UNIVERSITY OF PORT HARCOURT

"THE TALE OF THE UNSEEN WORKFORCE IN THE JOURNEY TO SUSTAINABLE ENVIRONMENT"

An Inaugural Lecture

By

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ORDER OF PROCEEDINGS

2.45 pm. Guests are seated

3.00pm. Academic Procession begins

The Procession shall enter the CBN Centre of Excellence auditorium, University Park, and the Congregation shall stand as the Procession enters the hall in the following order:

Academic Officer
Professors
Deans of Faculties/School
Dean, School of Graduate Studies
Provost, College of Health Sciences
Lecturer
University Librarian
Registrar
Deputy Vice Chancellor Research and Development
Deputy Vice Chancellor Academic
Deputy Vice Chancellor Administration
Vice Chancellor

After the Vice Chancellor has ascended the dais, the Congregation shall remain standing for the University of Port Harcourt Anthem.

The Congregation shall thereafter resume their seats.

THE VICE CHANCELLOR’S OPENING REMARKS.

The Registrar shall rise, cap, invite the Vice Chancellor to make his opening remarks and introduce the Lecturer.

The Lecturer shall remain standing during the Introduction.

THE INAUGURAL LECTURE

The Lecturer shall step on the rostrum, cap and deliver his Inaugural Lecture. After the lecture, she shall step towards the Vice Chancellor, cap and deliver a copy of the Inaugural Lecture to the Vice Chancellor and resume her seat. The Vice Chancellor shall present the document to the Registrar.

CLOSING

The Registrar shall rise, cap and invite the Vice Chancellor to make his Closing Remarks.

The Vice Chancellor's Closing Remarks.

The Vice Chancellor shall then rise, cap and make his Closing Remarks. The Congregation shall rise for the University of Port Harcourt Anthem and remain standing as the Academic [Honour] Procession retreats in the following order:

Vice Chancellor
Deputy Vice Chancellor Administration
Deputy Vice Chancellor Academic
Deputy Vice Chancellor Research and Development
Registrar
University Librarian
Lecturer
Provost, College of Health Sciences
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- Distinguished Ladies and Gentlemen.

DEDICATION

This inaugural lecture is dedicated to God Almighty for His great grace and unfathomable depth of love. I also dedicate the lecture to my loving and very supportive husband, Dr. Blaise Ositadinma Chikere, my adorable children Hilary, Audrey, Pearl, and Fitzblaise. Lastly to my parents, I dedicate this to you both for raising a legendary and global icon in me.

ACKNOWLEDGEMENTS

To God the Creator and Enabler of talents, you are the source of all wisdom and strength, I bow in total reverence. Your guidance and grace have illuminated my path, sustaining me through the darkest nights and guiding me towards the brightest dawns. Your infinite wisdom is the wellspring of inspiration that has made this journey possible. I offer my heartfelt and deepest gratitude to God Almighty, to Him do I owe it all.

I would also like to thank the 9th Vice-Chancellor of the University of Port Harcourt, Professor Owunari Abraham Georgewill for granting me the approval to present this inaugural lecture to you all. You have shown great support to the advancement of science in this great citadel of academic excellence and learning as a legendary and visionary Pan-African leader!

I cannot forget to mention all my lecturers, supervisors, colleagues and mentors who have in one way or the other contributed immensely to all the recorded successes. Worthy of mention are Prof. G.C. Okpokwasili (my PhD Supervisor-who discovered the genius in me as a budding scientist and nurtured me to greatness), Prof. Thomas Eugene Cloete (my PhD supervisor at the University of Pretoria, South Africa), Prof. N. N. Odu (Deputy Governor, Rivers State, Nigeria), Association of African Universities (AAU) Secretary General, Prof. Olusola B. Oyewole, Sir Engr. Dr. Clifford & Lady Margaret Iroanya and children, Prof. Henry Njoku, Prof. O.

Akaranta, Prof. Beatrice Opeolu (Global President, Society for Environmental Toxicology and Chemistry – SETAC World Council), SETAC teammates, my organizing committee, Dr. C.P. Okafor, Dr. C.C. Obieze, Dr. I. Ahaotu, Dr. Frank Orji, Prof. Memory Tekere (my line manager at the University of South Africa-UNISA, as an academic associate), Prof. Eunice Nwachukwu (diamond mom), Prof. Stella Ibe, Prof. Iyeopu M. Siminialayi (DVC R & D) and the EU-sponsored Erasmus+ AMIGO international credit mobility (ICM) consortium coordinators Profs. Manuela Morais (University of Évora) and Ana Ribeiro (University of Lisbon) in Portugal. To you all I give my heart-felt indebtedness.

My funders who gave me the grants, fellowships and support to establish an enviable and impactful research trajectory are well appreciated and they are Organization for Women in Science for the Developing World (OWSD), Trieste Italy; The World Academy of Sciences (TWAS); International Foundation for Science (IFS) Sweden; The Elsevier Foundation in the Netherlands; HERS-SA; Society of Environmental Toxicology and Chemistry (SETAC), Mothers in Science (MiS-France), International Society for Microbial Ecology (ISME – the Netherlands) and Applied Microbiology International (AMI) in the UK.

I appreciate all my past and present undergraduate, Master's and Doctoral supervisees. You all contributed to the advancement of my career and professional trajectories in tremendous ways.

Finally, I am grateful to my family, my husband who has been with me throughout this journey in thick and thin, providing me with all the support to carry on. To my four adorable and lovely children, I am exceedingly glad to see your growth along with mine as it was no easy feat being a full-time researcher and an intentional mom/parent. I toast to our collective success this day. I will ever remember the invaluable support and contributions of my parents and my only sibling, Barrister Enyinnaya Emmanuel Azubuine in all and this work is dedicated to my nuclear family for without them after God, I do not believe I would have been able to come this far in my academic expedition.

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PREAMBLE

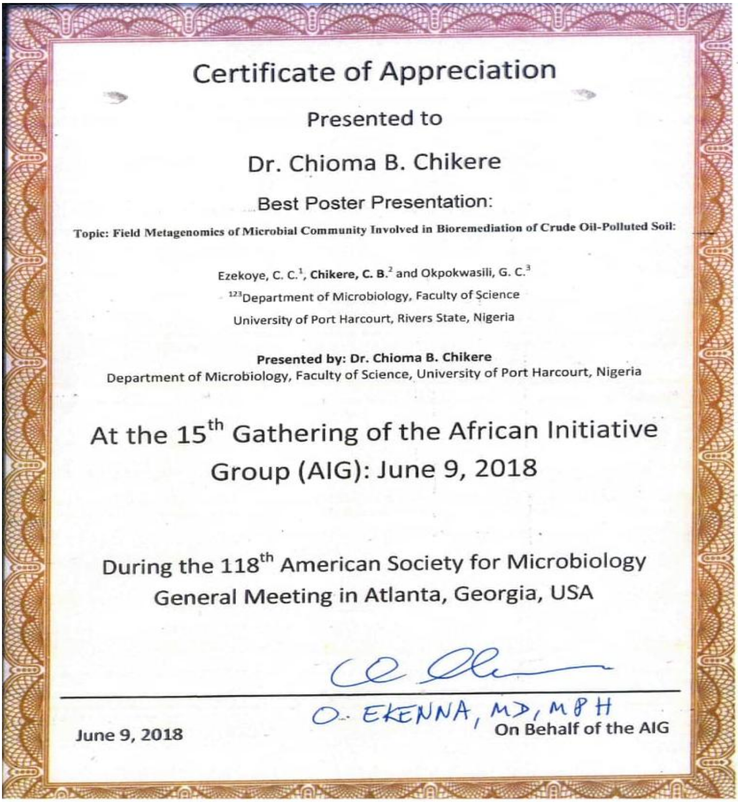
Being a career mom can be likened to sustainability…

In the same way a mother strives to ensure her family is well covered, nurtured and protected, so also scientists especially those of African origin want to engender, through research and innovation, a new Africa, as affirmed by our Heads of State under the African Union aegis through this blueprint and Pan-African Vision of "***An integrated, prosperous and peaceful Africa, driven by its own citizens, representing a dynamic force in the international*** **arena"**. This framework called "Agenda 2063" is the tangible demonstration and roadmap of how Africa, as a continent intends to achieve this huge vision within a 50-year period from 2013 to 2063. It is the master plan meant to guide the member states through a transformational journey that will birth an Africa that has global impact with local relevance made possible by her own citizens and rich resources, this is summed up in this slogan "The Africa We Want" (AU, 2023).

The United Nations Sustainable Development Goals (UN SDGs) on the other hand encapsulate the shared blueprint of all nations of the world both developed and developing to intentionally commit to actions that will ensure peace and prosperity for people and the planet both now and in the future (United Nations, 2023). There are 17 actionable models called the "17 SDGs" that provide the guidelines on how all the nations of the world in mutual partnerships will foster peaceful and sustainable co-existence between man and his environment especially in this era of unstable climate-driven global challenges. It is in the lines of these keystone continental and global mandates that I have built my research focus in my 18 years+ of working in higher education space as a lecturer, researcher and scientist, in order to contribute purposefully to a safer and more resilient planet for all to thrive and live in happily from my microbiological investigations and expeditions of the unseen workforce in the microbial world as an indefatigable environmentalist.

Balancing family-work-career-life-professional demands as a mother in science in pursuit of environmental wholeness

It is worthy of note to state that for me to push the frontiers of science, research, innovation and higher education leadership as an African woman, wife, mother of 4 adorable children and a professor with leadership positions both within the university and externally, I took certain bizarre risks to advance in my career and professional spaces while researching on microbial benefits in environmental sustainability. Some of which were conducting my research while heavily pregnant and travelling with suckling infants globally to present my research findings at conferences in-country and internationally. An unusual career step I took was in 2018, when I attended and presented my poster at the 118th American Society of Microbiology (ASM Microbe) conference in Atlanta Georgia, USA with my 7 weeks old baby being my 4th caesarean birth and won best poster award at the ASM-African Initiative group (AIG) competition.


Certificate of Appreciation

Presented to

Dr. Chioma B. Chikere

Best Poster Presentation:

Topic: Field Metagenomics of Microbial Community Involved in Bioremediation of Crude Oil-Polluted Soil:

Ezekoye, C. C.[1], **Chikere, C. B.**[2] and Okpokwasili, G. C.[3]

[123]Department of Microbiology, Faculty of Science

University of Port Harcourt, Rivers State, Nigeria

Presented by: Dr. Chioma B. Chikere

Department of Microbiology, Faculty of Science, University of Port Harcourt, Nigeria

At the 15th Gathering of the African Initiative Group (AIG): June 9, 2018

During the 118th American Society for Microbiology General Meeting in Atlanta, Georgia, USA

O. EKENNA, MD, MPH

On Behalf of the AIG

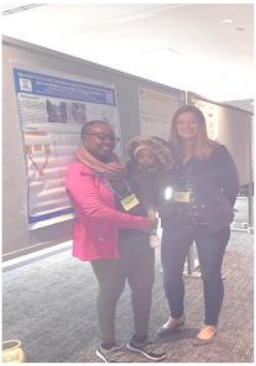
June 9, 2018

The title of my poster caught global attention having showcased the voracity of indigenous microbes in field-scale bioremediation of crude oil-polluted soil which led to my getting the best poster award. Earlier, I had also attended ASM Microbe conference and a bioinformatics workshop in Denver Colorado, USA in May 2013 with 5 months pregnancy of my 3rd child. The insights from this workshop enriched my toolbox with the requisite skills needed for the robust understanding and interpretation of the unseen microbial world encountered during the award-wining field-scale bioremediation project.

I share very beneficial resources such as information on conference calls, scholarships, internships, research opportunities and global events in higher education space. The outcomes of these life-transforming sessions have been mind-blowing and jaw-dropping as my mentees are all advancing in leaps and bounds after encountering my resources and achievements. There is a popular saying that a picture tells a thousand stories and, in this line, those surreal moments of trepidation, uncertainties, hope, diligence and resilience in the face of intense vulnerability while delivering on my tasks and targets as a mother in science, environmental microbiologist, university lecturer and researcher are presented in the photos below:


MONTREAL, CANADA, MARCH 2019


Awards and Membership
Registration and Membership
SETAC North America
40th Annual Meeting
TORONTO, CANADA NOV., 2019

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At the Association of African Universities, we build quality #highereducation for developing Africa's human capital to positively respond to the global challenges of the 21st century. Hear from a Beneficiary below - Dr. Chioma Blaise Chikere. We will be glad to have you also join us during the AAU General Conference on July 5 - 8
Link: ac.aau.org
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Association of African Universities gives academics in African Universities opportunities to acquire beneficial skills to enhance their careers as Lecturers at very discounted rates.
I attended this online course organized by AAU and this has greatly improved my delivery as a Researcher and Lecturer. Kindly follow the AAU LinkedIn page to get more information.
Chioma Blaise Chikere PhD
Senior Lecturer
University of Port Harcourt, Nigeria
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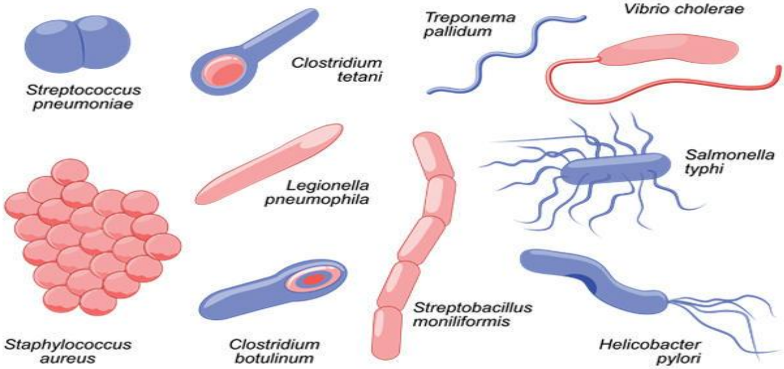
A voice for Africa at Canadian Microbiome conference
Published: 24 May 2019
Last reviewed: 03 Jul 2021
President's fund
Dr Chioma Blaise Chikere was awarded the SfAM President's Fund Grant earlier this year. Find out how this has furthered her career.

1.0. Introduction

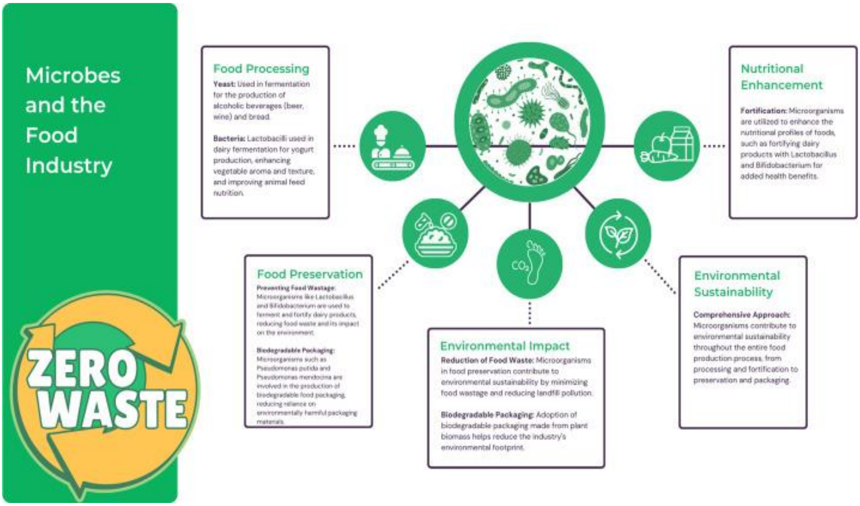
Microbiology as a discipline

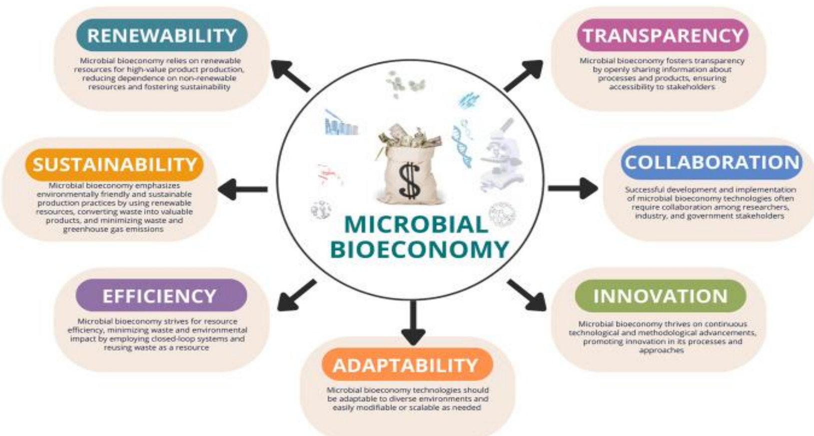


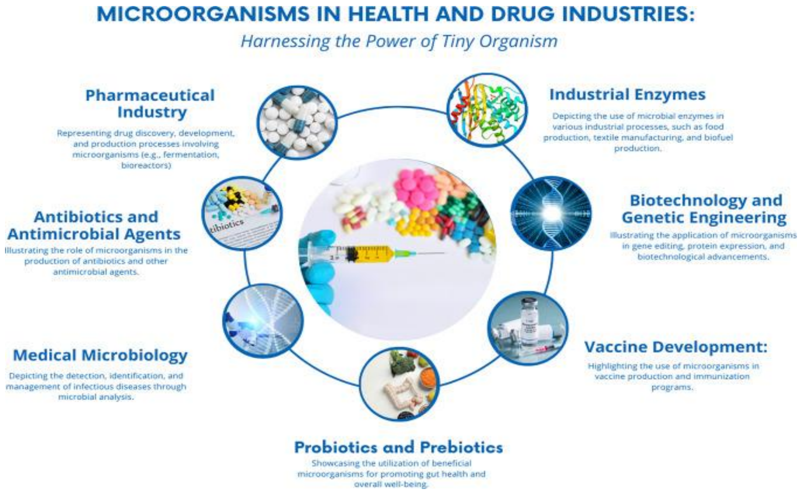
(Graphics from Microbiology Society: https://microbiologysociety.org/whymicrobiologymatters/whatis-microbiology/bacteria.html)

The study of invisible organisms that can only be visualized using a specialized equipment called a microscope is microbiology. The microscope has the power to magnify these tiny creatures over thousands of times to make them visible to the unaided eyes. Microbes can be friends or foes to man and his environment depending on the type of relationships that connect them. For instance, when microbes aid in the removal of hazardous contaminants from the environment such as toxic chemicals/substances, production of food and allied products, nature-based agrofertilizers as biostimulants and plant growth promoters, combating disease conditions in the form of stabilizers in the guts to treat food allergies and intolerance, they are seen as our friends in these instances because they play very beneficial roles to promote wholesome wellbeing and environmental sustainability but on the other hand, when they cause diseases and infections with grave fatalities, destroy the aesthetics of the built environments, spoil food leading to food poisoning, cause huge economic losses to farm produce during cropping and storage seasons, are deployed as bioterrorists in biological warfare to attack humans and animals, destroy crude oil pipelines and oil installations due to biocorrosion and biodeterioration, their activities become huge problems that will definitely lead to devastating and negative consequences.

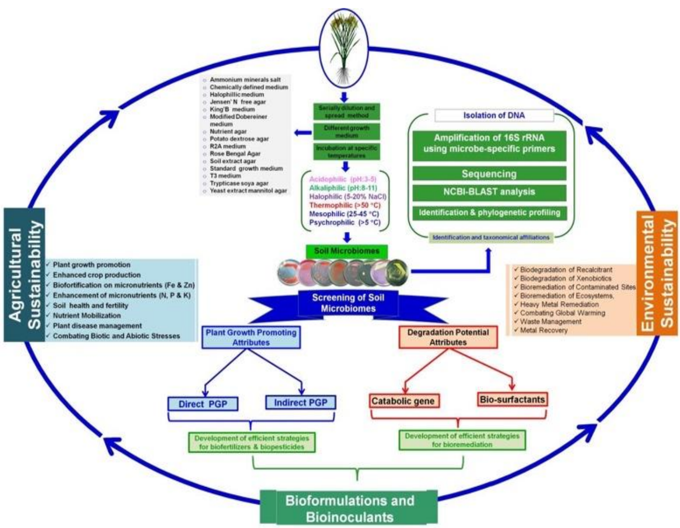
The study of microorganisms encompasses different areas of the discipline such as Environmental Microbiology (this focuses on the activities of microbes as they pertain to ecosystem functions such as nutrient cycling, breakdown of substances, waste treatment, resource management, pollution abatement, climate action), Food/Industrial Microbiology (relates to the application of microbes or their products in food processing/preservation, fermentation and production), Clinical/Medical Microbiology (this area focuses on the roles pathogenic microbes play in disease causation, health issues, the diagnoses and treatments of ailments of microbial origin based on the host's responses to microbial invasion). Microbes are very pivotal to achieving sustainability according to the UN SDGs framework as shown below.







The roles of microbes in achieving the UN SDGs (Graphics from Akinsemolu, 2018)



Microbes and their interlinked roles in environmental and agricultural sustainability (Graphics from Yadav *et al.*, 2022)

Unseen yet powerful- the microbial workforce

Because microorganisms or microbes cannot be seen with the naked eyes, it is not out of place to call them the "Unseen Workforce" having enumerated several roles both beneficial and harmful, that they play as planetary inhabitants. Man and his environment have been co-existing harmoniously until when industrialization and technological advancement became integral parts of development in order to enhance life and living with increasing human population and urbanization. Based on man's insatiable quest for improved quality of life, economic growth, process enhancement, trans-border corporations and exploitation of his natural environment, human activities began to unleash very unsavory environmental impacts on the fragile planet leaving behind woes and pains of degradation, climate problems and introduction of toxic substances that are harmful to microbes, man and every other living organism.

1.1. Microbes and Sustainable Environment

Despite the negative environmental footprints of human activities, microbes have evolved into powerful foot soldiers that attack and remove toxic substances from the different parts of the environment such as water, soil, air and sediment while feeding on them and transforming these offensive substances into end-products that are harmless such as smaller nutrients suitable for plant growth, water and carbon dioxide. To maintain this balance in resource consumption and replenishment for planetary sustenance, the concept of a "sustainable environment" becomes a go-to tool that will ensure the planet is not obliterated due to incessant negative impact of human activities on it. **One would then ask, what is a "sustainable environment"**? A sustainable environment is one in which there is a consistent, responsible and intentional use of natural resources in such a way that they are conserved and preserved for the wellbeing of the current and future generations without compromise. Without this consciousness, our world will tip over and all life forms will gradually go into extinction. This is very important because the Earth is a finite entity, with limited natural resources – land, forests, water, wildlife and their associated microbial allies that will definitely deplete with time if over-exploitation is not decisively checked. Therefore, sustainable resource consumption and management are the only purposeful ways to make sure life continues to exist on the planet even when we are long gone.

In the journey to sustainable environment especially from the pollution abatement standpoint, microbes have become a formidable unseen workforce that can combat, attack, transform, remove, break down and attenuate toxic substances from impacted sites thereby saving man and his environment from further destruction and possible extermination.

Environmental Sustainability

In recent years, the concept of environmental sustainability has become a priority (United Nations, 2015). Environmental sustainability encompasses the delicate balance between the overall wellbeing of the human race and our use of the available natural resources. This balance is crucial to the survival of the planet earth and the future generations of the human race. However, the previous abuse of mother earth without recourse to its degradation has given rise to the dire consequences which the earth currently faces. This neglect of the environmental effect of human actions over the years gave rise to a plethora of problems experienced in recent times like the climate change issues and global warming at an alarming rate of 0.15^{o}C to 0.2^{o}C every decade since 1975 (Hansen *et al*., 2020), desertification, acidification of oceans, plastic pollution, and other environmental issues which are the basis for world's hunger and wars.

The United Nations Sustainable Development Goals (UN SDGs) as well as the African Union Agenda 2063 are the major frameworks designed to combat the decline of the planet. Microorganisms are critical for the realization of a number of these goals. The UN SDGs (Plate 1) such as 6, Clean Water and Sanitation; 7, Affordable and Clean Energy; 11, Sustainable Cities and Communities; 12, Responsible Consumption and Production; 13, Climate Action; 14, Life Below Water and 15, Life on Land– can all be handled with microbial inclusion (*Transforming Our World: The 2030 Agenda for Sustainable Development | Department of Economic and Social Affairs*, n.d.). These microorganisms can work synergistically or neutrally, at times even antagonistically together. Gaining insight into their interactions and effectiveness in handling our environmental issues in the planet is key to collating efforts on the sustainability frontier (Chikere *et al*., 2011).

Plate 1: The 17 sustainable development goals as stated by the United Nations. Microorganisms are one hidden key to the successful achievement of a number of these goals, most especially 6, 7, 11, 12, 13, 14 and 15.

2.0. The UN SDGs and Microbial Involvement

The ubiquitous nature of microorganisms could be harnessed for positive outcomes. These microorganisms play crucial ecological roles, hence are important to the overall balance of the environment which include decomposition, production of oxygen, nutrient cycling, carbon dioxide removal, pests and pathogens removal/suppression, improvement of soil structure/soil aggregation and water cycling among others. These microbial abilities have clear applications that can be maximized and further researched for greater use in the achievement of the UN Sustainable Development Goals.

Below in Plate 2 are the various ways microorganisms play vital roles in ensuring environmental sustainability for man and the planet.

2.1. Clean Water and Sanitation

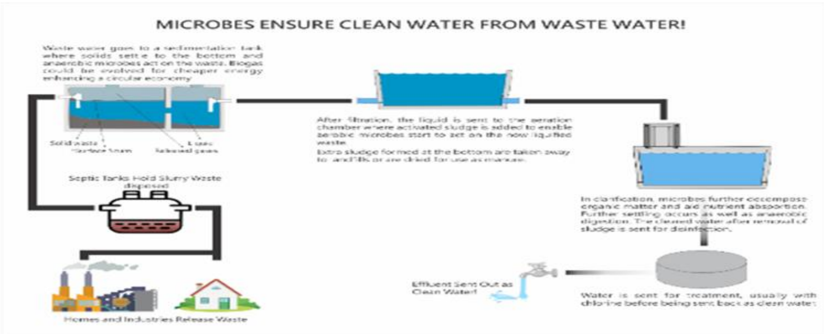


Plate 2: Microorganisms in wastewater treatment elaborated from production of effluent to the production of treated ready-to-use water.

Microorganisms are very efficient in the cleaning of waste bodies of water and can be used to improve inland water and oceans. Their ability to degrade pollutants and other debris in water bodies contributes to the availability of sustainable water treatment through means such as anaerobic digestion (Parkin & Owen, 1986) which can be looked into when contributing to cleaner fuel production and waste management, and activated sludge processes which reduce water contaminants in the digestion of municipal sludges (Parkin & Owen, 1986), as part of the treatment process.

2.2. Life on Land (and under Water)

Land and water are the two vastest habitats that are host to microenvironments as opposed to the air, which does not readily provide microorganisms with their needs for survival. Land and water cycles can benefit greatly from the fixating abilities of the unseen workforce, microbes. They efficiently make use of organic matter that would otherwise constitute waste. Their decomposition of organic matter, plastics, and other wastes has helped to make soil more fertile and they have degraded wastes that would last longer in the environment than what should be acceptable sustainably. The activities of soil species promote bioavailability and improvement of soil quality (Rashid *et al.*, 2016). The root nodules of legume plants, such as soybeans and clover, are home to microorganisms that fix nitrogen meant for enhanced plant growth. These microorganisms modify air nitrogen so that it may be usable by plants, highlighting the numerous benefits from the activities of the unseen workforce even to crops that provide food on our tables. Going by this wonderful phenomenon, farmers may lessen their reliance on man-made nitrogen fertilizers, which can result in water pollution and greenhouse gas emissions, by growing legumes alongside other crops (Bhattacharjee *et al.*, 2008).

Microorganisms contribute to the production of water-stable aggregates, which have an impact on the physical characteristics of soil. The breakdown of organic wastes in the soil is necessary for the beneficial action of microorganisms. When soil particles interact chemically and physically with chemicals produced by organisms and by-products of decomposition throughout the decomposition process, aggregate stability may be increased (Martin *et al.*, 1955). The ability of microorganisms to aggregate soil and profile it after adding to the nutrient content via decomposition of materials present is useful in soil regeneration. Filamentous bacteria compact clay particle with their branch-like protrusions called hyphae while others may secrete exopolysaccharides – a substance that aids aggregation of soil (Gupta, Gupta, Singh, *et al.*, 2017). Procaryotes (mostly eubacteria and archaeabacteria) and some eucaryotes (Plate 3) have been found to synergistically partner in natural roles that aid in environmental wholesomeness.

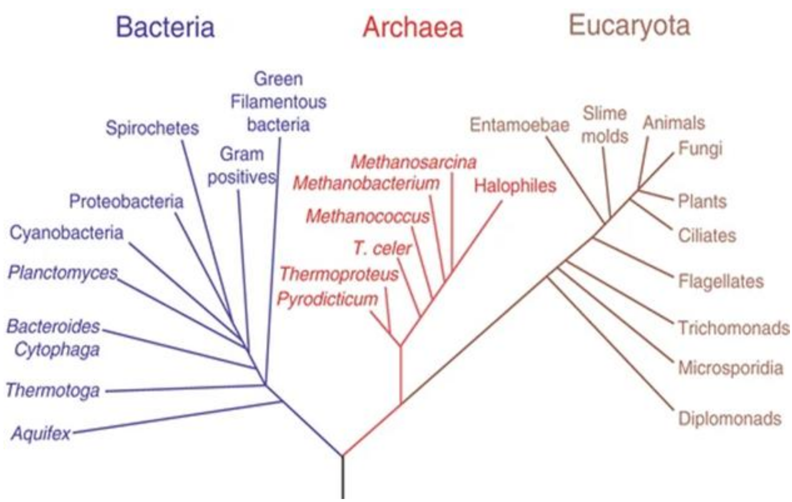


Plate 3: An illustration for the classification of all living things obtained by ribosomal ribonucleic acid (rRNA) gene sequencing.

Biogeochemical cycles, which involve movement and transformation of natural compounds and chemical elements among living organisms, the atmosphere and earth's crust from complex to simple forms, benefit from and depend on the activities of the unseen workforce, the microbes (Plate 4) to run more efficiently. Humans can harness these essential microbial functions in nutrient recycling for improved soil conditions across the globe whilst promoting food availability and environmental sustainability.

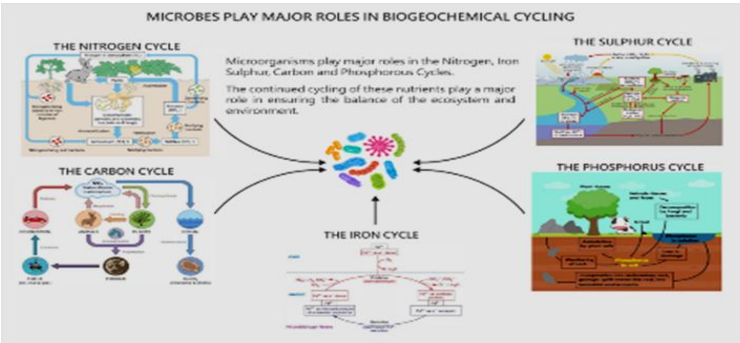


Plate 4: Various biogeochemical cycles illustrating the profound roles microorganisms play in nutrient cycling.

2.3. Climate Action

Climate change is an increasing threat to all life on earth and is one of the points included in attaining a sustainable environment. Environmental states such as drought, warming and rising oceans, storms, loss of species and forest fires can change much of the ecosystem negatively. The ubiquitous nature of microorganisms promotes them as ideal partners in bringing about a balancing effect on climate with proper understanding of their overall effect on the environment as well as their interactions with each other.

Biogeochemical processes involve the activities of microorganisms and could have a role in regulating these cycles (*Understanding Soil Microorganisms and Nutrient Recycling Ohioline*, n.d.). Coincidentally, microorganisms produce greenhouse gasses and consume them simultaneously, for instance methane-oxidizing bacteria (MOB) in methane sequestration in wetlands (Ho *et al*., 2016). Strategic use of microbial species that consume or modify greenhouse gasses can help ameliorate climate crisis and environmental decline. The entire nutrient cycling processes for oxygen, carbon and nitrogen by microorganisms can be taken as their greatest impact as these nutrients' availability affect all biotic life forms on the planet (Gupta, Gupta, Singh, *et al.*, 2017).

Biogeochemical processes for carbon (methanotrophy and methanogenesis-for methane consumption and production); Nitrogen (fixation and respiration), Sulphur (disproportionation and reduction), weathering, decomposition and mineralization are driven by these microscopic organisms and hence are very essential in environmental sustainability/ecosystem balance (Hutchins*et al.*, 2009; Martínez-Espinosa, 2020).

3.0. Microbes in the clean-up of industrial pollutants-Bioremediation

Microorganisms can be effectively used in bioremediation and soil regeneration. Bioremediation refers to the natural process that relies on living things (microorganisms, mushrooms and/or plants) and/or their derivatives (enzymes or biomass) to degrade, eliminate, immobilize, detoxify or alter environmental contaminants in soil, water and other environments (Chikere *et al*., 2011). It has been proven to be effective in the clean-up of oil spills and can be done at the site of the pollution (*in situ*) or away from the site (*ex situ*). Bioremediation simply put is any method employed to mitigate or eliminate the adverse effects of pollutants on the environment (Gogoi *et al.*, 2003). Bioremediation aims to speed up the removal of contaminants from the environment using changes in the natural conditions and the indigenous microorganisms. It can be categorized as either natural attenuation (also called bioattenuation), biostimulation or bioaugmentation as shown schematically in plate 5.

Bioremediation could be in the form of natural attenuation or intrinsic bioremediation where the native unseen workforce detoxifies the pollutant without external input. This method is mostly affected by the quality or concentration of the contaminant and polluted site(s). **Biostimulation** on the other hand, is also a form bioremediation where the indigenous microbes are enhanced either through the addition of nutrients or by improving the environmental conditions of the polluted site, thereby activating the microbial de-contamination process. **Bioaugmentation** is another form of bioremediation which involves the addition of viable microbes and/or their products to the affected area. It increases the population of pollutant-scavenging microorganisms by introducing specific microbial cultures cultivated separately under controlled conditions (Xu & Lu, 2010). This extensive bioremediation affects microbial processes and the conditions in which they thrive to hasten biodegradation. Oil-eating species can consume oil spills, thus reducing the damage in such areas. Microorganisms have been used to clean up contaminated soils in recent times. Some strains of bacteria, like *Pseudomonas* and *Rhodococcus*, are capable of breaking down hazardous hydrocarbon compounds like polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) (Shuai *et al.*, 2010). A schematic of the bioremediation techniques that are used in ecosystem restoration are presented in Plate 5.

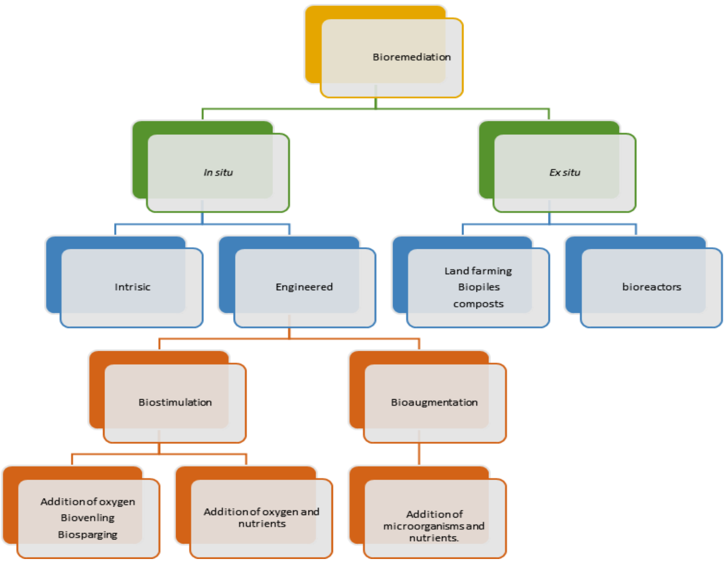
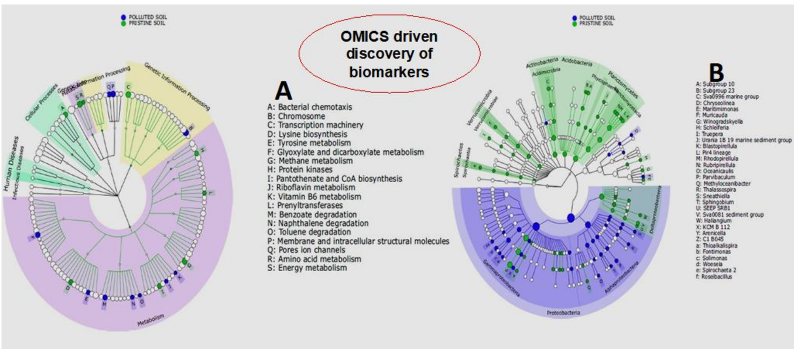


Plate 5. Bioremediation strategies

4.0. My Jurisdiction in Environmental Bioremediation

In my research group, we have developed various methods to aid the effectiveness of microorganisms in their bioremediation capabilities. Research aimed at producing a slow-release fertilizer (SRF) granting sustained source of nutrients to microorganisms degrading pollutants in the soil was conducted by Ehis-Eriakha *et al*., (2020; 2021), a former PhD supervisee and we discovered that the nature-based nutrients enhanced microbial proliferation in polluted ecosystems while encouraging removal of the contaminants. This is a sustainable method as it prevents hazards in usual fertilizer delivery such as eutrophication along with the use of organic sources for delivery material making it a method with reduced harmful blowback to the environment. We have even researched into the application of remediation aids such as oil-mixing agents (biosurfactants), starting with a review of its pros over synthetic biosurfactants use in environment remediation (Fenibo *et al*., 2019); followed by experimental investigations to buttress these findings (Nwaguma *et al*., 2019; Aruotu *et al*., 2023;). Another research on biosurfactant production by Nwaguma and me isolated and characterized *Klebsiella pneumoniae* strain IVN51 phenotypically and by molecular techniques (Nwaguma *et al*., 2016). The produced biosurfactants were found to have emulsifying effects on hydrocarbon products petrol, kerosene, xylene, toluene, and diesel. The produced emulsifier was a phospholipid with a 60% emulsification index – which was considered useful for enhanced bioremediation of polluted sites.

My research laboratory as a part of the effort in advancing studies employing the use of these tiny oil-eating machinery produced research that functionally profiled microorganisms in an oil-polluted site in Ogoniland, as described by Chikere *et al*. (2019), using molecular biology analysis. By studying the metabolic traits through next generation sequencing and bioinformatics as shown below, we identified keystone microorganisms involved in hydrocarbon degradation and further established that the presence of crude oil hydrocarbons reduced microbial diversity and at the same time selected specific microbial groups tailored to hydrocarbon utilization which we proved to be a global trend when our datasets were compared with publicly available data from other geographical locations worldwide (this is the beauty of open science, open data, open research and open access). More interestingly was the discovery of the acid-tolerant nature of the microorganisms in that area which can be useful for bioremediation in Ogoniland, Rivers State, an area with predominantly acidic soil.



Detection of biomarkers in oil-contaminated soils. **A.** Detection of signature metabolic pathways in oil-polluted soils **B.** Biomarker taxa's importance in tracking hydrocarbon pollution.
Source: **Chikere, C B.,** Obieze, C. C., Mordi, I. J., Chikere, B. O., Selvarajan, R. and Ashafa, T. O. (**2019**). Comparative metagenomics and functional profiling of crude oil polluted soils in Bodo West Community, Ogoni, with other sites of varying pollution history. ***Annals of Microbiology***. 69(5): 495-513. https://doi.org/10.1007/s13213-019-1438-3

However, depending on what is available, is not always the most efficient method for pollution abatement. Strengthening of methods to ensure microbial presence is needed. This can be achieved with further research and a continual attempt to stay up-to-update with the latest trends in unravelling the intricate functions of the unseen workforce within polluted ecosystems.

4.1. Linking the United Nations Sustainable Development Goals (UN SDGs) and Africa Union (AU) Agenda 2063 through research of the unseen workforce – My contributions to R & D

Our goal is to use our research outputs as veritable tools for the advancement and actualization of both the UN SDGs (Goals 1 (No poverty), 2 (Zero Hunger), 3 (Good health and Wellbeing), 4 (Quality Education), 13 (Climate action), 15 (Life on Land), 16 (Responsible consumption) and 17 (Partnership for the goals); and the AU Agenda 2063 (Goals 2: Well-educated citizens and skills revolution underpinned by science, technology and innovation); 5 (Modern agriculture increased productivity and production); 7 (Environmentally sustainable and climate resilient economies and communities); and 18 (Engaged and empowered youth and children). Some interconnections between the UN SDGs and the AU Agenda 2063 are summarized in Table 1.

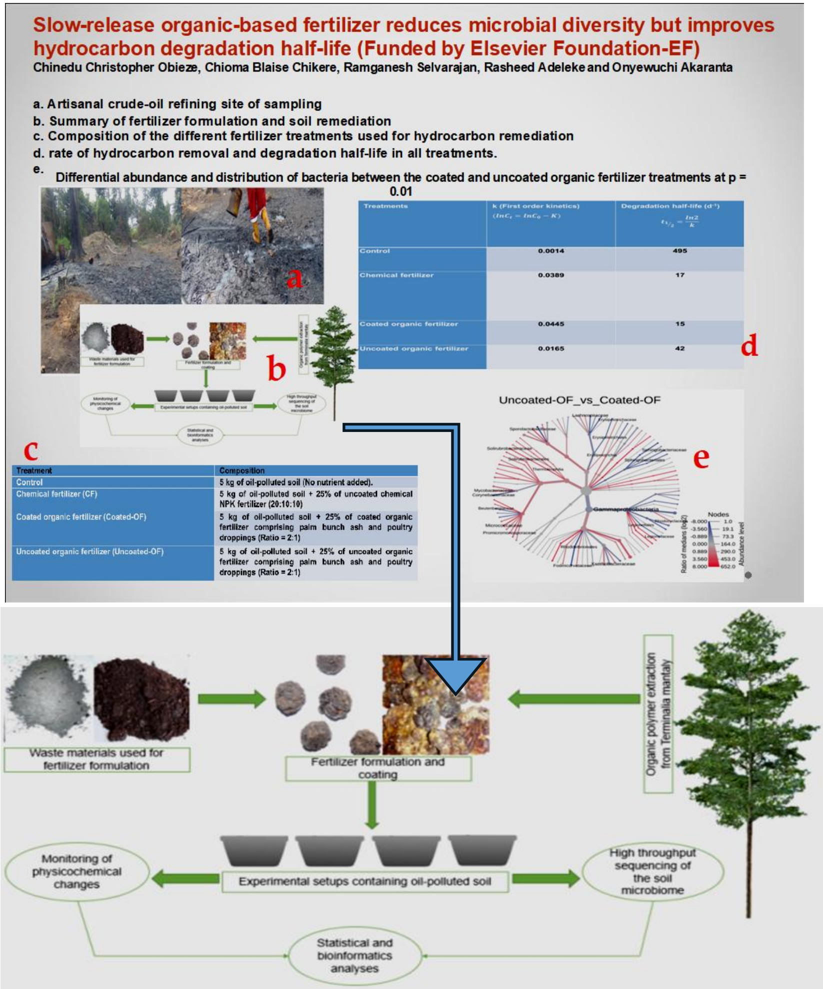
Table 1. Linking AU's Agenda 2063 and the UN SDGs https://au.int/agenda2063/sdgs

S/No.	Agenda 2063 Goals	Agenda 2063 Priority Areas	UN Sustainable Development Goals
1	A high standard of living, quality of life and well-being for all citizens.	Incomes, jobs and decent work Poverty, inequality and hunger Social security and protection, including persons with disabilities Modern, affordable and liveable habitats and quality basic services	1. End poverty in all its forms everywhere in the world 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture. 8. Promote sustained, inclusive and sustainable Economic growth, full and productive employment and decent work for all. 11.Make cities and human settlements inclusive, safe, resilient and sustainable.
2	Well educated citizens and skills revolution underpinned by science, technology and innovation.	•Education and science, technology and innovation (STI) driven skills revolution	4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
3	Healthy and well-nourished citizens.	•Health and nutrition	3. Ensure healthy lives and promote well-being for all at all ages.
4	Transformed economies.	•Sustainable and inclusive economic growth •STI driven manufacturing, industrialization and value addition •Economic diversification and resilience	8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

To this end my research on the unseen workforce has contributed to the sustainable development of our university and the society as follows:

1. Empowerment of students especially the doctoral students who worked on these projects and this has advanced their chosen careers.

2. Production of sustainable nature-based products from locally available materials useful in microbial enhancement and reclamation of hydrocarbon polluted soils, an example is the nature-based fertilizer formulated from organic and inorganic sources (palm bunch ash, gummy plant exudate for nutrient encapsulation, granite dust and poultry droppings) that we deployed during the Elsevier Foundation-funded bioremediation of crude oil polluted farmland in Ngia Ama, Tombia as shown below.

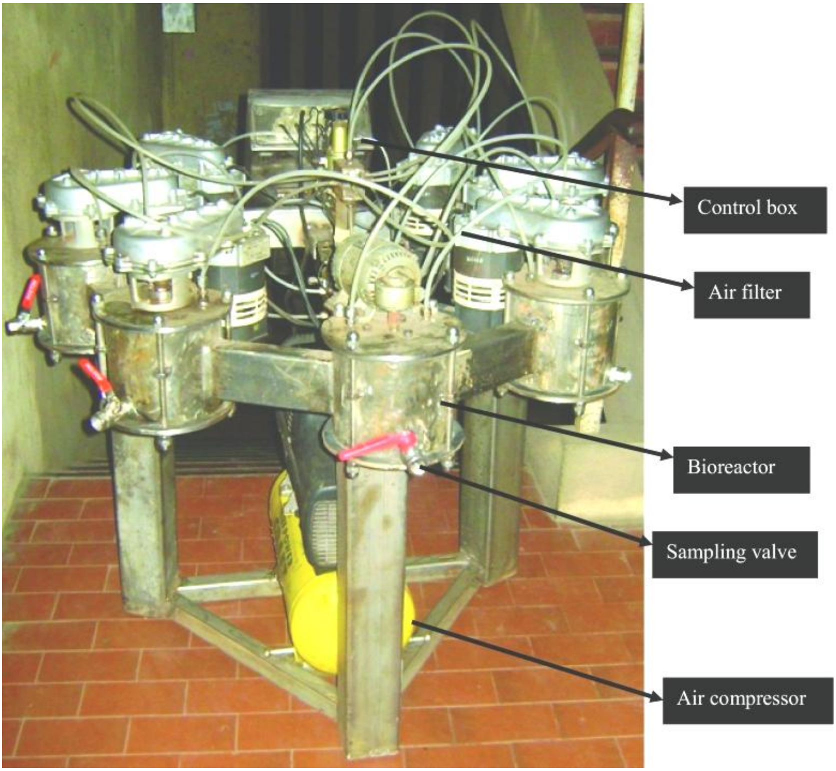


3. Recovery of crude oil hydrocarbon-polluted soils in Ibaa and Ngia-Ama communities in Rivers State and Ikarama community in Bayelsa State Nigeria thereby restoring vibrant biodiversity and ecosystem services to the areas post-remediation.

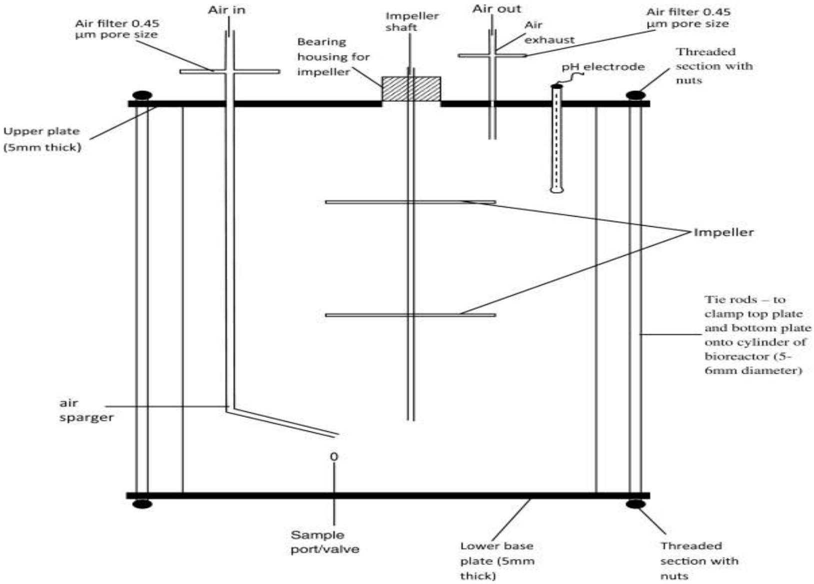
4. Publication of several research articles in Scopus-indexed journals, conference presentations and chaired conference sessions to promote research communication to stakeholders.

My main research interest focuses on bioremediation of crude oil-polluted environment using eco-friendly and nature-based strategies. In my early career years, I won International Foundation for Science (IFS) research grants twice in 2007 and 2012 respectively and these funded my reach team's investigation of the bioremediation of oil-polluted marine sediments from Ogoniland.

The IFS-funded projects helped me to fabricate 7 stainless steel bioreactors used to simulate controlled environment for pollutant degradation and monitoring. Series of undergraduate and postgraduate students from University of Port Harcourt and other universities used both cultivation-dependent and molecular biology methods to monitor the microbial communities actively degrading the crude oil hydrocarbons in the sediments after nutrient addition in the seven 2.5L bioreactors with the interior shown below (Chikere *et al.*, 2012a,b).



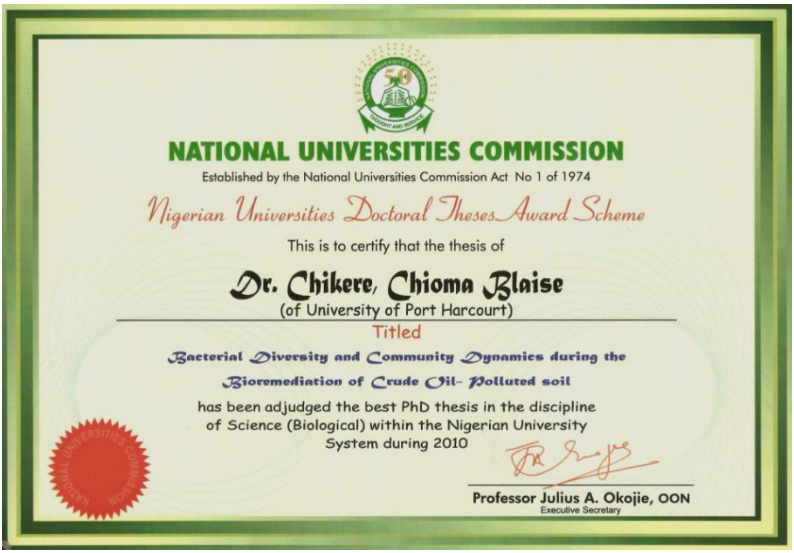
The seven 2.5L bioreactors
Source: (Chikere *et al*., 2012a)



Design of the interior of the 2.5L bioreactors Source: (Chikere *et al*., 2012a).

From all the investigations done using the 7 bioreactors, it was established from the results obtained that the Ogoniland marine sediments harboured petroleum-degrading microbes whose degradation potentials were enhanced after external nutrient addition, a proven and evidenced-based testament of the power of the unseen microbes in the restoration of our natural ecosystems post-pollution.

In the course of time, I have been using molecular and high-end techniques such as next generation sequencing, bioinformatics and chromatographic procedures to evaluate the effect of long-term exposure to petroleum hydrocarbons on soil microorganisms/microbiomes. Our research also focuses one co-restoration of polluted soils to levels within regulatory compliance limits post-bioremediation as enshrined in the standards of Nigerian Upstream Petroleum Regulatory Commission (NUPRC) (Chikere *et al*., 2011; 2012b). Hence, the research curiosity that started during my doctorate degree programme won the prestigious NUC award (certificate is shown below) for the best thesis in Biological Sciences and this formed the background of my research activities post-PhD graduation into the world of the unseen foot soldiers in pollutant removal from the environment.



Over the years, research perspective on the pollution burden in the Niger Delta has evolved. However, each remediation project starts with a laboratory-scale study to determine the presence and diversity of hydrocarbon-degrading microorganisms and their readiness for the field-scale remediation projects. Many of my projects involve detection of hydrocarbon-scavenging genes from the indigenous microorganisms and evidence-based confirmation of microbe-driven pollutant removal at the site of pollution. Several research outputs to this effect are further discussed as follows:

1. Findings reported by Ehis-Eriakha *et al*. (2020) a former PhD student I supervised at the World Bank ACE-CEFOR University of Port Harcourt, demonstrated the abundance of functional genes for hydrocarbon degradation in soil microbiome exposed to aged crude oil.
2. Preliminary study on the impact of crude oil on soil microbial community (Chikere and Fenibo, 2018) established the investigated site's amenability to bioremediation. The study on Ogoniland oil pollution (Chikere *et al*., 2019) highlighted the involvement of uncultivable microorganisms in the bioattenuation of petroleum hydrocarbons in oil-impacted sites in Ogoniland. These two projects produced reliable baseline datasets establishing that the Niger Delta soil ecosystem contains metabolically active, extant indigenous microorganisms with requisite catabolic capabilities to degrade both aliphatic and aromatic hydrocarbons in polluted soils. Other related publications from my research group have confirmed that the soil ecosystem in selected Niger Delta locations have rich microbial diversity requisite for hydrocarbon degradation (Chikere *et al*., 2020, 2011; Chikere and Fenibo, 2018; Okafor *et al*., 2021; Okoye *et al*., 2019, 2024; Okafor *et al*., 2022)
3. Furthermore, my research team and I monitored field-scale bioremediation in different Niger Delta

Communities (Ngia-ama and Ibaa communities, Rivers and Ikarama community, Bayelsa States) where crude oil spill occurred as shown below. The findings successfully established ecosystem recovery using microbial signatures underpinning restoration of biodiversity (Chikere *et al*., 2017; 2019a, b; 2021).

Crude oil polluted land in Ikarama, Bayelsa State, Niger Delta pre-remediation (9 weeks post-pollution in 2018- plates 1&2); Plate 3- site during remediation

Ikarama site post–remediation; 9 weeks after bioremediation commenced (re-vegetation taking place signifying ecosystem and biodiversity restoration- plate 4)

4. Following the site remediation projects, there has been need for application of nature-based amendments as opposed to the chemical additives previously in use. My team and I have formulated different types of nature-based, green organic and inorganic slow-release fertilizers from agricultural and industrial waste materials that contain nitrogen, phosphorus and potassium (NPK) in balanced ratios (Chikere *et al*., 2020) adequate for the supply of essential nutrients to enhance microbial activities needed for biodegradation of petroleum hydrocarbons.

Study by Obieze *et al*. (2020), a PhD student I supervised at the World Bank ACE-CEFOR revealed that field-scale deployment of nature-based formulated fertilizers from organic and inorganic waste materials resulted in increased hydrocarbon degradation, microbial functional activities, existent but unseen, were also more intensified in the nature-based treatment than in chemical fertilizer treatment and control. This project was funded by The Elsevier Foundation (EF) Chemistry for Climate Action Challenge, the 2nd prize given to me in 2017 following the selection of my proposal from nearly 700 applications for this global competition (Plate 6).

Plate 6. The Elsevier Foundation Chemistry for Climate Action Challenge prize given to Chioma Blaise Chikere in 2017.

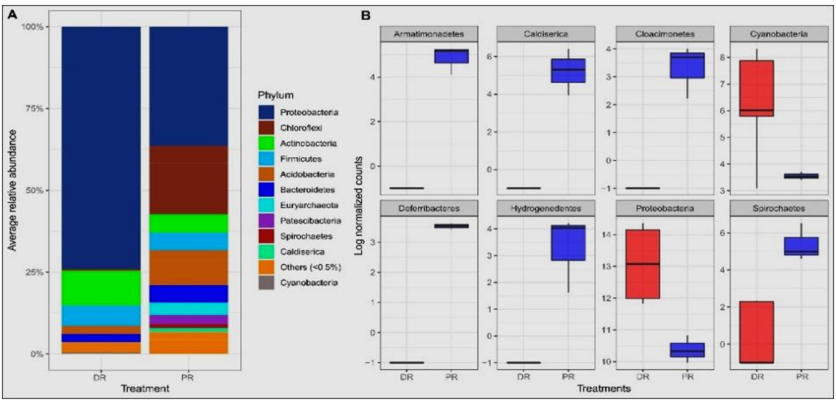
This field-scale bioremediation project focused on the reclamation/recovery/restoration of crude oil-impacted soil ecosystem using nature-based solutions (NbS) such as the voracious petroleum-degrading microorganisms and valorized poultry litter to enhance biodegradation and removal of hydrocarbon pollutants from the soil.

Plates1&2. Site mapping, clearing, excavation and ridge making during field-scale bioremediation of Ngia Ama polluted land, Rivers State, Niger Delta in 2018 with my PhD students and community youths; Plate 3 full biodiversity restoration 307 day post-remediation

Microbial activities were monitored using high-end DNA sequencing to drastically reduce experimental biases and reliably detect the unseen key players in pollutant removal. This project successfully achieved biodiversity recovery and restoration of ecosystem services in the treated soil underpinned by the presence of rich microbial diversity evident of soil health restoration. The full story can be found here in this link: (https://elsevierfoundation.org/gscc-5th-anniversary-interviews-with-past-winners-series-1-dr-chioma-blaise chikere/ https://www.elsevier.com/about/press-releases/archive/corporate-social-responsibility/winners-announced-for-the-2017-elsevier-foundation-green-and-sustainable-chemistry-challenge/)

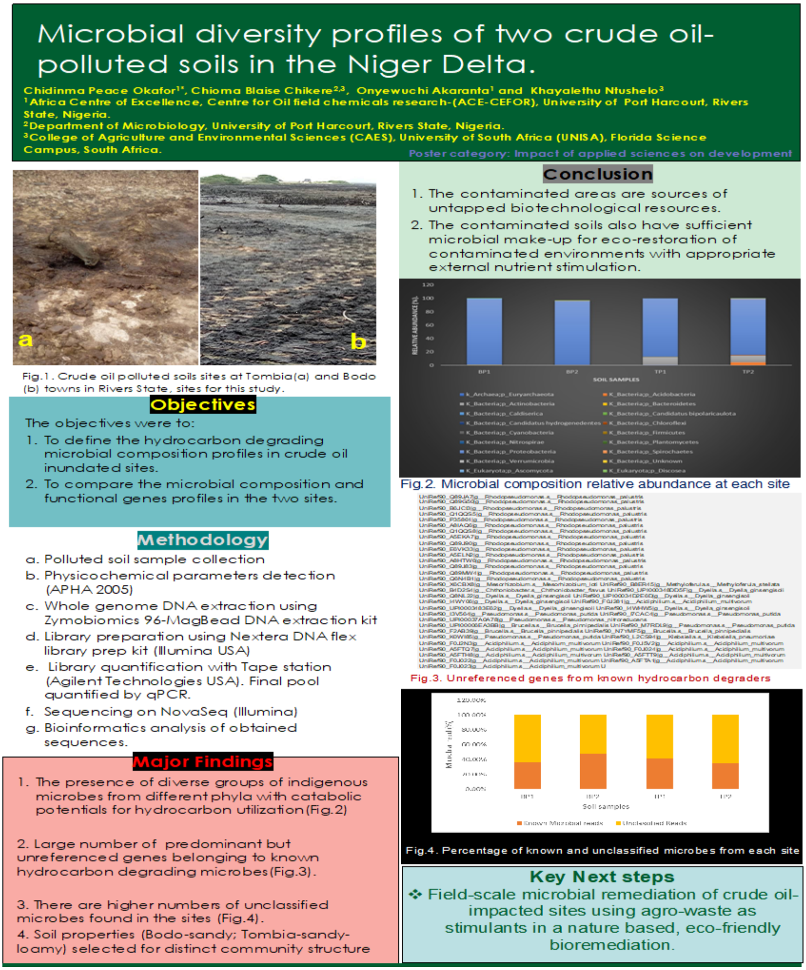
5. My research has contributed immensely to cardinal UN SDGs like goals 1, 2, 4, 5, 12, 13, 15 and 17 by ensuring poverty was reduced in the locality where the field-scale bioremediation project took place as community youths were employed to work with my team through citizen science; hunger was erased by restoration of the farmland to its original state, graduate students were empowered with PhD degrees through my supervision while working on my project thereby promoting quality equitable education for all, circular economy was encouraged by using animal litter as nutrients to stimulate indigenous hydrocarbon degrading soil microorganisms, protection of life on land was advanced and purposeful partnerships and collaborations with the EF, colleagues from foreign universities and World Bank Centre for Excellence in Oilfield Chemicals Research (ACE-CEFOR) University of Port Harcourt were actualized.
6. Additional resounding pioneer discovery made by my team and I demonstrated that complex microbial interactions especially those carried out by unculturable microorganisms (unseen workforce) help in the removal of petroleum hydrocarbons in soil both in the presence and absence of oxygen. Methanogens (methane-producing microbes) were identified as key drivers of some of these interactions in the subsurface by the use of high throughput 16S rRNA amplicon sequencing and bioinformatics (Obieze *et al*., 2022).

Crude oil-polluted artisanal refining site pre-remediation (A) and during remediation (B)



Average relative abundance of phylotypes at the phylum taxonomic rank (A) and biomarker phyla pre-remediation and during remediation (B).

7. In another study from a PhD project supervised by myself and a group of international/interdisciplinary collaborators, datasets generated from polluted soil metagenome in Tombia and Bodo communities using shotgun sequencing technique on an Ilumina NovaSeq platform (Okafor *et al*., 2022) have been deposited in a publicly available repository at the European Nucleotide Archive (ENA) of the European Molecular Biology Laboratory (EMBL). It was observed from this study that the majority of uncultured and unseen microbial species were novel and unique to these 2 oil-polluted sites, furthermore they were found to be strongly affiliated with crude oil degradation. These findings mean that we still have untapped and unreferenced rich microbial diversity in our impacted ecosystems which can be further harnessed for more robust biotechnological benefits especially in pollutant removal. A poster prepared from this research was presented at the Organization for Women in Science for the Developing World (OWSD) general annual meeting in 2021 as shown below.



This research output is in line with UNESCO's **F.A.I.R.** (**F**indable, **A**ccessible, **I**nteroperable and **R**eproducible) principle that promotes - open access, open research, open data and open science.

8. I and my international collaborators under the auspices of the International Society for Microbial Ecology (ISME) based in Wageningen, the Netherlands, are working on

African Microbiome project, which is geared towards mapping the indigenous African microbiomes in biological and environmental sources, (Adeleke *et al*., 2022) in order to conserve genetic/molecular diversities and information peculiar to the African continent (Makhalanyane *et al*., 2023).

9. Quorum sensing (QS) is a phenomenon in which microorganisms, as the unseen workforce, communicate among themselves through chemical signalling. A minireview which emerged from a global collaboration involving myself and my undergraduate mentee comprehensively reviewed the current information/research on this topic. It unravelled the roles of quorum sensing in a plethora of applications; biofilm formation, virulence in pathogenic bacteria, and its grander effect on the environment by influencing biogeochemical cycling in deep-sea environments. The review opined that further studies on QS and employing biotechnological enhancements to microorganisms would lead to improved techniques for the degradation of recalcitrant pollutants and other beneficial applications of the phenomenon (Edamkue *et al*., 2023).
10. Additional interesting output recently produced from my undergraduate research team was directed at new discoveries in microbe-pollutant-soil interactions. Using crude oil-polluted soil samples from two sites in Rivers State, Nigeria, the ability of consortia constituted from the naturally occurring degraders to utilize polycyclic aromatic hydrocarbons effectively was demonstrated. Isolated microorganisms which were enriched with

anthracene and naphthalene additionally utilized these pollutants coupled with the production of crude-oil blending agents that make the microbes to attack the hydrocarbons unhindered. This showed that indigenous microorganisms, a formidable unseen workforce, can be repurposed for clean-up of contaminating oil spills (Aruotu *et al.*, 2023).

11. Edamkue *et al.*, (2023), my undergraduate supervisee compared microbial abundance in relation to depth and soil texture of crude oil-contaminated soil within the Niger Delta. Hydrocarbon degrading bacteria were enumerated and isolated with their degradation rates measured using 2,6-dichlorophenol-indophenol (DCPIP). Statistical analysis revealed that the effect of depth and texture had an insignificant effect on the distribution of degrading microorganisms for these soils in Tombia and Bodo areas meaning that the microbes were well adapted to the polluted environment irrespective of these 2 variables considered.
12. I strive to provide immense support, mentorship and training to undergraduate and graduate students in my research group by putting them on the international scientific map ensuring diversity, equity, inclusion and belonging are balanced in all my mentorship and leadership roles. With my research grants, I sponsored 2 Master's project students' researches from 2012 to 2015 in my department. I equally secured 7 PhD fellowships for my supervisees, 5 females and 2 males, at the World Bank Africa Centre of Excellence in Oilfield Chemicals Research (ACE-CEFOR) University of Port Harcourt for

2014-2017, 2017-2020, 2018-2022 and 2023-2026 sessions. All these mentees worked on the pivotal roles of the unseen workforce in contaminant removal from polluted soil ecosystems and findings from these investigations have been fully published in accredited/indexed journals and equally presented at notable international scientific conferences.

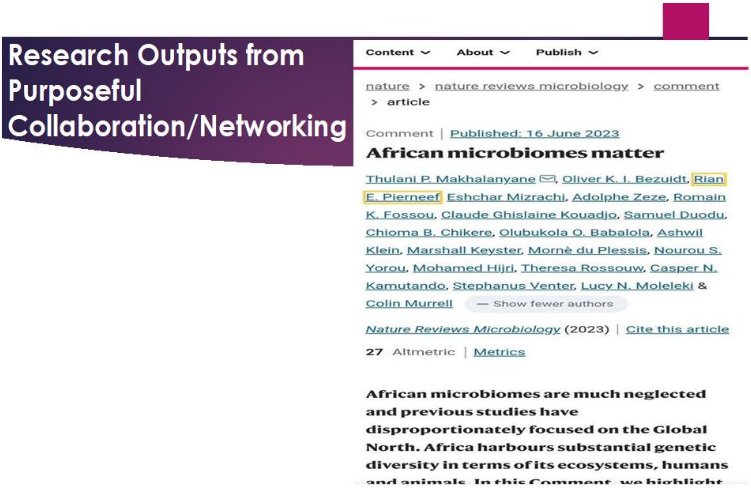
4.2. Conference presentations and professional engagements

Over 70 conference presentations (in-country and internationally) have been made from my research group in several professional conferences showcasing the beneficial roles of microbes, an incredible unseen but powerful workforce, in environmental bioremediation, pollutant removal and ecosystem restoration.

Purposeful peer engagement, collaborations and partnerships are beneficial and invaluable resources that scientists enjoy from membership in reputable scientific organizations and professional societies. In this vein, I have a robust network of collaborators and mentors who are expanding my horizon in terms of microbial interventions and knowledge co-creation in environmental remediation and pollution abatement as shown in the deck below during Society of Environmental Toxicology and Chemistry (SETAC) 33rd annual Meeting in Dublin, Ireland April30-May4, 2023.

4.3. Current Research

I and my international collaborators under the auspices of the International Society for Microbial Ecology (ISME) based in Wageningen, the Netherlands, are working on African Microbiome project, which is geared towards mapping the indigenous African microbiomes (microbial communities) in humans, different environments (Adeleke *et al*., 2022), plants and animals to conserve genetic/molecular diversities and information peculiar to the African continent (Makhalanyane *et al*., 2023). We already have a review on this topical subject that was published as shown below in *Nature Reviews Microbiology* in June 2023 by 20 of us from several African/foreign Universities and research institutes who are in this formidable team.



4.4. Future Research

I am in serious talks for collaborations and partnerships with other African Universities (University of Johannesburg, South Africa; Cape Peninsula University of Technology-CPUT, South Africa) for human capacity building for the development of omnibus toolbox of machine learning package to support microbiome studies and analyses in sensitive, rich and peculiar ecosystems in the Niger Delta region. With this empowerment, we can develop keystone microbial products for climate-smart agriculture, biodiversity conservation and environmental sustainability.

5.0. Challenges, Recommendations and Conclusion Challenges

1. Despite the grand progress recorded by this research team, the issue of environmental degradation is not getting the proper attention it deserves. Due to the long-

term effects of environmental related problems, issues concerning environmental pollution are usually relegated to the background. It is pertinent that a state of emergency be declared in the environmental sector, to sensitize stakeholders on the imminent dangers associated with pollution.

2. Inadequate funding opportunities for environmental-related research projects are also a growing concern. These investigations are very capital intensive and hence require huge funding to cater for manpower, logistics, lab consumables, experimentations, field trials, analyses and salaries for researchers.
3. Open access to publications and F.A.I.R data sharing principle are very crucial in the discoverability of scientific information and knowledge sharing. Access to information is very vital for advancement of scientific researches. Hence there is need for open access to works and research findings to enable other researchers and policy makers access the required appropriate evidence-based information that will aid sustainable research and development in environmental sciences.
4. Stakeholders' involvement and security issues are serious bottlenecks in environmental sustainability plans. The volatility of the Niger Delta region is an issue owing to the state of insecurity in the region. There is very high risk of workers abduction and other security related issues which hinder the pace of our research work. Community relations and sensitization are expensive and they hinder to a very large extent the work that can be done at the spill sites.

Recommendations

1. The environment is everyone's business and as such aggressive sensitization of the society is needful for inclusivity and accountability as they relate to environmental protection, responsible consumption and proper waste management/treatment.
2. There should be stricter sanctions for environmental pollution and laws governing environmental sustainability should be fully implemented to protect sensitive ecosystem like the mangrove habitats.
3. Regular monitoring and timely intervention to oil spills should be enforced by the regulators.
4. Stakeholder education on the long-term effects of oil pollution especially on human and environmental health is very needful to discourage tampering with oil installations and pipelines by unpatriotic elements.
5. Citizen science and indigenous people/knowledge should be integral parts of our sustainability frameworks to ensure we incorporate beneficial nature-based solutions in our ecosystem restoration plans.

Conclusion

Microbes, though invisible, are vital contributors to sustainable use of natural resources and maintenance of life on earth. They are invaluable agents for ecosystem restoration in a climate-changing world occasioned by colossal pollution from human activities. The range and extent of services microorganisms provide in maintaining the balance of the planet to finding novel ways to continue the present but necessary ecological processes and natural resources' mining are very important to us. With the broadening opportunities availed us by new technologies and pathways in biotechnology research, microbially-driven environmental processes are invaluable in maintaining ecosystem balance, resilience and productivity thereby contributing immensely to a sustainable environment for humans, other living organisms and the planet.

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Chioma Blaise Chikere (formerly Chioma Emmanuel Azubuiñe) is the first of 2 children (the second being, Barrister Enyinnaya Emmanuel Azubuiñe) of Elder Emmanuel and Deaconess Mabel Elijah Azubuiñe of Umuakam Eziala, Okaiuga Nkwoegwu autonomous community, Ohuhu, Umuahia North, Local Government Area, Abia State, Nigeria. She attended Ofali Agwu Primary School, Ohafia and Afugiri Girls' Secondary School, Umuahia both in Abia State from 1983-1993. She obtained her B.Sc. Honours Degree (2^{nd} Class Upper Division) in Microbiology in 1999 as the best graduating student from Abia State University, Uturu (ABSU); MSc degree in Industrial Microbiology from the Federal University of Technology Owerri (FUTO) in 2005. She received the 2005 Organization of Women in Science for the Developing World (OWSD) PhD Fellowship for split-site programme at the Universities of Port Harcourt and Pretoria, in Nigeria and South Africa respectively and was awarded a PhD degree in Environmental Microbiology by the University of Port Harcourt in 2011.

Chikere is a Professor of Environmental Microbiology and Biotechnology in the Department of Microbiology, University of Port Harcourt, Nigeria, where she was employed in 2005 as an Assistant Lecturer and has grown meritoriously through the ranks in academia. She was the Director, Entrepreneurial Centre, University of Port Harcourt 2022-2024 and currently the head, Department of Microbiology, Faculty of Science, University of Port Harcourt. Prof. Chikere also holds an Academic Associate position as Professor Extraordinarius at the Department of Environmental Sciences, College of Agriculture and Environmental Sciences (CAES), Florida Science Campus, University of South Africa. With over 60 articles in peer-reviewed journals, 70 local and international conference papers presented and 9 conference proceedings, this Amazon is a global academic legend. Her Ph.D. Thesis entitled **'Bacterial Diversity and Community Dynamics during the Bioremediation of Crude Oil- Polluted soil'** was awarded by National Universities Commission (NUC) Nigeria the 'BEST DOCTORAL THESIS IN BIOLOGICAL SCIENCES' for 2010. Other awards and honours to her credit are: International Foundation of Science (IFS) Sweden research grants in 2007 and 2012; University of Port Harcourt 2015 distinguished merit award for diligent and meritorious service; 2016 TWAS-UNESCO Associateship (June 2016-Dec. 2020) to Department of Environmental Sciences, University of South Africa (UNISA); the Elsevier Foundation (EF) 2017 Chemistry for Climate Action Challenge 2nd prize; Applied Microbiology International – AMI (formerly Society for Applied Microbiology - SfAM) conference abstract scholarship travel grants; TCC-Africa 2021 trainee; 2022 SciDev.Net 20% women in climate action research in the global South; 2022 Sense about Science (UK) global risk practitioner, Higher Education Resources Services-South Africa (HERS-SA) Academy Alumna, University of Port Harcourt's Chancellor's research icon award at the 33rd combined 2022 convocation; HERS-SA 2022 alumna/woman leader in Africa's higher education, Times Higher Education sub-Saharan African universities advisory board member; the Vice Chancellor's award for globalization of University of Port Harcourt through research contributions in 2023, Nigeria Senior country ambassador for International Society for Microbial Ecology (ISME – the Netherlands), Council member, SETAC Africa and European Union-funded Erasmus+ AMIGO International Credit Mobility (ICM) project 2022 - 2026 with 5 European Universities. Professor Chikere is happily married to Dr. Blaise Ositadinma Chikere and they are blessed with 4 amazing children Hilary, Audrey, Pearl and Fitzblaise.

Prof. Owunari Abraham Georgewill
Vice Chancellor