A PHYSICIST / GEOPHYSICIST APPROACH TO SOLVING MAN'S CHALLENGES

6TH INAUGURAL LECTURE

OF COLLEGE OF EDUCATION WARRI,

DELTA STATE, NIGERIA.

BY

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DATE: MAY 20TH, 2021

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Day: 20TH MAY, 2021

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Dedication

This lecture is dedicated to:

- my loving children for the enormous support and love I enjoy from them.
- my late parents, Professor Alfred and Felicia Unomah for raising me to believe that anything was possible, and to
- my beloved husband Hon. Solomon Ighrakpata for making everything possible.

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Protocol

Delta State House of Assembly Members
The Chairman, Governing Council of the College
The Provost,
The Members of Governing Council Present,
The Registrar,
The College Librarian,
The College Bursar,
Deans of Schools and Student Affairs, Directors,
HODs and other Officers of the College,
Respected Chiefs of our Kingdoms here present,
Executive Members of the various Staff Unions,
Members of my family
My in – laws
Staff and Students of the College,
Gentlemen of the Press,
Distinguished Ladies and Gentlemen

Preamble

Provost ma, I am elated that you gave me this opportunity to deliver the 6th Inaugural lecture of the College, it is a rare privilege thank you ma.

I also want to specially thank everyone present for finding time to attend this inaugural lecture. I am extremely humbled by your presence. God bless you all.

This is the first inaugural lecture in the College from the Physics Department in School of Science.

Provost ma, my interest in Physics dates back to 1985 when my Uncle Dr. George Unomah, now a retired renowned geophysicist from Exon Mobil, introduced me to the subject – PHYSICS. As a secondary school student then, he made me fall in love with the subject and this led to my studying it at the University of Benin where I was the only female student in the class of 1989 studying Pure and Applied Physics. It seemed then, that physics as a tough course was meant for male students only. My interest in physics led me essentially to study the course up to Ph.D level. Over the course of my teaching career, I have

been involved in research and development for the advancement of knowledge.

What is Physics?

Physics is that branch of Science concerned with the nature and properties of matter and energy. Much of physics is the study of energy and its transformation, and energy is the heart of environmental issues. Environmental issues are defined as problems with the air, water, soil etc. that have developed as a result of human interference. The physicist can in the several ways help to solve some problems facing mankind, through the various research works as espoused in this Inaugural lecture. The Physicist in studying energy transformation may seek to examine how steady power generation could be a game changer in economic development.

Electricity Generation

The correct application and utilization of knowledge gained from the study of physics leads to the production of materials and equipment necessary for enhanced standard of living which is a basic factor for national development. No business can succeed in the absence of a well powered electricity system.

More often than not, we experience incessant power failure. This failure on the part of Benin Electricity Distribution Company (BEDC) and other generation and distribution companies has transformed into inactivity in the socio – economic life of people (the tax payers) who depend on electricity for survival. Electricity holds the key to national development, many businesses have folded up or have reduced their staff strength drastically, thus increasing the existing unemployment rate in Nigeria. Meanwhile, one major reason why people in the rural areas move to urban areas is to enjoy the benefits and employments available in the cities, however, in most cases, they get disappointed as the jobs are just not there. So what do they do? They constitute themselves into city miscreants. This situation can be addressed by creating viable employment for the youths through electricity generation.

One of my research work was in solving this problem.

Generation of sustainable electricity from Sugar cane. A panacea for stabilizing democracy for national development in Nigeria. (Ejakpomewhe, Ighrakpata and Emekeme, 2005).

The study showed that

- Electricity can be generated using sugar cane bagasse – a kind of biomass made up essentially of water, cellulose, hemicellulose, lignin and several other minor constituents.
- . The natural gas obtained from the combination of biomass can be used as fuel.
- For democracy to survive and be stabilized, the citizens must be in the right frame of mind at all times so that they can contribute meaningfully towards its operation

Providing A Cooling System

In most rural areas in Nigeria, electricity is a problem. Most villagers do not have enough money to buy refrigerators and even where they can buy one, electricity is not available. The inhabitants of these localities have learned how to adjust to their harsh environment and also learned how to exploit some of her physical parameters to their advantages for such remote areas where conventional source of energy are not accessible. One of such use of the physical parameter is evaporating cooling. For a liquid to evaporate, it requires a certain amount of heat to change its state from liquid to gaseous at the same temperature. This quantity of heat is called the

latent heat of evaporation. In evaporative cooling this heat is extracted from the material to be refrigerated and consequently, its temperature drops and cooling is achieved.

Ighrakpata, and Aimiuwu, (2002) examined the evaporating cooling system of ceramic materials.

Eight ceramic clay pots were fired to different temperatures between 700^0c to 1050^0c. To find out what temperature was best to achieve faster cooling.

- The study revealed that firing ceramics to different temperatures actually affects the evaporating cooling of water.
- Pots fired to a temperature of 700^0c cooled water at a much faster rate thus it serves as means for the provision of cold portable water at no energy cost.

  Recall that our old parents in the villages in years past kept their water cool by storing in clay pots which were made by firing. This work showed the optimum temperature needed to provide a good cooling pot.

Using Solar Energy

Energy is an important factor of production and economic growth and the availability of energy in sufficient quantity, is key to all development activities. The need for alternative energy sources to fuel wood and diversification of energy utilization into clear, secure and renewable energy is a major concern to Energy Institutes in Nigeria ad centre of Nigeria's energy policy. A review of the state of renewable energy activities in Nigeria was carried out by **Morka, Molua and Ighrakpata (2009).** In the work titled "**A review of Renewable energy resources; Development and Utilization for sustainable Energy in Nigeria"** it was noted that achievements in renewable energy application and utilization in Nigeria include;

- Rural electrification of Small and Isolated Communities.
- Street Lighting
- Cathodic protection of oil pipelines and storage thanks
- Storage of drugs and vaccines in remote health clinics.

- Powering remote transmitters in telecommunications and rail way signalling etc.

However, in spite of the county's high level of solar isolation which indicates the existence of immense potentials, Solar PV (Photo Voltaic) Systems, have not found wide applications in the county due to funds and economic situation.

Design of a Solar Dryer

The energy from the Sun (Solar Energy) has inherent advantages over other forms of energy because of its renewable nature, wide range of application, near non-hazardous nature, abundant availability even in regions remote from source of fossil fuels and direct usage (not being processed before use) (Edward, 1976 and Richards, 1972). These advantages thus encourages research in the technology and application of solar energy. The direct use of solar energy cannot be said to be new as it was used by prehistoric man for drying of his crops by simply spreading the crops on the bare ground (Daniel, 1964), however this method of exposing the products to be dried in the open, makes the farmer suffer a lot of inconvenience such as rainfall, insects, and rodents (animals) attacks, which will demand the farmers constant attention or presence to gather the

crops when it is threatening to rain on the crops (Eggers, 1976).

Agbor is a predominantly agrarian community cultivating crops like yam, maize, melon, tomatoes etc. Most crops planted there are harvested annually often in the rainy season with reduced isolation. To forestall the aforementioned inconveniences, the use of the solar dryer for drying these crops becomes imperative.

Design and performance of an Eco-friendly domestic Solar dryer for agricultural products in Agbor, Delta State, Nigeria (Igherighe, Molua, Omoigade and Ighrakpata, 2012).

The dryer used for this study was constructed locally but the emphasis was on its performance / evaluation.

- Yam chips / slices of the same size were cut and dried both in the dryer and in the open.
- Drying rate in the dryer and in the open (outside) were compared
- The result obtained from the dryer's analysis reveals its potentiality. The

dryers temperature was always above ambient temperature accounting for why the yam chips dried faster in the dryer than in the open.

Farmers in Agbor will benefit from the use of the dryer as it would enable them dry their produce faster and with little or no hassles.

Provost Ma, having X – rayed the basic definition and input of the physicist to solving some problems of mankind, it is now appropriate to define Geophysics and explain the input of the Geophysicist to mankind.

What is Geophysics?

Definition

Geophysics according to Sheriff *et al.,* (1982) is derived from two words, Geo – meaning Earth and Physics meaning the study of matter in relation to energy. In simple terms geophysics is the physics of the earth, in its broad sense geophysics is the science of applying the principles of physics to investigations of the earth including its hydrosphere and atmosphere by measuring the physical properties of the features at or near the earth's surface using direct physical measurement. Physical

properties include; elasticity, density, permeability, resistivity, conductivity, magnetic susceptibility etc.

Geophysics can be classified into two main sub – heads.

Global geophysics (GG) which deals with the physics of the whole earth such as earthquake seismology.

Exploration geophysics (EG) which investigates geophysically restricted parts of the upper crust to determine the distribution of physical properties at depth.

Exploration geophysics is mostly used in search for oil, gas, mineral, water etc. for the purpose of economic exploitation. In exploration seismology, discovering structures that have potentials to trap hydrocarbon is done using the seismic reflection method. Geophysics provide direct clues to the presence of economically useful deposits.

What are Hydrocarbons?

Hydrocarbons are the main constituents of petroleum and natural gas. Most of the natural fuel sources we use are hydrocarbons. Compounds like Butane, Methane, Hexane and Propane are hydrocarbons. Hydrocarbons are very important for the modem economy. The most important use for

hydrocarbons is for fuel. Gasoline, natural gas, fuel oil, diesel fuel, jet fuel, kerosene, propane are some of the commonly used hydrocarbon fuels. They serve as fuels and lubricants as well as raw materials for the production of plastics, rubbers, solvents, lubricants, explosives, fibres (synthetic fibres) and industrial chemicals.

Hydrocarbon exploration is done to determine the location, quantity, type and how it can be recovered in the earth.

Mudlogging as an Exploration Tool (A case study of Uzere Well) (Molua and Ighrakpata, 2007).

- Mudlogging also known as hydrocarbon Well logging is the creation of detailed record of a borehole by examining the bits rock or sediments brought to the surface by the circulating drilling medium.
- This provides information about the lithology and fluid content of the borehole. Tools to detect oil and gas have been evolving for over a century.

- Simplest and most direct tool is Well cuttings examination. Some older oil men grind the cuttings between their teeth and tasted to see if crude oil was present. This is not done nowadays.
- The hydrocarbon saturation for the studied Uzere well was found to be 30%
- This value is low for the hydrocarbon prospect of this well to be significant.

Analysis of OGOM – 1 Well using mudlogging exploration tool (Ighrakpata, Molua, and Igherighe, 2011)

- This well was owned by SPDC. The well name is a hypothetical one for security reasons.
- The mud logging formation data was interpreted geologically revealing their physical parameters such as depths, lithological tops , colour and description.
- This reservoir was concluded as a hydrocarbon bearing formation.

Characteristic delineation of OGO – 16, Well using mud logging technique (Molua, Igerighe, Onwuka and Ighrakpata, 2010)

- The mud logging carried out on OGO – 16 Well was able to give the geophysical breakdown of the various lithologies making up the area at different intervals which were mainly shale, sand and sandstones with a mixture of particle at the total depth of 8.898ft.
- The mud logging data revealed the presence of hydrocarbon in commercial quantities.

Conclusively mud logging plays a very important role in the drilling of exploratory and developmental Wells because it provides relevant information on the characteristic of the formation and also helps in monitoring and recording of the total amount of gas and hydrocarbon content of the formation.

Optimal use of dual laterolog in the determination of formation resistivity (Molua, Ujuanbi and Ighrakpata, 2006)

- In this study the logging method used is called dual laterolog it provides for better recording of formation resistivity

- Field examples in this study was used to illustrate the effectiveness of this method in various types of formations.
- The results showed that hydrocarbon saturation in fresh water environment is very significant in hydro carbon exploitation.

Amplitude versus Offset (AVO) Method

The AVO methodology was popularized by Ostrandler's (1982) demonstration that gas sand reflection coefficients varied in an anomalous fashion with an increase in offset. His ability to show how to use this anomalous behaviour as a direct indicator on real data was a major break for the AVO (Amplitude variation with offset analysis) techniques. According to Castagna (1993) in addition to being a "seismic lithology" tool. AVO provides an improved model of the reflection Seismogram thus allowing for better estimate of the normal incidence reflection coefficients and background velocities.

AVO is used as a tool to "derisk" exploration targets and to better define the extent and composition of existing hydrocarbon reservoirs. (Castagna, 1993).

AVO analysis pre – stack data for the purpose of evaluating and modelling AVO anomalies. Explorationist are successfully using AVO anomalies to find hydrocarbons all over the world. (Castagna, 1993).

Rutherford and William (1989) used AVO as a tool to classify gas sands. This classification was proven to be useful and valid in exploration. Chiburis (1987) successfully reported the utilization of AVO to detect oil reservoirs.

Emikanselu and Adekanle (2012) have used AVO techniques for the direct detection of hydrocarbon reservoirs on pre- stack time seismic data in an offshore Niger Delta field.

Analysis of Buka I Well using Amplitude variation with offset technique in determining the anomalous and gas zones. (Ighrakpata and Ujuanbi, 2013).

- This study showed anomalies at a time range of 2980 mls – 3030mls.
- The near angle stacks showed very little AVO effects when compared to the mid and far angles.
- The gas zones were shown prominently

- The gas zones plotted mostly in the third quardant and from the gradient analysis, the intercept was positive while the gradient was negative thus the anomaly was classified as class two (II) according to Rutherford and William classification.

What is a Shale?

Shale is a type of sedimentary rock rich in kerogen.

It is commercially important and is used to make Brick, Title, Pottery and Portland Cement. Natural gas and petroleum may be extracted from oil shale. (www.thoughtco.com).

SP log as an aid in determining some reservoir characteristics. (Molua, Ujuanbi , Ighrakpata and Igherighe, 2010).

Self-potential logging was carried out in an un-cased hole containing a water based fluid between an electrode on the sonde in the borehole and a stationary reference electrode at the surface in a part of Niger Delta area of Nigeria.

- The two components of self-potential curve were used to detect the permeable beds and to locate boundaries between beds in order to

obtain good values for formation water resistivity.

- The study showed that the sands are water bearing and there are sufficient proportion of shaly material.
- The sands also contain oil and gas.

Comparison of the strength of two different rock samples. (Ighrakpata, Molua, Igherighe and Idialu, 2012).

- This study was to determine the strength of Igneous rocks –(Granite) and Metamorphic rocks – (marble) samples.
- The table of readings collected were used to plot a growth of force against area from which the minimum stress required to fracture the different rock samples were obtained.
- The results revealed that the stress required fracture the sampled igneous rock – Granite is of the order of 8.82 x $10^6 NM^2$, while for the sampled

metamorphic rock - marble it is of the order of 5.7 x $10^6 NM^2$.

- The stress required to fracture the rock samples should be borne in mind when using any of the rock samples for any engineering work.

Using Geophysical and driller's log for the determination of Aquifer in Extreme Owa region (Delts State Nigeria) (Molua, Ighrakpata and Onwuka, 2013).

- This study was to investigate the geophysical borehole logging of extreme Owa region in Delta State, to determine the lithology of the area, resistivity of the formation was carried out.
- Results showed that the Interval between (0 – 12)m bears loose lateritic sand.
- The depth zone of (24 - 30) m, (30 - 49) m and (55 - 58) m consists of clay rich Sandy stones which is capable of bearing water.
- Intervals (110 - 116) m to (158 - 160) m shows whitish colour particles with light brown silty clay within the depth intervals of (62 - 78) m

and (92 - 102) m with formation resistivities of maximum values up to 6,500nm and 6,100nm respectively.

- The interval (78 - 92) m with moderately low resistivity between (700 - 2400) m has moderate water bearing aquifer. (Clay Sandy Zone).

Pollution Control

The Geophysicist has also helped mankind in the area of pollution control. Oil spillage in the Nigerian economy caused mainly by sabotage and other activities in the petroleum industry has become a national problem owing to damage of properties, degradation to the environment, loss of lives and income etc. In the cause of my research, i have looked at cases of oil spills.

Oil spillage, causes and its Remedial Measures (Niger Delta Area of Nigeria as a case study). (Molua, Igherighe, Emagbetere and Ighrapkata, 2010).

- This study gave an in-depth report of the possible causes of oil spillage which are

streamlined into upstream and downstream operations of the oil industry.

- It revealed the adverse effects of a spill on the environment and good contingency planning in order to achieve an effective control of this prevalent hazard.
- State-of-the-art containment and recovery devices coupled with techniques and oil spill chemicals that can be used in clean-up operations were extensively discussed.

Environmental management and pollution control (Egbuchunam, Ighrakpata and Ottah, 2007).

- The study showed that a rise in population combined with high industrial activities in urban areas have contributed largely to environmental pollution.
- Identified the major environmental problems to be;
    - ✓ Soil degradation.
    - ✓ Water contamination.
    - ✓ Deforestation.

- ✓ Over exploitation of natural resources.

- The study suggested the inclusion of environmental education in school curricula and an increase in the budgetary allocation made available to the environmental sector.

As an educationist, I have carried out an appraisal of physics teachers' level of competence in ICT in secondary schools in Delta State in an article titled,

"An Appraisal of physics teacher's level of competence in ICT and its implication for Vocational and Entrepreneurship education". (Asarhasa, Ejakpomewhe and Ighrakpata, 2013).

- The population was 40 physics teachers in secondary schools in Delta State Central Senatorial District.

- The study showed that physics teachers were not competent in the majority of the ICT skills.

- Only few schools have computers.

- This poses serious danger for our quest for crafts and entrepreneurship education in Nigeria as the teachers who are facilitators lack the skills they are expected to transmit.

Conclusion

Provost Ma, ladies and gentlemen this lecture has been able to establish the input of this Physicist/Geophysicist in approaching man's challenges based on the research.

- To establish the value chain of steady power supply and availability of electricity.
- Determine and identify alternative energy sources; Solar energy, Wind energy etc.
- Determine the strength of igneous rocks – granite and metamorphic rocks – marble.
- Considering the numerous oil reserve in the Niger Delta region and the increasing cost of qualitative interpretation of seismic data, Amplitude versus offset technique combined with other seismic techniques would help to reduce cost of interpretation and thereby increasing the revenue yield of the nation.

Recommendations

1. Government at all levels should invest hugely in the energy and power sector especially energy from biomass.
2. Improve the ease of doing business with friendly government policies and regulations.
3. The government should pay attention to renewable energy.
4. Government should implore a standard for oil operating companies in constructing their installation to avoid spillage due to failure of equipment as a result of poor standard of manufactured materials.
5. Oil companies should embark on educating / training their employees so as to ensure their competence in fighting against spillage.
6. As part of efforts to strengthen the local content policing of Federal government, oil companies should be encouraged to patronize indigenous institutions in the area of quantitative interpretation by providing required data, software and work stations.

Acknowledgement

I give all thanks to God Almighty who has made all things possible for my family and I.

I thank my parents late professor and Mrs. Alfred. C. Unomah whom God used to bring me into this world.

My special thanks also goes to the Chairman of the Governing Council – Mr. V.O.T Abanum and all members of the Governing Council of this College. God bless and keep you all.

I deeply appreciate from the bottom of my heart the Provost of the College Prof. (Mrs.) Mary Olire Edema for being an exemplary leader and for giving me the privilege to deliver this 6th Inaugural lecture.

I recognise and gracefully thank all the Principal Officers of the College.

I thank the former Dean of the School of Science, Mr. Enukpere E., may God bless you with all you wish for.

I thank the former Deputy Provost, Dr. (Mrs.) Philippa Oganwu, for her support .

My gratitude also goes to Dr. and Mrs. H. Ojogan, Mr. and Dr. (Mrs.) Okpetu, and Mr. F. O. Uveruveh. May God meet you all at you point of need.

I appreciate my colleagues in the College, School of Science and Physics Department in particular amongst whom are, Mr. Peter Asaharasa, Mr. Chris, Ejakpomeule, Mr. Ufuoma Onaivwe, Mr. S. Sheke, Bishop J. Omosheye, Mr Austin Onojiafe, Mrs. H. Odiyoma, Mrs. Christy Efayena, Mrs. F. Afoikine, Miss.Gladys Igwulu, Miss. Grace Iwetan, Mrs. A. Onwo, Mrs. H. Salami, Mr. C. Ucheaga, Mr. U. Osammor, Dr. J. Eshenake, Mr. J.K, Ozobokeme, Mrs. H. Ukulu, Mr. N. Unomah, Mr.Ogaga.Owereh, Mr.Dennis Uvietesivwi, Mr. Bawo Jones, Mr. Jab Egere, Dr. O.C. Molua and others too numerous to mention.

I thank my dynamic Friends family, God bless you.

I thank all my in – laws, especially, Madam Okpako Ighakpata and Mrs. Irene Ladokun for all the love and support they continually show me.

I thank my sister Mrs. Ngozi Azike, for her prayers

I thank my children : Chamuke, Maro, Tega, Efe and Oke for the joy you all bring to my life and for encouraging me always.

I thank my darling husband, Hon. Solomon, O. Ighrakpata; a man that means a lot to me, my one true love, my everything. He has been a pillar of support in my life. And am very lucky to have him and pray God continues to bless our union.

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www.thoughtco.com

Biography

Dr. (Mrs.) Fidelia, Chukwudumebi Ighrakpata was born on the 10th day of October, 1972 in Ibadan Oyo State, to the family of Professor Alfred and Mrs. Felicia Unomah.

She received her primary education at staff school University of Ibadan and Bendel State University staff School Ekpoma. She proceeded to Mary Mount College Agbor for her secondary education from 1983 – 1988. She was admitted into the University of Benin, Benin City in 1989 for her undergraduate studies where she graduated in 1993 with a B.Sc (Hon.) degree in Pure and Applied Physics.

She proceeded for the mandatory one - year national youth service at the Nigerian Petroleum Development company (NPDC) Benin City, Edo State from 1994 – 1995. After the national service, she taught briefly at a private school in Benin – City and went back to school to pursue a Master's Degree in Physics at the same University of Benin which she obtained in 1999.

In 2005, she obtained her PGDE from Delta State University Abraka, and received her doctorate degree from Ambrose Ali University Ekpoma in 2015 in Physics/Geophysics.

After joining the College of Education, Warri in 2001 as a lecturer III in the Department of Physics, she rose steadily to the position of Chief lecturer in 2016. In between these two positions, she has attended seminars, conferences and workshops in different parts of the country and

today she has to her credit 26 Journal articles as well as 20 conference papers. She has authored and co-authored three books among which are the book: Waves and Optics published by Jinitech prints and Fundamentals of statistical physics published by Coewa publishers. She has also functioned in various administrative capacities in the College as follows; Head of Department of Physics, March, 2011 – March, 2013, Acting Head of Department of Physics, March, 2013 – February, 2014, Acting Head of Department of Physics, March, 2014 – March, 2016, Head of Department of Physics, March, 2016 – May, 2018, Director, Management Information Systems, May, 2018 – February, 2021, She has served and is still serving as Chairman and member of so many committees in the college. She is a Fellow of the Institute of Policy Management Development (IPMD), a Member Nigerian Institute (NIP), a Member of the Nigerian Association of Petroleum Explorationists (NAPE), and a Member of the Teachers Registration Council of Nigeria. She is happily married to Hon. Solomon Ighrakpata and they are blessed with lovely children.

Dr. (Mrs.) Fidelia, Ighrakpata is presently the **Deputy Provost** of the College of Education Warri Delta State.