Nigerian Chemical & Engineering Industry MAGAZINE

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(A Division Of Nigerian Society Of Engineers)

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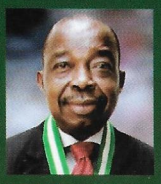


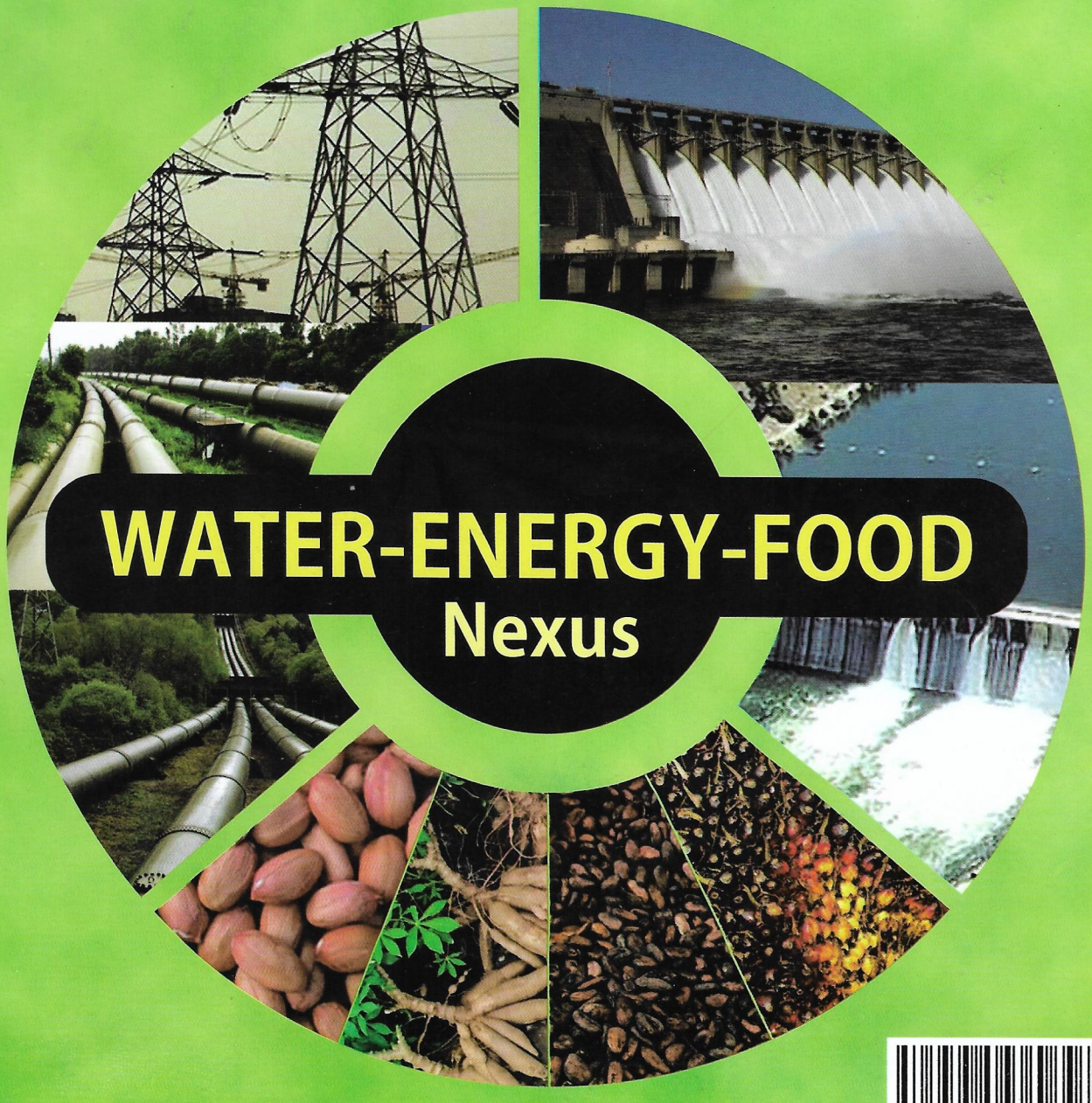
NSChE's Conference On Agric Value Chain

Engr. Onochie Anyaoku, FAEng
NSChE President

NSE Dynamics Photo Gallery

NSChE's Fellows Confab On Renewable Energy

Engr. Ibikunle Ogunbayo, FAEng
27th Confab Chairman



WATER-ENERGY-FOOD Nexus

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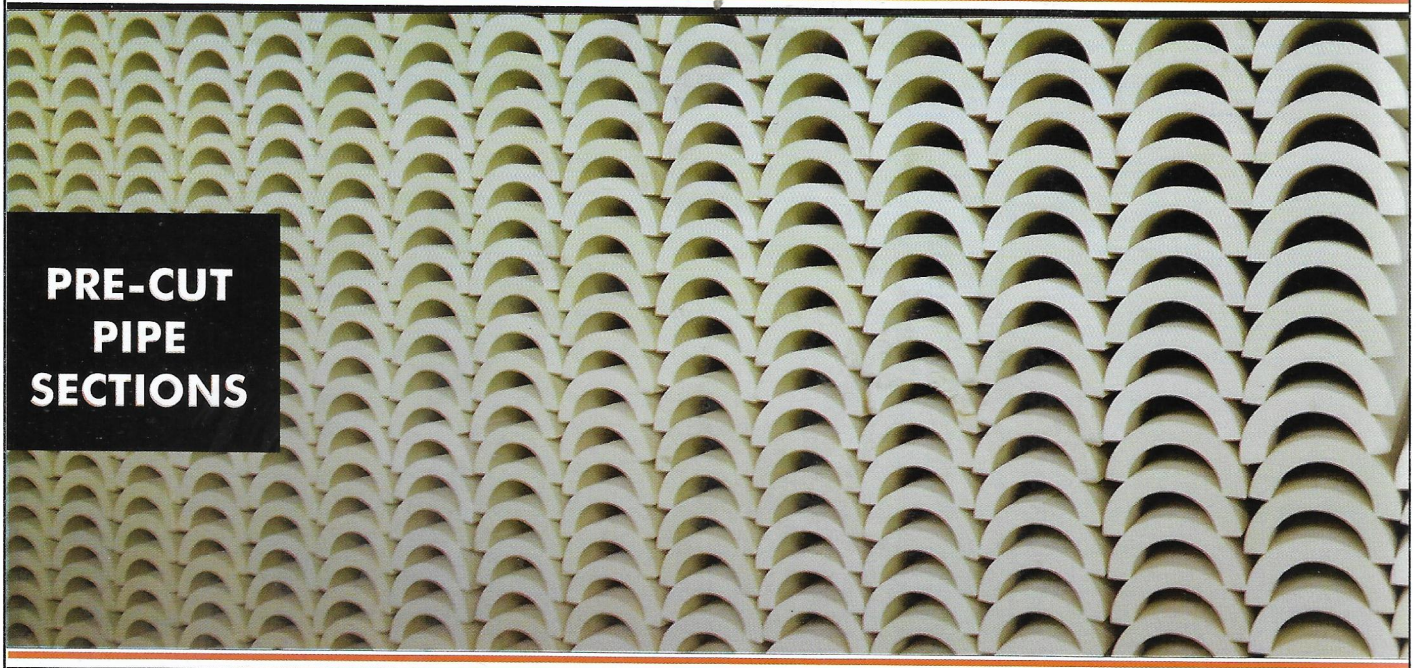

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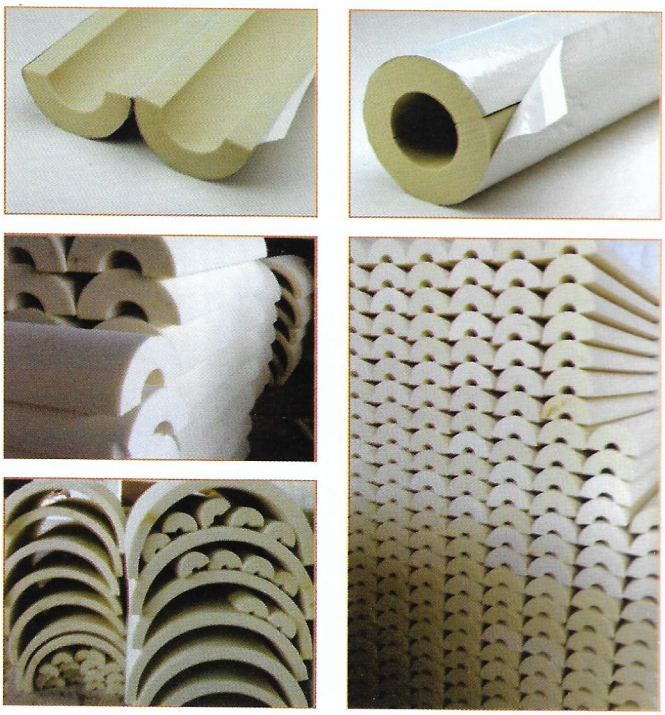

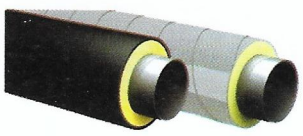

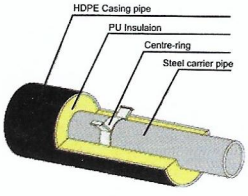

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NSChE VISION

"To be the Center of excellence for the Chemical Engineering Profession in Africa and the Prime Mover of Industrialization in Nigeria".

NSChE MISSION

"To organize the Nigerian Society of Chemical Engineers into a virile professional body capable of promoting the relevance and versatility of the profession, achieving better training and updating of Chemical Engineers through its activities. Fostering of relationships with the academia, research institutes, industries, other professional bodies and government will be the basis for stimulating accelerated industrialization of the country and improving the quality of life of the Nigerian people".

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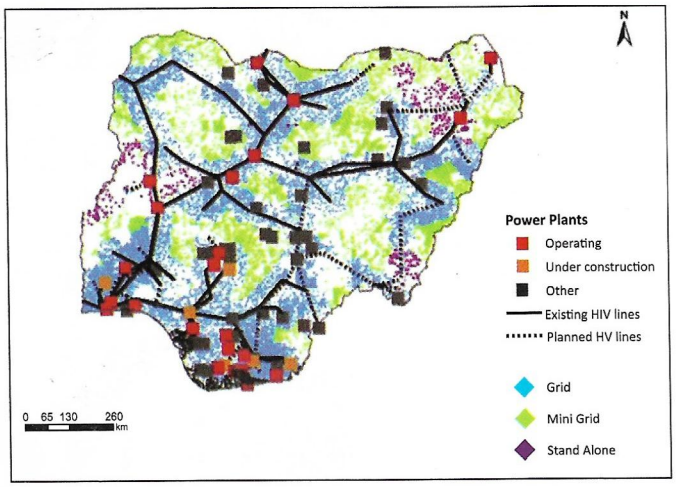
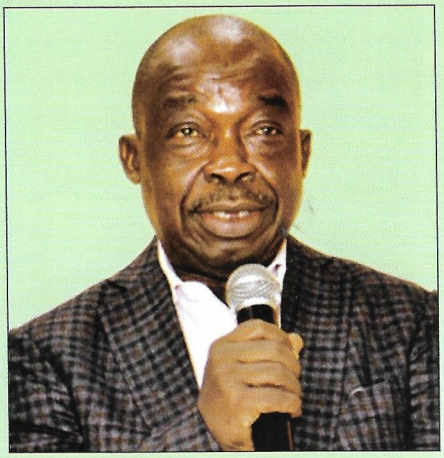


AIChE/NSChE MoU Renewal Pictures



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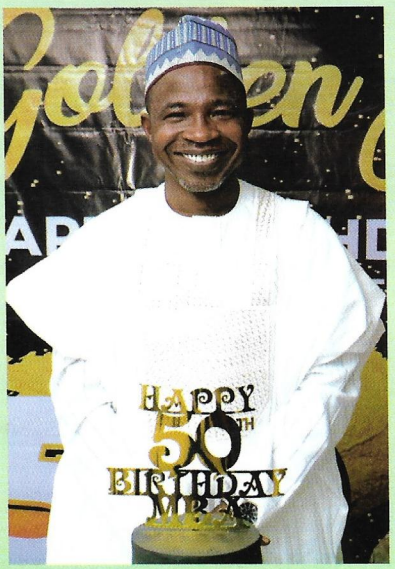

ENGR. MAMOUD ABUBAKAR BELLO'S BIRTHDAY

FROM THE *Editorial* SUITE

***Engr. Donatus Uweh**, MNSChE*
(Editor-in-Chief)

The Editorial Team of our well-read magazine is quite excited to present this first edition in 2020 to the reading public. In line with our mission to provide a lucid educational and exciting material, the contents in this edition are well chosen to achieve that purpose.

As we are well aware, the constraints posed by COVID-19 pandemic have affected business activities globally, hence the delay in the release of this edition. The first index case of the novel Corona virus (COVID-19) was reported in Nigeria on February 27, 2020 when an Italian citizen arrived in Lagos. Since then, there has been noticeable increase in infections spreading into various states. We should, however, be hopeful that normalcy will soon return to our country in particular and the world in general.

Several, things, will catch your attention in this edition. First of all, we are glad to report that Process Safety Initiative of Nigeria (PSIN) has been established. As the Executive Secretary puts it 'The main thrust of PSIN will be to foster knowledge and best practices in Process Safety in the Oil & Gas and Process Industries in Nigeria, leveraging on the experience and success of the Centre for Chemical Process Safety (CCPS)". More details are in the Executive Secretary's column.

Secondly, memorable photographs of the feat of winning the first position in 2019 Nigerian Society of Engineers (NSE) Dynamics competition by NSChE are presented. Interestingly, that was the third time in a row.

Other notable features include:

i. Pictures taken at the AIChE/NSChE MoU renewal meeting in the US

ii. National President's Welcome Address at the 2019 Fellows Confab held under the distinguished chairmanship of Engr. Ibikunle Ogunbayo, FAEng. He set the ball rolling at the Confab by drawing the attention of the participants to the need to address the adverse effects of climate change through greater attention to the development and deployment of renewable energy resources. More details are given in his address.

iii. NSChE's 27th Fellows; Confab Comunique based on the theme "Renewable Energy: A Key factor for Sustainable Power in Nigeria". Pictures of the event are also presented.

iv. NSChE 's 49th Annual Conference Communique based on the theme "Enhancement of Agricultural Value Chain for Economic Development: The Role of Chemical Engineering" This theme notably aligned with the government's diversification thrust in the Economic Recovery and Growth Plan (ERGP). Snapshots at the Conference are shown also in scenic pictures.

v. A lucid treatise on "Evaluating Water-Energy-Food Nexus For Sustainability of Healthy Living in Nigeria" by Prof. Awajiogak A. Ujile, FNSChE. This piece is an eye-opener to all stakeholders responsible for sustainable use of vital natural and national resources at our disposal.

Do not miss to read 'You and Your Health' column. There is a spice there added in this edition on what to do to enhance your health.

Finally, we congratulate Engr. Mamoud Abubakar Bello, FNSChE who celebrated his 50th birthday in grand style. Take a look at the memorable pictures as presented in this edition. We wish him good health and many more years of joyful life.

We do appreciate all those who contributed to the successful publication of this edition.

Please relax and enjoy your reading.

Engr. Donatus Uweh, *MNSE*
(Editor-in-Chief)

NSChE SPEARHEADS THE FORMATION OF 'PROCESS SAFETY INITIATIVE OF NIGERIA' AS A NON-PROFIT ORGANIZATION

INTRODUCTION

Following the Bhopal tragedy that occurred on December 3, 1984 in which more than 5,000 deaths were recorded in India (according to the figures released by government), the American Institute of Chemical Engineers (AIChE) formed the Center for Chemical Process Safety (CCPS) in 1985 as an industry alliance to share and enhance process safety expertise in the industry. Through the efforts of CCPS, Process Safety has since gained corporate importance and extended into the general skill set of chemical and petroleum engineers and operators, and many industry-wide guidelines for process safety have been developed. Today CCPS is the leading global exponent of Process Safety and has its reaches and footprints all over the world (North America, South America, Europe, Asia/Pacific), perhaps with the exception of Africa. Nigeria has also suffered several human and material losses arising from disasters that occurred in process plants which could have been prevented if necessary care were taken or at least reduced to the barest minimum.

***Sam O. Bosoro**, MNSChE*
(Executive Secretary, NSChE)

"Process Safety has since gained corporate importance and extended into the general skill set..."

The formation of Process Safety Initiative of Nigeria (PSIN) by NSChE was borne out of the compelling need for process industries to imbibe the culture of operating under safe conditions by putting in place standard policies and operating guidelines as doing so guarantees their continued existence and reduces to the barest minimum the possibility of a disaster occurring.

OBJECTIVES OF PROCESS SAFETY INITIATIVE OF NIGERIA (PSIN)

The main thrust of PSIN will be to foster knowledge and best practices in Process Safety in the Oil & Gas and Process Industries in Nigeria, leveraging on the experience and success of CCPS. The key objectives shall be to:

- Create strong awareness of Process Safety in the Oil & Gas and Process Industry Sectors.
- Consistently highlight compelling need for commitment to safety culture for all industry practitioners.
- Engender sharing of best practices amongst all players in the sectors.
- Advance and deepen Process Safety knowledge and best practices.
- Assist to close Process Safety gaps in the industry.
- Drive implementation of Process Safety Management Systems and strict adherence to regulations and standards.
- Spearhead the inculcation of Process Safety in undergraduate and graduate curricula in relevant technological disciplines.
- Equip lecturers and academics in the relevant disciplines with the vital knowledge and skills required to instruct the students.
- Enhance the competencies of industry practitioners in Process Safety on a continuing basis.
- Provide a collaborative platform for interfacing with the global Process Safety community.

STRUCTURE OF PROCESS SAFETY INITIATIVE OF NIGERIA

PSIN shall be a fully registered non profit organisation in Nigeria, anchored by NSChE, and supported by the collaborative participation of oil & gas, petrochemical and process industry companies, organisations and stakeholders, which represents a model that has consistently delivered success in the area of industrial safety in many countries of the world. This initiative would bring together manufacturers, consultants, contractors, government agencies, academia, researchers, insurers, etc, for the purpose of improving and deepening Process Safety in the country. Funding for the programs and activities shall be from the participating organisations. Funding may also be obtained from multilateral agencies and international donor organisations interested in Process Safety.

THE JOURNEY SO FAR...

1, NSChE took the first step towards successful realization of this objective when a paper titled 'Imperatives of Process Safety in Nigeria', was presented at the 2016 DPR International HSE Conference on the Oil & Gas Industry to sensitize that industry.

2, A one day mutual conference on Process Safety in Nigeria was held in October 2017, hosted by NSChE and supported by Department of Petroleum Resources (DPR), with the participation of CCPS of AIChE and the Safety & Loss Prevention Special Interest Group (SIG) of the Institution of Chemical Engineers (IChemE) of UK.

3. Registration of PSIN as a non profit organisation in Nigeria is currently on-going.

PLANNED ACTIONS GOING FORWARD

1. We shall soon embark on active membership enlistment drive.

2. Effort would be made to develop Process Safety Workshop packages for training of members of the academia in Chemical Engineering and related technical disciplines (Petroleum Engineering, Mechanical Engineering, Chemistry, Physics, etc) as well as process industry operators. This will facilitate awareness of the benefit and value of the PSIN programs and compliment the enlistment drive.

"PSIN...anchored by NSChE,...represents a model that has consistently delivered success in the area of industrial safety in many countries of the world."

INVITATION TO JOIN PROCESS SAFETY INITIATIVE OF NIGERIA

We wish to invite all the oil & gas, petrochemical and process industry companies operating in Nigeria to come and join the PSIN so that together we can make a success of this noble idea which when practised would ensure the security of assets, safety of lives and properties which otherwise would have been lost.

For further enquiries, kindly contact:
Executive Secretary
Nigerian Society of Chemical Engineers
Plot 4 Oyetubo Street
Off Obafemi Awolowo Way
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Tel: 09035764128
E mail: nationalhqtrs@nsche.org.ng

APOLOGY

THE INITIAL PROPOSED NAME OF THE INITIATIVE, NPSI, AS PUBLISHED IN THE LAST EDITION WAS NOT APPROVED HENCE THE CHANGE OF NAME TO **'PROCESS SAFETY INITIATIVE OF NIGERIA'** (PSIN) WHICH HAS BEEN ACCEPTED. PLEASE ACCEPT OUR APOLOGY.

NSE DYNAMICS 2019

Each year, at the Annual Conference of Nigerian Society of Engineers (NSE), the authorized Committee of NSE announces the results of the competition carried out among the Divisions. The competition is geared towards promoting activities among the Divisions which are professional development oriented within the year in question. In 2019, the Nigerian Society of Chemical Engineers (A Division of Nigerian Society of Engineers) attained the 1st position in the competition. This feat was achieved the third time consecutively having attained the 1st position in 2017 and 2018. The snapshots of the awards received and victory celebrations in 2019 are shown in memorable pictures.

Chemical Engineers celebrating their victory having won the 2019 NSE Group Dynamics Competition for the third consecutive time

NSChE Executive Secretary, Samuel Bosoro, receiving the plaque from Dr. Olusegun Ajayi

NSChE Executive Secretary, Samuel Bosoro, receiving the trophy from Dr. Olusegun Ajayi

Chemical Engineers celebrating their victory having won the 2019 NSE Group Dynamics Competition for the third consecutive time

Bosoro receiving the N1million cash award from the NSE President, Engr. Adekunle Mokuolu, FNSE

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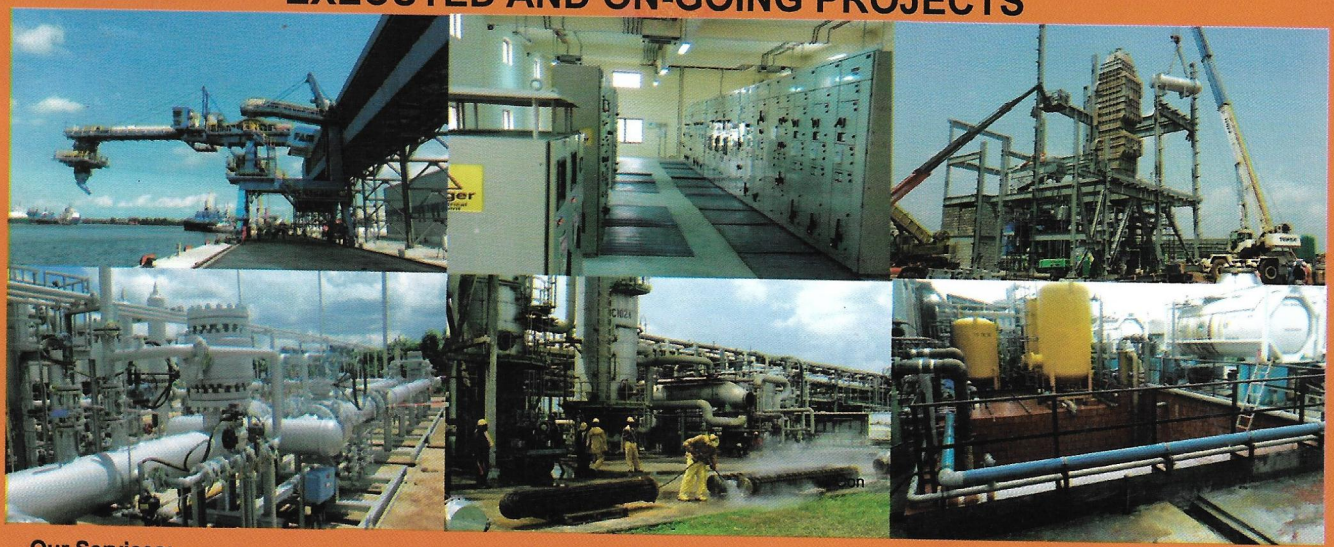
EXECUTED AND ON-GOING PROJECTS



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AIChE/NSChE MoU Renewal Pictures

The AIChE/NSChE renewal MOU was signed at Orlando, Florida on November, 11, 2019. The event was attended by Dr N. J. D. Erinne (first right above), Past President of NSChE on behalf of the National President, Engr. Onochie Anyaoku. To the immediate right of Dr. Erinne is the AIChE Executive Director, June Wispelwey.

Dr. Emmanuel Dada (first right) –the USA Chapter Chairman and others at the MoU signing event.

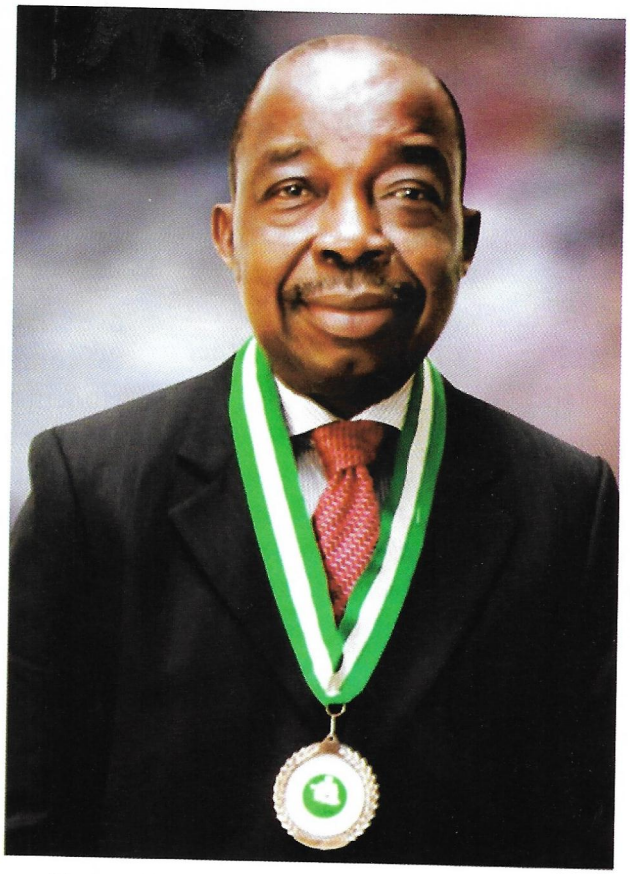
NIGERIAN SOCIETY OF CHEMICAL ENGINEERS
(A DIVISION OF NIGERIAN SOCIETY OF ENGINEERS)

WELCOME ADDRESS BY THE NATIONAL PRESIDENT, NSChE, ENGR. ONOCHIE A. ANYAOKU, FNSChE, FNSE, FAEng AT THE 27TH FELLOWS' CONFERENCE ON OCTOBER 3, 2019.

The Chairman of this occasion
Engr. Kunle Ogunbayo, FAEng.
Chairman, KOA Consultants Ltd
Our distinguished Guest Speakers
1. Pharm. Bolade Soremekun
Chairman, CEO BAS Consulting
2. Prof. Adesoji Adesina, NNOM
A renowned Professor of Chemical Engineering

Past Presidents of NSChE
Deputy National President,
Engr. Saidu Mohammed
Distinguished Fellows
Gentlemen of the Press
Distinguished Ladies and Gentlemen
I am very delighted to welcome you all to this 27th Fellows' Conference of the Society on behalf of the Board of Directors and National Executive Council. Since the first Fellows Confab which was held on the 2nd of July 1993, year in year out, our discourse has been on topical issues that are considered very crucial to the growth and development for our country in general and our Society in particular.

For example, the theme of the Conference held last year, on October 4, 2018 was:
"The African Continental Free Trade Area Agreement (AfCFTA) – The advantages and disadvantages to the Nigerian Economy "
As you are aware, President Mohammadu Buhari, GCFR signed that agreement recently after engaging in extensive consultations with the stakeholders..
The theme of this year's Confab is Renewable Energy – A key Factor of sustainable power in Nigeria.
You would agree with me that apart from ICT, 5G, Data , IOT and Artificial Intelligence amongst others, one of the key factors that is impacting the world economy is the urgency for low carbon footprint GDP growth. The use of renewable energy which can be obtained from Biomass, Wind, Hydro-power, Geothermal and Solar sources and converted to electricity, stored and supplied to our homes, industries and transportation has become central as we are challenged by climate change adverse consequences.



Engr. Onochie Anyaoku, *FNSE, FAEng*
(NSChE National President)

What makes Renewable Energy attractive is that it is sustainable and more job friendly amongst others. According to the International Energy Agency's (IEA) renewables report, sharp cost reductions and improved policy support are paving the way for continued growth in the renewables sector as shown below China is the undisputed renewable growth leader, that would account for over 40% of the total global clean energy mix by 2022

India's renewable capacity is expected to more than double by 2022 while about 90% of the expected capacity growth would be from solar and wind. Denmark, for example, is expected to generate 69% of its energy from renewable sources by 2022, which would make it the world leader. Ireland is following suite, with the report predicting it will generate one-third of its energy needs from renewable sources.

"It is a well known fact that the problem of epileptic power supply was a major factor that has led to the..."

UK and several European countries are looking at phasing out all cars that use fossil fuel before 2030.

In other European countries, the share of wind and solar will exceed 25% of total generation.

China, USA and India would account for two-thirds of global renewable energy by 2022.

Given the above scenario, there is no doubt that the future will be renewable energy driven.

Within the last four decades, Nigeria recorded a stunted growth in the power sector of the economy including generation, transmission and distribution whereas her population more than tripled during the same period. This led to a huge gap between the demand and supply of power for domestic and industrial consumption. It is a well known fact that the problem of epileptic power supply was a major factor that has led to the near collapse of our process industries and arrested growth in the sector. Other problems associated with poor power supply are insecurity, air and noise pollution resulting from the use of generators. All these can be tackled through our unwavering and deep commitment to the development and implementation of a robust energy supply plan which incorporate renewables within a framework of supply security, competitiveness and affordability.

Finally, Renewable Energy can also be used to bridge the electric power demand and supply gaps of the rural communities in the country if there is a will to do so.

The Chairman of this Confab, Engr. Kunle Ogunbayo FAEng is a Past Chairman of the Institute of Electrical and Electronics Engineers, Nigeria Chapter, Past President of the Association of Consulting Engineers Nigeria and Past President of COREN. He is also on the Governing Board of the International Scientific Technology and Innovation Centre for South-South Cooperation, a UNESCO sponsored Centre in Malaysia. He has been honoured with many awards, including the Construction Industry Hall of Fame, Professional Excellence Foundation of Nigeria and has received numerous other awards for his contributions to society and the profession.

Our First Guest Speaker, Pharm. Bolade Soremekun is the founder and CEO of Bolar Pharmaceuticals Limited. He presides over several organisations, including: BAS Consulting Ltd, a renewable energy consulting and capacity building firm; Rubitec Solar, a renewable energy company; and Rubitec Power, a provider of gas generators for the local market in partnership with German partners, 2G-Africa. Mr Soremekun is also the founder of IREC-Africa, a renewable energy NGO.

The Second Guest Speaker, Prof. Adesoji Adesina is a renowned Professor of Chemical Engineering who worked for more than two decades with the School of Chemical Engineering, University of New South Wales, Sydney, Australia. There, he built and directed a world-class catalysis and multiphase reaction engineering group. His research activities span the interdisciplinary areas of energy, water and environment where he was credited with over 450 refereed publications. He has supervised to completion more than 160 graduate research students including 50 PhDs and trained several postdoctoral fellows and research associates. In 2017, he was awarded the Nigerian National Merit Award in Engineering/Technology by President Muhammadu Buhari, as a distinguished intellectual for his outstanding contributions to the academic, growth and development of Nigeria.

Our Guest Speakers who are experts in the field will surely do justice to the topic of the day.

I wish to seize this opportunity to commend the Fellows' Conference Committee under the dynamic leadership of Engr. A. A. Badiru and the National Secretariat for the excellent preparations made for this event.

You may now relax and enjoy this program which promises to be very exciting and relaxing.

Once again, I welcome the Chairman, our Guest Speakers, Fellows and all others present. I thank you for making it a date with us. God Bless you all.

ENGR. ONOCHIE A. ANYAOKU, *FNSChE, FNSE, FAEng*
National President (2019)

COMMUNIQUÉ OF THE 27TH FELLOWS' CONFERENCE OF THE NIGERIAN SOCIETY OF CHEMICAL ENGINEERS (NSChE)

HELD AT THE SHERATON HOTEL AND TOWERS, IKEJA, LAGOS, NIGERIA ON THURSDAY, OCTOBER 3, 2019

A. PREAMBLE

The Nigerian Society of Chemical Engineers (NSChE) held her 27th Fellows Conference at Sheraton Hotel and Towers Ikeja, Lagos State, Nigeria on October 3, 2019. The theme of the conference was: "Renewable Energy- A Key Factor for Sustainable Power in Nigeria." A paper with the same title as the conference theme was presented by Pharmacist Bola Soremekun, the Chairman/CEO of Rubitec Nigeria Limited and deliberated on.

The conference which was hosted by the President of the Nigerian Society of Chemical Engineers, Engr. Onochie Anyaoku, FAEng, had Engr. Kunle Ogunbayo, FAEng, the Chairman/ CEO of KOA Consultants Limited as the Chairman of the conference. Other dignitaries included: Engr. Saidu Mohammed, the Deputy National President of the Nigerian Society of Chemical Engineers, Prof. Francis Ogunye, FAEng, Engr. Chief Joseph Akpieyi, FAEng, Engr. Babajide Soyode, FAEng, Engr. Dr. John Erinne, FAEng, and Prof. Sam Adefila, FAEng, who are all Past Presidents of the NSChE.

B. OBSERVATIONS

The following observations were made at the end of the conference:

1. NATIONAL RENEWABLE ENERGY POLICY, VISION 30:30:30:

The Nigerian government has developed the National Renewable Energy and Energy Efficiency Policy with the accompanying Vision 30:30:30 which aims at achieving 30,000MW of electricity by the year 2030 with renewable energy targeted to contribute 30 per cent of the energy mix.

2. NIGERIA'S INSTALLED ELECTRIC POWER CAPACITY:

Nigeria has an installed power generation capacity of about 12,522 MW (more than half of the capacity of the whole of West Africa). Generation capacity actually available on the grid fluctuates between 4,000 and 5,000 MW for a demand that is escalating with the rising population and socio-economic activities.About 80% of Nigeria's energy mix is made of electricity generated through gas-fired power plants while 20% of the mix is obtained though hydropower plants. The grid power is only available to meet the needs of about 30% of the population (mostly urban centres) while the rest (mostly rural dwellers, comprising about 70% of the population) are left at the mercy of traditional biomass energy to meet their energy needs. Poor grid power has forced most private companies to acquire and own independent self electricity generation equipment and solutions known to be costly and highly polluting. Electrification rate stands at merely 45%. In 2009 and 2011, the World Bank estimated that the self-generation capacity was even higher than the power made available through the grid.

3. IDENTIFIED ELECTRIC POWER POLICY AND REGULATORY OPPORTUNITIES IN NIGERIA:

In order to promote a vibrant electric power sector in Nigeria, the following opportunities need to be encouraged:

(i) Distributed Generation

Distributed energy, on-site generation or decentralized energy, electrical generation and storage provided by a variety of small grid-connected devices are referred to as distributed energy resources (DER). Historically, large power plants – Coal, Gas, Hydro etc are built for economies of scale far away from the consuming population, Classic electricity paradigm is the central power station model, whereby a single power generating station, e.g coal, nuclear and gas could generate and transmit over a long distance, but with the advent of Renewable Energy (RE) technologies, there can be several sources of power generating stations. A combination of different RE generating sources e.g wind, solar, hydro and bio could be executed successfully in Nigeria as the resources are readily available.

(ii) Grid Pricing Parity

Grid parity occurs when an alternative energy source can generate electricity at a levelized cost of electricity (LCOE) that is less than or equal to the end consumer's retail price. Reaching grid parity is considered to be the point at which an energy source becomes a contender for widespread development without subsidies or government support. Since the 2010s, grid parity for solar and wind has become a reality in a growing number of markets, including Australia, several European countries, and some states in the U.S. If on grid renewable energy input is encouraged, Nigeria will have grid parity.

(iii) Power Democracy
This means the shift of power (literarily) into the hands of consumers and the gradual death of monopolies.

(iv) Power Generation Licence acquisition
Nigeria is a huge market for power generation as only 45% of the population is connected to the national grid despite the expenditure of huge amounts of money on power generation. This provides an opportunity for private utility companies to participate in power generation.

4. FINANCE
Small scale renewable power generation outfits find it difficult to secure funding as a result of poor credit rating and when they do, the interest rates are prohibitive. These are undoubtedly as a result of the absence of effective polices of government necessary to mitigate risks and drive wide participation in an environment that is yet to mature.

5. MANAGEMENT
Some of the existing small scale renewable power generation outfits lack human resources and development skills to operate their businesses successfully. They, therefore, need to be supported through organized workshop and seminars that address their specific needs.

6. WASTE MANAGEMENT AND POLLUTION CONTROL
The greenhouse wastes associated with legacy baseload power generation plants are non-existent with renewable energy plants. However, new areas of challenge and opportunities with respect to sourcing of raw materials, manufacturing and disposal of components for renewable energy (RE) are beginning to emerge.

7. OTHER OBSERVATIONS ON THE STATE OF AFFAIRS IN THE POWER SECTOR
i. Centralised, Legacy, fossil power plants are becoming outdated and financially inferior to clean energy competitors.
ii. Power is becoming more decentralized and distributed as "new energy" companies and individuals produce electricity for clusters and for themselves.
iii. Communities are reaping greater economic rewards from power generation, as electric customers, individually and collectively, produce more localized electricity.
iv. NERC is using regulation to liberalise electricity generation and supply to eligible customers.
v. Net metering is a strong possibility in the near future in areas of stable grid.

C. RECOMMENDATIONS
The following recommendations to the above observations were proffered:

(1) VISION 30:30:30:
This vision should be strictly implemented and monitored to ensure that stable electricity is provided for both commercial and household needs by the target year.

(2) ENERGY MIX AND PRICING:
Federal and State Governments should make deliberate efforts to encourage the use of renewable energy to supply power to homes in their new estates and even in existing communities that may wish to connect with power produced by renewable energy producers. Pricing parity can also be created if government serves as bulk offtaker of electric power produced by small scale renewable electric power producers.

(3) POWER DEMOCRACY:
It is noteworthy that government has over the years been using deliberate government policies and interventions to ensure that consumers of electricity are not shortchanged.

(4) POWER GENERATING COMPANY LICENSING:
Power generation can be greatly increased if the conditions for acquiring the license to generate and distribute off-grid power of between 1MW to 5 MW of electricity is made less stringent.

(5) NIGERIA PRESENTS A HUGE MARKET FOR RENEWABLE ENERGY:
Therefore, the country should articulate and legislate robust policies that do not turn the country into a dumping ground for RE components and equipment manufactured by other countries. The growth of RE must be anchored on full in-country knowledge, technology and domestication engendered by SMART government policies.

(6) COLLABORATION:
The NSChE through Nichem Ventures Limited will collaborate with Mr Bola Soremekun (Rubitec Nigeria Limited) in renewable energy by holding workshops, seminars etc in the same field.

D. CONCLUSION
There is no doubt that when the necessary steps are taken, renewable energy will be a great contributor towards ensuring regular power in Nigeria.

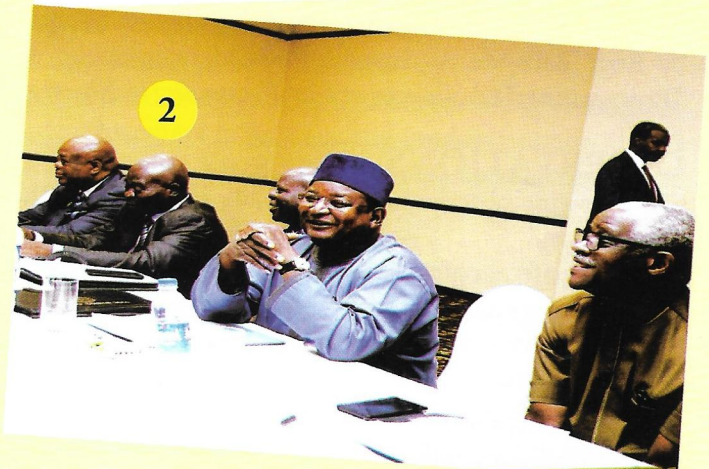
Engr. Onochie Anyaoku, *FNSE, FAEng*
National President

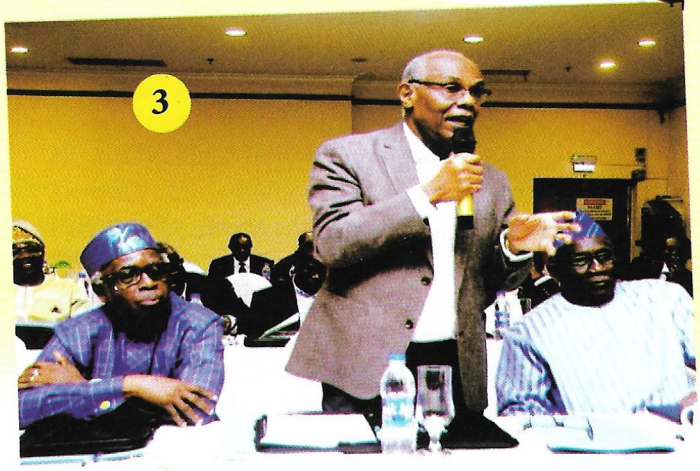
Engr. Kola Badiru, *FNSChE*
NSChE Chairman, Fellows' Confab Committee

FELLOWS CONFERENCE PHOTOS

National President, NSChE, Engr. Onochie A. Anyaoku, FNSChE, delivering his welcome address. ***L-R:*** *Immediate Past President, NSChE, Prof. Sam S. Adefila, FNSChE; Chairman, Engr Kunle Ogunbayo, FAEng; National President, NSChE, Engr. Onochie A. Anyaoku, FNSChE; Deputy National President, NSChE, Engr. Saidu Mohammed, FNSChE and Guest Speaker, Chairman/CEO, Bas Consulting, Pharm. Bolade Soremekun.*

Left To Right: *NSChE Executive Secretary, Samuel O. Bosoro; Immediate Past President, NSChE, Prof. Sam S. Adefila, FNSChE; Deputy National President, NSChE, Engr. Saidu Mohammed, FNSChE; Guest Speaker and Chairman/CEO Bas Consulting, Pharm. Bolade Soremekun; National President, NSChE, Engr. Onochie A. Anyaoku, FNSChE; Chairman, Engr. Kunle Ogunbayo, FAEng and 2019 Fellows Committee Chairman, Engr. Adekola A. Badiru, FNSChE.*





1. *Cross Section of participants at 27Th NSChE Fellows Confab*
2. *Enthusiastic participants during the event.*
3. *Engr Alex Ogedegbe, FNSChE, making his contribution on the topic of discuss during event. Others Are Chief J. J. Akpieyi (1st left) and Engr Babajide Soyode.*
4. *Engr Siky Aliyu, FNSChE, (Middle) making his contribution on the topic of discuss at event.*

NIGERIAN SOCIETY OF CHEMICAL ENGINEERS (NSChE)
A DIVISION OF THE NIGERIAN SOCIETY OF ENGINEERS (NSE)

COMMUNIQUÉ OF THE 49th CHEMICAL ENGINEERING CONFERENCE, EXHIBITION & AGM OF THE NIGERIAN SOCIETY OF CHEMICAL ENGINEERS (NSChE), "KADA 2019"

HELD AT HOTEL SEVENTEEN,TAFAWA BALEWA WAY, KADUNA, FROM 13TH – 16TH NOVEMBER, 2019

PREAMBLE

As advances are made in Chemical Engineering, the chemical process industry will be able to produce more useful products economically on a large scale from agriculture-based inputs. Value-addition to agricultural produce is the magic wand for transforming the nation's economy and providing meaningful employment for the teeming youth. The pivotal role of chemical engineering as the engine of growth for the economy is indispensable. Consequently, the Nigerian Society of Chemical Engineers (NSChE) organized a National Conference on the theme, "Enhancement of Agricultural Value Chain for Economic Development: The Role of Chemical Engineering". The theme was carefully chosen in line with the Federal Government's diversification efforts as enshrined in the Economic Recovery and Growth Plan (ERPG).

The 49th National Chemical Engineering Conference, Exhibition and Annual General Meeting (AGM) of the Nigerian Society of Chemical Engineers (NSChE) tagged "KADA 2019" was held at Hotel Seventeen, Tafawa Balewa Way, Kaduna from 13th – 16th November, 2019. The 4-day event comprised variety of activities including the Opening Ceremony, Plenary and Technical Sessions, Panel Discussions, Poster Presentations, Exhibitions, Meetings of Sectoral groups and the Annual General Meeting (AGM). The Conference was enriched with other social activities that enhanced interaction amongst the participants. These included Excursions (visits to the Palace of the Emir of Zazzau among others), Spouses Programme, Sporting event (golf tournament) and Annual Dinner and Awards. All activities were well attended by Chemical Engineers and their Spouses, Researchers, Academia, Industrialists, Policy makers, Development Partners, and other stakeholders.

Three hundred and thirty nine (339) participants registered for the Conference. Ten (10) lead papers were presented and discussed at the plenary sessions, seventy-four (74) technical papers and five (5) posters were presented during the Technical Sessions, while Six (6) accredited companies and organizations participated in the exhibition. A major attraction of the exhibition was the 5-tonne capacity tomato processing plant constructed by Centre for Technology Development, Kaduna Polytechnic, Kaduna. The Opening Ceremony was graced by various personalities including Mal Nasir Ahmad El-Rufai, OFR, The Executive Governor of Kaduna State who was ably represented by Dr. Shehu Usman Mohammed Makarfi, Hon. Commissioner for Education, Kaduna State and the Honorable Minister for Science and Technology, Dr. Ogbonnaaya Onu, who was ably represented by Prof. J.T. Barminus, DG, NARICT, Zaria. Lead papers were presented by eminent scholars which included Prof. S.S. Adefila, FNSChE, Immediate past President of NSChE who spoke on ***"Arable Land and Value Addition to Raw Agricultural Produce, A Veritable Tool to Economic Development in Nigeria"***; Alh. Adamu Mohammed Kabiru, MD/CEO, Bank of Agriculture, Kaduna, ably represented by Dr. Auta B. Jamaka, Head of Corporate Planning, Bank of Agriculture, Kaduna who spoke on ***"Investment Opportunities and Financing Agro-Allied Business in Nigeria"*** and Mr Robert Colman, MD, Rice Division, Dangote Group of Companies, ably represented by Engr Babajide A. Soyode, FNSChE who spoke on ***"Prospects and Challenges of Rice Processing in Nigeria."***

OBSERVATIONS

The following observations were made at the end of the Conference:

1. The Conference theme is in line with the nation's vision to make agricultural growth and value addition to her raw materials as pivot to industrial transformation in the country.
2. The agricultural sector is the largest employer of labour in the country but its present contribution to Nigeria's GDP is very low.
3. Enhancement of the value chain in agriculture will result in sustainable economic growth, national income, positive impact in employment rate and eventually improve living standards of the citizens.
4. Agro-business and agro-allied industries will maximize the benefits from the country's agricultural resources by building an end-to-end integrated agricultural value chain, boosting local production to meet local demand and reducing the country's reliance on imports of processed food.
5. Nigeria lacks a well-developed cold chain infrastructure strategically located across the country

for the storage of agriculture produce.

6. Chemical Engineering is central to the growth of agricultural sector and thus Chemical Engineers in the country should rise up to the challenge.
7. There is more need for research based technology to bring about sustainable growth in the agricultural downstream sector.
8. There is low use of fertilizer in the country.
9. Presently, most policies in the agricultural sector are short-term and therefore unable to make the necessary impact.
10. Sustainable competitive agricultural development within the framework of an integrated rural development policy is key to the realization of food security for all.
11. The Anchor Borrowers' Programme of the Central Bank of Nigeria (CBN) focuses mainly on rice production.
12. The slow adoption of mechanization in Nigeria has significantly reduced the quantity of agricultural products that can be produced locally.
13. Poor collaboration between the academia and the industry, misplaced priorities of government in the agricultural sector and inconsistent policies pose challenges to the growth of the downstream agricultural sector.
14. Climate change compounds the challenges confronting agriculture. The sector is dependent on the natural resource base and thus faces risks such as desertification, rising temperatures, changing rainfall patterns and sea level rise.
15. ICTs have become important tools in promoting agricultural value chain efficiency.
16. The use of Zeolite in agriculture can bring about great improvement in produce and product output.
17. Most agro-based practitioners/entrepreneurs in the country are not aware of the various funding opportunities available for them to access while others consider the process of accessing financial assistance too cumbersome and are not even willing to apply for such available facilities.
18. To boost their potential in the value chain, the farmers need more training, infrastructure, financial services, affordable inputs, and better access to technology and markets.
19. Government should comply with the African Union 2003 Maputo Declaration on Agriculture and Food Security that 10% of national budgetary resources be allocated to agriculture and rural development.
20. Previous industrialization policies were not effective due to inadequate monitoring and enforcement. Nigeria should deliberately adopt the participatory approach to industrialization and discourage turn-key projects.
21. The curricula being operated by our tertiary institutions are outdated and should be revised immediately and periodically as a matter of necessity.
22. Curricula structure should be debottlenecked to allow smooth students transition. The issue of prerequisite should be seriously considered when developing and reviewing chemical engineering curricula.
23. Engineering educators should pay more attention to the foundation level courses as success at foundation seems to predict final academic success.

RECOMMENDATIONS

The following recommendations were made at the end of the Conference:

a. The government's transformation programme in the Agricultural Sector should entail reforms in the input supply regime, a deliberate increase in the output of priority commodities, post-harvest systems development, a strong orientation towards agri-business and promoting value-addition in the product chain.
Action: *Federal and State Ministries of Agriculture and Rural Development*

b. The policies aimed at supporting and improving the agricultural value chain should not be short term but long term and must be implementable.
Action: *Federal and State Ministries of Agriculture and Rural Development*

c. Government should provide urgently relevant infrastructure to support agro-allied industries in the rural areas. This includes the introduction of food processing plants in rural areas to cut down cost of transporting farm produce to urban areas for processing.
Action: *Federal and State Ministries of Agriculture and Rural Development*

d. The exploration of the renewable energy option to power cooling chains in the rural area will ensure that food spoilage is reduced. To this end, the relevant government agencies should facilitate the construction of cooling chains in the rural areas where perishable food spoilage is rampant.
Action: *Federal and State Ministries of Agriculture and Rural Development/Energy Commission of Nigeria*

e. There should be appropriate and consistent policies to support local manufacturing of agro-processing equipment. To this end, Government should provide incentives to local manufacturers of agro-processing equipment
Action: *Federal and State Ministries of Agriculture and Rural Development/Federal and Ministries of Science and Technology/TETFund*

f. Governments should comply with African Union 2003 Maputo Declaration on Agriculture and Food Security that mandates African States to allocate 10% of national budgetary resources to agriculture and rural development.
Action: *Federal and State Ministries of Agriculture and Rural Development*

g. The Federal Government should set up an organ that can bring together zeolite specialists, soil chemists and agronomists to address improvement in farming in the country.
Action: *Federal and State Ministries of Agriculture and Rural Development/Federal and State Ministries of Science and Technology/PTDF*

h. A National Policy on the enhancement of Agricultural Value Chain for Economic Development is a logical strategy to promote the Economic Recovery and Growth Plan (ERGP) of Federal Government of Nigeria (FGN). Modalities for the production of the national policy should be put in place.
Action: *Federal and State Ministries of Agriculture and Rural Development*

i. Government should put in place responsive human capital development strategies to produce the critical skilled manpower deficit in agriculture downstream sector to improve the capacity needed to drive the enhancement of the value chain in the sector.
Action: *Federal and State Ministries of Agriculture and Rural Development/Federal and State Ministries of Science and Technology/Federal and State Ministries of Education*

j. Government should consider as the next strategy to the current agricultural revolution to link the agricultural produce to industrial processing (raw materials required) by the manufacturing companies in Nigeria. Government should give incentives to firms that produce their raw materials locally.
Action: *Federal and State Ministries of Agriculture and Rural Development/Federal and State Ministries of Science and Technology*

k. Government should consider solar and other renewable energy inclusion as part of the sources for the production of electricity for the national grid.
Action: *Ministry of Power/Energy Commission of Nigeria*

l. Vocational and technical education and training should be given priority as a matter of national importance. Incentives should be put in place to promote vocational and technical education and training.
Action: *Federal and State Ministries of Education*

m. The formation of cooperative association by farmers in the country can greatly enhance their chances in accessing facilities by the Bank of Agriculture. The Bank of Agriculture and relevant financial institutions should facilitate this process
Action: *Central Bank of Nigeria/Bank of Agriculture*

n. The Bank of Agriculture should be proactive in engaging farmers in the area of providing loan facilities to fund agriculture activities/
Action: *Central Bank of Nigeria/Bank of Agriculture*

o. The Anchor Borrowers' Programme of the Central Bank of Nigeria, CBN should be extended to other crops such as maize and soya beans, sorghum and millet and to other agriculture activities in the downstream sector such as processing and storage of agricultural produce.
Central Bank of Nigeria

p. The Nigerian Society of Engineers should develop a strategic plan to put Chemical Engineers in the forefront of industrialization of the country especially in the agricultural sector.

q. Chemical Engineers should direct their efforts in solving challenges in the agricultural downstream sector and production of agro-chemicals. NSChE should identify and engage relevant agencies and organizations to draw up programmes for the active participation of members.

r. Institutions should as a matter of urgency institute the review of the curricula of Chemical Engineering programmes.TETFund and other relevant agencies should as a matter of urgency put in place a programme for the speedy review of not only the Chemical Engineering curricula but all obsolete curricula of programmes in tertiary institutions.

s. Industry should not only take part in the revision of tertiary education curricula but should also provide financial support for the exercise since they are part of the major beneficiaries of well-trained graduates of these institutions.

t. Partnership and collaboration between the Ministry of Agriculture and the Nigerian Society of Chemical Engineers should be forged to bring improvement in the downstream sector of agriculture and fast-track local content initiative in agricultural value chain.

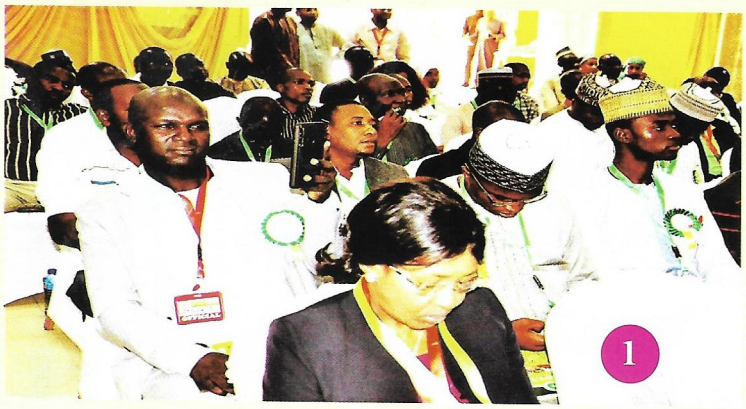
u. The Nigerian Society of Chemical Engineers should create a database for agro-equipment and machines producers in the country to enable stakeholder to be aware of our internal capabilities. NSChE should therefore carry out a survey to identify the producers and their capabilities.

v. NSChE should form a committee to develop strategies on the involvement of Chemical Engineers in revamping the textile and allied industries. A holistic approach should be pursued in identifying the various sectors that require funding (such as the chemical sector) in the textile industry instead of concentrating on cotton production and provision of machinery alone.

Authors: *Prof. I. M. Bugaje, FNSChE, Chairman 2019 LOC, KADA 2019, Samuel O. Bosoro, MNSChE, Executive Secretary, NSChE, Engr. Onochie Anyaoku, FNSChE, President, NSChE*

49th CONFERENCE IN PICTURES

Cross section of participants at the high table



1. *Cross-Section of some participants at the NSChE's 49th Annual Conference/AGM*
2. *A group picture of some NSChE Executives, some participants with the Traditional Ruler at NSChE's 49th Annual Conference/AGM*
3. *The Chairman, Engr. Abubakar Yar'adua delivering his address at the opening ceremony of the conference. To his immediate left is the National President, Engr. Onochie Anyaoku, FNSChE*
4. *The National President, Engr. Onochie Anyaoku, Fnsche, delivering his welcome address at the opening ceremony of the conference. To his immediate left is Past President, Prof Ayo Ogunye, FAEng*
5. *The LOC Chairman, Prof. Idris M. Bugaje, FNSChE, delivering his welcome address at the opening ceremony of the conference*

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EVALUATING WATER-ENERGY-FOOD-NEXUS FOR SUSTAINABILITY OF HEALTHY LIVING IN NIGERIA

PROF. AWAJIOGAK A. UJILE

Prof. Awajiogak A. Ujile, FNSE, FNSChE (Professor of Chemical Engineering), Dept. of Chemical/Petrochemical Engineering, Rivers State University, Port-Harcourt.

1.0 INTRODUCTION

Countries have challenges of providing water, energy and food for the growing human population within the limits of its environment. These three are closely connected in a nexus in the sense that it requires water and energy to produce food, it requires water and possibly biomass to produce energy and it requires energy to produce usable water (Xie, et al, 2018). Abraham stated that the global challenges for meeting the human needs for food, water and energy are inter-connected in a complex way (Abraham, M. A. 2018). A clear understanding of these linkages would be enhanced when they are treated together as a unit in this treatise.

Sustainability and sustainable development of healthy living should be taken as a matter of urgency. Majority of the population in Nigeria reside in the rural/semirural areas where there is scarcity of potable water and energy. Even in urban cities, individual household provides water for domestic use while industries make use of borehole with treatment units incorporated to obtain processed water for their usage. Das and Cabezas stated that the increasing use of nonrenewable resources to support an increasing (non-controlled) population has created an unsustainable situation in the nexus (Das, T. and Cabezas, H., 2018). If this trend is allowed to continue without check and control, the following consequences may ensue: (1) future generations will be unable to maintain a high standard of living, (2)developing countries will have less opportunity to raise the level of their healthy living.

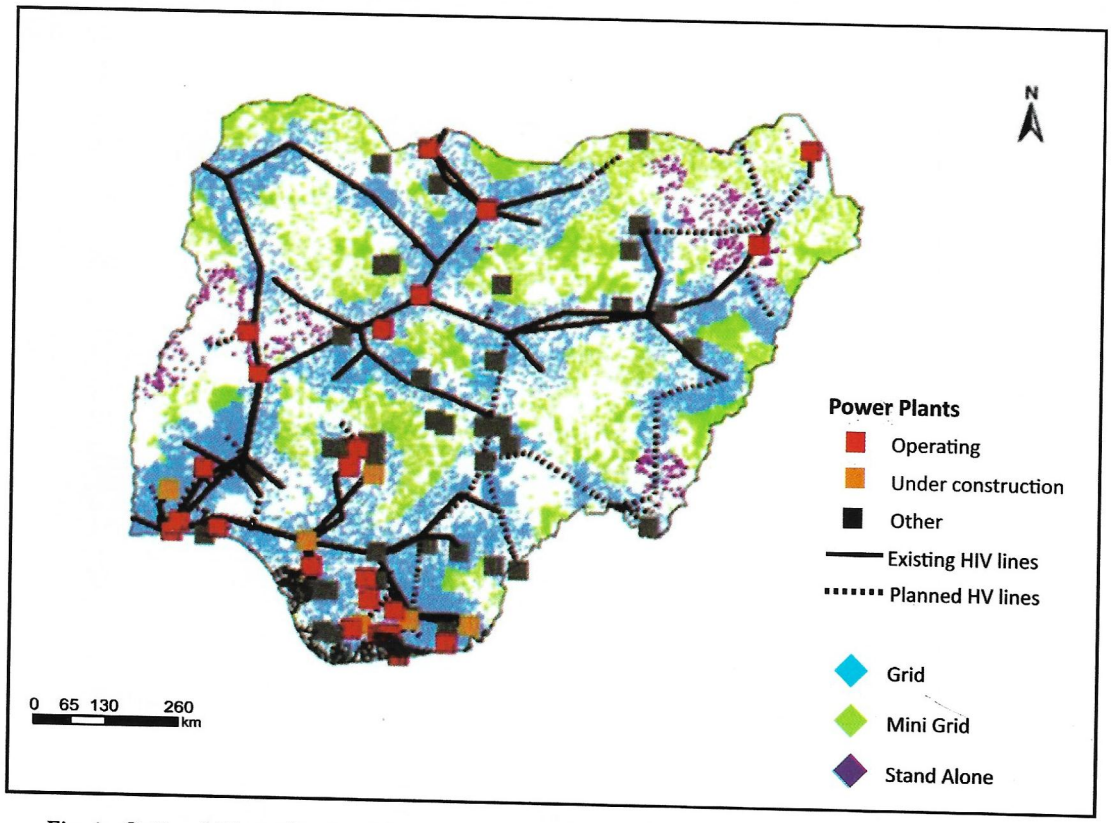


Fig. 1: Optimal Electrification Mix in Nigeria (Source: Mentis et al. 2015)

On energy, a study carried out with geo-spatial analysis for developing optimal electrification plan in various regions was made by Mentis and others. The operatingpower plantslocations: thoseunder

construction, existingand planned High Voltage (HV) Lines and other features are shown in figure 1.The methodology developed can inform the formulation of an integrated strategic electrification system, which should contain useful analyses like engineering load efficiency, a necessary tool in grid expansion (Mentis, et al, 2015).

Chemical engineering practice involves the use of both renewable and non-renewable materials, energy and exergy (available energy) resources and water for the production of chemicals, value added goods, food and wastes in form of pollution. It therefore becomes imperative that engineers, chemists and experts in other disciplines who are involved in production processes should incorporate the idea of pollution prevention into process and product designs, manufacturing, and value-chain management (Das and Cabezas, 2018).

This paper evaluates the availability of water, energy and food supply with the prevailing population growth index and correlates the consumption rates in Nigeria. This could establish deficiencies that might inform stakeholders and managers of the resources to work on so as to maintain high standard of healthy living in the country. Engineers and other professionals alike would be able to proffer solutions to the dearth of water, energy and food supply chains in the country.

2.0 WATER

Globally, water requirements have increased with time Therefore, countries have progressively increased its supply by steadily increasing the extent of utilizatio of their available resources. Table 1 shows the trend of effort other countries have made to increase their water resources. The fundamental question that requires answer from Nigerian Chemical Engineers is: To what extent should the water available be developed economically with appropriate social and environmental safety? Appropriate methodologies to carry out such analyses with reasonable degree of accuracy are scarce.

However, groundwater has always been considered to be a readily available source of water for domestic agricultural and industrial use (Gupta, A. D. 1998 Hassan, Dolla and others performed a global-scale analysis of the impact of water withdrawals on water storage variations, using the global water resource and use model Water GAP (Water- Global Assessment and Prognosis). They reported that the source of 35 of the water withdrawn worldwide is groundwater and it contributes 42%, 36%, and 27% of water used for irrigation, households and manufacturing respectively. They assumed that surface water is used only for livestock and cooling of thermal power plants (Hassan, A. 2017 and Dolla, P et al., 2012). However the groundwater resource in the country has be

Countries	Population				Annual renewable fresh water available (km^3)	Per capita freshwater availability ($1000m^3$)		
	Millions			Growth Rate % per annum				
	1994	2025	2050	1985-1994		1994	2025	2050
Argentina	34.2	46.1	53.1	1.4	994	29.06	21.56	18.71
Bangladesh	117.8	196.1	238.5	2.0	2357	20.00	12.02	9.88
Brazil	150.1	230.3	264.3	1.8	6950	46.30	30.18	26.30
Canada	29.1	83.3	39.9	1.3	2901	99.69	75.74	72.70
China	1190.9	1526.1	1606.0	1.4	2800	2.35	1.83	1.74
Egypt	57.6	97.3	117..4	2.0	59	1.02	0.60	0.50
India	913.6	1392.1	1639.1	2.0	2085	2.28	1.50	1.27
Indonesia	189.9	275.6	318.8	1.6	2530	13.32	9.17	7.94
Japan	124.8	121.6	110.0	0.4	547	4.38	4.50	4.97
Mexico	91.9	136.6	161.4	2.2	357	3.88	2.61	2.21
Nigeria	107.9	238.4	338.5	2.9	308	2.87	1.29	0.91
Turkey	60.8	90.9	106.3	2.1	203	3.34	2.23	1.91
United Kingdom	58.1	61.5	61.6	0.3	120	2.07	1.95	1.95

Table 1: Population and per capita water availability for selected countries (Adapted from world bank, 1992)

Country	Population (Million)	Generation Capacity (GW)	Energy Consumption (Billion kwh)	Energy Consumption per Capita (Billion kwh)
USA	321,368,864	1,053	3,883	12,083
Germany	80,854,408	178	583	7,204
UK	64,088,222	76	304	4,740
South Africa	53,675563	44	234	4,363
China	1,367,485,388	1,505	5,523	4,039
Brazil	204,259,812	119	479	2,344
Egypt	88,487,396	27	129	1,462
Indonesia	255,993,674	41	156	609
India	1,251,695,584	223	758	605
Ghana	25,327,649	3.0	11	403
Nigeria	**178,562,056**	**7.6**	**23**	**129**

Table 2: Nigeria's Energy Situation compared with Selected Countries (Onyekena, et al. 2017)

contaminated. Ujile has extensively investigated the sources of contamination (Ujile, A. A., 2003).

Ujile has made an appraisal of the groundwater storage, geology, hydrogeology and aquifer systems, some pollutant distribution profiles, groundwater quality, model development and application of the model in the Niger Delta region (Ujile, A. A. 2017). The highlights of these concepts, and recommendations to appropriate regulatory and governing bodies for implementation, control and management of groundwater resource for the region could be obtained from the literature cited.
It is therefore required that engineers should make effort to bring the groundwater resource to acceptable quality with minimum energy requirements, as to complement the sustainability of the other components in the nexus.

Table 1 shows that for a country such as Nigeria, whose population is expected to increase significantly from about 108 million in 1994 to some 339 million by the year 2050, its per capita water availability is likely to decline from 2,870 m3/year to only 910 m3/year by 2050.There are exceptions in few countries such as Japan.

3.0 ENERGY

Energy is a vital input for the techno-industrial development and economic growth of any country. Despite the enormous endowments of renewable and non-renewable primary energy resources, Nigeria is still faced with obnoxious electricity problems; ranging from generation, transmission to distribution and marketing. This has hampered its economic development. The total installed capacity of power generation in Nigeria as at August 2015 is 12, 522 MW, but 7,141 MW is said to be available [Nigeria Power Baseline Report, 2016].

As at the time (2020) of preparing this report, Nigeria is battling with 3,500 MW for over 180 million people. The available energy is on a very low side. Nadabo expressed that the persistence of the problem is due to the government's adaptation of short term, hasty policies and carrying out energy projects which are detrimental to long term energy needs that will help the nation to achieve sustainable energy and energy efficiency(Nadabo, S. L., 2010).

Moss and Portelance stated that Nigeria is 80% below its energy use, based solely on income levels. This is the lowest in the world (Moss, T. and Portelance G. 2017). Table 2 represents the appalling state of energy consumption in Nigeria relative to selected developed and developing countries. Nigeria's economic growth is also constrained by insufficient electricity generation capacity, which results in a lack of a reliable and affordable supply of power. At the same time, Nigeria flares considerable amounts of associated gas, a by-product of offshore crude oil extraction. Flaring generates significant greenhouse gas emissions and wastes a considerable amount of energy. To reduce gas flaring and increase generation

of clean energy generally through greater private sector participation, the Centre for the Study of the Economies of Africa supports the Government of Nigeria's efforts to better manage the sector https://www.usaid.gov/nigeria/economic-growth (Accessed on 7th April, 2020).

4.0 FOOD

Water, land and energy are critical components of the food system. Energy type, price and availability are key factors that influence growers and manufacturers. The use of food and agricultural waste and solar power as energy will be a boon to overall environmental and social health. Better use of food waste supports environmental and social sustainability by reducing associated economic losses and climate impact, (Schmitz, H. H. and D'Cruz, F., 2019). Water for example, is fundamental to the production, manufacture and distribution of food. Its availability and application will shape the way farms, homes and people operate (Kachergis, E. 2014).

People around the world are living longer and consumers are becoming increasingly interested in improving their physical and mental performance as well as their ageing process (Marsman, D., 2018). In 2016, food production index for Nigeria was 124.6. Food production index of Nigeria increased from 27.4 in 1967 to 124.6 in 2016 growing at an average annual rate of 3.32%. Food production index is computed for food crops that are considered edible and that contain nutrients. Coffee and tea are excluded because, although edible, they have no nutritive value (Knoema, 2020). Innovation in the food sector is, as in many other sectors, rooted in the interaction among universities, government research institutes, policy makers as well as industry itself.

Table 3 shows that Nigeria ranks 103 out of 119 countries on the Economist's Global Food Security Index (GFSI 2018). This Index considers the core issues of affordability, availability, and quality across a set of 119 countries, with a score of 0-100, where 100 is the best. The situation in Nigeria improved slightly in 2010 compared to 2005. The index is only available at the national level, so regional figures cannot be extracted.

Chemical engineers and experts in food technology should borrow a leaf from China. Established companies will need to look for innovation opportunities in emerging markets to drive innovation in other areas. China has a fertile innovation ecosystem with many rising professionals interested in innovation, a large consumer base with disposable income, inexpensive resources and favourable government policies. Overall government support encourages entrepreneurship and innovation allowing university-enterprise collaborations to thrive and maintain a talent base (World Economic Forum White Paper, 2016).

# (0-119)	Country/Year	2000	2005	2010	2018
22	Mexico	10.8	9.1	7.7	6.5
77	Kenya	36.5	33.5	28.0	23.2
80	Benin	37.5	33.5	28.1	24.3
103	Nigeria	40.9	34.8	29.2	31.1
119	CAR	50.5	49.6	41.3	53.7

Table 3: Global Hunger Index IFPRI (2018) over Years

"Water can be made to contribute to the national economy through the development of the country's water resources and expanding irrigation schemes."

5.0 ANALYZING THE NEXUS

5.1 WATER POLICY

There have been numerous activities in the area of water resources development in dam construction, urban water supply, irrigation and power generation. Each of these sub-sectors has developed water resources without adequate consultation with other stakeholders. This has resulted in underutilization of the facilities provided. In order to overcome this deficit, the Nigerian Government should embark on pursuing a vision of optimizing the use of Nigeria's water resources for present generations to live in harmony with environmental requirements without compromising the existence of future generation.

In the light of this vision, the new management of water resources has to overcome the challenge by carefully balancing the water uses and water protection through a regulatory system of river basin based management and regulated allocations of water resources. The limits of self-regulation should be recognized. Water is too valuable a commodity for its management to be handed over solely to its users. There remains a vital role of government for monitoring and enforcement (NWP, 2004).

During the oil boom days of the 1970s and early 1980s, the country invested heavily in water resources development, particularly in the construction of multipurpose dams. The dams were meant to control flood, provide water for domestic and industrial uses, control riparian rights releases and for the environment, hydro-power generation, fishing, livestock, inland waterways and irrigated agriculture amongst others. Nigeria has constructed 200 dams storing up to 31 billion cubic metres. Out of these, 11 billion cubic metres are meant to cater for up to 340,000 hectares of irrigated land. So far, about 100,000 hectares of land have been equipped with the infrastructure whilst currently only about 60,000 hectares can actually be irrigated. Thus, the remaining 40,000 of the equipped field need some major rehabilitation. The balance of 240,000 hectares of land that can be catered for by the water stored so far, need to have the full complement of irrigation facilities in order for the country to derive the benefits fully. The National Water Resources Policy has provided a framework for addressing some challenges that could solve the problems of energy and food deficiencies.

5.2 IRRIGATION AND DRAINAGE

Water can be made to contribute to the national economy through the development of the country's water resources and expanding irrigation schemes. The result will be improvement in agricultural production. Indeed, water shortage problem caused by the unpredictability of rainfall would be reduced. Other problems observed are: non-effective operations of many irrigation schemes, insufficient collection of operational fees and lack of ability to meet the maintenance and repair cost leading to degradation of existing schemes.

The population, especially the poor can therefore not profit sufficiently from the existing schemes. Reducing poverty through the delivery of efficiently operating irrigation schemes is the main thrust of the Nigerian Water Resources Policy. This is what this policy intends to outline meanwhile a separate strategy for Irrigation is being developed.

5.3 HYDROPOWER GENERATION

As far back as 1995, a total aggregate of installed capacity of power plants under NEPA was 6,000 MW (1,900 of hydro and 4,100 of thermal). Out of the 6,000 MW capacity only about 4,000 MW has been made available due to some major breakdowns which occurred in the past in plant, machinery and equipment. Quite often, hydropower plants

of Kainji and Jebba on the Niger River suffer from the decrease of reservoir inflow due to effect of the Sahelian drought and anticipated use of the Niger water by upstream countries as well as invasion by water hyacinth.

The following strategies are pursued by the Nigerian government in order to improve hydropower generation:

a) Encourage balancing, modernization and Rehabilitation works on all the existing hydro power plant .

b) Pursue with vigor the present privatization and commercialization of some aspects of NEPA hydro power installation.

c) Encourage the development of major hydro power plant on Built, Operate and Transfer (BOT) policy.

d) Identify potential mini-hydro sites for isolated rural electrification involving State Rural Electrification Boards under coordination of Rural Electrification Agency (REA), River Basin Development Authorities (RBDAs), private sector and the Energy Commission of Nigeria (ECN).

e) Carry out studies on it; is also expected that five multipurpose large scale dam projects are to be sited on the left side of Benue River within the next twenty years.

Water scarcity and poor water quality impact virtually everyone, making water management a critical global issue (UNESCO, 2017). A recent United Nat (UN) report states that more than 80% of gl wastewater is released to the environment wit treatment, and that more than 95% of that waste is discharged in the least-developed countries. report further states that water strategies attem minimize water use involving the 4Rs (UNES 2017).

- Reduce pollution at source
- Remove contaminants from the wastewa
- Reuse wastewater
- Recover byproducts.

The Nigeria Water Policy has integrated some o strategies. With many chemical process indust (CPI) facilities facing tightening water disch limits, as well as the high cost of wastewater treatm the chemical engineering personnel should r efforts on the first R, that is, reduction. It follows f this standpoint that chemical process designs sh consider minimizing production of wastew Process integration tools are now widely used water minimization studies. Water pinch ana allows users to set flowrate targets ahead of de and is suitable for processes with single contamin Mathematical programming, on the other hand useful for cases with multiple contaminants.

Year	Ave. Gen. availability (MW)	Maximum peak generation (MW)	Maximum daily energy generated (MWh)	Total energy-generated (MWh)	Total energy-sent out (MWh)	Per Capita Energy Supply (kWh)
2007	3,781.3	3,599.6	77,322.3	22,519,330.5	21,546,192.2	155,3
2008	3,917.8	3,595.9	86,564.9	18,058,894.9	17,545,382.5	120,4
2009	4,401.8	3,710.0	82,652.3	18,904,588.9	18,342,034.7	122,0
2010	4,030.5	4,333.0	85,457.5	24,556,331.5	23,939,898.9	153.5
2011	4,435.8	4,089.3	90,315.3	27,521,772.5	26,766,992.0	165.8
2012	5,251.6	4,517.6	97,781.0	29,240,239.2	28,699,300.8	176.4
2013	5,150.6	4,458.2	98,619.0	29,537,539.4	28,837,199.8	181.4
2014	6,158.4	4,395.2	98,893.8	29,697,360.1	29,013,501.0	167.6

Table 4: Electricity generation profile (source: nerc, 2015)

Foo stated that both water pinch analysis and mathematical programming can be easily set up in a spreadsheet to evaluate the potential for water recovery in a process plant. This helps to preserve water resources, which enhances the sustainability of process plants (Foo, D. C. Y., 2019)

6.0 ENERGY POLICY

With an installed capacity of 13,308 MW, only plants with capacity totalling 6,158 MW were operational in 2014. Of these, 3,000 MW to 4,500 MW are actually being generated due to unavailability of gas, breakdowns, water shortage and grid constraints. The poor performance of the power plants has led to acute shortage of power across the country (NES, 2015).

The power sector in Nigeria is seen by many analysts as the key constraint on economic development. Assessing the ease of getting electricity, the World Bank ranked Nigeria 187 of 189 countries in the 2015 edition of its Doing Business report. For a business in Lagos, to obtain permanent electricity connection takes 260 days [WB; 2014: b]. Once connected to the electricity provider, Nigerian businesses' biggest reported problem is the erratic power supply. About 83% of all managers surveyed considered electricity outages to be a serious problem – more than any other constraint.

Firms of all sizes, in all states and sectors, report average power outages equivalent to eight hours per day. The average firm claims outage related losses equivalent to more than 4% of sales. No peer country experiences such severe business losses related to the power supply [World Bank (WB); 2011]

Table 4 shows that despite the increase in the available installed capacity over the period, only 3,000 MW to 4,500 MW were actually being generated. The highest peak being 4,517.6 MW in 2012. It was further reported that up to 2,700 MW of power generation capabilities were lost due to gas shortage; 500 MW were lost to water management and several hundred megawatts were lost due to line constraints.

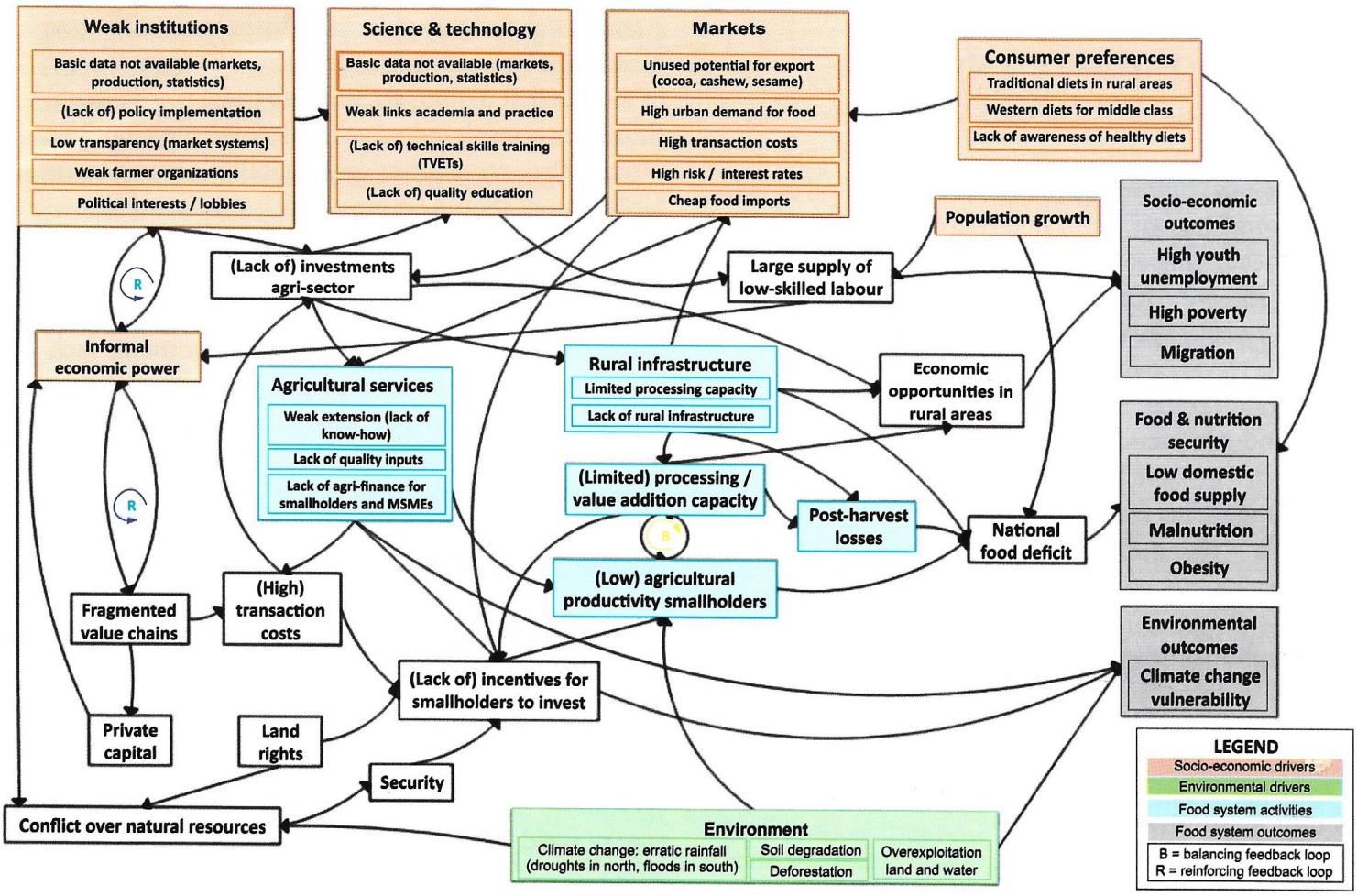


Fig.2: Causal diagram Nigerian agri-food system (Posthumus, et al, 2019)

RESOURCE	HANDLING	RETAILING	CONSUMER
Water	Input as an ingredient in processed food; Cleaning food products Sanitation of food handling areas, processing facilities, and preparation equipment Sterilization of packaging materials, Hand, water, clothing sanitation	Cleaning retail display space Sanitizing freezer, cooler Operating freezing and cooling systems	Preparation, cleaning, cooking Cleaning tools, pans, refrigerat oven Sanitation of cooking and food preparation area
Energy	Operating processing, sorting, grading , cleaning facilities Operating of water movement systems (pumps, wastewater disposal) Lighting, heating, cooling, ventilation of work areas Distribution and transportation Disposal of solid waste (food) through municipal waste stream (MWS)	Storage: freezing, cooling Lighting, heating, cooling retail stores Distribution and transportation Disposal of food and packaging waste through MWS	Food preparation: heating, cooking, preparation Storage: freezing, cooling Lighting, heating, and cooling c cooking areas Transporting food home Disposal of food and packaging waste, MWS

Table 5: Energy and water uses for food handling, post farm to consumer (source: Zimmerman, et al, 2018)

7.0 FOOD SUPPLY AND CONSUMPTION SYSTEMS

The climate and agro-ecological conditions favour agricultural production. Nigeria also has an abundance of natural resources (gas, oil, iron, zinc, lead, tin, etc.) that contribute to the export revenues, even if some revenues are declining (e.g. oil). Private capital is available within Nigeria and can be leveraged to finance investments in the agri-food sector. There is a huge domestic demand for food products, so markets are readily available. The port in Lagos provides access to international (food) markets. Despite the many challenges it faces, Nigeria – being the largest African economy – has huge economic potential.

The opportunities and challenges were identified for different commodity value chains in Nigeria (Posthumus et al, 2019). The details show that various commodities like horticulture, vegetables, palm oil, cocoa, white yam, cassava, sesame, soya bean, dairy (milk and milk product), poultry and aquaculture have challenges and opportunities/ strengths and areas of linkage to power and w management. For Nigeria to be removed from the of food deficit nation, attention to these compone should be considered so as to increase the GDP p capita. Also, regulations and enabling environm for investors should be provided.

Figure 2 depicts the main drivers and causal proces in the Nigerian agri-food system. Negative feedba loops between a weak enabling environment, la of incentives and finance for investment and lo agricultural productivity keep the agri-food sect locked into underperformance. Poor energy an unavailability of process water have constitute weak environment that have resulted in Nigeria t be among the national food deficit country.

8.0 BUILDING A COMBINED WATER – ENERGY – FOOD MODEL

Boss and others carried out a study on globa agriculture as an energy transfer system and th energy yield of world agriculture (Boss, S. K. et a 2018).

"A generalized model could be obtained by selecting energy and water connectivity with food system."

Their study established the fact that systematic energy losses from wastes, diversion of energy output as feed for livestock and poultry, and appropriation of energy output for biofuels synthesis may reduce the available energy for human consumption to levels consistently less than the human metabolic requirements. Figure 2 shows that there are economic opportunities in the rural areas as a result of post-harvest losses.

A generalized model could be obtained by selecting energy and water connectivity with food system. Table 5 depicts a conceptual network-basedmodel capturing fundamental components for a typical urban food system.

For processing, freezing uses the most energy, followed by baking (Masanet et al 2012).

Many other processes for food preservation exist, for example, vacuum packing produce. As the table shows, water and energy are critical inputs to food processing, distribution, retailing and consumption.

9.0 WATER FUNCTION OF ENERGY

For planning purposes, we need to determine the total amount of water used in energy use life cycle. Water footprint factor, ewf, is used to express the amount of water used to generate a unit of energy. Thereafter, the total amount of virtual water with the energy resources consumption is given as:

$$W = \sum_{i=1}^{P} e_i ewf_i$$

Equation 1

where W is the total amount of water required for the energy system, m3; P is the number of energy categories consumed in the city or region; ei is the annual total amount of energy category I in the city or region; ewfi is the water footprint factor of energy category I annually, m3/Kj, (Xie, et al, 2018).

10.0 ENERGY FUNCTION OF WATER

The concept of virtual energy is cited to express the total amount of energy consumption in water use cycle from intake to discharge. This can also be expressed as:

$$E = \sum_{i=1}^{n} w_i wef_i$$

Equation 2

where E is the total virtual energy of water resources consumption, KJ; n is the number of water intake for a city or the water resources categories for a country or region; wi, is the annual water amount of the No i intake point, m3; wefi is the energy footprint factor of No i intake point, KJ/m3.

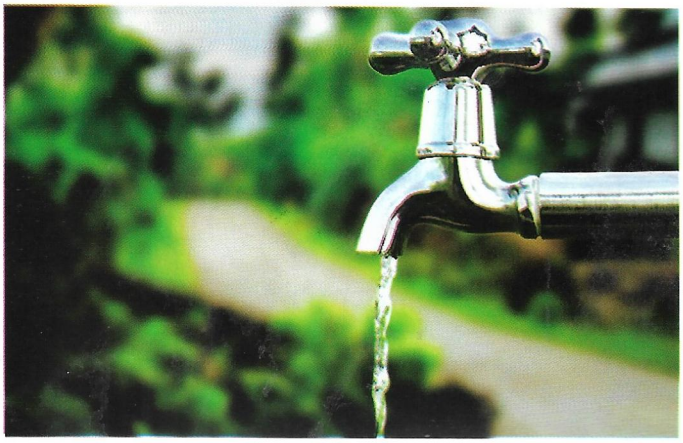
The combination of equations (1) and (2) can be modified with table 5 to establish models for food handling, retailing and consumer processes.

11.0 CONCLUSION

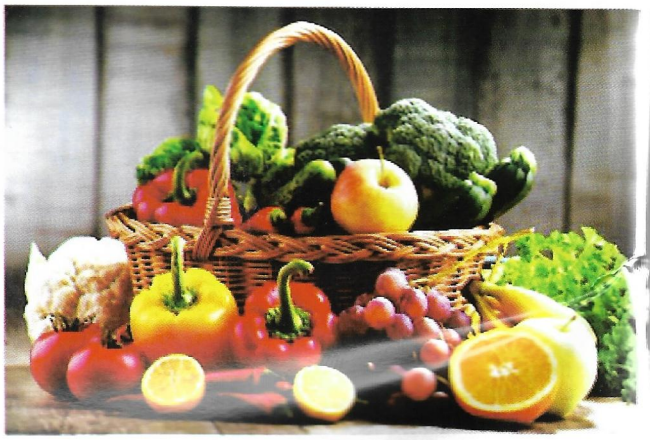
This evaluation has been able to establish linkages among water and energy resource usages, and the extent of their interactions can always support the dynamics of food systems development. It is a known fact that Nigeria per capita potable water availability is very low. Likewise, the energy generation and consumption per capita is low. Similarly, the economist's global food security Index has placed Nigeria among the third world countries.

Attempts have been made by various governments to study the water, energy resources and food security index with comparative advantage of other nations. Experts outside the country were engaged for the studies and the results show deficiencies in the sectors.

"Attempts have been made by various governments to study the water, energy resources and food security index with comparative advantage of other nations."



A community potable water supply.



Food basket. Source: Shutterstock.com

However, the corporate governance framework that has failed to fight corruption, improper planning schedules, political upheavals and hasty policies on implementation of such studies contribute to unsuccessful achievement of the set goals. It is the opinion of the author that chemical engineers should use the conceptual models established to solve the problems of food deficit, dearth of potable water and sustainability of reliable energy resource.

The models could be applied with modifications to identify, visualize and analyse in quantitative terms the water, energy and food consumption requirements of the teeming population in the country. Government should encourage entrepreneurs to invest in the sectors by creating conducive environment. Sustainability of healthy living in Nigeria could only be attained with a new paradigm of business and industrial activities.

It is best for these activities to be handled or guided by professionals to achieve optimal results. In using these resources optimally, food and potable water in particular, must meet the quality standard required for healthy living when consumed.

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YOU AND YOUR HEALTH

POSTURE

1.0 WHAT IS GOOD POSTURE?

Posture is the position in which you hold your body upright against gravity while standing, sitting or lying down. Good posture involves training your body to stand walk, sit and lie in positions where the least strain is placed on supporting muscles and ligaments during movement or weight-bearing activities. Proper posture:

- Keeps bones and joints in the correct ligament alignment so that muscles are being used properly.
- Helps decrease the abnormal wearing of joint surfaces that could result in arthritis
- Decreases the stress on the ligaments holding the joints of the spine together
- Prevents the spine from becoming fixed in abnormal positions
- Prevents fatigue because muscles are being used more efficiently, allowing the body to use less energy
- Prevents strain or overuse problems
- Prevents back ache and muscle pain
- Contributes to a good appearance. See Fig. 1.

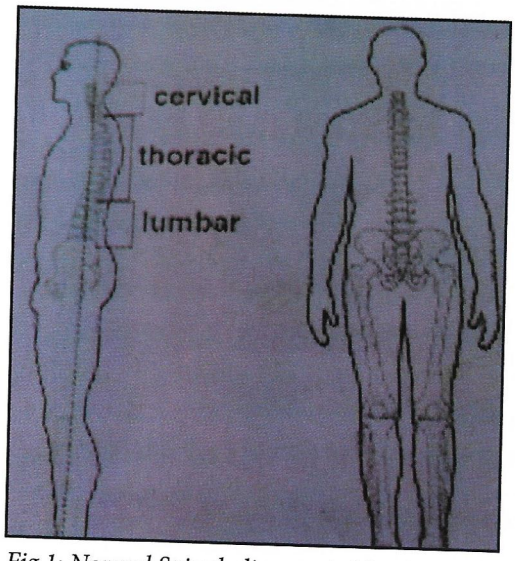

Fig.1: Normal Spinal alignment side view and front view. The spine should have three normal curves: cervical, thoracic and lumbar.

2.0 CORRECT SITTING POSITION

- Sit up with your back straight and your shoulders back. Your buttocks should touch the back of your chair.
- All three normal back curves should be present while sitting. A small, rolled up towel or a lumber-roll can be used to help you maintain the normal curves in your back. See Fig. 2.

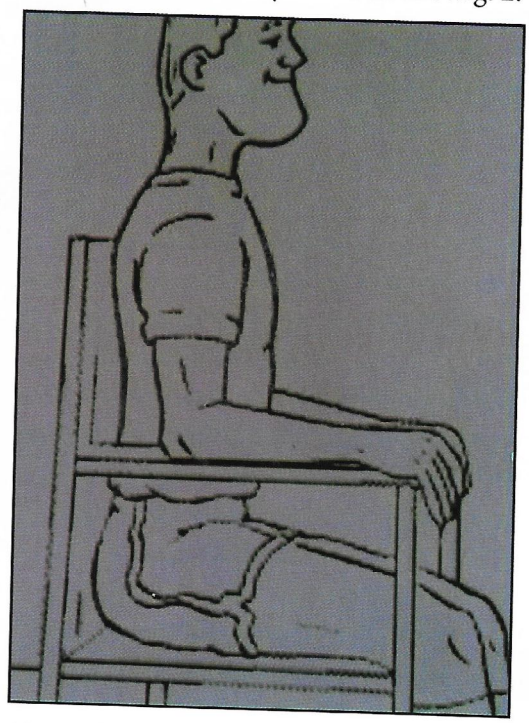

Fig. 2: Illustration of correct sitting position

3.0 CORRECT DRIVING POSITION

- Use a back support (lumbar roll) at the curve of your back. Your knees should be at the same level or higher than your hips.
- Move the seat close to the steering wheel to support the curve of your back. The seat should be close enough to allow your knees to bend and your feet to reach the pedals

4.0 WHAT IS THE BEST POSITION FOR SLEEPING AND LYING DOWN?

No matter what position you lie in, the pillow should be under your head and not your shoulders. The pillow thickness should be such that allows your head to remain/maintain a normal position.

- Try to sleep in a position which helps you maintain the curve in your back (such as on your back with a pillow under your knees or a lumbar roll under your lower back; or on your side with your knees slightly bent. Do not sleep on your side with your knees drawn up to your chest. You may wants to avoid sleeping on your stomach, especially on a saggy mattress since this can cause back strain and can be uncomfortable for your neck.
- Select a firm mattress and box spring set that does not sag. If necessary, place a board under your mattress. You can also place the mattress on the floor temporarily if necessary. If you've always slept on a soft surface, it may be more painful to change to a hard surface. Try to do what's most comfortable for you.
- Try using a back support (lumbar support) at night to make you more comfortable. A rolled sheet or towel tied around your waist may be helpful.
- When standing up from the lying position, turn on your side, draw up both knees and swing your legs on the side of the bed. Sit up by pushing yourself up with your hands. Avoid bending forward at your waist.

The above advice will benefit a majority of people with back pain. If any of the above guidelines causes an increase of pain or spreading of pain to the legs, do not continue the activity and seek the advice of a physician or physical therapist.

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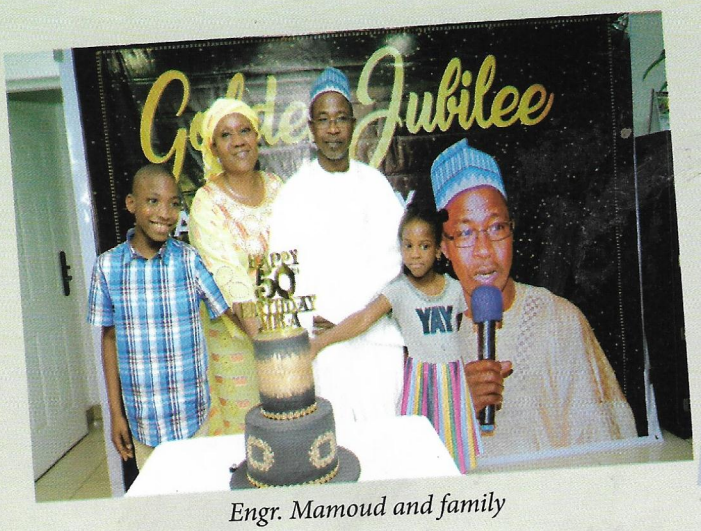
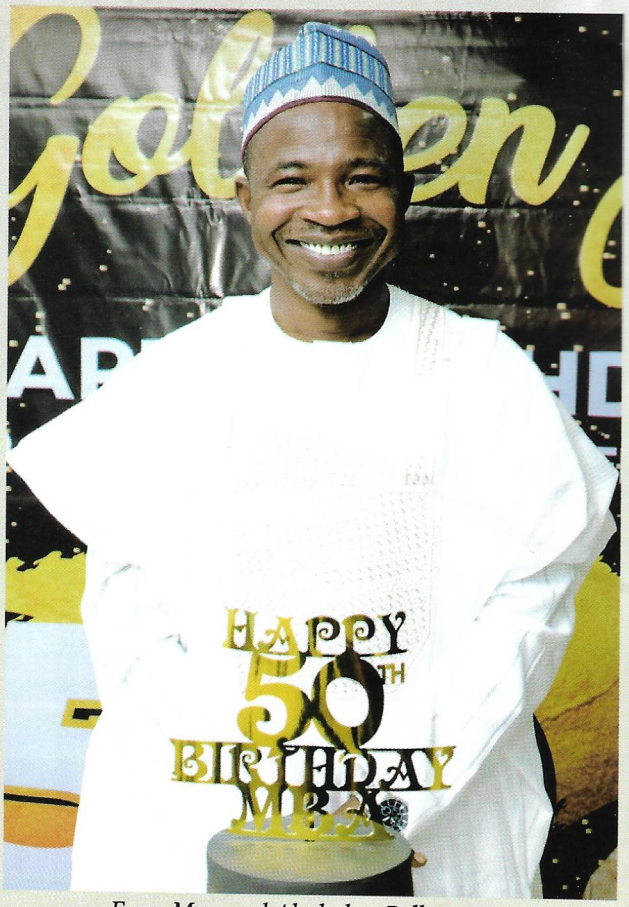


Engr. Mamoud and family

Engr. Mamoud and immediate Past President, NSChE

Engr. Mamoud conversing with NP NSChE TWO

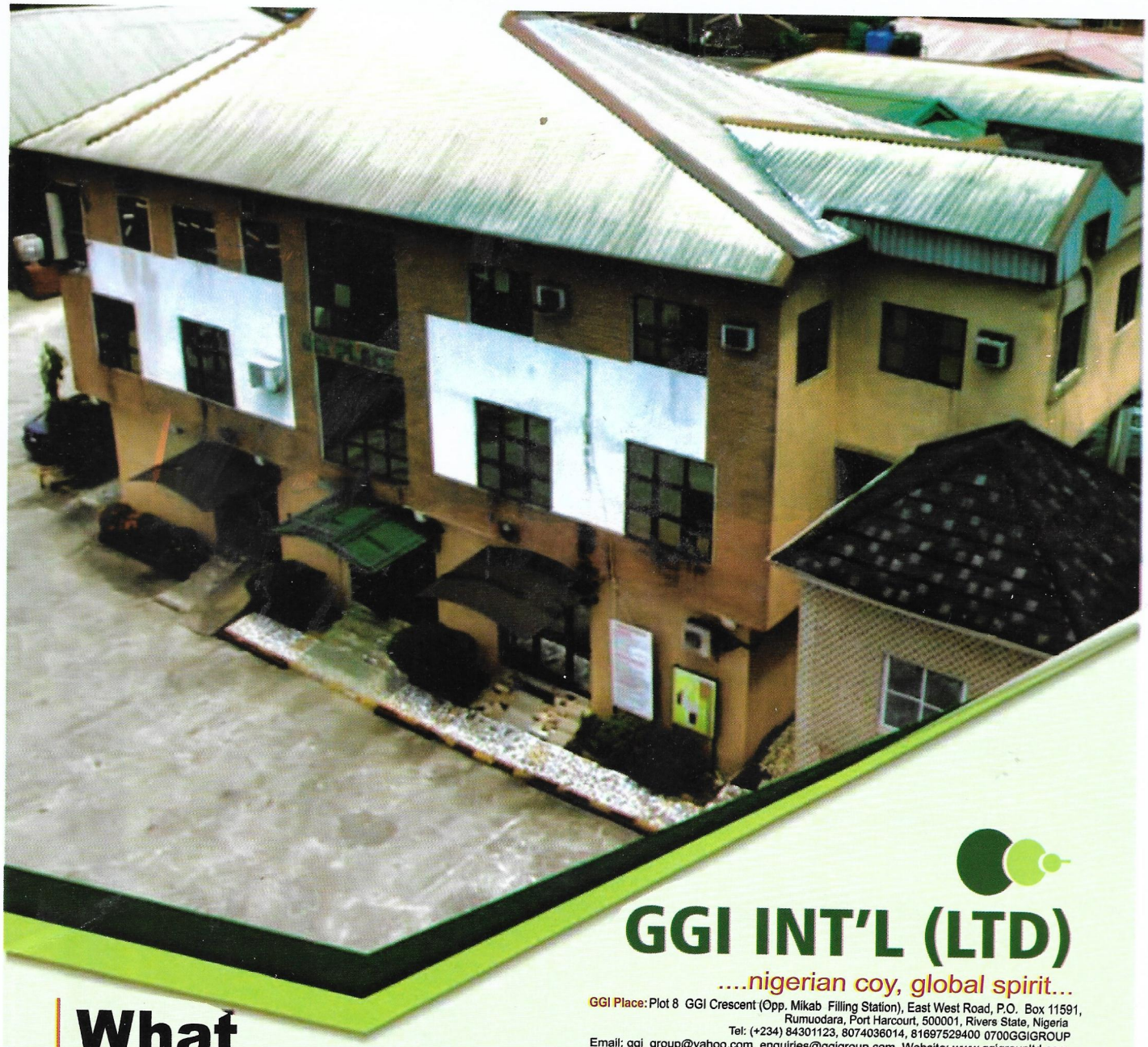
Engr. Mamoud



Engr. Mamoud Abubakar Bello

Engr. Mamoud with Chemical Engineers

Engr. Mamoud and staff of EEMS with IPP



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