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Engineering The Environment

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Professor of Water Resources and Environmental Engineering

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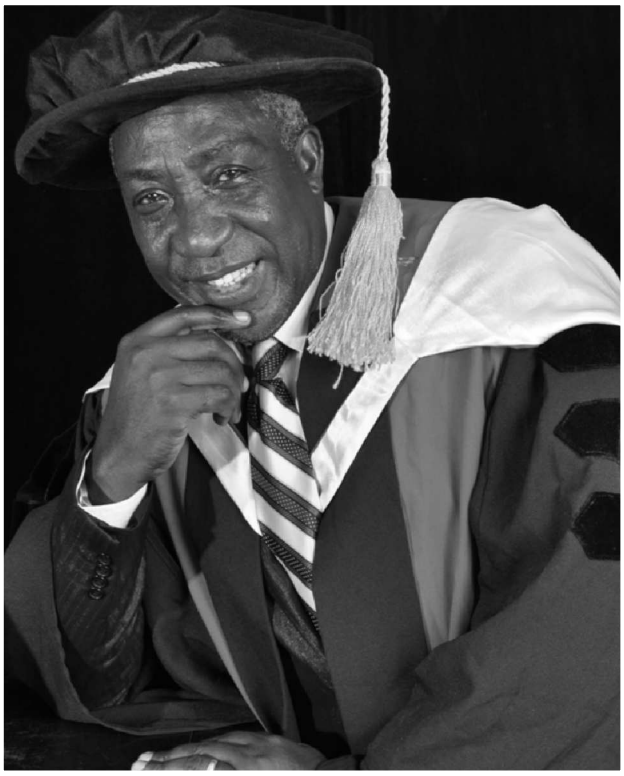

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Engineering the Environment

An Inaugural Lecture delivered
at the
University Hall,
Niger Delta University,
Wilberforce Island,
Bayelsa State, Nigeria
On Wednesday 25th February 2014
By

Engr IfeOluwa Kehinde Adewumi, ***PhD***

Professor of Water Resources

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ENGINEERING THE ENVIRONMENT OUTLINE

Content

PROTOCOLS

1.0 EXORDIUM

Mr Vice-Chancellor Sir, I must appreciate the opportunity given me today to share my academic thoughts and, in a way, the story of my academic life with this august audience of dignitaries, erudite scholars, my colleagues across the University and our students in particular. I also acknowledge the presence of members of the fourth realm (the Press) whose role in nation-building is crucial.

Permit me to also for this hour assume the role of *Loo-Owei* (The Massueur) in Clark-Bekederemo (2007)'s *Song of a Goat*. The Masseur in the Izon culture is an important figure and part of the life of the people as he massages bones, heals the sick and gives spiritual direction to reorder lives of his people. As a communicator with the gods, he also helps people to change their destiny if they heed the voice of the gods. In this light, I see an Inaugural lecture not just as a discourse of what the presenter has done only, but an opportunity to share and challenge the audience and readers of the work on what to do to carry on the good works in academia or in the larger society.

I have toyed with the title of this Inaugural lecture since 1987 during my first postgraduate studies in my alma mater, Obafemi Awolowo University, Ile-Ife, Nigeria (OAU) and from where I obtained my four degrees, BSc and MSc Environmental Health and MSc and PhD Civil Engineering. By the time I took the bold step to venture into Civil Engineering and joined the teaching staff of the Civil Engineering Department in OAU, I had known that majority of the problems confronting us as a nation as far as the environment is concerned would need majorly an engineering solution.

My MSc Environmental Health Thesis was on deriving parameters for the design of wastewater stabilization ponds

system to improve the efficiency of the existing primary oxidation pond at OAU (Adewumi, 1989; Adewumi and Songonuga, 1995). Engr Prof Oluwole Songonuga was pioneer Head of Environmental Health and Epidemiology Department, College of Health Sciences, OAU and he, not only mentored me in the two degrees but, encouraged me to join academics. Even when he was offered another employment that took him back to the United States, he delayed accepting the offer because of me to enable me complete the postgraduate degree. That is leadership!

Only two things changed in my projections on this Lecture, one is the venue and the other is the timing. I had projected that by 2009 or 2010, I will have become a Professor and that the Inaugural will have been held at OAU by 2011 or 2012 before my 60th Birthday. The change in timing and location however has not reduced from the lecture what has been the reason for the title of this Inaugural Lecture. Rather it has given more opportunity to enhance the issue of the need to engineer or re-engineer our environment, especially in the light of documented and evident overwhelming environmental degradation and health issues in my new place of sojourn in the Niger Delta Region of Nigeria.

1.1 The Environment and Environmental Systems

The *Environment* has been described in Henry and Heinke (2005) as the physical and biotic habitat which surrounds us (human beings and other living things –animals and plants). This definition covers all that we can see, hear, touch, smell, and taste with our five sense organs. What about the sixth sense of the emotions that affects our sensibilities and humanities—spirit, soul and body? These fall under the realm of social environment.

In the same reference, System is defined as a "set or arrangement of things so related or connected as to form a unit or organic whole; as, a solar system, irrigation system, supply system, the world or universe (Henry and Heinke, 2005). Environmental Systems could

then be physical, biological, emotional, political, and to take into the esoteric, these are often governed by the spiritual forces and powers.

1.2 The Environmental Engineer and Sustainable Development

The group of civil engineers classified as *'Environmental Engineers'* adopted this nomenclature in the 1960s but has a long history dating back to centuries before the First Advent of Jesus Christ, that is around 1940 BC Isaac received divine instructions to locate groundwater aquifers and dug wells with which he watered his farms and made hundred fold harvest (Gen 26::12). King Hezekiah in the Bible qualified to be called a notable Water Engineer with records of engineering designs and civil works developed to protect his people or bring water supply to his Cities such as the conduit that brings water into a livestock farm for sheering of sheep in a fuller's field (II Kings 18:17; 20:20; II Chronicles 32:30).

The roots of environmental engineering profession go back into several major disciplines including civil engineering, public health, ecology, chemistry, geology and meteorology (Weiner and Mathews, 2003). From each of these foundation disciplines, the environmental engineering profession draws knowledge, skill, and professionalism including from ethics from which, like other engineering families, we draw concern for the greater good.

The focus of the early fathers of the profession revolves around the provision of save water supply, especially during epidemic outbreaks such as cholera, typhoid and similar water-related diseases, hence they were classified as water engineers. Later when issues of solid wastes and garbage disposal, faecal wastes management wreaked deadly havoc in communities, engineering knowledge was applied to provide sanitation facilities such as toilets and wastewater management systems and those crop of practitioners were addressed as Sanitary Engineers.

The ravaging public health diseases of medieval period led to developments of public health infrastructure and the engineers

are called public health engineers. The last century witnessed serious environmental health problems such as air pollution, water and wastewater pollution, soil degradation from erosion, contamination from dumped wastes and improper management of wastes. The environment then becomes a global focus as humanity realizes that the teeming global population and our polluting habits has grossly impacted the total physical, biotic and social environment such that sustainability becomes a global concern.

It is currently realized that all our anthropogenic activities have so much polluted the earth that we would need an equivalent of 4.5 times the space of the current earth to reduce the carbon footprint of all our unsustainable activities and about 3 times the global freshwater to take care of the water footprint of the world! Unfortunately for us, we only have this dying earth to live on. Little to say that man himself has embarked on a self-destruct path through our careless and carefree lifestyles. Rather than manage the earth as God directed our First parents, we lack discipline in both our consumption of resource materials and production of things we need.

The concern for sustainability in both consumption and production has led to the new field under environmental engineering known as sustainable (environment) engineering which relies more on modeling softwares to provide owners of industries with an idea of the impact of their production, from cradle (raw materials sourcing) through gate (finished product sold to consumers) to grave (disposal after end of life of the product). This new field of environmental engineering developed after the first global Conference on the Environment in Rio de Jainero, Brazil in 1992 and the subsequent Rio + 10 and Rio + 20 of 2002 and 2012 respectively anchored by the United Nations Environment Programme (UNEP).

From all these background information, it becomes obvious that

whatever the level and type of environmental problem, whether anthropogenic or as a result of natural disaster, the professional environmental engineer has the unique role to perform in thinking through a practicable solution. UNEP (2010) has published a summary of what constitutes the thoughts on Sustainable Consumption and Production and other tools to assist whoever is interested to contribute to environmental management.

2.0 RESEARCH FOCUS

As a Christian and ordained Minister [of the Foursquare Gospel Church in Nigeria], Theology has taught us that the seen world was spoken into existence by the All-Knowing, All-Wise God Almighty through His Son Jesus Christ and the Power of the Holy Spirit. And after each day of creation, God confirmed that all that were created was good and at the end of the sixth day, when Adam was molded and received the breath of life and Eve was made as his help-meet God said all that day's work was very good. From the fall of our first parents, the created world has continuously experienced degradation., understandably because we are fulfilling the Mandate to be fruitful and multiply and subdue the earth! From a population of 2 at creation, the global population is now close to eight billion all squeezed on to the same available land space.

Even the pre- Noah's flood event and generation has done worse so much that the Lord regretted that He had made man on earth, and He was grieved at heart (Gen 6:6 Ampl). Beyond the flood and the judgment on Sodom and Gomorrah the scenario has not changed. Man went into the Moon and left traces of pollution (including a star-studded flag waving to no one in the vacant lunar space!). That is part of our God-given blessing of dominion over all He created.

The first recorded building engineering project at the Tower of Babel in Gen. 11, where bricks were burnt to make it impervious remained a major materials development method that also has

contributed to air pollution from the biomass used in producing the bricks until sun-drying of lateritic materials was found to have less impact on the environment in recent times. Two major lessons I intend to derive later in this lecture from this account: The power of unity of purpose and the need for sustainable consumption and production (or productivity).

2.1 Public Health Background

Mr Vice Chancellor Sir, it is important for me to briefly share with this August audience, especially our students the need to know that no knowledge gained is ever lost or useless. After passing my West African School Certificate Examination in 1971 and seeing the need to assist my parents in the training of my siblings, I received good counsel not to take up a Clerical Officer's job but go for an In-Service Training in any of the middle cadre Institutions. I then sat for the Health Inspector-in-Training examination into the School of Hygiene, Ibadan and passed. After the three years training, I was posted to a Health Office in Ibadan where I worked as a Health Officer until 1978.

2.2. Challenges of Municipal Wastes Management in Ibadan in the 1970s

During that training and my posting to Ibadan, I was always challenged by the inability of the Health Offices to effectively manage the volume of wastes that seem to defy solution. As soon as the heaps are removed, they have grown as Hydra head again and again. In my second year in the University, there was a Call for an Operation Keep Ibadan Clean for one month that fell within our long vacation. I then went as a Volunteer, *pro bono,* to enable me get answers to the issue. In the offices and on the field, I found that there is no adequate data on how many premises or households, are producing what volume of wastes, at what rate, etc. The tipper operators only guess the volume of wastes removed from the capacity of the vehicles used in haulage of the

wastes. That experience prepared me for the World Bank Project we later did between 1996 and 1999 in 11 cities of southwestern Nigeria (Adewumi et al, 2005a,b; Adewumi and Fajewonyomi, 1997).

2.3. Immunization Services against Communicable Diseases

As a Health Inspector, I was also involved in going with Public health Nurses to administer immunizations against prevalent communicable diseases, especially those affecting children under five years, and provide medications for controlling guinea worm infection. Usually we commence such services with a health talk and keep records for remittance to the Federal Ministry of Health.

It was this aspect of my professional services that pointed out to me that majority of the communicable diseases are water related and preventable by provision of wholesome water. I also found that mindset influenced the responses of patients to treatments we offer them during such Communicable diseases control programmes. I can never forget an old man with guinea worm infection who insisted the appropriate mediations given to him will not work except we give him injection. I refused.

On our way back to the Office, one of the Nurses said I should have just injected ordinary saline water into his buttock and advise him to back it up with his medications. Two days later, I went back to check his health. He had kept the tablets unused. His face however brightened up when I said I brought his injections. I swabbed his buttock and injected ordinary injection water and said the injection needs the drugs given earlier to work. Needless to say he got healed shortly after. Mindset!

2.4 Issues of Poor and Insufficient Housing for Nigerians

Different statistics on the number of houses needed to meet Nigeria's housing need abound. However, the reality is that most of the existing offers cannot and will not solve the problem of

inadequacy. There is the need for a paradigm shift from this top-down, from Master with a take-it or suffer attitude to a desperate and impoverished majority, whose meager subsistence cannot fit into any mould of offers on meeting the housing needs.

I experienced this problem first hand in 1973/74 when we went to Lagos for our Port-Health Training. A friend, now of blessed memory, who had agreed to accommodate me suddenly became quiet when I arrived his Office to take me to his home in Itire. As a Central Bank staff who knows my comfortable accommodation back home suddenly became quiet. 'Please Kehinde, when we get to my place, just manage whatever you find.' he pleaded. I said 'no problem, if you are there, I will also cope'. He: 'Kehinde, please you have to get up very early, if you want to toilet, so that you will be relaxed' I again said no problem. He: 'Well, you have to know some of my cousins are staying with me in my apartment'. I said no problem.

When we got home, it was a one-room apartment with a bed, a lounge seat and a central table. Late that night, shortly after my friend came back, the room suddenly crowded and we were nine adults in the room. Initially I thought they were just visiting and will soon leave. But around 10:30 pm, mats began to surface from under the bed and my friend offered me a choice of sharing the bed with two others or take the lounge seat. I settled for the seat! The central table usually give way for the mats over which five or six adults lie. I woke up late and found that the toilet is on a pedestal (Bucket latrine that has been phased out now in Lagos). I adjusted my toileting to a time when I will be in the Office in Harvey Road or at the Airport.

If several people are able to communally share just one room for survival, can they not also use similar communal spirit to build low-cost houses in rotation as it was in several communities in Nigeria? How can we make such communal building projects to be of high technology and low cost? I then concluded that one man

may not easily build a house on his own, but 10 men could build 10 houses and in less time it will take only one man to do so!

3.0 ACADEMIC AND PROFESSIONAL DEVELOPMENT

Mr Vice Chancellor Sir, and this August Audience, that I stand before you as a Professor is only by the Grace of God, and those who God has used in one way or other to contribute to what I am today. Apart from Pa Fasola of blessed memory who was my Headmaster who counseled me on choice of career explained above, there is also late Dr Lateef Windokun, the Medical Officer of Health (MOH) at the Onireke Health Office, who in early 1976 indirectly challenged me not to settle for mediocrity. I was in charge of immunization of those travelling out of the country against Smallpox, Yellow Fever and Cholera at the time, but the MOH is the one that signs the stamped yellow cards we bring to him.

As a newly graduated Health Inspector, a bachelor then, without much responsibility than just to support my sisters in their education, my father would plead with me to maintain integrity at my work; do not collect money from the people of the public and if you need money, ask me for money, etc, etc. The doctor then sent a messenger to call any Inspector in the Office, I was the only one and I went to meet him. Being tastefully dressed in muffty, he took me for a prospective traveler who has come for his yellow Card and said that much. I then said, no Sir, you asked the messenger to call me to your Office, what do you need of me Sir?

He then spoke in Yoruba language, Wolewole ni o? [You are a health Inspector?] Did you attend a secondary School, did you pass your subjects? Etc and I said yes. He then said, I took you for someone here to collect his Immunization Card. If you have what you claimed, what is your eagle doing amongst domestic fowls?! Look at this young lady, she is going to the United States and needs immunization card. If it is dirty job you want to do for the

rest of your life, there is the reported corpse of a mad man found along Moniya Road, go and arrange for its removal. Go, Go, Wolewole!

My legs wobbled and I left his Office. The devil then said, don't mind that braggart, he is trying to disgrace you because of that chick! But the Spirit of the Lord said, Ife, the questions asked you and the passion in that man's voice saw you as an eagle, why not soar above your present limitations? As luck would have I just read an advertisement for Extra-Murral Classes of Advanced Level Courses in University of Ibadan. I took the good voice and went home to pick my checkbook and went to purchase the form for a 2-year, six days a week program.

Till today, I never know what happened to the corpse along Moniya Road, but I continued in the Extra-Mural classes until we took the first Joint Matriculation Examination in 1978 and then I gained admission to University of Ife.

From that turning point, I lost 'friends' with who I go out to booze every evening after work but no regrets.

3.1 Development as an Environmental Health Scientist (1978-88)

Once in, I found that a vista of opportunities were opened until I completed my first two degrees. If I had known I would end up in academics I probably would have taken my first degree program more serious, but coming in as an adult at 26 years, I allowed the University to pass through me in my journey through the University and graduated with a strong second class lower degree.

After my Youth Corps Service and employment at the Federal Polytechnic Idah, I returned to my Alma Mater for the MSc in Environmental Health when my interest in Civil Engineering was renewed. Shortly before I completed the program, a rationalization Process by the University cancelled this first of its kind in Africa program. It is pertinent to note that the University of

Botswana, used the curriculum to establish its own program and other African countries are struggling to develop Environmental Health Scientists. I
n Nigeria today, the Environmental Health Officers Registration Council (EHORECON) has been going round Universities to encourage the establishment of a degree program at undergraduate and postgraduate levels, and the Nigeria Universities Commission (NUC) has approved the training module for any interested University to adopt and commence such degree programmes.
Mr Vice Chancellor Sir, I will appeal that the University allow the degree programmes to be commenced in the University, especially in the light of the global interest in the protection of the Environment. These cadre of officers are major players in most of the global flagship programmes for which the University could get funding to run and promote the program.

3.2 Development as a Registrable Civil Engineer (1991-2005)
After benefiting from the mentorship by Engr-Prof Oluwole Songonuga who supervised my first two degrees, and at the oral defence of my MSc Thesis, there was indication that Engr-Prof Martins Olusola Ogedengbe, was interested in bringing me to his Department. He was the Internal Examiner and my post -oral examination interaction with him showed that my interest in finding solutions to the sanitation-housing-water trio of major contributors to health problems is best realized as a Civil Engineer.
From the time I realized my employment as Lecturer in Environmental health problem will not materialize due to the rationalization of the program, I weighed what it will take for me to make a fresh start into another profession.
As his protégé, I had to follow Prof Ogedengbe to classes and watch him teach, taking notes and later, he would ask me to prepare lecture notes that he would grade and then tell me to take

his class, while he sits at one corner watching the delivery.
I then began to audit for some courses in Civil Engineering and when Engr Francis Olofin, the Ag Head of Department resigned to take employment with the Lagos State Government in 1995, I was asked to coordinate the Department by the Dean. I was just an Assistant Lecturer and was being reviewed for the Lecturer II grade.
Later when the Accreditation Team of COREN came led by Engr-Prof Ofodile, the then Registrar, I was drilled for obvious reasons: I had no degree yet in Civil Engineering and acting as Head of an engineering program. All explanations by Prof Ogedengbe that he was actually the substantive head, but that because his health would not allow him to be climbing stairs, etc, he advised the Dean to appoint me as Ag Head, while I am accountable to him. He went further to state that I am already on my MSc degree program.
The Team firmly told me that even if I completed the MSc program, I will not be registered except I pass a minimum of at least 60 Credit Units of core Civil Engineering Courses at the 200-300levels in particular. The alternative is that I should get OND and HND Diplomas and do the Graduateship Examination and then do the Corporate Examination of Nigeria Society of Engineers (NSE). I made a mental calculation of duration of each option and I told my mentor that I would take the relevant courses. I then registered and had to be in Class with my own students and seat for the Examinations. It took three Semesters to remedy this gap in my educational background. Initially my students thought I was there to monitor their attendance, etc and I told them to face their studies because I am also there to learn. I reminded them of my usual counsel to all new students in my department that they only have course mates and not class mates.
While I had colleagues who identified with my plight and gave me their lecture notes to photocopy and prepare for exams, there are one or two who humiliated me more with threats that if I miss their

classes I will fail. I owe them no grudge but my philosophy is that one cannot be too old to learn, except there is pride which the Bible says come before destruction.

My crowning moment was in 2013 when I sat beside Engr-Prof Ofodile at a COREN Workshop program and introduced myself and thanked him for his firm position that has helped me to qualify as a registered Civil Engineer. I cannot leave this issue without appreciating Engr Prof Mike O. Faborode, who as Dean identified with my efforts and defended all the efforts I have explained above to the COREN Committee on Registration when they did not know I took undergraduate courses to make up for my background. He is the first Engineer to be Vice Chancellor in OAU.

Mr Vice Chancellor, I narrated this to help our students and possibly some of our colleagues or guests to decide whether they want something enough to humble themselves to do it as it should be done and have the needed confidence to say by God's grace and enablement, I am what I am.

3.3 Challenges of Mentorship and Academic Freedom

This brings me to the issue of Mentorship and academic freedom. I have mentioned four mentors already above. Another man who has helped me in my academic career is Engr-Prof Femi Ajibola. I have deep respect for this astute scholar who has mentored so many people in OAU in particular. When he appointed me as Coordinator, he gave me very useful advices on how I can organize my time to meet with the demands of acting as head of Department, coping with my studies as well as the courses I teach.

One truth he told me then was that if I am careless, the system would use me and dump me and if I like, I could plan my work and benefit from the services. He emphasized the need for me to publish my papers from my Thesis and research efforts. Between him and the late Prof Ogedengbe, they would review my draft manuscripts until they are satisfied and then suggest to what

journal I should send it..

However the developments above are of course with their challenges and problems. Whereas I enjoyed the mentorship and leadership provided by Engr Prof Songonuga, I learnt my first lesson in Mentor-Protégé relationship under him.

Shortly after my admission into the MSc program, and based on some efforts I have made in developing biogas digesters, I wanted my project to be on how to develop appropriate technology for the design of the digester. I developed a steel digester charged with poultry droppings from a nearby poultry farm used to supply biogas to my wife's cooker where we were living in Ondo in the late 1980s.

When Prof Songonuga said I should submit a Project Proposal, it was around this issue. After several submissions and red paints over the papers. I had to pray and ask God for direction. The Holy Spirit said, go and ask your Supervisor to suggest a Project! His response when I did so was "Now you are talking!" And that was the solution. Once we resolved the issue of what to do, the objectives were set and agreed upon and the methodology was straight forward. I concluded the project in record time and had two very good publications from that project. The Determination of parameters for the design of institutional oxidation ponds and the DOE Profiles were from that work (Adewumi and Songonuga, 1989; 1995; Adewumi) .

Noting that a Call for Conference paper was in the area of my project, he also encouraged me to draft Abstract (s) and submit it. I made two Abstracts both of which were accepted for oral presentation. He then encouraged me to develop the full papers and attend even before I did my oral examination.

The second Masters degree followed almost similar pattern, where I was trying to work on development of low cost housing technology as a Civil Engineer, while my Supervisor wanted me to focus on water or wastewater treatment. In the two cases, my

mentors considered limitations in or available facilities in our laboratories to give guidance that made my program successful.

Mr Vice Chancellor, I virtually scoffed at the idea and for those who knew my Mentor very well, once he has made up his mind on an issue, no one can change it. It was about this time that Prof J.A. Adepetu, a Soil Chemist in Faculty of Agriculture contacted me and enlisted me in a Joint World Bank/ National Agricultural Research Program (NARP) Project, with Prof P.O. Aina, a Soil Physicist and current Vice Chancellor of Ekiti State University as Co-Investigators. Two papers from that project has been cited in high impact journals since 2005 (Adewumi et al, 2005a,b) with one being the most cited of my works and also referenced in high impact journals and abstracts.

At the end again, I prayed and asked God to show me what to do and how to enjoy the project. By the time I was through with the Masters degree, I continued further study at the PhD level and today, apart from publications, ***Mr Vice Chancellor Sir, I have a Patent License to my credit*** (Pat. No NG/P/2012/627).

Once anyone decides to put his/her neck to work or study in a way that (s)he submits to the Spirit of Jehovah [the only true God] who created the Universe, His Holy Spirit will give revelations that will glorify the Works of He who some Philosophers refer to as the Great Mind or the Super Being.

At the nano-scale investigation of the micropores created in activated carbon from palm kernel shells (PKS), I found that by varying the medium, duration and heat conditions of activation, different products with different scanning electron micrographs (SEM) could be produced Fig 4, Of note for the patented product was the ability of the BBC 945 adsorbent to remove trihalomethanes (THMs), heavy metals (HMs) and other major organic impurities from all types of water sources (public tap water, borehole waters and raw surface water sources. This reminds me of the DNA in our bodies that characterize us and

make us as individuals uniquely, wonderfully and fearfully created. You are original and not a duplicate or counterfeit!

Whereas there is a happy ending to the two projects above, my freedom of choice of project topic was appropriately denied me by my mentors based on the circumstances of lack of adequate facilities as in the first MSc Thesis, or lack of Supervisor in the area of interest in the Second Case. This negates the Bologna Treaty on Academic Freedom. The right to choose an area of study should override a Supervisor's interest since the student is the one that will do the project anyway. However, wherethe student comes out categorically to say he or she has no idea of what to do, then the Supervisor could then offer suggestions on appropriate topic.

This also does not hold in case the Supervisor has access to a Fund for a specific project. The admission of such student will be based on an agreement to conduct the given research on specific objectives.

4.0 FOCUS OF THIS LECTURE

Mr Ag Vice Chancellor, in deciding on the title of this Paper, I resolved not to limit the generic word *Environment* only to the usual physical environment. My humble research efforts were directed to this area but I will, apart from reviewing my contributions in that area, I will devote time, with your kind permission, to share my views on Academic/University Environment, Community Environment, Nigeria Environment, Socio-Political Environment, since Universities are set up mostly for a *Town-Gown* relationship, through which identified community (social, commercial, industrial, agricultural, cultural) issues are studied ostensibly to find solutions to such issues.

4.1 Academic /University Environment

The current global focus on University Education is on programmes leading to sustainable development, entrepreneurial skills development among others. For engineering education, the focus is more on sustainable production and work environment

through functional, qualitative education that matches intellectual capacity with industry, initiative and conscious efforts at minimizing exploitation of natural resources and maximizing output.

For Nigeria in particular to develop and be competitive with other developed nations which we hope to qualify to join, there are aspects of our national policy that must give way. For as long as we promote mediocrity through such policies as national character, quota system of admissions and employment, membership of clandestine associations of indigenous staff, etc, etc, the Institution, the State, and in effect nation shall remain at the bottom rung of development.

A policy or political system that promotes ethnicity, religious bigotry, that favors only the children of the rich without using merit and excellence as yardsticks for decision taking is doomed to wallow in poverty even when resources, both human and material are in abundance.

How do we then engineer the academic environment to ensure scholarship and promotion of excellence?

In South Africa, any academic that publishes a research article in a high impact journal gets some honorarium that is in three categories of level of the Researcher's status. Most importantly, multi-disciplinary or inter-disciplinary research is encouraged. It will interest us that engineers and sociologists, even artists [sculptors, painters, etc] can collaborate in a research. In environmental studies, it is not uncommon to find botanists, microbiologists, biologists, limnologists, economists, geographers, chemists, physicists, statisticians, demographers, etc working together with civil engineers, mechanical engineers, electrical engineers, chemical engineers in a major project.

There is also funding of academic staff to attend Conferences by most of the Universities in South Africa, Ghana and other countries of lesser resources than Nigeria. The essence is to

encourage networking and learning of new things from participants at such programmes or fora. It was pathetic to learn in January 2012 from Prof Yaquub , the Immediate Past Executive Secretary of Tertiary Education Trust Fund (TETFund) that majority of Universities in Nigeria do not utilize at all or in full the allocation for International Conference Attendance and Academic Staff Development. Overseas Training are at times reserved for the "good boys or girls" of the Chief Accounting Officer of some tertiary Institutions (Universities, Polytechnics or Colleges of Educations), whereas those with better qualification are sidelined because they cannot kotow or hero worship or are not indigenes of a State.

In the conduction of environmental impact assessments (EIAs) in particular, the ear never asks, what has the foot got to do with me? All members of the academic body are to work together for high impact or landmark discoveries and/or solutions to major problems in the environment. Even within the same professional calling as we have in Faculty of Engineering and within each Department, a pooling of resources of each discipline could lead to outstanding solution to peculiar problems confronting a company, a community, a State, or even the whole nation.

Mr Ag Vice Chancellor, my first visit to this University was during an Academic Staff Union of Universities (ASUU) National Executive Council Meeting hosted by the NDU Branch of ASUU. I immediately fell in love with the Serene environment despite its obvious challenges. Having worked here for over two years, I have identified some basic areas of need that can promote scholarship in this University.

The Terrain Environment of the University is obviously a water-logged one with very high water table. I also found that the major building material is dredged sand which costs about four times the average of procurement in Inland areas of Western Region of Nigeria. In such situations, the best developmental approach is a

Vertical Engineering Development, with multi-storey buildings on Pile foundation. The wetland terrain also requires land reclamation efforts that would reduce impact of flooding as we experienced in December 2012.

Crucial areas of needs are for Staff Housing, especially of Academic Staff who are responsible for promoting the academic excellence; provision also of staff schools at the Nursery, Primary and Secondary Schools levels; Social amenities of steady water and electricity supply to enable Academics work in their laboratories till late in the night, as is the tradition in World Class Universities.

A situation where both staff and students undergo stress to get to work every morning, or where majority are still residing in Port Harcourt and even Yenagoa to commute to Amassoma will only breed mediocrity, will limit research potentials and keep the University undeveloped. The State Government, therefore should not treat the Institution as sole property of TETFund but come up with proactive ways of generating adequate funds to make the University develop to a World Class Institution.

Mr Vice Chancellor, ASUU in its presentations to the Federal Government and through the recently published NEEDS Assessment showed that for every student admitted, the Visitor or Proprietor should make a budget of at least one million naira minimum per annum. So, for the 4000 students admitted this year alone, a minimum of four billion naira is needed to provide additional facilities and conducive teaching environment. For the total student population, that would mean a requirement of 12 billion naira per annum.

With the free education policy of the Federal Government, what minimum "maintenance charges" could a University then charge its students without attracting the wrought of ASUU and NANS (National Association of Nigerian Students)?

Or in other words, how do we then engineer the University

environment to be able to sustain its academic and scholarly activities, without putting more burdens on parents, majority of who global statistics show are living below poverty level of an income less than one US dollar per day? That is a ridiculous N260 per person per day!

Local Content Needs To Be Redefined

Mr Vice Chancellor, a sustainable way of addressing the issue of funding is to exploit the Local Content Policy of the Federal Government of Nigeria (FGN). The way this policy that is supposed to empower Nigerians from any major project or consultancy executed in Nigeria is presently conducted is froth with problems that has been skewed by corruption to favour the multinationals that operate in Nigeria.

There is no State that does not have one major FGN project or the other at any particular time, be it road construction, building project, or NGO or Multi-nationals funded Programmes. Each of these projects are supposed to enlist for participation and remuneration Nigerians in the different categories of the personnel needed.

Mr Vice Chancellor, there is the need for the Visitor to the University in drawing contract terms for any project to insist on the patronage of relevant Departments of the University; appointment of Academic Consultants of proven competence to supervise and be involved in the execution of the project from the conceptual stage through to its commissioning and subsequent use. Apart from the monetary benefits of such redefinition, academics would be able to produce functional papers from such projects.

The Federal Government in like manner should make inclusion and use of staff in Universities around which a project is to be executed a major condition/criteria for meeting the local content aspect of a Contract agreement.

The second benefit of this inclusion is that students in engineering

and/or science disciplines could be given industrial exposure by being included as Labour team and paid some allowance also factored into the contract which I tag as *"Dignity of Labor & Apprenticeship (*DOLA)*" Allowance*. While such participation will form part of their Industrial Work Experience that will greatly enhance their professionalism, Those that will get paid the DOLA are those that have demonstrated Industry, Initiative, Intelligence and Integrity in assigned jobs in the project. Definitely, this will relieve the students of some financial needs and help them in their studies.

So, with all the road construction, building construction, works in the state, Civil Engineering, Electrical engineering, mechanical engineering students in particular will acquire field experience that will make them competent, registrable engineers on graduation. Osun State and some other Governments have enacted laws directing that all building plans for approval must have seals of professionals (Architects, Town Planners, Civil Engineers). Beyond such Policy decision, it is not out of place to involve both staff and students in all building or developmental projects in towns where such institutions are located. That way the menace of collapsed structures, failed roads, etc would be drastically reduced.

Such policy decision should also naturally cover all projects that are done within the University.

4.1.2 Policy of Tax Deductible Research Grants for Companies

The other major source of funding that has not been utilized in Nigeria is the endowment of Chairs by various Companies and Multinationals operating in Nigeria. While majority of them would argue and probably think that the Education Tax deducted from their Earnings (Profit Before Tax –PBT) is or should be enough support to education, the reality of what obtains in their own country is to the contrary.

Whereas in their own country apart from paying tax, including

education tax, majority of Industries still endow Chairs and make annual Research Grants available to Universities. Although mostly individual Academics apply for those Grants, but the subsisting Policy of the Companies and Legal Enactment of Governments that makes such fund tax-deductible and so encourage such release of Grants.

Since the Company would commit fund to find peculiar solution to their production and materials needs/management, Companies would readily be willing to release funds and get tax relief for supporting Research. This double advantage includes solution to their domestic or even global production problem. The Researchers involved would also publish articles and share Patent License with the funding Company apart from extra income to the Researchers above their regular monthly salary. The University also gets recognition for proffering solution to such industrial problem

4.1.3 International Grants/Fellowships

One major source of promoting academic excellence and scholarship and acquisition of educational materials – scientific equipment/instruments, books, soft tools, etc is through a very effective access to internet connectivity through which one can quickly get linked and synched with institutions that are requesting partnership on funded global project. Most funding agencies require involvement of academic institutions in countries other than that of the applicant. Some would specify involvement of academics in both developed and developing countries for cross-fertilization of ideas.

Without access to internet facilities with very large broad band width, most staff will lack essential information that could connect them with mentors or partners globally. Investment by nay University on Internet facilities is thus *sine qua non* to visibility and connection with potential funding bodies. The Alex von Humboldt Fellowship for instance has potentials to grant Fellows

access to equipment and materials that they can use and keep in their institution after their program. Similarly the Carnegie Foundation has programs for supporting Institutions especially in Research that focus on Gender issues.

4.2 Community Environment

The University Host Community has a lot of impact on the Research Base of such Institution and its ability to interact proactively and positively with the people. The social and economic activities of host Institutions have mostly been transformed where there is a positive town-gown relationship. However where the community is hostile, exploitative or non-patronizing, the community remains mostly unknown beyond its borders. Thus World Class Universities such as Oxford, Cambridge, Massachusetts, outside Nigeria have a tradition of placing the Host Community on global map.

Closer home, the Agbowo Community in Ibadan developed around and because of the Premier University in Nigeria, where both staff and students live and share their lives with the community. The commercial and social lives of Agbowo gradually change with the demands of the generations of staff and students who live within it. This is also the case with the Obafemi Awolowo University and Ile-Ife Community.

It was with relieve that the connection of Amassoma to the National Grid around December last year brought some semblance of urbanization to this University town. With the University subsisting on diesel fueled generator for over 10 years, substantial fund that may have gone into developing some infrastructure remained tied down into providing energy. This contributed to noise and air pollution for almost every day except on weekends when the generator rests for 12 hours each on Saturdays and Sundays.

The effect of this is to make most staff that would have stayed the weekend to travel to places where they can have comfort of

semblance to civilization. The impact on research is also grievous. Even when you are willing to stay and continue with a study requiring electricity, the researcher's indolence is encouraged by this lack of essential infrastructure. Whatever it will cost, for excellence, the University community must be sustained on constant access to energy and water supplies.

4.2.1 Impact of the University on the Environment

Mr Vice Chancellor Sir, shortly after my resumption in the University, I went round to know the community and identify potential impact of the University on it. We found that though Amassoma is living virtually upon water and surrounded by water, yet it has grossly polluted water sources.

The tell-tale red or brownish pigmentations on elevated water tanks is a pointer to high ferric ion concentration in the borehole water sources that remains the only viable water source. This qualitative evidence does not show the quantitative gravity of the pollution, especially if there are other hazardous substances.

One was equally irked by the presence of elevated tanks and borehole in the University Guest House, yet the rooms have no water except from those brought for sale by Mallams who wake us with their singsong of "Va-ter! Vaa-ter!!" Their near German hawking of Water angers me and keeps me wondering why it was so. The answer was poor plumbing works on the building that makes water flow into the walls instead of flowing out through the faucets. The 'solution' is then to pump just little to a Ground tank at the back from where you can either fetch water on your own as an early morning exercise or pay N100 for three kegs of 20-litre jerry cans!

Apart from this issue of water supply, we also observed that due to lack of proper disposal plan for electronic wastes and in fact other wastes generally, there are pools of electronic wastes under

staircases, in stores within the University and carelessly discarded into vacant plots by the former owners within the town.

Apart from the hazardous nature of some of the constituent materials in the e-wastes, there is no data of the number, types, quality, etc of the wastes. Together with a colleague, Engr Sapre-Obi, and two of my final year students both in this University and Obafemi Awolowo University (OAU) where I came from, we conducted a preliminary investigation into the potential hazards of e-wastes scattered in Niger Delta University and OAU. There was high potential for valorization of electronic wastes, thus making it safe for disposal. The possibility of establishing a thriving business and also a research institute for e-wastes management was identified in our paper (Adewumi et al, 2012).

4.3 Nigeria's Environment

Some have often joked that there are three nations in the whole world, the developed countries, the developing countries and the Nigeria nation. This has both a negative and positive undertone with the negative being promoted by those who do not understand the Nigerian nation. Of course Nigeria is a special country that received extra creative time from the Maker of heaven and earth. Where the rest of the world expects us to be at each others' throats, we would show some level of anger and, like kids, we soon forget and we are in play again. At times we appear to be our own enemies but somehow we are still kicking and are the happiest people on earth!

Mr Vice Chancellor, while I will not go into much discourse on what makes us to be specially endowed with resilience to survive the severest abuse, I will pick on few points that we must consider if we will make the Nigerian environment sustainable in a more or less political engineering.

4.3.1 Socio-political environment

From the amalgamation of the northern and southern protectorates to what we call Nigeria today, through our flag independence to the present democratic dispensation and in our 100 year of human engineered togetherness but which to me is Divinely ordained, the socio-political environment of Nigeria has mostly remained a copy-cat type drifting from the Parliamentary System of governance of the Independent Nigeria to the most expensive democratic dispensation that is peculiarly Nigerian in nature and very much different from that of the United states of America we allude to copy.

The present Do-or-Die Politics must give way to a truly democratic type of politicking if the Nigerian environment will experience true freedom. The earlier parliamentary type, where Law-makers or parliamentarians are mostly teachers, senior officials, who did not have to retire from their paid-job to be a member of Parliament and who only are paid Sitting Allowance, to me seems where we must revert, even if it will still be democratic system.

Would most of those who are in Senate or House of Representative, accept to be paid only sitting allowance, where you only get paid an allowance if you make contribution on the floor of Senate or Lower Chamber, even if it means struggling to get the Speaker's attention and say, Mr Speaker Sir, I concur with what Honorable Adewumi has been saying. The Clerk records that and all those who have attended gets an allowance only for the days in Parliament.

This means, each member must have a paid job or be self employed with evidence that he is just not in Parliament for what he would earn, only then can our political environment improve. We need to go back to that system of paying political office holders just honorariums and allowances and not Jumbo Salaries that encourage only violent individuals get elected while those that could provide leadership and service are terrorized away from

serving their fatherland. This is essential in reducing the corruption that is presently rife in the political arena.

4.3.2 Religious environment

By God's grace, I am not only a Child of God and Servant of the Most High, I am an ordained Minister in a Gospel Church. Today there is a lot of misrepresentation of the Good news of salvation and living. The Church is the body of believers in Christ as their Saviour, and not the physical edifices where we worship. Religion is our own effort to reach out to God, while Christianity is God coming down in human flesh to save sinners and reconcile them to God. The true religion is to fear God, help orphans and widows and those who are in need. As much as possible, religion is and should remain personal, private and purposed towards doing what would please the Living God. Other faiths have their own tenets and should be respected. The mutual respect for other peoples' faith, fears and functionalities is fundamental to having a healthy environment within which to even work as an academic or non-academic.

Since the fear of God is the beginning of wisdom, the wisdom we need in our academic environment is to be diligent in our work as *loco in parentis* to our students, and for our students also to do their jobs as they should, at the time assigned for each and then commit their efforts to prayers.

The situation where some students turn lecture halls into Religious grounds, with musics and shouts that affect other staff and students, leaving their studies unattended to and finding that they do not understand questions in an examination, write obscene messages such as "I am trusting God to use you to favour me and overlook my mistakes" makes mockery of God they profess to serve. The Lord Jesus Christ was diligent in all He did, even to the death of Calvary, he was a time keeper and organized. He had time for everything He did. His followers should not do

less if they are true followers. Otherwise, they are frauds instead of being followers.

My students know my two prayers before I grade scripts and having satisfied my conscience that I have taught and done all I should do: I tell them my humble prayers is, God as I am about to judge individual lives and their future, let me not fail, those who should pass and let me not pass or favor those who should fail" because in Judgment I will answer even for my own role, Amen.

If we academics are conscious of this and can pray so, we will probably take our duties more seriously to the benefit of our nation.

4.3.3 Educational environment

Nigeria's educational environment has become shylocked with heavy commercialization and little to show for it. From the primary level through the Secondary School level to the Universities and Tertiary Institutions, there has been sorrowful decay in quality of impacted knowledge. Today we have many undergraduates even in their final year in the University, who cannot write a single correct sentence without one silly mistake or the other. Often the blame for poor communication skills and job performance skills of graduates of University programmes is mostly misplaced at the doorsteps of lecturers!

In our growing up years, by the time you are in Primary three you already know how to write letters both in native and English languages. Primary three! Today, we have undergraduates who do not know how to start a letter, nor where to put signatures in a letter that most of the time is full of grammatical errors! Even when they need an obligation and come to your office, their sentences are full of "as in" or "it's like". A final year student walks into your office and say, "I want to sign this form Sir". Mostly I coolly, give such illiterate a ball-point and say, what is stopping you? Mostly they look dumb-founded, and then I would go further and say, "Is that the correct sentence for requesting for a favour?"

We need to go back to the basics. Where the Primary teacher is busy hawking sideline business, there won't be good communication skill taught the students, or where the teacher too is a dropout and is only there because he could not get any job; or was forced on the system by a Gutter System [Governmental policy of Quota System or Federal Character]. I was not surprised when the Kwara State Governor subjected all Secondary School teachers to Examination a couple of years ago, and majority could not pass the examinations.

The same problem is carried into the Secondary Schools, where desperate indolent parents encourage their children/wards to commit examination malpractices just to be able to get distinctions and credits in registered subjects for West African School Certificate (WASC)/General Certificate Examination (GCE). Most of such are also helped to pass their Joint Admission Matriculation Board (JAMB) Examinations and Post JAMB Examinations organized by some Universities. Unfortunately such students matriculate and get into the University only to find that they cannot cope.

No wonder such students spend almost double the normal study period only to graduate with an ordinary Pass degree or even be withdrawn after Failure. This explains why such students join cults and terrorize innocent lecturers instead of their parents who believe it is only University education that would make their wards succeed in life. Not many remember Bill Gates dropped out of the University, but only know he is the richest man on earth. Why that, he focused on the essential and found himself doing what he knows best.

Our educational environment therefore needs to be re-engineered from the primary school level through to the tertiary institutions. Those who have no aptitude for scientific or abstract learning may be competent in vocational skills. There is the need for a paradigm shift from rethorics learning to entrepreneurial skills –backed

learning that would make graduates think of becoming employers of labour instead of looking for non-existent jobs.

4.3.4 Production environment

Someone said that the game of life is played between the best and the worst over the head of the rest in the middle! The best in this instance refers to a producer and the worst is he who only consumes but do not produce anything. Nigeria is a consumer nation, forget about the fact we export oil, Are we really the owner of the rigs used in the drilling or the multinational companies that has been exploiting the oil reserves since 1957! It would appear gloatful if one says thank God for the drop in oil price to below US$50 per barrel! Perhaps it will wake this sleeping giant we call Nigeria from its deep slumber.

Where are the Groundnut pyramids we grew up to know in our Civic lesson? Where are the cocoa farms and stores in the West, where are the oil palms and rubber in the East? At the peak of our affluence and as world's leading oil palm producer, we gave to Malaysia free of charge oil palm seedlings in 1958 shortly before our independence. Today, Malaysia is the leading oil palm producer in the World, producing from the same *Elais guinensis* we generously gave them, more than 39 products including car interior padding, varnish, polish, activated carbon, etc, All we could produce are the palm oil, palm wine, palm kernel cake, palm kernel oil and the shells we use as fuel.

Lack of energy source made many major industries to relocate to neighboring countries to reduce their overhead on power supply. Yet the government has not deemed it fit to limit or even outrightly ban the importation of generators to force local development of our energy source from biofuels and hydro electricity sources that are abundant in the country. These contributed to the devaluation of our currency which was almost twice the strength of the US dollar in the early 1970s. Today N190 exchange for one dollar!

Mr Vice Chancellor Sir, some years back I took Man O War Club

members of the OAU on a tour of the Eastern Part of Nigeria. We visited many landmark locations such as the Obudu Cattle Ranch (before the Cable Cars were installed by Governor Donald Duke; the Ogbunike Cave, and the War Museum at Umahia. What intrigued me most were the explanations of the artifacts at the Museum by the Guard./Curator who pointed out to us "Things bought by Nigeria" to execute the Civil War and on the other side were "things made by Biafra" to defend themselves!

This spoke volume to me then and still speaks volume even until now! I often ask myself, is the Civil War over or still on? If it is over, where are those cerebral minds that developed 'Armoured Tanker", the *Ogbunigwe* rocket, the *Mosquito* Kite used to drop bombs in Federal territory? Are they still treated with suspicion when they should have been put in an Ammunitions Laboratory to develop weapons and similar materials to reduce our annual budget on importation of defence equipment and materials?

This was the case of a gunsmith in my locality that was routinely arrested by the Police for manufacturing light weapons, 4-round revolvers, short guns, etc, despite keeping accurate data of all his clients who also sign an undertaking that they would use the weapon only for Games hunting and not for nefarious activities.

Should we not transit as a nation to fully gain our industrial independence by assembling these and like cerebral minds to locally produce ammunitions for our Army and Security operatives, repair and maintain those developed, such that over time, the quality will rival those we presently import?

That was how our colonial masters called our locally distilled gins, illicit so that their schnapps and whiskies would sell on our markets and drive the local technology of brewing underground for many years until Prof Soyinka challenged this and got acquittal for using the local gin and paved way for local production of gins and other alcoholic drinks!

There is the need for us as a nation to realize that we shall remain a consumer nation for as long as local efforts are classified as illicit or illegal or native! These are derogatory words to keep us in perpetual bondage to their commerce!

Close home, here, there are local technologies developed across and all over Ijaw and Izon land to refine crude oil into motor spirit and diesel. I want to posit that the Technology has been there for centuries and the tradition has been passed down to succeeding generations by local apprenticeship and oral literature. Our own law enforcement agents, paid from our common wealth are taught to impound and destroy the local distilleries because the business is classified as illegal and yet we do not have enough refined products to meet local demands. What makes it illegal? Because Britain said so or because our past leaders were not sensitive enough to realize that Britain only wish us to have a flag independence and not economic and resource independence. This must change!

The Chinese, Indian and Japanese approach to this is to promote the small scale technologies, organize them into groups and possibly empower them to increase their processing capacity and thereby solve the local bunkering instinct/activities. Such recognition and empowerment will create more jobs, ensure proper sustainable production process and certification and reduce the pollution in the Niger Delta Area.

Beyond creating employment in the areas where the oils are extracted, it will solve the mystery of fuel subsidy where some individuals are feeding fat on the nation's economy for doing nothing. We have scoffed for too long at our own wisdom and embrace a recolonization process that demands we accept sodomy as a way of life if they will give us financial support. Has heaven not blessed us with abundant resources with which we could easily say to hell with their so called Aids?

5.0 ENGINEERING THE ENVIRONMENT

5.1 Establishing Small-Scale Refineries

Based on my view in the last paragraph above, there is the need for this University in particular to contribute to the development of the Nigerian nation. Our Departments of Petroleum and Chemical Engineering have intellectuals and technical staff with cerebral capacities who could develop appropriate small scale oil refinery technologies, and an improvement on the local methods of crude oil refining towards a sustainable production of prime motor spirit and the fossil fuel byproducts.

One of the artwork I always admire each time I pass through the project grounds of the Faculty of Fine Art is the Man with his Local Refining Plant, blackened probably by the fumes from his crude distillery or probably a symbol of our strength to adapt to our environment (Fig 4)!

Fig 4: Local technology of fuel distillation illustrated by an Art Student in NDU

The Faculty of Social Sciences could conduct a Research to find out prominent practitioners of the technology; while chemical/petroleum and even Civil engineers could also appreciate the simplicity of the technology, identify how to improve upon it and come up with an environment-friendly low cost but high technology refinery that could achieve the required minimum octane number for prime motor spirit (PMS) and other

products. We could then serve as Consultants both for the production of the small-scale refineries and their maintenance and make that one of our major contributions to this Region blessed by Heavens. Civil Engineers would assist in appropriate construction materials and design.

The by-products of such refinery activities could also serve as materials for further engineering use. Another major study area that the Engineering Faculty could initiate local Research is in the area of mitigation of oil spills. Whereas there are conventional methods in use, are there local methods of oil spill amelioration that could be further developed?

5.2 Flood Mitigation and Land Protection

The flood episode of 2012 that cut the University off from the 'World' had not been taken for granted by the University. It is on record and commendable that the Vice Chancellor, took proactive steps to set up a Committee to come up with recommendations on how to prevent future occurrences of damage to properties by flood in the University and, if possible, the whole State. I am privileged to have served as the Convener of that Committee and our investigations showed that some essential engineering control measures needs to be put in place.

Essentially, as stated in the Preliminary Report submitted to the Vice-Chancellor, there is the need to create adequate capacity drainage channels and sinks into which surface waters could drain and be stored for domestic and agricultural use or allowed to flow into nearby creeks. Detailed Report on this is expected to be produced from a University funded research on flood mitigation that will involve field Work to identify possible obstructions to river or flood water flow by structures built in waterways.

A needed action for control is the demolition of all structures that fall within the water mark of floodplain in the area. With the high water table levels generally in the State, we found that recharging of aquifers may not be a viable option since the aquifers are

saturated to overflowing. A further geophysical analysis at an extensive level is required to enable us make a scientific position on appropriate methods such as flood mitigation dam construction, widening and dredging of waterways among other methods.

5.3 Building Technology in Riverine and Wetland Areas

As is the case with local refinery technology, the Izon/Ijaw culture has adapted to their water environment with the use of local building technology that we could improve upon and make housing accessible and affordable. The Japanese and Chinese use of bamboo and fibre materials is a classical example of how native intelligence has evolved into sustainable housing system. In land-scarce situations as we have in Bayelsa State, the conventional approach is to focus on vertical development of multi-storey structures as is the case in Japan and Singapore. Such structures will be on pile foundation mainly.

The bamboo and timber struts on which the huts in Riverine are built can be engineered to support durable locally sourced materials tor replaced with reinforced concrete piles hat could reduce cost of construction and ensure durability.

Faced with scarce funding in the last Session and the challenge of desire for accreditation of the Civil Engineering Program of the University, I have initiated with my colleagues, Dr T.S. Orumu, a Senior Lecturer in the Department, and Dr Efe Ikpomwonsa, an Associate Professor of Civil Engineering on Sabbatical from University of Lagos, designed a full scale beam and slab testing rig and initiated a study of profile concrete decks as a way of reducing cost of slabs (reduced concrete thickness and replacement of conventional reinforcement rods with just 0.8 mm thick profile sheet) . The outcome showed that the cost of reinforced concrete slabs could be substantially reduced. Deforestation through use of bamboo scaffolds to support slabs was also reduced thereby promoting reforestation (Figs 5 & 6).

The Steel Profile Concrete Slab (PCS) could be made precast in a factory and brought to where it will be used or could be cast in situ monolithically with the supporting beam over which the profiled plates will be laid to form framed structure.

Fig 5: Houses on stilts (left) or wetlands (right) in Nigeria coastal areas

Fig 6: Full scale Steel Profile Concrete Slab (PCS) under analysis using test platform developed in the Department (Adewumi et al, 2014)

The analysis we did showed that reinforcement rods will not be needed for the decks apart from the steel plate that is folded to strengthen the metal sheet. A slab thickness of 100 mm also reduced the usual concrete slab depth by 33 % and could find application in rapid construction of shelters especially in times of natural disasters.

Apart from this breakthrough, the designed rig saved the University at least N2.7 million. The most important gain however was that the COREN Accreditation Team commended the

initiative of developing local solutions to civil engineering programmes. The Council (COREN) has now accredited the Civil Engineering Program for the first time since its establishment in 2000 effective from November 2014 until 2019.

6.0 A SUMMARY OF MY CONTRIBUTIONS TO ENVIRONMENTAL ENGINEERING FIELD

Having talked generally Mr Vice Chancellor, what specifically could I then say I have seen as my humble contribution to Civil Engineering profession? I started out as a Health Officer to seek solution to solid wastes management, find how to make housing affordable and accessible to the average worker; and develop technologies that would reduce the communicable diseases traceable to or associated with poor quality of water or shortage of it. These three area provided the driving force that has influenced my academic researches and career development.

6.1 Wastes Valorization

6.1.1 Organic fertilizer production from wastes

Apart from lack of working data on the magnitude and quality of wastes generated in cities, an earlier work (Adewumi and Fajewonyomi, 1997) found that one major contribution to inability of governments (local or municipal) or their agencies to properly manage MSW is lack of adequate and relevant equipment. The equipment imported for local use also did not consider the anthropometric size of major users of public storage bins. In Nigeria and most of Africa, children are responsible for taking out wastes to public dump sites, whereas in Europe, it is the man of the house who takes wastes out for collection. The storage bins are much higher than the size of the average school child and so, refuse are dumped on the ground. This adds to the labour of the agencies who collect the wastes.

From the World Bank/NARP jointly funded research headed by Prof Adepetu (1996-99) in which we investigated the municipal

solid wastes (MSW) and livestock farmyard manure (FYM) wastes management methods in eleven cities of Western Nigeria. One treatment method was the use of aerobic composting method for which we derived appropriate composting ratios of mixing MSW:FYM as being 70:30 (Adewumi et al, 2005a,b). The chemical characteristics of the organic fertilizer showed high content of both micro-nutrients and macro-nutrients needed for plant growth. The focus of that research was to see how to use those wastes to improve farm yields.

The project led to the development of a Refuse sorting machine that would improve the management of MSW (Adewumi et al, 1999). The work also showed that both the poultry droppings in farms and MSW could be used to produce biogas and organic fertilizer (Adewumi, .

6.1.2 Activated carbon from palm kernel shells

Mr Ag Vice Chancellor Sir, palm kernel shells (PKS) is a common wastes from the processing of oil palm fruits into palm oil and palm kernel oil, palm kernel cakes using local technologies which has been improved upon in the last 3-4 decades. The PKS resulting from the processing of oil has two major local uses- the raw PKS is used as solid fuel for households and the charred shells are used for heating local furnaces and hearths by blacksmiths.

One major global use popularized from the early 70s is as industrial adsorbent from processing of the carbonaceous shells into activated carbon (AC) either in its granular form for use as deep column adsorbent beds or in its powdered form in upflow adsorbent beds for oil palm refining into what we call groundnut oil from Malaysia or Indonesia or for other fluid purification.

My late mentor, Engr Prof Martins Ogedengbe pioneered local study into AC production following his effort at recycling of PKS into filtration bed medium (Ogedengbe and Tella, 1984, Ogedengbe et al, 1985). It was my fortune to be asked to work further on the study for my MSc and PhD projects (Adewumi,

1999, 2006) from which we published a couple of papers (Adewumi and Ogedengbe, 2004; Adewumi 2007).
We found that by varying the conditions of production (temperature (Low or high), duration of activation (short or long) and medium of activation (ordinary, alkaline or acidic water medium), different qualities of AC can be obtained with specific adsorbent capacity or activity (Fig 7). Further work on the production method after my PhD showed

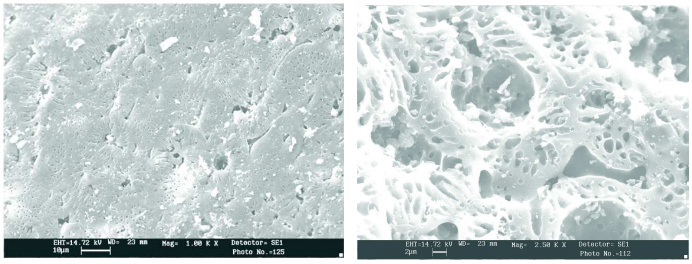

Fig 7: SEM of grain of ordinary charred PKS (left) and of fully activated carbon type BBC945 (right)

that a particular grade of AC could remove several hazardous materials from water and wastewater in particular. Of note is the removal of trihalomethanes (THMs) which are compounds resulting from the disinfection of water with chlorine. The three types of chloramines formed to yield free residual chlorine remains in treated water and must be removed before drinking or else it will bio-accumulate in the intestines and stomach lining of the body to cause cancer.
The adsorbent I coded as BBC945 was found to be very effective in removing all the THMs and also HMs and other conventional organic impurities (odour, taste and colour) and what I classified as non-filterable turbidity (NFT) in my work (Adewumi, 2006).
It was this BBC 945 and BAC945 that I processed and got a Patent License (Pat. No NG/P/2012/627) for shortly after I was appointed a Professor by this University. Plans are on to go into

commercial production once I obtain the patent license for the furnace and part of the processing units that will make the production less cumbersome.
Since it is difficult to differentiate between ordinary charcoal/carbon and activated carbon with physical eyes, a Scanning electron microscope (SEM) is normally used in the Laboratories to show the micropore structures as exemplified in Fig 7 above.

To overcome this limitation to both producer and buyer of AC I developed the Methylene Blue Value (MBV) Table that makes practical estimation of the activity and quality possible from the number of mils of 0.001M Methylene Blue solution adsorbed by 1 g of carbon in a test tube when shaken for 1 minute after each addition (Adewumi, 2009).
The sustainable management of electronic wastes has attained prominent global concern, more so that most developing economies are target recipient of previously owned/used white electronic (kitchen wares such as refrigerators, cookers, microwaves, etc) and other e-products such as television sets, computers, printers, etc at low cost but with equally low life span. Mobile phones have also accounted for most of e-wastes in Nigeria. We have presented papers on the potential of e-wastes that are left in the open to degrade and release toxic materials, especially heavy metals into the soil from where they can leach into the groundwater aquifer. (Adewumi and Sapre-Obi,2012, Adewumi et al, 2014). The potential for a Recycling Industry for electronic wastes was presented in both papers above , which could be made sustainable if appropriate separation and recovery methods are developed. This has potential for private-public-institutional partnership.

6.2 Alternative Energy Developments

My interest in renewable, sustainable alternative energy source dated back to my undergraduate project period when in doing my literature review found the use of biogas in China for cooking, lighting and even driving of automobiles very interesting. I had wanted to work on it in my first MSc degree until my Mentor persuaded me to work further on the determination of parameters for the design of waste stabilization ponds system for residential institutions (Adewumi, 1989). My interest is in how to design the digesters to suite our local environment. Prof Odeyemi, a Professor of Environmental Microbiology, has blazed the trail in local research in Nigeria, and cooks in his house with it. My interest is on how to simplify the design and still have a water tight and air tight condition needed for the system.

I had a simple household unit fed with poultry droppings in my rented apartment when iwe were living n Ondo, which attracted a visit by officials of the defunct Directorate of Foods, Roads and Rural Infrastructure (DFRRI). I then determined engineering parameters from the digestion of different livestock wastes in laboratory scale modeling (Adewumi, 1995). The work established projected storage and substrate capacities for each type of manure (cow dung, piggery wastes, goat and sheep manure and poultry droppings.

Since then my students and I have modeled biogas production from mixed substrates such as MSW and poultry manure (Adewumi, 2005; Adekunrun and Fakayode, 1997); studied wet fermentation against dry fermentation approach (Adewumi, 2006; Adenekan and

The possibility of producing ethanol from cassava peels and wastes was the objective of a Masters degree Thesis by Adetokun (2013) which we presented in an International Conference (Adewumi and Adetokun, 2014). Methane yield from open dumps along Tombia were determined both by Civil Engineering Students in the Department and, Mr Anthony Onakpohor, a

postgraduate student at the OAU was shown to be substantial with higher yield in the dry season (Dagana, 2012; Odogu, 2012; Onakpohor, 2013). Onakpohor (2013)'s work showed that the methane gas and other gases were effectively diluted in the air at a distance of 12 km from the source. Particulates were also dissipated within the distance. Tapping of the methane from open dumps is possible as is presently being studied by the Lagos State Waste Management Agency (LAWMA).

6.3 Water Treatment and Management

With the global access to water grossly reduced due to population increase, many diseases are traceable to poor drinking water quality, inadequate treatment of water for different purposes, disposal of sewage and other contaminants or pollutants into water bodies (both surface discharge or leachate into underground aquifers) , etc. Water for irrigation plays prominent role in provision of food to the growing
Global population (Fig 8).

Fig 8: An irrigation canal on the outskirt of Kaduna along the Kaduna-Kutegi Road in Nigeria.

Chemicals in fertilizers used in farming on irrigated lands may be leached into the subsoil aquifers and result in grievous health problems or if discharged into surface waters may cause Eutrophication of water bodies. Flood waters washed into such

channels may carry pathogenic microorganisms that may lead to an outbreak of cholera or similar diseases.

6.3.1 Development of design parameters for wastewater treatment

Adewumi (1989) and Adewumi and Songonuga (2005) established that for a given usage (wastewater from a residential, institutional, residential institutional, commercial or industrial uses), the deoxygenation rates remain the same, even though the population served and volume of water use may change. The Daily Oxygenation Estimates (DOE) profiles developed by removing the previous day's Dissolved Oxygen (DO) value from the current value gave a profile that helped in analyzing the bacterial activities in the sample being monitored. When plotted over the incubation period, the DOE profile partitioned the activities into aerobic deoxygenation by heterotrophic microorganisms up to the 10th day and anaerobic nitrification and degradation due to methagenic microbes. The different curves over the months, especially during the rainy season, showed the effect of dilution from freshwater.

6.3.2 Activated carbon development

The development of activated carbon for water and wastewater treatment has been mentioned before. Apart from producing AC from PKS, I have produced or supervised production of AC from carbonaceous municipal solid wastes (MSW), almond leaves and fruit pods, piggery manure, etc with very good results. These are projects for converting wastes to wealth. In my PhD Thesis, a furnace built with laterite as refractory lining was tested and it was able to operate at an inner temperature of 1,200 degC and after operating for two hours, the external temperature remained below 50 degC (Adewumi 2006). While the use of chlorine or its compound (chloride of lime) remains the cheapest means of disinfecting drinking water the trihalomethanes (THMs) formed

in the reaction of the disinfectant with amines in natural waters is carcinogenic and needs to be removed to make it safe for drinking. The adsorbent developed and patented from my PhD work was proved to be effective in total removal of chlorine and its compounds from tap water, and water from wells and other sources to make it safe for drinking (Adewumi 2006, FGN/PN/2012/657 of 2012).

6.3.3 Groundwater Treatment

Mr Vice Chancellor Sir, one of the challenges put to me during my interview for appointment in this University was the issue of undrinkable waters generally in bore hole water sources that serves as the only major source of water in Bayelsa State. It is ironical that the land is surrounded by surface waters, the oil prospecting activities has grossly polluted what would have been a major source of drinkable water.

The brownish pigmentation on most water tanks are clear evidence of high concentration of dissolved iron which on oxidation is reduced to the stable, rustic ferric pigment. Experience has shown that often ground waters contain dissolved heavy metals as well to varying concentrations. While simple aeration is all that is needed to reduce iron to the stable pigment, removal of heavy metals would require adsorption on activated carbon beds. Final year undergraduate students have been given projects to assess the level of such pollutants in groundwater samples from within the University community (Seikorowei,2012,

6.3.4 Flood mitigation

The unusual flood of December 2012 could be classified as a 50 year return flood that submerged the Amassoma Community and cut the town from Yenagoa due to washed off road pavement (Fig 8). The major findings of the Investigation Committee I was privileged to convene established that most of the submerged parts of the community are below sea level. The water table is also very close to the surface with aquifer located far below the

unconfined surface aquifer. A multi-disciplinary Research is being proposed presently to identify possible unsaturated aquifers into which pre-treated flood water could be channeled as recharge water. The creation of one or two artificial lakes as sinks is a practical option, with such lakes used for aquacultural and recreational purposes.

The construction of dykes around structures or infrastructure below sea level is a time tested engineering solution to flooding of low-lying areas such as Netherlands, Sweden and coastal area of Oakland in California, USA. Before leaving this issue, I see the potential of creating a multi-functional waterway for recreation, transportation and tourism. This would reduce the traffic congestion that is gradually building up in the State Capital. The ox-bow lake in Yenagoa could also be made to be more attractive and economically viable. Than its present level.

6.4 Housing

As a young lecturer, I had conducted researches and supervised thesis projects on possibility of making housing affordable. Housing is not just about the building but also about other infrastructure that makes living in such buildings comfortable. Having read about the efforts of an Egyptian Architect, Dr Hassan El -Fathy, who designed and created a whole village community using adobe bricks as both walling and roofing materials, I desired developments of such domed or barrel-vaulted roofs over adobe walls.

The challenge of moisture in the humid tropical southern Nigeria that has potential to weaken such adobe structure led to the study of how to make such materials stable. Amongst my students involved in such studies are Dr Yemi Fajobi with who I found that we could use sawdust wood ash as replacement for ordinary Portland cement in the stabilization of adobe or lateritic bricks (Fajobi and Adewumi, 1997, 2009). With Engr Olabisi Oladipo, and Akanbi Lot we modeled the use of bamboo as organic fiber

reinforcement for steel rods in concrete beams and slabs. The only limitations is that one would need six times the cross sectional area of steel in bamboo reinforcement.

Due to recent frequent cases of collapsed structures, one of my Masters degree student developed a simple field testing equipment for cement blocks. We found that majority of the blocks do not have adequate cement:sand ratio in the mortars used in production as a way of increasing profit (Adewumi and Aderounmu, 2010).

Looking at the traditional building technology in Riverine areas, that relies on the use of wooden struts to raise floors of houses above dominant flood level, the need to improve on the technology and reduce unnecessary expenses incurred in sand-filling was modeled. Since maintenance of organic struts is frequent and not sustainable, a concrete pier approach offers a more durable and sustainable alternative.

In our quest to reduce deforestation through the use of organic scaffolds (bamboo stems, timber sections) in construction I supervised the modeling of profile concrete slab sections, using the available steel plates (0.8mm thick steel plates) folded into shape to strengthen it into a 2.5 m by 0.9 m slab. We found that though shear reinforcement is not significant at 5% confidence level, slab depth is the major significant factor with a slab depth of 100 mm attaining desired strength comparable to the conventional 150 mm reinforced concrete slab.

As prefab slabs, this will offer a prominent reduction in cost and time of construction on specially designed framed structure with potential for multi-level construction. Our target is the adoption of this framed structural design for use in areas with land scarcity as in Bayelsa State.

Rather than sand-fill sites at very high cost, the use of concrete piles or steel stanchions to carry this surface profile slabs will not only make construction cheaper, but also effective in reducing

economic loss or damages from flooding.

7.0 CONCLUSION AND RECOMMENDATIONS

Mr Vice Chancellor Sir, I have used some of the outcomes of my research efforts to show that, whatever may be the physical problems in our God-given abode, the earth, there are engineering means of solving those problems, even if the solution creates another problem. I also tried to show that the Environmental Engineer today is one who uses scientific and engineering knowledge to solve environmental problems resulting from improper handling or disposal of solid wastes, from pollution of water bodies with organic wastes, the discharge or release into our air environment toxic contaminants or pollutants that may have hazardous effect on human health, or affect or destroy both fauna and flora whether at micro or macro levels.

The ethics of the engineering profession, especially of the environmental engineer, is in consonance with the desire of God for mankind to tend the garden into which he put our first parents, Adam and Eve. He also wish that we have dominion over all that He spoke into existence. And because we have the Spirit of God in us, that power of creativity is inherent in us.

Like the two sons that were asked to go and work in their father's farm, the first said he would not go, but left and later repented and went to work. The other who promised to go did not. We know the one who has done the Father's will amongst the two.

Today, most people in the developed world have degenerated so much and do not profess to know God, but have created useful things that we crave to have or buy. Despite their sinfulness and sodomy, they use the same Science and engineering knowledge we know and have to make their world a better place to live in.

We that are reputed to be the most religious and most happy in the world, remain a consumer nation and wallow in our polluted environment and ignorance. It has been joked that we don't need

a Visa and flight to get to places because both witchcraft and aircraft have 'Craft" in common! Just imagine it and some supernatural forces take you there and back. Unfortunately, no one sees the spirits or what is brought for common good, but ailments and sorrow.

The same heart, the same blood, the same creator, but our thoughts and foundations have given us a broken dilapidated life. The Bible says in Psalm 11, vs 3 that "If the foundation be destroyed what can the righteous do?" The answer and solution to this is what in Civil Engineering we call "UNDER-PINNING'. A defective foundation must be exhumed, the cause of settlement removed and a more stable material is then used to rebuild the foundation and the footings. The house that has been underpinned endures. That is the only way the structure can stand.

The spiritual underpinning is only available in Christ Jesus! A new heart and new way of thinking is needed to get us out of the mess we are in! That new way of thinking would require that our President and Government call those we signed Oil Exploration Business agreement with, to come to a review of the agreement that has no consideration for the environment and living conditions of people amongst which the operations are carried out. The polluter (Must) Pay Principle that exists in their own country must be followed to the letter or we revoke their license!

The new thinking also will make it mandatory to declassify local efforts at processing of our minerals or production activities as illegal. China , Japan and India are full of many small scale ventures, which sum exceeds the demand for products locally and makes exportation possible.

What is needed is for us to ensure that such productions are sustainable and environment-friendly. This is the basis for the new trend in sustainable environment engineering that monitors and account for impacts on the environment from cradle (sourcing

of raw materials) to grave (end of use/life) and from grave back to the gate (recycled products from discarded wastes).

Let us stop looking to developed countries for Aids or Funds that they won't give because they do not wish us well. Who came to our rescue during the Ebola epidemic if not God and our decision to take our lives in our hands and God fought for us! Nigeria is the Israel of God in and for Africa, and whoever curses us is cursed and whichever country that blesses us will be blessed.

USA is selling weapons of destruction to India to keep Peace; is that really for Peace? It is because India has a lot of money and resources (electronics development). Henceforth, let no Task Force destroy efforts at indigenous refining of petroleum, let the government establish cottage industries and empower the producers; let the Police also stop arresting those who manufacture ammunitions locally, put them together and empower them to improve. That I say is the option for a 21st Century, Clear thinking, productive Nigeria that will not be a consumer nation.

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