Development Council (RMRDC), Abuja in February 2005. Hopefully, rhetorics will give way to actual funding to enable us develop a pilot scale version of this rather simple innovation which derives its concept from the (laborious and dirty) indigenous traditional method of accomplishing the task. Efforts are on, in collaboration with colleagues from five other universities, with support from the National Agency for Science and Engineering Infrastructures (NASENI), under the leadership of Professor O. O. Adewoye, formerly of this Faculty's Department of Metallurgical and Materials Engineering, to develop an automated medium-scale

industrial plant for producing quality cassava flour to meet the emergent needs of the flour industry, which must now substitute 10% of cassava flour into the flour for making bread.

I should obviously not forget my first attempts at crawling and walking in the field of machine design. I am referring to my first and second machine designs, namely the hammermill (Fig. 6) designed for crushing cocoa husk, bone and maize for compounding livestock feed rations, and the overgrown tree crops plantation weeding machine. The hammermill, designed under the guidance of the then Dr M.T. Ige, is a very versatile machine for milling a variety of agricultural produce. This particular machine has been used since 1978 almost all over this campus crushing, in addition to the materials it was primarily designed for, water hyacinth (for leaf protein extraction work in Chemistry Department), limestone (Geology), animal feed (Teaching and Research Farm – see also Fig. 7), glass and other materials for fortifying concrete or lateritic blocks (Civil Engineering) to mention a few. In a later work, the Department has presented and recommended a modified version of the hammermill as the best-practice device for 'grating' cassava in its processing into *gari,* in place of the erstwhile cassava grater (Fig. 8). Output (throughput) of the grater-hamm ermill is ten times greater than that of the conventional grater and it is more ergonomically convenient to use by both male and female operators. Little wonder that the University Teaching and Research Farm and some shrewd investors have readily adopted this appropriate technology. The cocoa plantation weeder (Fig. 9) was designed, under the guidance of Prof Makanjuola, to address a critical problem of cocoa and other plantation farmers. A prototype was fabricated, tested and adjudged suitable for the job. With no further support and encouragement, this machine like many more to come adorn the *museum of innovation antiquities* in the Department, signposting another sad commentary on the nation's understanding of the imperatives of technological development. A country with leadership that despises knowledge, relegates and subjugates the academia, and does not

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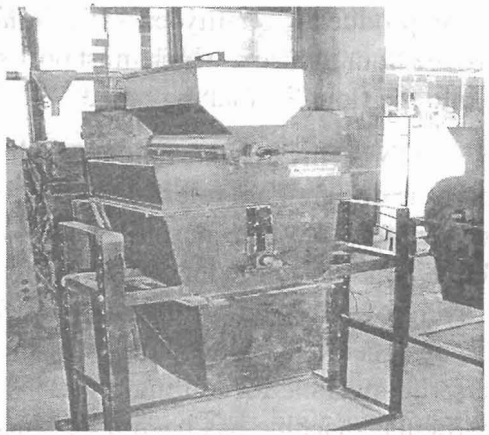

Fig. 3: Ifesifta 202 - The 2002 version of the cassava sifting machine, which won the NOTAP Technology Innovation 1st Prize in 2002. It is the product of a final year student project. That Student, Mr Clement Oladigbo has now been employed by the university after graduation in Dec 2004.

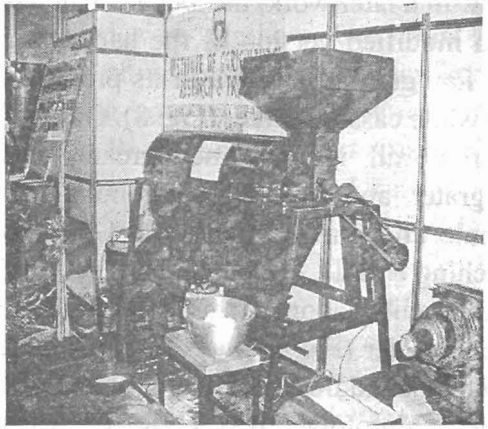

Fig. 4: The New automated cassava sifter cum fryer for *Gari* production. Developed by LA Sanni and MO Faborode, won the outstanding contribution award at the NURESDEF 2004 Fair for the University and the Researchers

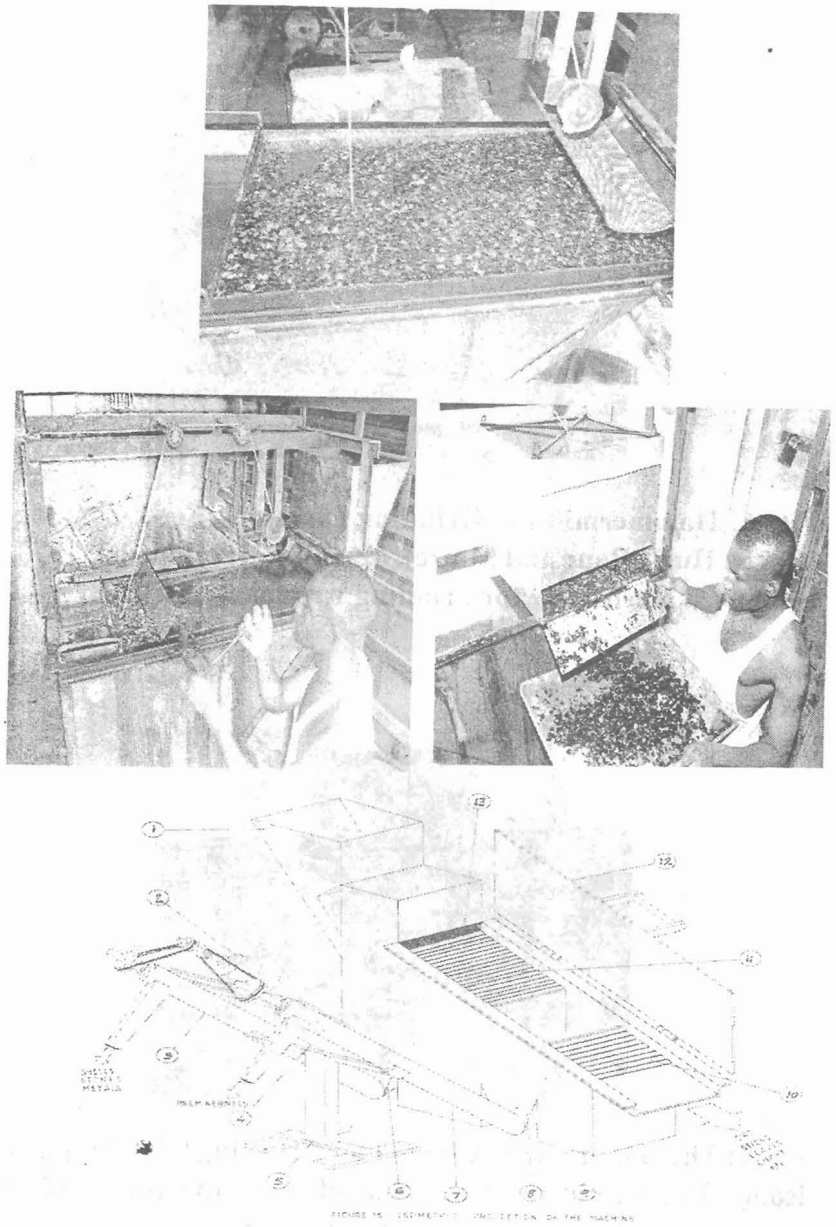

Fig. 5: New Machine for Producing Export Grade Palm Kernel, won 4th position at the 1st National Raw Material Processing Plant Design Competition in February 2005.

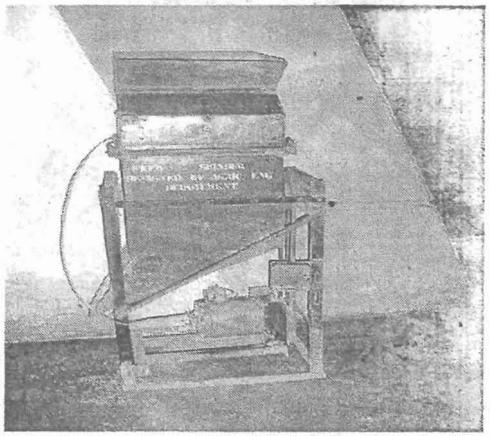

Fig. 6: Hammermill for Grinding Livestock Feed Components (Cocoa Husk, Bone and Maize). Machine, developed in 1978, has been used extensively for grinding various items.

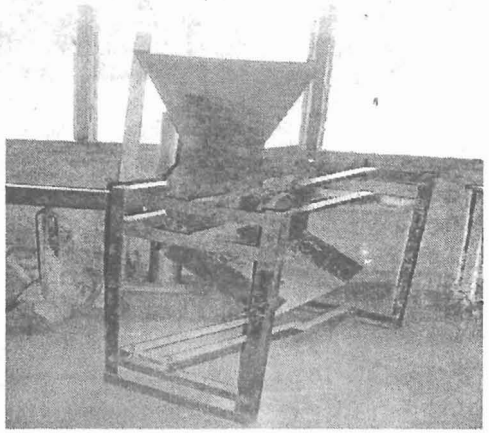

Fig. 7: The Hammermill Adapted for Crushing (Grating) Cassava Roots. Has output ten times that of the conventional abrasion grater and is more ergonomic to use

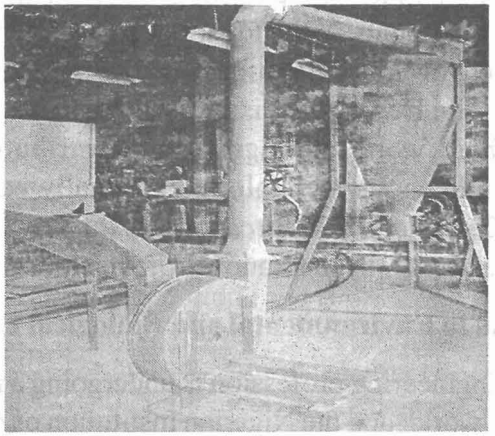

Fig. 8: The Hammermill as part of a Modern Feedmill designed for the Teaching and Research Farm by the Department of Agricultural Engineering.

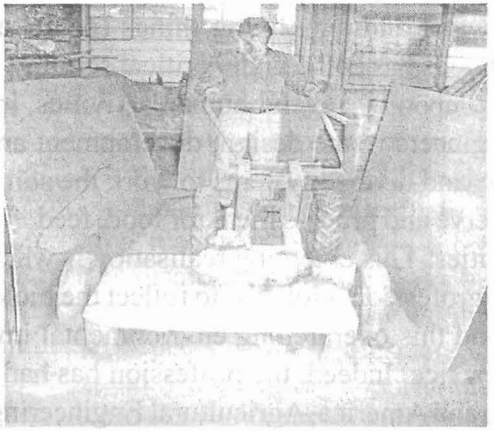

Fig. 9: Plantation Weeding Machine (Self-Propelled) Developed in 1982. Suitable for cocoa and other plantations overgrown with weeds.

harness and reward creativity is not likely to know that research is the basis of innovation, much less investing wisely in knowledge for development. Such a country will for a long time reap economic regression no matter how much it yearns for economic empowerment and advancement. The Department is lucky though that the totality of its dedicated hard work and significant contributions to the development of indigenous technology has finally earned it the designation as ***a Centre of Excellence,*** one of the few departments so designated in the country by the National Universities Commission.

From Agricultural to Environmental and Biological Engineering

The Agricultural Engineering profession is undergoing a momentous change all over the world, and the Nigerian Institution of Agricultural Engineers, as a corporate body, has taken bold steps to align the practice in Nigeria with the new global trend. All over the world, there is the ever increasing awareness of the importance of environmentally sound, socio-culturally acceptable and economically viable agricultural, industrial and land management practices. Hence, the impact of the practice of the profession on the environment (the biosphere; land, water and air), living things (plants and animals) and human livelihoods has come under critical scrutiny. Agricultural lands are impacted upon by several human activities, including that of agricultural engineers in the design, development and utilisation of power elements and diverse systems to work the soil, plant crops, rear animals, preserve and process them for food, feed, fibre and other livelihood necessities. This emerging realisation is what has made it incumbent on the profession, globally, to reflect the biological nature of living things and this overarching environmental impact of their activities in its practice. Indeed, the profession has had a chequered history. In Europe and America, Agricultural Engineering, first called "Farm Mechanics or Rural Engineering (*Ingenieur rural)*" grew to Agricultural Engineering about a hundred years ago, flourished and prevailed to become one of the most compelling and influential engineering disciplines in the 20th century. Agricultural Engineering

transformed vast unproductive lands into highly efficient, structured, mechanised and thriving agro-industrial endeavours. The discipline dramatically catalysed the emancipation of millions of people from the clutches of drudgery, and irreversibly altered the economic, social, intellectual and cultural landscapes of their world. For example, the farming populace was reduced from over 37 percent to less than 2 percent in the U.S. in a space of about fifty years. Today, most agricultural engineering institutions in Europe, the Americas (see box) and Australia have changed to Biological and Agricultural Engineering, Biological and Environmental Engineering, Biological Systems Engineering, Agricultural and Bioresources Engineering, and Biological Engineering to widen their operational base and be more responsive to NEEDS and concerns of society. The ease of the change and the bold switch to "biological" nomenclature is a reflection of the state of development of these societies.

In Nigeria, the intended goals of Agricultural Engineering are far from being achieved, in spite of the spectacular performance of some of the products here and there. Also, there has been some decline in the entry of bright intakes into the departments, largely because of misconceptions of youths who do not see a bright future in the way agriculture is practised and relegated in Nigeria. Ironically, this misconception actually justifies the need for Agricultural Engineering interventions as earlier enumerated. We are repositioning the profession to attract bright students who will develop to become engineers who can design and develop systems, machines (fixed and mobile equipment), implements, and farm buildings/facilities, and optimise production systems through intellectual management and control of environmental resources. While we intend to retain the agricultural aspect of the discipline, it is necessary to move with the entire world by expressively and genuinely taking on-board the inherent environmental aspects of the profession. Concern for the environment is opening many engineering opportunities as the society strives to maintain biological and ecological balance within the biosphere. No doubt about it, nearly all agricultural activities yield numerous wastes which have adverse effects on the environment. Even tractor use; traffic and tillage sometimes impact negatively on the soil and plant environment. Furthermore, the interaction between

soils, water and the atmosphere, which induces numerous effects on the human and plant environment, are within the scope of the discipline. It is therefore important that such effects are consciously identified and taken care of in the production, handling, preservation and processing of agricultural products and by-products in a way that they do not impede the attainment of sustainable livelihoods for the populace, being one of the laudable goals of agricultural mechanisation. This is the basis of the decision we have taken to rename the department: **"Department of Agricultural and Agro-Environmental Engineering"** and the degree to be awarded shall become **"Bachelor of Science in Agricultural and Agro-Environmental Engineering"**. Hopefully the University Senate will very soon, without any hesitation, give a nod to this proposition.

Box 1: Examples of the names adopted by Institutions in America and Asia

a. Agricultural and Biosystems Engineering, University of Tennessee, Knoxville Tennessee.

b. Agricultural and Biological Engineering, Purdue University, West Lafayette.

c. Environmental Engineering, San-30, Changjundong Keamjungku, Pasan Korea.

d. Biosystems and Agricultural Engineering, Oklahoma State University, Oklahoma.

e. Biological and Agricultural Engineering, University of Arkansas, Fayetteville.

f. Biosystems and Agricultural Engineering, University of Minnesota, Minnesota.

g. Biosystems and Agricultural Engineering, University of Kentucky, Lexington.

h. Biological and Agricultural Engineering, University of Georgia, Tilfon, Georgia.

i. Biological Systems Engineering, Washington State University, Prosser.

j. Biosystems Engineering, University of Hawaii, Hawaii.

k. Biological Systems Engineering, University of Wisconsin, Madison, Wisconsin.

Essentially, the agricultural and environmental/biosystems/bioresources engineering programme prepares men and women for careers requiring application of physical, biological, and engineering sciences to problems that involve living systems. Agricultural and biosystems engineers are uniquely qualified to solve problems involving engineering aspects of agricultural production, biomaterials handling and processing for food and non-food products, and environmental resources management. Preparation in agricultural and biosystems engineering can serve a broad range of career interests, providing opportunities for men and women from both urban and rural backgrounds. A careful balance has to be struck in order to allow agricultural production systems producing biological raw materials for non-food use to meet public demand in terms of quality, supply, sustainable land management and biodiversity preservation. In order to get the best possible yield from crops, storage and transport systems must be developed to ensure the preservation and recovery of valuable components. Consequently a lot of effort is being made to ensure that these 'new' agricultural processes can work smoothly alongside traditional food production systems in rural communities with industrial and agricultural needs being considered in parallel. Product-oriented research focuses on the extraction of physical, chemical and biological elements from plants, animals and wastes, as well as the modification of oil, protein, starch, sugar and fibre material. This is then processed into bulk or fine chemicals or biopolymers.

FROM COMPACTION TO COMPRESSION – KNOWLEDGE AT THE SERVICE OF HUMANITY

My specific scholarship is situated in the area of biomaterial properties and bioprocess engineering; i.e., in the inter-phase between farm power and machinery and agricultural processing/post harvest technology. My approach to machine development often starts with some theoretical work to gain fundamental understanding of the processes for which machines are later to be designed. Such fundamental work, reported in the best international journals in the

field, have considered stress analysis, moisture effects and rheology in the process of compaction/briquetting of agricultural residues, physical/mechanical properties and stress analysis in cocoa pod deformation, fermentation and drying phenomena in cocoa beans and steeping and drying characteristics of maize and cassava. The main areas in which I have worked are compaction/briquetting of fibrous agricultural residues, mechanisation of the operations of on-farm processing of cocoa beans, and expression/extraction of oil from oil-bearing materials.

Compaction of Fibrous Biomaterials

In the area of material compaction/briquetting, our work (my PhD Supervisor, Professor J. R. O'Callaghan and I) has significantly contributed to the fundamental understanding of the interaction between inertial and elastic forces in the process, as well as the effects of several process and material parameters. Development of the compression ratio model equation, identification of the critical compression density and a rheological model to characterise the process are considered to be very significant contributions to the physics of biomaterial compaction. Biological materials behave in complex ways when loaded, and exhibit time-dependent force-deformation characteristics, the study of which falls into the general field of rheology, which entails a combination of liquid-like and solid-like characteristics (or viscoelasticity), governed by the fundamental concepts of elasticity, plasticity and viscoelasticity. When the ratio of stress to strain is a function of time alone and not of the stress magnitude, the material is said to be linearly viscoelastic. However, if the viscoelastic behaviour is not dependent only on time, but also on stress magnitude, such that the resulting strain is mostly non-recoverable upon unloading, the material is said to be non-linearly viscoelastic or simply viscoplastic. Unconsolidated fibrous materials do not exhibit linear flexural stiffness nor do they dissipate energy by viscous flow only, hence we modelled their behaviour with non-linear rheological elements. Relevance of the work has been demonstrated

to several agricultural residues including straws, dried cocoa pod husk, maize stover and water hyacinth. A review of work on biomaterial compaction acknowledged the significance of the critical density while emphasising that the use of the compression ratio model and the rheological model give a satisfactory description of the increase of pressure with piston displacement and material density over a wide pressure range. The great attraction for the work on compaction stems from the fact that an otherwise seemingly complex process for which researchers had toiled relentlessly and had only been able to represent by empirical equations for different pressure ranges, has now been simplified as basically a stress-strain problem for which a single equation was developed, and critical transition points identified. Consequently, the importance of the bulk modulus and the porosity of the compacting mass of material to the process was easily and logically elucidated (Faborode and O'Callaghan, 1986, 1987, 1989 a&b, Faborode 1990).

It is noteworthy that our results now form the basis for the optimal design of bi-axial compaction and briquetting presses today, with considerable savings in process energy and enhanced performance efficiency. Bio-fuels hold great promise for rural energy economies now that the cost of fossil fuels has continued to rise. Gone are the days, when very cheap diesel and gas supply makes the use of farm waste briquettes unattractive. The equation has now changed and thermal plants fired by bio-fuels, particularly for on-farm drying and other crop processing (e.g. oil palm, with its considerable biomass wastes) and storage activities, have become realistic and feasible options. Hopefully the day will come, when with sensible and knowledge-based planning our farmers will not have to dry their farm produce at the road sides with the attendant pedestrian and vehicular pollution, pest infestations and microbial contamination that impair their quality and increase the vulnerability of our rural folks to preventable diseases.

Fluid Expression from Biomaterials

The fundamental study of compressive processes has been extended to understanding the physics of oil expression and mechanical de-juicing processes. The increased possibilities for the use of oilseeds for industry, which has resulted from research to develop genetically improved (designer) seeds imbued with special qualities such as fatty-acid profiles to suit specific needs, has attracted renewed interest in seed-oil expression technology. So far, our work has analysed seed-oil expression as a drained consolidation process in terms of the stress-strain response of the seed bed and the dynamics of the oil (fluid) flow, leading to identification of the specific compressibility which characterises the microstructure of oilseeds, and at the macro-level, the expression (consolidation) coefficient as dominant physical properties of oilseeds.

Significantly, the oil-point, which indicates the threshold pressure at which oil emerges from a seed kernel during seed-oil expression, is theoretically related to the kernel density of the constituent oilseed thereby enabling its evaluation from initial material properties of a bed of seeds. Precise sensing of the oil (pore) pressure permits experimental verification of the theoretical prediction that the oil-point generally occurs at the point where the bed density approaches the kernel density of the constituent seed or material particle. Seeds are classified and the effects of seed pre-treatments explained on the basis of oil-point parameters which define the seed's structural integrity, while transmission electron microscopy (TEM) has been employed to relate these characteristics to seed microstructure. Hard and more rigid seeds with low compressibility such as palm kernel and soybean are shown to have thick cell walls and more compact cellular architecture in comparison to the thin cell walls and large occurrence of inter-cellular spaces filled with air in soft and highly compressible seeds.

We are now further extending this knowledge to the mechanics of oil extraction from oil palm fruit through a PhD research, which has taken my junior collaborator, Mr O. K. Owolarafe, to India on a split-site study funded by the Third World Academy of Sciences (TWAS). Here, we are challenged by the unique micro- and macro-structure of the palm fruit mash which features novel departures from the classical oilseed. This is another case of placing research at the service of development. Our goal is to use our findings to change the way palm oil is processed in order to attempt to reverse the pitiable fortunes of the Nigerian palm oil economy. Oil palm remains the most prominent oil bearing crop in Nigeria, in terms of quantity consumed directly or crushed into oil and cake. Palm oil and palm kernel oil account for 72% of vegetable oil production. Nigeria used to be the leading world producer in the 60s and early 70s. However, today, Nigeria is a net importer annually of over 300,000 tonnes of vegetable oils, and its palm oil continues to be non-competitive in the world export market. It is estimated that N8.2 billion was spent on the importation of vegetable oils and fats in 2001, while as much as half of that amount must have additionally been smuggled in. Palm oil's unique composition makes it versatile in its application in food manufacturing and in the chemical, cosmetic and pharmaceutical industries. Its semi-solid physical properties are needed in many food preparations. Its non-cholesterol quality and digestibility make it popular as a source of energy, while its technical and economic superiority makes it preferable as base material in the manufacture of various non-edible products. Oleochemicals manufactured from palm oil and palm kernel oil are now popular for the manufacture of environmentally friendly detergents, as they are readily biodegradable. The basis of our oil palm productivity improvement programme is the overarching desire to enhance the **production** and **quality** of oil palm products in Nigeria to cost-effectively meet local demands and also for export such that the nation can achieve national self-sufficiency in palm oil and palm kernel oil and enhance rural household income and well-being in the country.

Cocoa and Cassava Processing Research and Biotechnology

Our work on cocoa started a few years ago, precisely in the early nineties, but within the short space of time, some useful contributions have been made. More importantly, mechanisation of cocoa processing has been established as a major research area in the department. Several PhD and MSc research students as well as final year undergraduates have been usefully engaged in this research. Within the cocoa processing subject matter, our work covers stress analysis in cocoa pod deformation and studies on the cocoa pod's physical and mechanical properties towards development of technology for pod processing, studies on fermentation and drying of cocoa beans, corrosive effect of cocoa constituents on materials of machine construction, quality evaluation and control, cocoa storage and by-products' utilisation. Hertz Theory of contact stress has been applied to the analysis of cocoa pod deformation, breaking cocoa pods and for grinding cocoa husk for livestock feed preparation. The work on cocoa has enjoyed funding support from the International Foundation for Science, Sweden, and the British Council/DFID under the University's Higher Education Link (HEL) with the University of Newcastle upon Tyne, while a major research proposal on the effect of the interaction between fermentation and drying on cocoa quality, submitted for funding support by the European Community under its STD programme, suffered from the battered image of Nigeria under Abacha's disastrous maximum rule. The prototypes of machines/ devices developed for breaking cocoa pods and for drying the wet beans also adorn our *museum of innovation antiquities*. Similarly funding was sought for work on cassava processing and biotechnology by a research team in the University (from the Departments of Agricultural Engineering – Faborode and Ajibola, Chemistry – Adewusi, and Food Science and Technology – Esther Balogh) in conjunction with European partners, the International Institute of Tropical Agriculture (IITA), Ibadan and two other Universities in Benin and Ghana. This again suffered the same fate because of the

uncompromising attitude of the International Community towards the Abacha junta.

A reverberating question in cocoa flavour research was why fermentation was very critical to flavour, and why sun-dried beans from West Africa (Ghana and Nigeria in particular, in spite of declined productivity) gave the best cocoa flavour, prized by chocolate and other cocoa product industries. With research colleagues in the UK (Dr John Favier, then of Newcastle University and the Mars Bar Factory in York) and Germany (Professor Bole Biehl and Dr Voigt of the Botanisches Institute under DAAD funding), and working here in collaboration with the late Professor Esther Balogh, and Professors B.O. Solomon and O.O. Ajibola, we embarked on studies to unravel this mystery. In a review of the significant advances in research into the origin of cocoa flavour characteristics, cocoa flavour was presented as the totality of quality perceptions of raw cocoa including aroma, astringency, bitterness, acidity and other off-flavours. It was shown that the major flavour notes in cocoa derive from the inherent genetic attributes of the cocoa seed as conditioned by basic biochemical transformation processes during fermentation. Specifically, the precursors of normal cocoa flavour note, the hydrophilic oligopeptides and hydrophobic free amino acids, are products of post-mortem protein digestion, while phenolic compounds are important to cocoa astringency and early developing bitter taste. The volatile flavour compounds are generated when cocoa seeds are roasted, while the intermediate flavour compounds, *Amadori products*, are produced during drying. Off flavours mainly result from defects in fermentation and the use of ineffective drying regimes. Indeed, without proper drying, a well-fermented cocoa is not likely to achieve its maximum flavour potential. The need for more fundamental research into cocoa drying to enable the development of a suitable drying system, that will produce cocoa of comparable and indeed better flavour than sun-dried cocoa has been identified.

With respect to drying, fermented cocoa bean (since it must undergo fermentation as noted above) presents a unique, scientifically challenging and immensely fascinating biomaterial. Unlike some other crops, especially grains, whose drying has been well studied under controlled laboratory conditions, not much fundamental work was available on cocoa drying vis-a-vis the effect of the various drying conditions on its quality. Our work boldly took up the challenge, with the fresh cocoa pods being air-freighted to Newcastle upon Tyne where the beans were extracted, fermented and then subjected to thin-layer drying under various controlled conditions. The robustness and versatility of the equipment and instrumentation, and the reliability of the results permitted us to re-appraise the fundamental drying mechanism of cocoa beans, and corrected some past misconceptions in the literature. From the work, it was made clear that in the forced-air drying of cocoa beans, after an initial warm-up and surface drying period of very short duration, a succession of falling rate periods sets in, the exact number depending on drying temperature and post-rest moisture content. Critical transitional moisture contents were identified to be 70% (40% w.b.) and 30% (23% w.b.) dry basis. Dried product evaluation demonstrated the beneficial effect of intermittent resting in-between drying runs, and further work on developing a prototype dryer, which would simulate and upgrade sun-drying was based on these findings. Work is on-going by an M.Sc student on the final version of such a dryer.

RESEARCH FOR DEVELOPMENT

In his 1978 convocation address, the then Vice Chancellor of this University, Professor Ojetunji Aboyade, spoke extensively on scholarship and underdevelopment, made a case for research and techno-science. We still had a country then that has some commitment to funding education and research. The Federal Ministry of Science and Technology used to award research grants to scientists, and indeed a special National Science and Technology Development Fund (NSTDF) for research was operated under a Board of Trustees. In the

last twenty years and particularly in the last fifteen, so called holocaust or IBB-Abacha years, everything has dried up, and the nation has totally and irresponsibly abdicated support for research and indeed education. Yet we yearn rhetorically for 'technological take-off'. Our universities and indeed other educational institutions are like the shadows of their past. The global rating of universities has confirmed our worst fears that we no longer have universities that can compete with the world's best, not because we do not have the potential human capital to do so, but this environment has in the words of our Nobel laureate, Wole Soyinka become '*a killing field*'. Unfortunately, those of us who stayed back, in spite of the undeserved harsh environment and in lieu of the temptations of emigration, are not appreciated but despised by the nation's leadership. The young academic thus becomes an endangered specie who can end up disoriented, unaccomplished and unfulfilled.

It is against this background that the likes of me, who can stand before you today to deliver an inaugural lecture, have every cause to appreciate those whose vision has given us support and encouragement. I consider myself to be not only an embodiment of the grace of God, but also of the goodwill of humankind. The International Foundation for Science (IFS), founded in 1972 and based in Sweden, is dedicated to supporting and nurturing young academics in their research with 'small' grants, which can be renewed based on performance. Specifically the IFS mandate states that

> **It shall contribute to the strengthening of capacity in developing countries to conduct relevant and high quality research on the management, use, and conservation of biological resources and the environment which these resources occur in and depend on. The activities shall include identifying, through competitive grants and a careful selection process, young promising scientists with a potential**

for becoming future lead scientists and science leaders; supporting them in their early careers to enable them to become established and recognised, nationally and internationally; and continuing, once their official association as IFS grantees is completed, the support of these scientists, whenever feasible and relevant.

In me, my work and my academic/leadership accomplishments, IFS has a good testimony. I have the privilege to have enjoyed two consecutive grants for my work on cocoa, which had multiplier effects on my other research commitments. I am not alone in this respect, as the Foundation has impacted on the lives and work of many other colleagues in this University and other parts of the developing world. Like these others, all over the developing world, I owe my liberation from the shackles of academic redundancy, research atrophy and/or imminent emigration into slavery by the timely support earned from the Foundation. IFS support should be appreciated for what it is: hope in the midst of hopelessness, support when all else seems to have failed, especially when your country has failed you, and continues to reap where it has not sown. I also want to place on record my deep appreciation for all other agencies and bodies mentioned elsewhere in this lecture who have supported my work and academic carrier in one way or the other. In this regard, I must also mention the Association of Commonwealth Universities (ACU) for granting me the Commonwealth Scholarship for my Ph.D and a Development Fellowship for my sabbatical later in 1996. That sabbatical term was completed with a distinguished Senior Research Fellowship by the University of Newcastle upon Tyne. The German DAAD and the British DFID through the British Council also supported several short research visits when these mattered, i.e. my formative and maturing years.

Can Rainwater Harvesting Research Success in Tanzania be Transferable to Nigeria to Address Rural Livelihoods and Alleviate Poverty?

I am sure I will not be forgiven if I fail to mention our on-going work on Rain Water Harvesting (RWH), which has been a subject of intense media attention and deliberate publicity for some time. Though we have specialisations in agricultural engineering, it is on record that my erstwhile Supervisor and great mentor, Prof O'Callaghan traversed the entire professional landscape in his academic lifetime. So I am in good company to lead a research 'across the road' in the area of soil and water resources management. In any case, the work has its origin in a post-harvest study conducted in the rice growing fields of Erinmo, Erin Oke and Erin Ijesa, where water stress has left the popular rice mills of old idle with nothing to mill any longer. So the work on RWH is a means to an end, and not an end in itself. Even then, any work on rural livelihoods, rural development and poverty alleviation must necessarily be multi-disciplinary, bringing diverse knowledge to be blended for emancipating rural environments and livelihoods (REAL) in the service of humankind.

Our challenge in answering this question is to understand what had been achieved in Tanzania, how, why and what ingredients and methods have contributed to that success. As was discussed earlier, our approach had to be farmer-centred and participatory, so we can formulate and operate a good research-extension-farmer-input-linkage system (REFILS) to enable us communicate effectively among the linkage partners. The Post Harvest Technology Research Group (PHTRG) came in handy to fit the researcher component, with its diverse expertise, which was further complemented by GIS researchers from Regional Centre for Training and Research in Aerospace Survey (RECTAS) Ile-Ife, the Osun State Agricultural Development Programme (OSADEP) Communication expert, the media and an NGO, the New Nigeria Foundation (NNF). Added to our international partners from the University of Newcastle upon Tyne,

lead by Dr John Gowing, and the Sokoine Agricultural University in Morongoro, Tanzania, lead by Professor Nuhu Hatibu, a formidable research team emerged. Space in this lecture cannot adequately permit a detailed elaboration of the goals, expected outputs, constraints, activities and accomplishments of this rather successful research partnership. It suffices to remark that great lessons have been learnt, the researchers have become academically more confident and competent, and the PHTRG has been exceedingly strengthened by the research engagement under this international partnership.

The Post Harvest Technology Research Group

There are two things that today give me joy and underlie my sense of accomplishment. When PHTRG was established as a research group a few years ago, it initially revolved around the initiator and founder, Professor O. O. Ajibola and a few of us in the Departments of Agricultural Engineering and Food Science and Technology, who were involved in research on post harvest technology, and who were concerned that the different technologies being developed in our universities and research institutes were unknown to the farmers, processors, extension staff, even fabricators and other primary stakeholders on the field, and so such works had little impact on rural livelihoods and poverty reduction desires of the masses of our people. We also realised the need on our part to better understand the needs of the farmers and processors so that our R&D efforts can better target provision of solutions to the real problems as identified by them. Our activities were boosted, in the formative years of the group, by a research grant from the UNDP to undertake an assessment of the capacity and technology needs of women agro-processors in Osun and Ondo States. The fact that women dominate the post harvest sector required that gender issues in technology development and adoption be given critical attention in our work. The result of that work formed the basis for several capacity building workshops and invariably a Gender and Development (GAD) workshop, coordinated by Dr Kehinde Taiwo and I which received support from the British

Fund for International Cooperation in Higher Education (FICHE) of the Department for International Development (DFID), administered by the British Council. The high quality of the published proceedings of that workshop, edited by C. T. Akanbi, K. O. Osotimehin and A. J. Farinde is a testimony to how far the group has grown.

To have coordinated and nurtured the group to its present height of great accomplishment is a source of joy indeed. Most of the award winning designs featured in this lecture emanated from the work of the group. The group now includes not only agricultural engineers but also food scientists and food engineers, socio-economists/policy analysts, civil engineers, animal scientists and most importantly, academic and practising agricultural extensionists and communication/media experts, and has extended beyond the academic confines of this University. The group now organises monthly seminars addressed by experts from within and outside the university, who have something to offer, including its members. An annual collection of the technical seminar presentations is being peer-reviewed and will be published as *Annals of PHTRG*. Coordinating an inter-disciplinary research is not a mean task. And so my other source of joy is the opportunity for mentoring younger colleagues to greater heights. 'To live and lead is to serve'. Indira Ghandi, talking about the workplace once said *"there are two kinds of people – those who do the work and those who take the credit. Try to be in the first group; there is less competition there"*. This is a good quality of leadership. On the other hand, the mentored must be ready to be mentored. As the saying goes, 'heaven helps those who help themselves'; 'you can only take the horse to the brook…' Fortunately, the PHTRG is peopled by dedicated academics and researchers. In the coming years, the group will focus on a value-added agriculture programme, in addition to its primary research engagement, and target the following:

1. Provision of assistance on technical feasibility and technology transfer;

2. Provision of information on market analysis and development;
3. Provision of assistance in development of business plans based on a concept or idea;
4. Development and presentation of education and training programs; and
5. Provision of assistance in management of small businesses, including farms.

EPILOGUE

Mr. Vice-Chancellor sir, let me bring this lecture to a close on a historical note, having started off in the same vein. This I want to do, by ascertaining categorically that I am a born Agricultural Engineer. I want to wonder aloud how many Agricultural Engineers were born on a farming Saturday. I happen to be one of such for in the early hours of a Saturday, 22nd September, scores of years ago, my mother was about to proceed to the farm when the labour pains set in. Thank goodness, I would today have been named *Ayoko* or *Tokode* or the like. So, my being an Agricultural Engineer had been ordained otherwise I would have been admitted in 1973 for my first choice of Chemical Engineering. I thus give thanks to Almighty God that in me a destiny has been fulfilled. I have shown in this lecture the centrality of ***technology*** to human ***life*** and ***livelihoods***, and I have expounded on what little I have been allowed by the circumstances of being a Nigerian to contribute to its realisation. Though considerable opportunities have been lost in this 'killing field of wasters', we must keep hope alive, that one day, we too will truly belong to the committee of nations who believe that ***'without technology, all that labour for development do so in vain'***, and so apply ourselves to harnessing and nurturing the great potentials of this miracle that Nigeria is. Obafemi Awolowo University has a crucial role to play in this connection, and some of the ingredients for this engagement are in our strategic plan.

Thank you ALL for listening. God bless Nigeria.....*with Technology oriented Leaders!*

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