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# CILAZINE

AN ANNUAL PUBLICATION OF  
THE CENTRAL INSTRUMENT LABORATORY  
UNIVERSITY OF PORT HARCOURT

APRIL  
2025



AI TECHNOLOGY: A VERITABLE TOOL FOR  
ADVANCING THE FRONTIERS OF LABORATORY

HISTORICAL EVOLUTION OF THE  
CENTRAL INSTRUMENT LABORATORY (CIL)

POTENTIALS OF METHANE CLATHRATES AS  
ALTERNATIVE SOURCE OF FOSSIL FUEL

EXTERNAL QUALITY ASSESSMENT: THE BACKBONE  
OF LABORATORY ACCREDITATION

BLUE HYDROGEN TOMORROW'S ENERGY  
AND ITS COLOR CODES

CELEBRATION FORESTS AND FOOD GROWING  
GREEN FUTURES: INVESTING IN FORESTS FOR  
PEOPLE AND PLANET

2ND EDITION







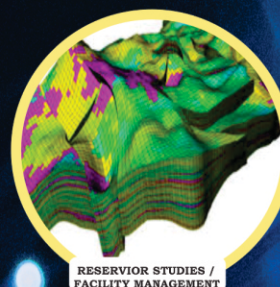
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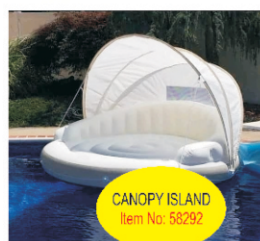






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Dr. G. Obah (Bursar), Dr. G. O. Chindah (Registrar) and Prof. K. Owete (DVC Acad)

## Some Giant Strides of Prof. Owunari Georgewill (9th Vice-Chancellor, University of Port Harcourt) are:

- Attracted the position of coordinating university among five others in Nigeria: University of Port Harcourt, Abubakar Tafawa Balewa University, Obafemi Awolowo University, University of Abuja and Michael Okpara University for the European Union-ERASMUS funded postgraduate programme on Embedded Artificial Intelligence. Modern equipment has already been received.
- Attracted scholarships from partners for over seven hundred indigent undergraduate students.
- Attracted solar-powered street lights for the three campuses of the university.
- An attractive solar power plant is currently being constructed by the federal government through the federal rural electrification project to ensure 24-hour electricity on campus.
- Attracted over five affiliations from different institutions of higher learning that now award Bachelor's degrees from the university.
- Attracted hotel building from Niger Delta Development Commission.
- Attracted the establishment of a direct Chinese Centre, thus ending the long years of sub-designation of Uniport under the Federal University of Technology Owerri.
- Hosted the Rivers State sports preparation for the National Sports Festival.
- Attracted so many collaborations, including that with Bournemouth University, United Kingdom, on the Gender Equality Project.
- Hosted so many national and international conferences/workshops, including workshop on cutting-edge technology for smart Agriculture sponsored by the Heidelberg Laureate Forum.
- Attracted the position of the first university in the South-South region of Nigeria for the establishment of a laboratory sponsored by the Tertiary Education Trust Fund.
- Attracted equipment donations such as laptops, electronic communication smart boards, projectors, and furniture from the MacArthur Foundation, which were handed over to the new Faculty of Media and Communication Studies.



**Compiled by**  
**BARR. OBINUCHI CHIMEZULE**  
Deputy Director, Academic  
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# UNIVERSITY OF PORT HARCOURT

Deputy Vice-Chancellor (R&D)  
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## OFFICE OF THE DEPUTY VICE-CHANCELLOR (RESEARCH AND DEVELOPMENT)

13<sup>th</sup> April, 2025

The Director,  
Central Instruments Laboratory,  
University of Port Harcourt.

Dear Prof Ibezim-Ezeani,

### Goodwill Message

On behalf of myself and the entire research ecosystem, who share a vision for progress and innovation, I extend my heartfelt commendation and goodwill to the Director of our Central Instruments Laboratory and organizers of the 2nd International Conference on Laboratory Research and Technopreneurial Innovations, hosted by the University of Port Harcourt.

This conference is a testament to the boundless possibilities that emerge when intellect, research, and entrepreneurship converge. By bringing together scholars, researchers, technopreneurs, and industry leaders, you have created a platform that fosters dialogue, collaboration, and the sharing of groundbreaking ideas—all of which are vital to driving technological advancements and societal progress.

Laboratory research is the bedrock of scientific discovery, while technopreneurship transforms those discoveries into tangible solutions that address real-world challenges. This conference exemplifies the synergy between these two critical domains, making it a beacon of hope for the future of innovation across Nigeria, Africa, and beyond.

May your efforts not only lead to meaningful discussions and new innovations but also inspire the next generation of scientists and technopreneurs to take bold steps toward solving global challenges.

To the Vice-Chancellor, thank you for your leadership and unwavering commitment to excellence in education and research. To the organizers, participants, and partners, I wish you a successful and impactful conference that will leave a lasting legacy in the annals of innovation and academia.

Congratulations and best wishes for this extraordinary event.

Prof. Iyeopu M. Siminialayi [FWASP, FNAMed]





# EDITOR-IN-CHIEF'S SCROLL

Researchers, scientists, technologists, and all other professionals who engage in laboratory research are invaluable assets to the world of innovative discoveries, research development and technological advancement.

The Central Instrument Laboratory (CIL) is a conducive and environmentally friendly research domain where the staff provide the:

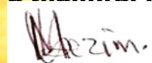
- ✦ Technical skill which impacts positively in the operations and maintenance of laboratory instruments
- ✦ Required expertise that aid the laboratory to function safely and effectively
- ✦ Consultancy services on entrepreneurial skills and laboratory investigations for researchers; as well as ensure conformance to specifications in scientific research and development under quality assurance conditions.

The commemoration of World Laboratory Day 2025 through organizing the 2nd International Conference on Laboratory Research and Technopreneurial Innovations with the theme, “RESEARCH AND TECHNOPRENEURIAL ADVANCES FOR CLIMATE AND GLOBAL ISSUES”, is to foster an exchange of fresh opportunities for inestimable ideas that will benefit the global community.

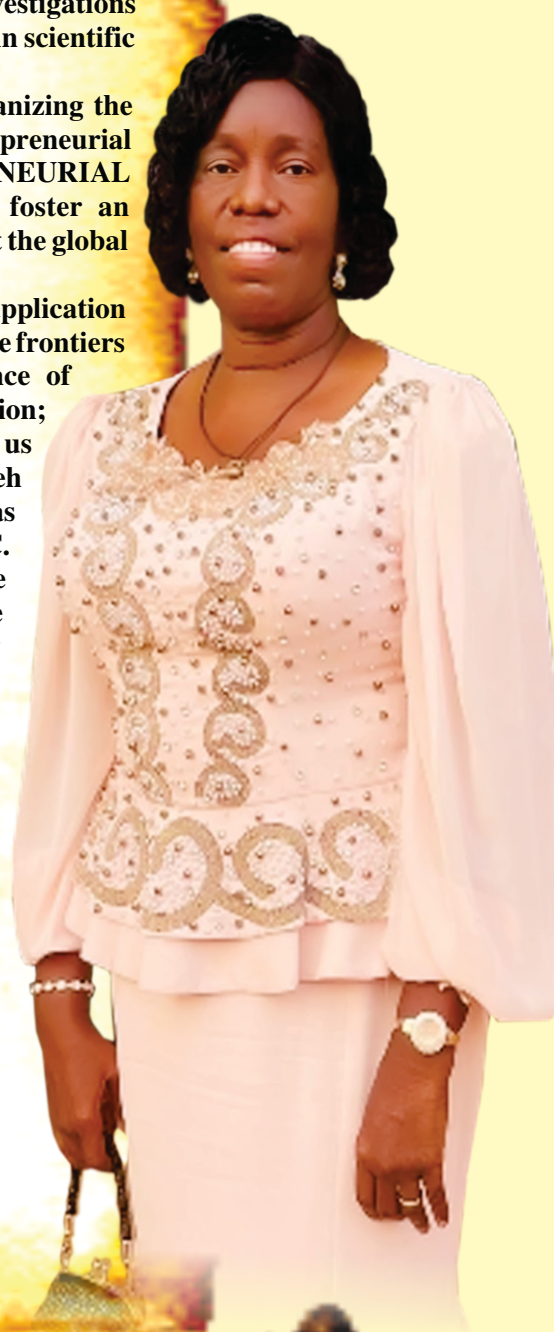
In this edition of CILAZINE, Professor V. I. Anireh encouraged the application of AI and its associated technology as a veritable tool for advancing the frontiers of laboratory research. Paschal Ugwu showcased the importance of external quality assessment as the backbone of laboratory accreditation; and CIL's pioneer Director (Prof. Gideon O. Abu, 2007-2012) takes us through the historical evolution of CIL. Professor O. J. Abayeh (Director of CIL between 2018-2020) enumerated blue hydrogen as tomorrow's energy with zero emission of carbon, while Professor L. C. Osuji presents the Potentials of Methane Clathrates as an alternative source of fossil fuel. The importance of growing green futures while investing in forests for people and our dear planet was discussed by Professor B. B. Babatunde.

I deeply appreciate the University management, Faculty of Science, Colleges, Faculties, Schools, Centres, Institutes, Unions, Associations, Authors, Contributors and Organising committee members (for the 2nd International Conference on Laboratory Research and Technopreneurial Innovation in commemoration of World Laboratory Day 2025) for your unflinching support. Very special thanks to our collaborators, partners, advertisers and friends [Prof. M. Onyekaonwu, Chief Engr. Dr. Sir I. Akuwve, Mr M. Ocheche, Mrs C. Okezie, Mr R. Nasir, Mr. A. Ogunrinde, Mr. D. C. Ezeani (Mayor), Prof. B. B. Babantunde, Dr. and Dr. (Mrs) D. Isiavwe, Mr A. I. Ezeani, Mr O. Ogunrinde, etc.] for their magnanimous contributions.

Experience a good read, while your desired input is welcomed with a thankful heart at [millicent.ibezim-ezeani@uniport.edu.ng](mailto:millicent.ibezim-ezeani@uniport.edu.ng).



Millicent U. Ibezim-Ezeani  
FCSN, FICCON, MPIN, MOWSD  
Director, CIL







**Professor Vincent Ike Anireh (PhD, UPH)**

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# AI TECHNOLOGY:

## A VERITABLE TOOL FOR ADVANCING THE FRONTIERS OF LABORATORY RESEARCH

### **INTRODUCTION: The Lab Partner You Never Had**

As we gather here to discuss the future of technopreneurship and innovation, let's keep in mind that the future isn't just coming—it's already here. It's wired into our equipment, coded into our systems, and accelerating the pace of discovery. The real question isn't whether Artificial Intelligence (AI) has a place in laboratory research—it's how boldly we're willing to embrace it, shape it, and unleash it to solve the challenges of today and tomorrow.

And maybe, just maybe, that lab of the future? It's not only smarter. It's more human—because it puts the soul of science—curiosity, creativity, and collaboration—back at the Centre. So, I leave you with this: What will you discover when the machines take care of the routine, and your mind is free to roam? It frees us to do what we do best: imagine, explore, and discover.

### **1 Historical Background**

Let us imagine a young scientist in the 1950s, hunched over a cluttered lab bench, meticulously recording data by hand under the glow of a flickering fluorescent light. One misstep—a decimal in the wrong place—and weeks of work could be undone. That was the reality of laboratory research. Long hours, endless repetition, and the constant hope that this time, the results would hold. It was demanding, imperfect, and incredibly human. Labs were the engine rooms of scientific discovery, giving us everything from penicillin to mRNA vaccines, and from the periodic table to the human genome. These breakthroughs didn't happen by chance. They happened in controlled, focused environments where scientists tested, failed, retested, and eventually changed the world.



In those early days, the most powerful tools were the scientist's curiosity and a notebook filled with scribbles. Microscopes revealed what was invisible to the eye, and Bunsen burners lit up more than glass tubes—they lit up imaginations. But it was slow. Painstakingly slow. Data was recorded by hand, charts were plotted manually, and results often came after weeks, sometimes months of hard work. And yet, those were the golden seeds of modern science.

Fast forward to today, and we find ourselves in a world transformed—not just by new technologies, but by the scale and urgency of the problems we face. The laboratory is no longer a quiet corner of curiosity; it's now a command center for addressing humanity's biggest questions. We're not just facing unknowns in a petri dish anymore—we're battling pandemics, decoding climate signals, engineering food resilience, and pushing the boundaries of what it means to live longer, healthier lives. We're producing data at a speed we can barely comprehend. Sensors, sequencers, and smart devices pour out information 24/7. But here's the catch: data without insight is just noise. That's where artificial intelligence steps in—not as a distant dream, but as a reality transforming labs around the world. Imagine having a lab buddy who never sleeps, never spills coffee on the results sheet, and has casually memorized every scientific paper published in the last decade. That's what AI brings to the bench today—minus the lab coat and attitude. That's AI in the lab today. From designing and optimizing experiments, to finding patterns hidden deep within data, to predicting results before an experiment begins—AI is doing the heavy lifting so scientists can focus on breakthroughs.

### **So, what is Artificial Intelligence?**

Artificial Intelligence refers to the ability of computer machines to perform tasks that typically require human Intelligence, such as learning, reasoning, and problem solving. Early Artificial Intelligence systems uses heuristics programming design and expert systems method to find solution to problems using computer machines. Heuristics is the rule of the thumb, strategy, method or trick used to improve the efficiency of a system which tries to discover the solutions of complex



problems. The adjective 'heuristic' means serving to discover and it is related to the word eureka (I have found it, from the Greek word 'heuriskein', meaning to discover or find). Expert systems mimic the knowledge of a professional and act in the like manner. The purpose of heuristic programming includes:

1. Understand Natural(human) Intelligence and
2. Use machine Intelligence to acquire knowledge and solve intellectually difficult problems.

Using the first purpose, he constructs a model and apply protocol method, repeats run through recursively until model is perfected. In the second purpose, he uses data acquired and derives intelligent behaviors from patterns in the data.

Characteristics of Artificial Intelligence systems are: Communication, Internal knowledge, world knowledge, goals and plans, creativity, and curiosity. Alan Turing (1912 - 1954), one of the founding fathers of Artificial Intelligence added that it should learn and generalize.

The Concepts of Artificial Intelligence include the basic understanding of Machine learning (ML), Deep learning (DL), Recurrent learning (RL), Transfer learning (TL), as well as Algorithms and techniques used to develop Artificial Intelligence systems. Others are Natural Language Processing (NLP), Computer vision, Ethics and Biases.

Some Artificial Intelligence you may want to explore: germini, copilot, chatsonic, Durable, eightify, perplexity, runway, meta, amazon code, cactus, reimagine home AIs.

Think about a geneticist using AI to find a mutation that could cure a rare disease in days instead of years. Or a chemist running simulations of a thousand compounds overnight to identify the most promising one by breakfast. Or a botanist using drones and AI to detect early signs of crop disease across an entire region in real time. This isn't science fiction (Si-Fi). This is science now—like the time researchers at DeepMind used AI to predict the 3D structure of over 200 million proteins, a task that would have taken decades through traditional lab work. That's the kind of revolution AI is bringing to the lab bench.

And the beauty of it? AI doesn't replace scientists—it empowers them. It turns labs into smart ecosystems, where decisions are guided by data, and where experiments can adjust in real time. Researchers are no longer limited by the speed of their tools, but only by the scale of their imagination.

Let's not forget: the world doesn't wait. Whether it's developing vaccines in record time, monitoring the health of our oceans, or responding to environmental disasters, the need for fast, accurate, and innovative science has never been greater. AI enables that. It allows labs to scale up, adapt quickly, and make discoveries with precision—all while maintaining the gold standard of scientific rigour.

## The Roots of Scientific Discovery

Long before the rise of artificial intelligence and cloud-connected lab instruments, the engine of discovery was driven by a force far more elemental—curiosity. Curiosity sparked by nature's mysteries: Why does lightning strike? How do plants grow? What makes one person sick and another healthy? These timeless questions laid the groundwork for centuries of exploration, and the answers—however small—came through experimentation.

The earliest scientists weren't called scientists. They were alchemists, philosophers, herbalists, tinkers—people who dared to look closer, to ask harder questions, and to document what they saw. Their labs might have been dimly lit corners of monasteries or wooden sheds—imagine an old scholar in a candle-lit cloister carefully mixing tinctures, or a tinkerer in a rickety outbuilding scribbling formula on parchment beside a bubbling cauldron, but their discoveries set the wheels of science in motion. Over time, their scattered practices evolved into what we now know as the scientific method—a cycle of observation, hypothesis, testing, and refinement.

It's easy to forget, but everything we do today in research labs stands on the shoulders of these pioneers. The microscope didn't just magnify tiny cells—it magnified our imagination. It opened up a hidden world, revealing that the invisible had structure, order, and meaning. The periodic table didn't just organize elements; it organized our thinking. And the double helix? It didn't just reveal DNA. It revealed a new era of possibility—one where the code of life itself could be deciphered, altered, and engineered.

What made these milestones possible wasn't just better tools—it was better thinking. Think of Galileo challenging established norms by peering through a telescope, or Marie Curie obsessively refining pitchblende to uncover the secrets of radiation. It was their mindset—not just their methods—that redefined what science could achieve. It was a willingness to observe failure without fear. A hunger for patterns. A passion for repetition. The roots of discovery are not tangled in complexity—they are simple, pure, and stubbornly human.

Even today, in a world of automated workflows and AI-generated models, the greatest breakthroughs begin with the simplest of acts: someone asking, "What if?" And it's in that moment—the quiet before the question becomes a quest—that the torch of discovery is passed from one generation to the next.



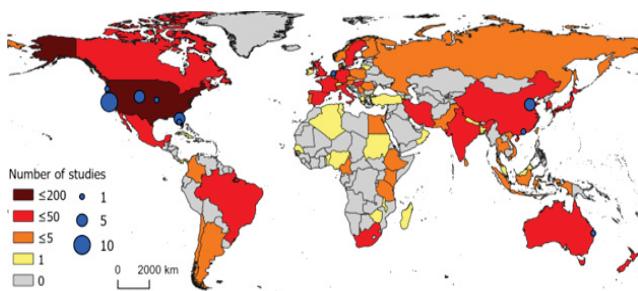


So, as we celebrate the future of laboratory research and technopreneurship, let's ask ourselves: how far can we go when the spirit of discovery meets the tools of tomorrow? let us not forget the roots. Because without curiosity, there is no innovation. And without the past, the future would have nothing to build on.

## 2. The World Has Changed

But as the world has changed, so too has the landscape of science. The questions have grown more complex, the data more immense, and the stakes more urgent. What once began with a candle and curiosity now demands supercomputers and strategy.

Once upon a time, a researcher's challenge was finding enough data to work with. Now, the challenge is knowing what to do with it all. From medical diagnostics and drug development to climate modelling and space exploration, laboratories today are swimming in a sea of information. Every second, sensors generate thousands of data points. Every hour, databases fill up with images, sequences, simulations, and logs. The question is no longer can we get the data?—it's can we understand it fast enough to act on it? And if we can't, what opportunities are we missing?



The world around us has changed—and with it, the expectations placed on science. We're no longer solving isolated problems; we're tackling global ones. A virus in one country can shut down economies around the world. A crop failure in one region can disrupt food chains across continents. Climate anomalies can swing markets, politics, and lives. In this interconnected world, science must be just as agile as the problems are complex.

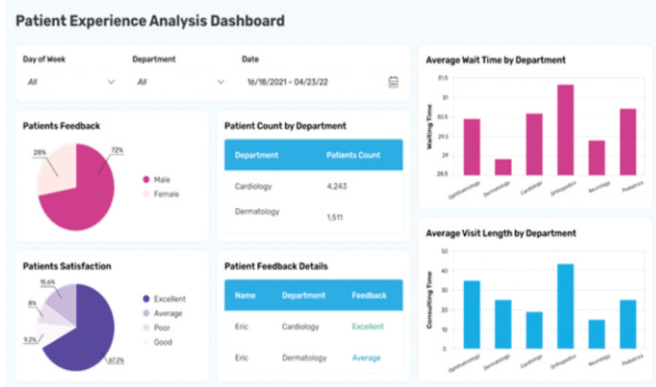
In the midst of this whirlwind, laboratories are expected to do more with less—to deliver faster, with greater accuracy, and with fewer resources. Funding is tight. Timelines are tight. The margin for error? Even tighter. Yet this is also a time of incredible opportunity, because the same challenges that pressure us are pushing us toward new tools and mindsets.

Artificial intelligence didn't arrive by accident. It was born out of necessity. When human brains hit the ceiling of what they could analyze, we built systems to help us see deeper, move quicker, and think broader. Take COVID-19, for example—AI models helped track the spread, identify variants, and accelerate vaccine development in ways that would have been impossible just a decade ago. AI became the flashlight in the data storm—the tool that doesn't just help us

collect information, but helps us understand it in real time.. It was born out of necessity. When human brains hit the ceiling of what they could analyze, we built systems to help us see deeper, move quicker, and think broader. AI became the flashlight in the data storm—the tool that doesn't just help us collect information, but helps us understand it in real time.

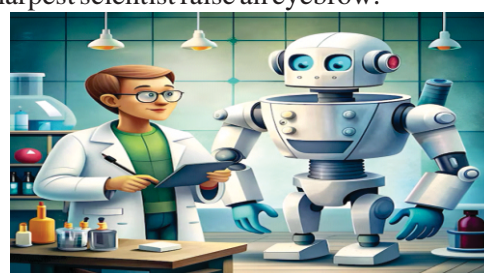
So yes, the world has changed. Yesterday's lab had petri dishes and chalkboards; today's lab has machine vision, neural networks, and smart sensors. It's messier. It's faster. It's far more demanding. But it's also more filled with potential than ever before. Change can feel overwhelming—but it can also be energizing because what's changing isn't just the lab—it's our reach, our speed, and our capacity to solve problems that far more demanding. But it's also more filled with potential than ever before. Because in the noise of a changing world, we have new ways to listen. And in the face of complexity, we now have intelligent allies ready to help us chart the way forward.

The lab isn't what it used to be—and thank goodness for that. Because science isn't supposed to stand still. It's supposed to evolve with the world it serves. And if the world around us is transforming, then it's time we ask—how do we transform with it? Because science isn't supposed to stand still. It's supposed to evolve with the world it serves.



## 3. Enter AI – The Lab Partner You Never Had

If you've ever wished you had a lab partner who never spilled a sample, never showed up late, and actually volunteered to do the boring stuff—well, meet artificial intelligence. It handles repetitive tasks with robotic precision. And yes—sometimes, it's literally a robot. (because, you know, it's often actually a robot), but it also brings a level of insight and speed that makes even the sharpest scientist raise an eyebrow.





And let's be honest, even the best minds get tired. AI doesn't. It keeps going, patiently sorting, analyzing, and learning. It's the lab partner who cheerfully runs that same assay 500 times—no complaints, no coffee stains, just results and still finds your spreadsheet formatting quirks endearing.

AI isn't here to take over your lab. It's here to make sure you finally get to go home before midnight—and still look like a genius by morning. And who wouldn't want to have a lab partner like that? It's here to make sure you finally get to go home before midnight—and still look like a genius by morning.

We've talked about AI as the dream lab partner—but if that still sounds abstract, let's make it real. Now let's move from theory to testimony. Because AI isn't just a buzzword or a cool demo—it's making real impact in labs across the globe, right now.



For decades, predicting how proteins fold—a key to understanding disease and drug design—was one of biology's grandest challenges. Then DeepMind's AI system, AlphaFold, entered the scene. It didn't just help—it solved it. In 2020, AlphaFold predicted the structure of thousands of proteins with accuracy rivalling laboratory methods. This wasn't just a computational achievement; it accelerated biology by years.

In the pharmaceutical industry, developing a new drug traditionally takes over a decade. But with AI, companies like Insilico Medicine have significantly cut that timeline. In 2021, Insilico used an AI model to design a new drug candidate that later advanced into preclinical trials in just 46 days—yes, you heard





right—46. From target identification to molecular design, the entire early-stage process was accelerated using deep learning algorithms. What used to be the slowest part of the pipeline is now sprinting.

### Story 3: Microscopy Meets Machine Vision

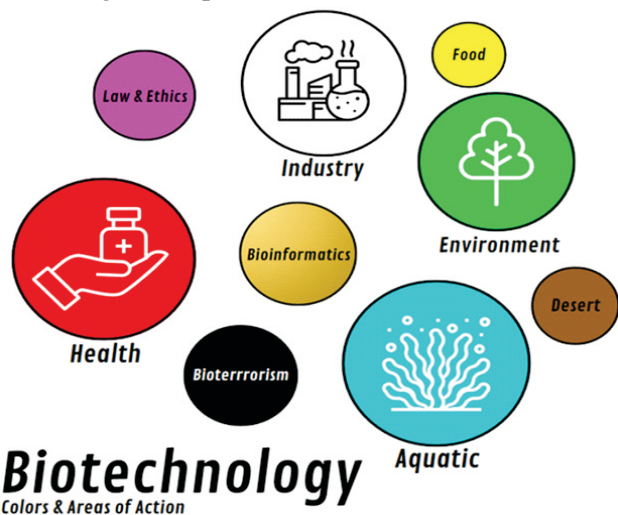
In cell biology labs, researchers spend hours scanning microscope slides. But AI tools like CellProfiler and Google's DeepVariant are now stepping in. These tools can identify cell types, count divisions, and even detect early-stage abnormalities in samples. One lab reported cutting its image analysis time by 70%, freeing up scientists for deeper interpretation rather than tedious counting.

### Story 4: Climate Watchdogs with AI Eyes

AI is also helping monitor the planet. At NASA and NOAA, satellite imagery and AI models work together to track changes in ice sheets, ocean temperatures, and atmospheric gases. AI identifies trends and anomalies that humans might miss—such as detecting unexpected glacier thinning in Greenland or unusual methane spikes over industrial zones—allowing faster response to environmental threats and better-informed policy decisions.

### Story 5: Pandemic Response Powered by Prediction

During the early days of the COVID-19 pandemic, researchers scrambled to identify virus mutations and predict outbreaks. AI systems like BlueDot and HealthMap scoured global data sources, flagged unusual patterns, and even detected early signs of the outbreak before many international health agencies. Their insights were used to inform early travel advisories, allocate healthcare resources, and initiate rapid-response protocols in cities like Toronto and New York. researchers scrambled to identify virus mutations and predict outbreaks. AI systems like BlueDot and HealthMap scoured global data sources, flagged unusual patterns, and even detected early signs of the outbreak before many international health agencies. These tools didn't just save time—they saved lives by enabling faster, targeted responses.



### Story 6: Chemistry's New Co-Pilot

AI is becoming an indispensable assistant in materials science. Take the case of MIT's use of AI to discover a new superionic conductor—a key material in battery technology. The AI model sifted through millions of chemical combinations and flagged a candidate that was later validated in the lab. What would have taken years of trial-and-error happened in months.

### Story 7: Agriculture Gets a Digital Upgrade

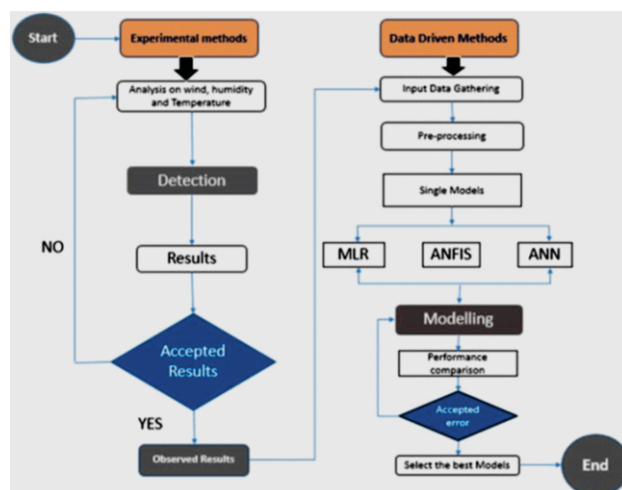
In precision farming, AI drones and remote sensors are used to monitor soil health, plant disease, and crop yields. In one case, an AI-enabled drone fleet in India helped small-scale farmers identify nitrogen deficiencies in their rice paddies, improving crop output by over 25%. By pairing traditional farming knowledge with AI diagnostics, a new era of smart agriculture is taking root.

These stories aren't science fiction—they're science real. And they prove a simple truth: when human curiosity meets machine efficiency, the possibilities don't just add up—they multiply. So, the next time someone says AI is coming for our jobs, remind them: it's not taking over. It's teaming up. And the partnership is already paying off. The real question is—how might your lab be next?. And the partnership is already paying off.

## 5. How AI Changes the Game

Now that we've seen the impact of AI in real labs, let's unpack what's truly transforming beneath the surface. It's not just that AI is helping in labs—it's fundamentally changing the rules of scientific discovery.

Traditionally, research was a linear process: form a hypothesis, test it, analyze, repeat. In contrast, AI dramatically shortened this loop—much like it did during COVID-19 vaccine development, where models helped streamline everything from antigen selection to trial prioritization. But AI shifts that rhythm. With its ability to learn from massive datasets, make predictions, and adapt in real time, AI introduces a new tempo—a more dynamic, iterative loop where hypotheses can be generated, tested, and refined at a pace that humans alone could never match.





Think of it as shifting from a single-lane road to a multilane superhighway—where more ideas, experiments, and data streams can travel side by side without traffic jams.

While we used to wait for results before moving to the next step, AI now enables multiple threads of experimentation to run concurrently. It simulates outcomes, suggests new directions, and alerts us when we're going in circles—all in the background, while the scientist focuses on the big-picture thinking.. It simulates outcomes, suggests new directions, and alerts us when we're going in circles—all in the background, while the scientist focuses on the big-picture thinking.

In practice, this means faster timelines and fewer dead ends. For example, researchers using AI in rare disease drug development have seen months shaved off early-stage trials by simulating compound responses before even touching a test tube. - In drug discovery, it's about going from “we'll know in five years” to “we've got a lead in five weeks.”

In environmental monitoring, it's about reacting to changes before they become crises.

In bioengineering, it's about custom-building molecules or therapies using predictive models rather than relying purely on trial-and-error.

Here are tables that shows some AI algorithms and areas of applications in lab research.

**Table.2: Summary of applications/reviews describing AI algorithms**

| s/no | Artificial Intelligence (AI) algorithms used in advancing laboratory research:     | Areas of Application                                                                                                     |
|------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| 1    | <b>Machine Learning Algorithms</b>                                                 |                                                                                                                          |
| a)   | Supervised Learning: predicting continuous values classification tasks             | Gene expression levels<br>Disease diagnosis                                                                              |
| b)   | Unsupervised Learning: clustering, dimensionality reduction, and anomaly detection | Identifying outliers in gene expression data                                                                             |
| c)   | Reinforcement Learning: optimizing laboratory protocols                            | experimental design and resource allocation.                                                                             |
| 2    | <b>Deep Learning Algorithms</b>                                                    |                                                                                                                          |
| a)   | Convolutional Neural Networks (CNNs)                                               | Image analysis, such as cell classification, tissue segmentation, and protein structure prediction                       |
| b)   | Recurrent Neural Networks (RNNs):                                                  | sequential data analysis, such as time series gene expression data or protein sequence analysis.                         |
| c)   | Generative Adversarial Networks (GANs):                                            | generating synthetic data, such as simulating gene expression profiles or protein structures                             |
| 3.   | <b>Natural Language Processing (NLP) Algorithms</b>                                |                                                                                                                          |
| a)   | Text Mining:                                                                       | Extracting relevant information from scientific literature, such as gene-disease associations or protein interactions.   |
| b)   | Sentiment Analysis:                                                                | Analyzing the sentiment of scientific articles or patents, such as identifying potential breakthroughs or controversies. |
| 4.   | <b>Optimization Algorithms</b>                                                     |                                                                                                                          |
| a)   | Genetic Algorithms:                                                                | Optimizing laboratory protocols, such as experimental design, resource allocation, or parameter tuning.                  |
| b)   | Particle Swarm Optimization:                                                       | Optimizing complex systems, such as laboratory workflows or resource allocation.                                         |
| 5.   | <b>Other AI Algorithms</b>                                                         |                                                                                                                          |



**Table.2** Summary of applications/reviews describing AI algorithms

| Application                                                  | Functions                                                                                                          | Technique/or Algorithm                                                                                                                  | Reference Citation      |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Drug discovery                                               | Used as metric to measure distance between two sets of molecules.                                                  | Fréchet ChemNet distance (FC metric) of deep generative model. Uses the penultimate layer of a neural network called ChemNet.           | Preur et al., 2018a     |
| Drug discovery                                               | Anticancer drug synergy prediction                                                                                 | Deep Feedforward Neural Network                                                                                                         | Anireh & Osegi (2020)   |
| Drug discovery                                               | Uses Biological machine Intelligence to classify and identify new drug compounds from a DNA sequence dataset.      | Machine Intelligence based on Hierarchical Temporal Memory                                                                              | Anireh & Osegi (2020)   |
| Drug discovery                                               | Uses a voting procedure to classify 1,555 compounds PI3K inhibition.                                               | Consensus models based on the machine learning algorithms $k$ Nearest Neighbors ( $k$ NN), naïve Bayes and Support Vector Machine (SVM) | Liew et al., 2010       |
| Disease detection and prognosis                              | Use Boolean reasoning and rule induction to detect, predict and diagnose interesting rules in a Meningitis dataset | Hybrid Rough sets                                                                                                                       | Zhong & Dong (2010)     |
| Biological Sequence Classification (DNA or protein sequence) | Comparative techniques for classifying Biological sequences                                                        | $k$ Nearest Neighbors ( $k$ NN), $n$ Order Markov chain models and Support Vector Machines (SVM).                                       | Deshpande & Kary (2002) |
| Gene expression clustering                                   | Similarity thresholds for forming data groups of genes                                                             | Iterative Gene Expressing Clustering (CAGE) from microarray data.                                                                       | Tseng & Kao (2002)      |
| Feature mining, general applications                         | A review on Classification Trees and Forests                                                                       | Classification Trees and Forest algorithms including: ID3, C4.5 and CART.                                                               | Chen et al., 2011       |
| Protein secondary structure prediction                       | Review of Protein second structure literature: Introduced several scoring metrics                                  | A discussion on Artificial Neural Networks including techniques Deep Recurrent Neural Network (RNN)                                     | Jiang et al., 2017      |
| Protein structure prediction                                 | Feature selection from microassay and bioassay datasets using evolutionary computing/neural techniques             | Genetic Algorithm Neural Network (GANN).                                                                                                | Tong & Mintra (2010)    |

**Table.3:** Brief description of some AI/machine learning techniques used in recent research in the fields of molecular biology and biochemistry.

| AI Technique                    | Class/Level                      | Operation                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Support Vector Machine (SVM)    | Machine Learning (Shallow)       | Basically, uses a concept called “best-decision hyperplane” for automatically classifying data into classes.                                                                                                                                                                           |
| Genetic Algorithms              | Evolutionary Computing (Shallow) | Uses principles of evolution for bio-data feature selection and network optimization which is based on Darwinian “Survival of the Fittest” hypothesis                                                                                                                                  |
| $k$ Nearest Neighbors ( $k$ NN) | Machine Learning (Shallow)       | Uses distance measures to build clusters from bio-data                                                                                                                                                                                                                                 |
| Hierarchical Temporal Memory    | Machine Intelligence (NA)        | Uses neurobiological inspired principles based on cortical learning theories/algorithms defined by intelligent operations in the neocortex for detection, classification, and prediction of biodata sequences. Can be very useful for detecting anomalies in time series biodata.      |
| Recurrent Neural networks       | Machine Learning (Deep)          | Uses deep learning principles and algorithms for detection, classification, and prediction of biodata. Some operations in the deep learning paradigm include but are not limited to:<br><br>Dimensionality reduction, batch learning, hyperparameter tuning and multilayer processing. |



An illustrative Example of AI in Drug Discovery Using Machine Learning Algorithm HTM.

Figure 1 illustrate a flow diagram of how a bioinformatic process for drug discovery may be accomplished. In such a process, a drug sequence or dataset is represented as a DNA-sequence drug pattern which is transformed into a sparse distributed representation using a technique based on machine learning intelligence algorithm called HTM-MAT. HTM is Hierarchical Temporal Memory; HTM-MAT is an AI technology with an algorithm that is inspired by the operational principles of the neocortex – the seat of intelligence in the brain. The technique offers support for predicting streaming or temporal structured data sequences all in a technical computing package.

Here, TV is the target value, DCN the drug compound name, and CS, compound sequences. While figure 2 is the HTM sequence Analyzer. Figure 3 is the flowchart of the same process, while the tables shows, the tuning parameter setting and the result of the process compared to, with other techniques.

### Experiment:

Two drug related datasets considered

- DNA-sequence dataset
  - ↳ 106 examples of DNA sequences – 53 are promoters and 53 are non-promoters.
  - ↳ Targets are promoters (re-labeled 2) and non-promoters (re-labeled as 1)
  - ↳ Goal - predict the target of a DNA-sequence (example) drawn from a sequence of DNA-sequences.
- RP-HPLC dataset
  - ↳ 52 samples of drug compounds (26train-10test)
  - ↳ 36 quantitative structural parameters
  - ↳ Goal – predict logkAGP which is the logarithm of RP-HPLC retention factor of acid glycoprotein (AGP) column.

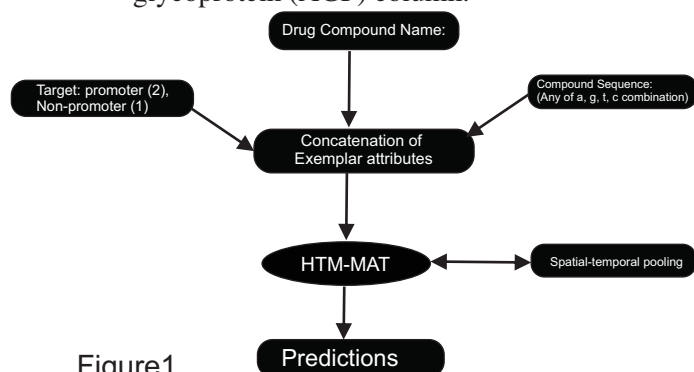
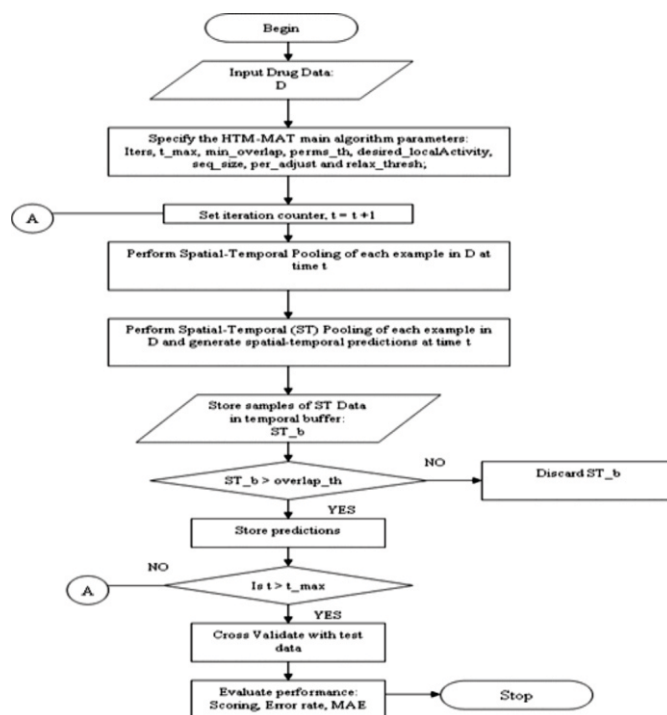
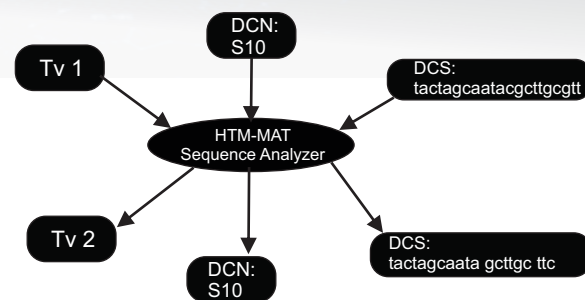


Figure1

- Experimental Technique
  - SDR (Sparse Distributed Representation) effect on DNA-sequence dataset
  - TV-target value, DCN - DNA compound name, DCS – compound sequence



$$\rho_{likelihood} = \frac{\left( \sum_{i=1}^N (S_{pred(i \arg et)} \equiv S_{test\_examples(i \arg et)}) \right)}{N}$$

Fitness function for the optimization algorithm

- Relaxation factor is a novel functional parameter introduced to further optimize HTM-MAT
- View the Relaxation factor as some sort of probabilistic threshold similar to performance metric – where any match of a generative cell with a real-world observation is a cause!
- Relaxation factor is tunable but with a fixed prior

Result:

| Relaxation factors | Average Error -rates |
|--------------------|----------------------|
| 1.000              | 0.3283               |
| 0.950              | 0.1075               |
| 0.900              | 0.0057               |
| 0.850              | 0.0019               |
| 0.800              | 0.000                |
| 0.750              | 0.000                |



| Dataset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | HTM-MAT                                   | ANN<br>(Bucinski et al, 2009) | KBANN<br>(Towell et al, 1990) |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-------------------------------|-------------------------------|
| drug_data1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 0.2449 <sup>a</sup> , 0.0265 <sup>b</sup> | 0.144 <sup>c</sup>            | -                             |
| drug_data2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 0.0283 <sup>d</sup>                       | -                             | 0.038 <sup>e</sup>            |
| <sup>a</sup> Mean Absolute Error (MAE) is reported for 10 MC iterations after 10 consecutive simulation runs using data from Bucinski et al, 2009).<br><sup>b</sup> Mean Absolute Error (MAE) is reported for 5 MC iterations after 10 consecutive simulation runs using data from Bucinski et al, 2009).<br><sup>c</sup> Reported MAE using a conventional multilayer perceptron ANN from (Bucinski et al, 2009).<br><sup>d</sup> Reported error rate for HTMMAT using the procedure and data reported in (Towell et al, 1990).<br><sup>e</sup> Reported error rate from Towell et al (1990) using the KBANN |                                           |                               |                               |

\*\*\*\*How do we assess Artificial Intelligent methods?

AI application methods are assessed by the following benchmark metrics: F1-Score, Accuracy, Precision, Confusion Matrix, and Fitness functions especially for evolutionary and optimization Algorithms.

**F1-Score:** A measure of Statistics used to evaluate the performance of a classification model, it is a harmonic mean of precision and recall.

Precision = True Positives/ (True Positives + False Positives), Recall = True Positives/ (True Positives + False Negatives)

**Formula:** 2\*(Precision \* Recall)/ (Precision + recall)

**Accuracy:** A measure of how well a model/system performs, an ensemble of correct prediction or classification over the number of attempts. Interpretations are Perfect accuracy (100%), High Accuracy (90%), and Low accuracy (below 70%). An alternative to F1 -score, Precision, and Recall.

**Formula:** True Positives + True Negatives)/Size of samples

**Confusion Matrix:** This a matrix table used to evaluate the performance of a classification model. It can be used to calculate other metrics, F1 -score, Precision, Recall, and Accuracy.

**Fitness Function:** This is a mathematical function that is used to evaluate solutions produced in solving optimization problems. It takes a solution as an input and returns a value that shows its quality or fitness to that problem. Characterized to have clear objective, measurable value for each solution, and allows for comparison between different solution. Types are single, multi, and constrained objectives of optimized solutions. Use cases are in Genetic, Evolutionary, and Optimization algorithms.

**Formula:** Fitness = f (derived solution)

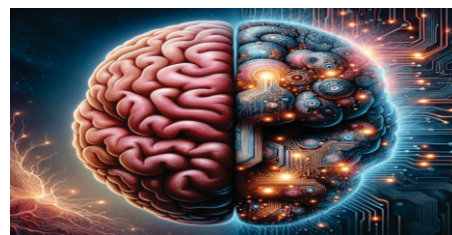
In the above experiment the DNA sequence was restructured and the result was tested for fitness based on the target value with the relaxation factor (threshold) providing the tuning effect.

So, AI doesn't just accelerate the process. It elevates the possibilities. It uncovers patterns we didn't know to look

for, and here's where it gets really exciting. It finds weak signals in noisy data. It spots connections across disciplines—like linking protein folding with climate data or agricultural patterns with public health. For instance, AI is helping epidemiologists find previously unseen links between seasonal crop yields and regional respiratory health, offering new opportunities for cross-sector collaboration. One surprising example? AI models that detect correlations between seasonal crop yields and disease outbreaks, helping both farmers and hospitals plan better.

**This is the game-changer:** AI expands the canvas on which scientists can paint. It's not replacing creativity—it's unlocking more of it. And in a world where time, accuracy, and insight are more valuable than ever, AI is turning the scientific method from a cycle into a cascade—where insights flow continuously, experiments update dynamically, and discovery accelerates like water down a well-designed channel.

So, if it feels like science is moving faster these days—it is. But it's not just speed for speed's sake. It's speed with strategy. Insight with agility. Discovery with direction. That's what happens when AI changes the game. So, ask yourself—how might AI reshape your research tomorrow?



## 6. Technopreneurship and the New Lab Economy

Let's talk about something truly exciting—where innovation meets opportunity: technopreneurship. We've seen how AI is revolutionizing lab work—now imagine harnessing that power not just to discover, but to build, launch, and scale impactful ventures. It's no longer just about working in a lab. It's about turning lab discoveries into products, startups, and scalable solutions that change the world—and AI is the bridge that makes it possible.

In this new lab economy, data isn't just a by-product of research—it's the currency. This economy is global, decentralized, and powered by both venture capital and open collaboration. Algorithms are the engines. And scientists? They're not just researchers—they're also creators, founders, and problem-solvers. The integration of AI allows small labs to punch above their weight, giving even resource-constrained researchers the ability to compete globally.

We're seeing AI-powered diagnostics being spun off into mobile health startups. Lab automation platforms turning into scalable SaaS solutions. Researchers becoming CEOs of biotech companies—armed not just with insights, but with agile tools to go to market.





Take the example of Synthace, a startup software company in the UK, that turned AI-driven experimental design into a platform that streamlines lab workflows for scientists across disciplines—helping labs reduce time spent on trial-and-error by automating entire experimental processes. Or consider Benchling, their mission to unlock the power of Biotechnology, began as a lab notebook app and evolved—thanks to intelligent data integration—into a cloud-based powerhouse supporting global biotech teams and improving collaboration across research pipelines.

This shift is not just about technology—it's about mindset. The most successful technopreneurs aren't the ones with the fanciest tools, but those with the boldest ideas and the courage to launch it. Just look at the story of Dr. Sarah Richardson, a synthetic biologist who co-founded MicroByre—a company reimagining industrial bacteria—with a mission powered by both AI and unshakeable curiosity. AI levels the playing field. It makes iteration faster, pivots smarter, and scaling less risky. And in doing so, it empowers scientists to stop waiting for permission but to start building.

In this economy, labs are no longer locked behind institutional doors. They're mobile. Collaborative. Entrepreneurial. The boundaries between academia, industry, and entrepreneurship are blurring—and that's a good thing. It means your next breakthrough doesn't have to end with a publication. It can begin with a pitch deck.

So, whether you're in a university lab, a garage lab, or just dreaming one up in your notebook—remember this: AI isn't just powering research. It's powering possibility. And in the new lab economy, that possibility belongs to everyone brave enough to innovate. The only question is—what will you build?



## 7 Ethics, Trust & the Human Touch

With all the buzz around AI revolutionizing labs and launching technopreneurs, there's a deeper question we must ask: just because we can automate, should we? When a self-driving diagnostic tool makes a call that even experts can't explain, or an AI model is deployed without transparency—should we still trust it? Science has always been about more than results—it's about responsibility.

As AI systems take on more tasks in the lab, we also hand over more decisions. That means we need to ask: can we trust the models we've built? Do we understand how they work, what data they rely on, and whether they inherit bias? Because when an algorithm informs a drug formulation, flags a patient anomaly, or guides an environmental policy, the stakes are high—and so is the need for transparency.



This is where explainable AI (XAI) comes in. Imagine an AI tool suggesting a treatment path that contradicts standard practice—with no rationale offered. That's not just frustrating—it's dangerous. Scientists need to know why the model gave a certain result, not just what it predicted.

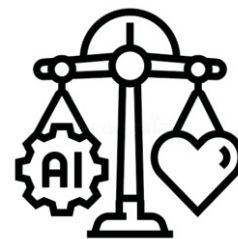
\*\*\*\*How do we explain and interpret Prediction derived from Artificial Intelligent Techniques (AIT)?

**Model-agnostic interpretability methods:** We use Model-agnostic interpretability methods/ techniques to explain and interpret the predictions of machine learning models, without requiring any modifications to the underlying model architecture. These methods are "model-agnostic" because they can be applied to any machine learning model, regardless of its type, architecture, or complexity.

### Common model-agnostic interpretability methods:

1. SHAP (SHapley Additive exPlanations): SHAP assigns a value to each feature for a specific prediction, indicating its contribution to the outcome.
2. LIME (Local Interpretable Model-agnostic Explanations): LIME generates an interpretable model locally around a specific instance to explain the prediction.
3. TreeExplainer: TreeExplainer is a model-agnostic interpretability method that explains the predictions of





tree-based models, such as decision trees and random forests.

4. Partial Dependence Plots (PDPs): PDPs visualize the relationship between a specific feature and the predicted outcome.

5. Individual Conditional Expectation (ICE) Plots: ICE plots visualize the relationship between a specific feature and the predicted outcome for individual instances.

6. Feature Importance: Feature importance methods, such as permutation importance, assign a score to each feature based on its contribution to the predicted outcome.

7. Model Interpretability through Attributions (MITA): MITA assigns attributions to each feature for a specific prediction, indicating its contribution to the outcome.

8. Contrastive Explanations Method (CEM): CEM generates contrastive explanations by finding the most relevant features that distinguish a specific prediction from others.

9. Anchors: Anchors generates explanations by finding the most relevant features that "anchor" a specific prediction.

10. Local Interpretable Model-agnostic Explanations with Visualizations (LIME-Viz): LIME-Viz generates visualizations to explain the predictions of machine learning models.

Model-agnostic interpretability methods provide insights into the decision-making process of machine learning models, helping to build trust, identify biases, and improve model performance.

Trust is earned through clarity. And clarity, in the age of AI, is not optional—it's ethical.

Bias in data is another challenge. One way to mitigate this? Build AI systems with diverse teams—people who bring different perspectives to the training data, the algorithms, and the evaluation process. If we train models on incomplete or skewed datasets, we risk replicating human prejudice in machine logic. This isn't just a technical problem—it's a societal one. Ethical science means not only building accurate models, but also inclusive ones.

There's also the human factor. The best labs don't just run smoothly—they think critically, ask better questions, and interpret results in the broader context of humanity. AI can support that process, but it can't replace it. It can crunch numbers, but it can't care. It can analyze patterns, but it can't advocate for people. That's where you come in. As Nobel laureate Jennifer Doudna once said, 'The power of CRISPR lies not just in its precision, but in how thoughtfully we choose to use it.' The same is true for AI. We must remember that ethics isn't just a chapter in a thesis—it's a living principle. As scientists, entrepreneurs, and educators, we don't just build systems. We build trust. And trust is what allows science to move forward without losing its soul.

So, as we embrace the power of AI, let's also embrace the responsibility that comes with it. Let's champion systems that are not only smart, but fair. Let's teach our students not just how-to code, but how to care. Let's build technologies that make science not only faster—but better for everyone. Because in the end, the question isn't whether AI can do amazing things—it's whether we can guide it wisely enough to do the right ones.

## 8. Call to Discovery – Shaping the Future with AI



We've journeyed from the candlelit benches of early science—like Galileo's rustic observatory or Curie's modest lab in Paris to the algorithmic landscapes of today's intelligent labs. We've seen how AI is accelerating discovery, fueling entrepreneurship, and reshaping what's possible in the world of research. But now the spotlight shifts—not to technology, but to us.

The future of science isn't just about faster machines or bigger datasets—it's about the people who dare to ask better questions. It's about you—the student curious enough to run one more test, the researcher brave enough to rethink an old method, the entrepreneur bold enough to build something that doesn't exist yet.

AI is a remarkable tool. But a tool is only as powerful as the hands—and minds—that wield it. Think of pioneers like Katherine Johnson or Elon Musk—individuals who didn't just use technology, but stretched it to serve bold, human-driven visions. It can amplify creativity, but it cannot spark it. It can process logic, but it cannot inspire purpose. That remains our role.

So, what does this moment ask of us? It asks us to stay curious. To ask not just 'how does it work?' but 'what is it for?' To stay human. To learn the systems—but also question them. To embrace technology—but never surrender our judgement. To build boldly—but always



with intention.

The next great breakthroughs won't come from machines alone. Just look at how researchers at MIT used AI to design a new antibiotic compound—one that no human had considered, yet was validated in trials. It took the machine to scan the possibilities, but it took the human mind to see its purpose. They will come from partnerships—between code and conscience, between AI and the awe of human inquiry. At this stage you may ask, can AI and human being coexist and work together? The answer is Yes, but this answer lies in the fact that AI can help human beings improve work efficiency, freeing time for them to focus on more sensitive tasks by means of handling bulk processing. The collaboration can cut down costs, time, fetch good ROI, and improve overall customer satisfaction.

So, I leave you with this: in the age of AI, the greatest discovery may not be what the machine finds—but what we do with it next.

Because the future of science isn't just being automated. It's being imagined. And the question is—how will you help shape it? It's being imagined right now by all of us.

Thank You and by way of Closing Remarks

Let me thank you for joining me on this journey—from the past to the present, and into the boundless future of science and AI. I'm deeply grateful to the organizers of this conference, and to each of you—students, researchers, entrepreneurs, and educators—who continue to push the boundaries of what's possible.

I hope today has sparked new questions in your mind, new ideas in your notebooks, and new confidence in your ability to lead in this new era of discovery. I hope you have learned, unlearn and possibly relearned.

So, go forward—build, question, innovate. And remember, the future isn't something we wait for. It's something we shape.

Thank you—and I look forward to your questions.. It's being imagined. And the question is—how will you help shape it? It's being imagined. Right now. By all of us.

## National Anthem

Nigeria, we hail thee,  
Our own dear native land,  
Though tribe and tongue may differ,  
In brotherhood we stand  
Nigerians all,  
Are proud to serve our sovereign Motherland.

Our flag shall be a symbol  
That truth and justice reign,  
In peace or battle honoured,  
And this we count as gain,  
To hand on to our children  
A banner without stain.

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## THE UNIVERSITY ANTHEM

On the green low lands and swampy planes  
Of the new Calabar Rivers stand  
The University of Port Harcourt  
A citadel of learning and excellent education  
A home of academic enthusiasts,  
Searching, searching for knowledge and wisdom.

Enlightenment and self-reliance, our mission,  
Our hope in the future is rooted in God alone;  
The vision of our father shining in the stars,  
Opportunities, unlimited and equal,  
Our progenies citizens of the universe  
From far and near, the pride of Uniport echoes.

### Refrain:

Unique, Unique, Unique Uniport  
Unique, Unique, Unique Uniport



# UNIVERSITY OF PORT HARCOURT

## FACULTY OF SCIENCE

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Port Harcourt, Nigeria



### GOODWILL MESSAGE

I have the singular honour and privilege to send this goodwill message on the occasion of the 2<sup>nd</sup> edition of the World Laboratory Day 2025, organized by Central Instrument Laboratory (CIL), University of Port Harcourt.

May I congratulate the Director, Central Instrument Laboratory (CIL), Prof. M. Ibezim Ezeani, as well as the conference planning Committee for putting together this world class international conference with the arrays of speakers, panelist, moderators and discussants of the various sessions of the conference. I am particularly elated by the fact that this conference brings together all stakeholders in our Laboratories to share experience on the challenges affecting research and innovation technology for climate change and global issues.

This year's conference theme "Research and Technopreneurial Advances for Climate and Global issues" is apt, as the impacts of climate change are diverse, highly ambiguous and varies depending on space and time. Research and technopreneurial advances are important responses to operational and realistic adaptation and mitigation of threats posed by climate change. Hence, articulating research and developing innovative technologies towards addressing climate change and other global issues are considered a worthy project.

Research and technopreneurial advances for climate and global issues presents different technological approaches to mitigate sources of GHGs to address the consequences of global warming. This recent approach focuses on the development and deployment of innovative technologies that improve energy efficiency, renewable energy, nuclear energy and carbon capture storage.

In conclusion, I wish us all a fruitful deliberation and hope you will come up with recommendations that will propel innovative technologies that could ameliorate the damming impact of climate change and associated global issues in our society as we progress in the various sessions of this conference.

Prof. C. N. Ehirim  
Dean, Faculty of Science





# EXTERNAL QUALITY ASSESSMENT: *The Backbone of Laboratory Accreditation*

**PASCHAL UGWU** MIPAN, MACS, MICCON, MCSN  
Gen. Manager- Quality & Laboratory Services  
Laser Engineering & Resources Consultant LTD

## INTRODUCTION

The World Laboratory Day is celebrated yearly to commemorate the significant role the laboratory plays in building the society. Like the famous Louis Pasteur (1822-1895) once appealed and I quote “I beseech you to take interest in these sacred domains so expressively called laboratories. Ask that there be more and that they be adorned for these are the temples of the future, wealth and well-being. It is here that humanity will grow, strengthen and improve.” This appeal is the truth of our days as major breakthroughs in human history was baked and nurtured in the laboratory and therefore the role laboratory play in research and technological advancement cannot be overemphasized in our modern-day society.

There is a saying that data rules the world. Majority of these data are products of laboratory activities. Every important industrial and medical decisions are taken relying on laboratory data and with dare consequences if such data are wrong. As a result, it's very critical that laboratories generate accurate but reliable data. Accurate in the sense that the data must be analytically correct and reliable in the sense that the data must be representative of its original sample. This calls for commitment and investment in the quality control and quality assurance of the laboratory. This actually differentiates the real laboratories from the quacks.

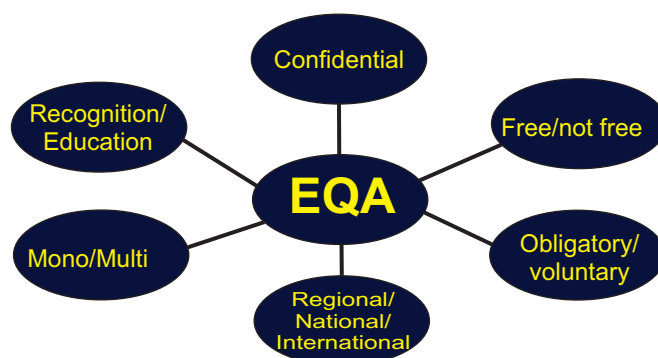
Laboratory activities are globally acclaimed and recognized with guidelines and standard requirements for its operations. No laboratory can work in isolation as the demand and awareness for standardized laboratory procedures and documentation is on the high with attendant strict measures offered by accreditation bodies for compliance to standard requirement. Robust and active laboratory quality assurance is key in ensuring accurate, defensible and reliability of data. This could be both internal and external, it is internal when laboratories have their procedures and quality control practices which validates the laboratory data and external when the laboratory employs some external

mechanism called External Quality Assessment (EQA) as part of her quality assurance management in ensuring the validity of laboratory data. Like the topic of this discourse says, External Quality Assessment (Proficiency Testing), The backbone for Laboratory Accreditation, the external quality assurance or assessment gives a third-party credence to the quality of generated data in a laboratory and as well validates the laboratory processes that generates the data. This is the only basis for which accreditation can be conferred to a specific scope of the laboratory activities in line with the ISO/IEC 17025:2017 standards which is the standard requirement for the competence of testing and calibration laboratories. This also implies that the laboratory has been able to demonstrate its capability to apply a standard method correctly to generate accurate but reliable results. This also entails that such accredited methods are reproducible within some acceptable range when applied elsewhere in the world. Furthermore, accreditation which is always backed by proven performance in external quality assessment confers to a laboratory the status of being a global laboratory.

## EXTERNAL QUALITY ASSESSMENT

The term external quality assessment (EQA) is used to describe a method that allows for comparison of a laboratory's testing to a source outside the laboratory. This comparison can be made to the performance of a peer group of laboratories or to the performance of a reference laboratory. The term EQA is sometimes used interchangeably with proficiency testing; however, EQA can also be carried out using other processes. Therefore, EQA is defined as a system for objectively checking the laboratory's performance using an external agency or facility

## PRINCIPAL CHARACTERISTICS OF EXTERNAL QUALITY ASSESSMENT





## EXTERNAL QUALITY ASSESSMENT: *The Backbone of Laboratory Accreditation*



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**Confidentiality:** Individual laboratory results are kept confidential. Usually each laboratory is given a code only known to the laboratory and the EQA provider. The result of the EQA is published using this code. However, the participating laboratories would have access to the overall results generally provided and allows comparison to the overall group.

**Free/Not free:** EQA programs can either be free-of-charge or require a fee. Free EQA programs include those offered by a manufacturer to ensure equipment is working correctly, NGOs and those organized by a regional or national program for quality improvement.

**Obligatory/Voluntary:** Some EQA programs are obligatory, either required by an accrediting body or by law. Others are voluntary, and the quality manager may choose to voluntarily participate in an EQA program in order to achieve improvement in the quality of the laboratory's performance.

**Regional/National/International:** The EQA program can be organized at different levels: regional, national, or international.

**Mono/Multi:** Some EQA schemes may address a single property, for example the EQA program for E. coli. Others may address many kinds of laboratory tests, like metals, physical properties and anions.

**Recognition:** Successful performance in an EQA program reflects the effectiveness of the laboratory's quality management, and allows for recognition of laboratory quality by external groups. EQA is important for improvement of the laboratory quality management system, as it is a measure of laboratory performance

**On-site evaluation:** Usually done when it is difficult to conduct traditional proficiency testing or to use the rechecking/retesting method. This involves a periodic visit by evaluators to assess laboratories using standardized techniques. This method is particularly useful when other EQA methods are not feasible or effective.

Another type of EQA is the inter-laboratory comparison (ILC) which involves the exchange of samples among a set of laboratories, usually practiced where proficiency testing is not available.

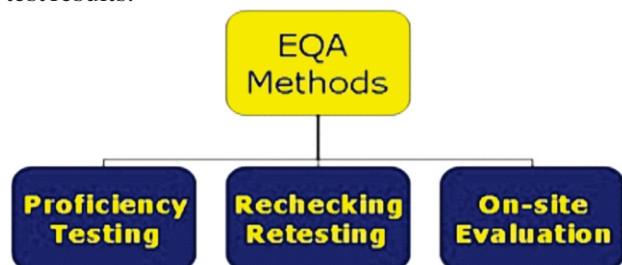
The inter-laboratory comparison (ILC) is defined by the standard ISO/IEC 17043:2010 as the organization, performance, and evaluation of calibration/test results for the same or similar item by two or more laboratories in accordance with predetermined conditions. ILC represents very effective means to demonstrate technical competence of the participant and also serves as a technical base for accreditation. Furthermore, it is a critical element for monitoring of quality of measurement results as required by ISO/IEC 17025:2017.

**Proficiency Testing (PT):** This is a process where a laboratory is given unknown samples to analyze, allowing for an external assessment of their processes and competence compared to established standards, typically by comparing their results with known value and to those of other participating laboratories, to identify areas for improvement and ensure quality control in their work.

Essentially, it's a way to verify if someone is performing a task at a required level of skill by testing them against known values that they are unaware. In other words, Laboratory proficiency testing is a process that assesses a laboratory's performance and accuracy by using unknown samples from an outside source. It's a crucial aspect of quality assurance, ensuring that labs consistently produce reliable and accurate results. This type of testing helps identify potential issues with procedures, equipment, or personnel training, ultimately improving the quality of laboratory work.

## TYPES OF EQA

External Quality Assessment (EQA) encompasses various methods for evaluating and improving the quality of analytical testing, often performed by laboratories. These methods include proficiency testing, on-site evaluations, and rechecking of samples. The main goal of EQA is to ensure reliable and comparable test results.



**Rechecking or retesting:** This is common with Biomedical laboratory where slides that have been read are rechecked by a reference laboratory; samples that have been analyzed are retested, allowing for inter-laboratory comparison. In other words, it involves a second laboratory independently testing samples that have already been tested to verify the accuracy of the original results

## PROFICIENCY TESTING PROCESS

In the proficiency testing process, laboratories receive samples from a proficiency testing provider. This provider may be an organization (non-profit or for-profit) formed specifically to provide PT. Other providers of proficiency testing include central reference laboratories, government health agencies, and manufacturers of kits or instruments.

In a typical PT program, challenge samples are provided at regular intervals. An optimal frequency will be 3-4 times yearly. If the program cannot provide challenges or rounds with this frequency, the laboratory may be able to seek additional sources.



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The laboratories participating in the program analyze the samples and return their results to the central organization. Results are evaluated and analyzed, and the laboratories are provided with information about their performance and how they compared with other participants. The participating laboratories use the information regarding their performance to make appropriate changes and improvements.

### ROLES OF THE PARTICIPATING LABORATORY

To be successful, PT instructions must be followed carefully, all paper work completed accurately, and results submission deadlines met. All PT results, as well as corrective actions, should be recorded and the records maintained for an appropriate period of time.

PT is a tool to measure laboratory performance. Therefore, there must be no difference in the treatment of PT samples and the routine samples. Proficiency testing providers make every effort to produce samples that exactly mimic, or closely resemble, usual samples received normally by the laboratory. PT samples must be processed by normal testing method(s) and involve personnel who routinely perform the testing.

When PT is used for any purpose other than internal quality improvement, the provider or central organization generally prohibits the discussion of results with other laboratories. Some PT organizers send different samples to different groups of laboratories to avoid inter-laboratory discussion.

### EVALUATION AND FEEDBACK TO PARTICIPATING LABORATORY

Upon closing a cycle or round, the PT provider will undertake statistical analysis and produce a report. The level of detail in a report will vary from provider to provider, but as a minimum, the laboratory should be able to easily see their performance against an assigned value or target, and compare it to acceptable limits of performance. There is no 'regulation' of what Analytical Performance Specification (APS) a PT provider should use, but several publications may have re-commendatory character as they report on APS for PT.

The choice of assigned value and performance specifications varies from provider to provider. The PT provider is responsible for informing their participants how the target value was assigned and the laboratory needs to assess whether the assigned value and performance specifications they are being assessed against are beneficial to their laboratory requirements.

In most cases, a PT provider will notify the participant when a report is ready for review. This may be an interim report or the final report. Participants will receive an individual report where their performance is assessed. In addition, there may be, where appropriate, expert comments discussing the general performance, possible sources of errors, suggestions on corrective actions and

other scientific content. Depending on the respective national legislation, results of the assessments are communicated only to the participant, or to supervisory authorities.

Finally, participants need to be aware of how they can give a response, or appeal, to the PT provider about the evaluation of their PT results if required. All information related to a participant's results and performance evaluation is confidential unless supervisory authorities require it differently according to national legislation.

### PARTICIPANT'S REVIEW OF PT REPORTS

The role of the laboratory is not merely to participate and analyse PT samples, they also need to actively review and act upon their results and any feedback reported by the PT provider.

It is the participant's responsibility to review each report, and the participant's local procedures will determine how they record within their Quality Management System (QMS) and what action is taken for poor performance. A participant may record satisfactory all PT returns within their QMS, or they may only record poor or borderline performance. The PT provider will have performance limits/criteria for their own PT programs and participants should adhere to these as they are all part of the PT program design. However, they may also have their own internal assessment triggers.

One mechanism of recording borderline/poor performance is using the Corrective Action/Preventive Action procedure, which should be established in all ISO-accredited laboratories. The depth of investigation and recording of borderline/poor performance will depend on the individual laboratory.

### FAILURE IN PT – WHAT SHOULD THE LABORATORY DO?

Beyond what regulatory bodies may require after a PT failure, the laboratory management needs to assess the risk of continuing testing, whether testing should be stopped until a root cause can be identified, or whether the failure is unlikely to affect other results and testing can continue. The laboratory management must also assess the need to control all samples tested since the last PT exercise.

The first step to resolution after a PT challenge failure is a Root Cause Analysis (RCA). A root cause analysis – as the name implies – is an investigation to uncover the ultimate cause of a failure. Once the root cause has been identified, it is essential to determine whether and how many test results were potentially affected by the gap in the process. These changes in results need to be listed in corrective reports. The impact is usually more likely when a problem is systemic. Accreditation bodies will review the report, communicate with the laboratory about any concerns, and store the report in the



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laboratory's file for the next accreditation assessment so the assessors can follow up on corrective actions.

When evaluating a PT report, a laboratory also needs to consider the performance specifications used by the PT provider and how much bias from the assigned value requires corrective action, with its uncertainty of the bias correction. According to ISO 15189:2022 laboratories should define their criteria for successful PT participation. Whether a laboratory sets different satisfactory performance criteria than those used by the PT provider will depend on the type and rationale of the tolerance limits provided by the PT organiser. When selecting a suitable PT, laboratories are advised by ISO 15189:2022 to consider sample commutability, assigned value and tolerance limits in relation to the intended use of the particular PT program.

It is important to state that although a failure in PT may have some immediate consequences for the laboratory, the process to correct this failure strengthens and improves the laboratory's quality and subsequent results.

### PT PROVIDERS-WHO ARE THEY?

ISO/IEC 17043:2013 is an international standard that specifies requirements for proficiency testing providers. It helps ensure that these providers are competent, impartial, and reliable.

It specifies the requirements for the development, and competent operations of Proficiency Testing Providers (PTP) and helps maintain the integrity of laboratory testing processes.

The ISO/IEC 17043:2023 accreditation of a PT program or individual measurand(s) also demonstrates the competency of the PT provider in terms of statistical analysis, information to participants, homogeneity and stability of PT samples, which is necessary for the PT results to reflect the laboratory's performance.

### THE BENEFITS OF PROFICIENCY TESTING

- Provides staff with an insight into their laboratory's performance and builds confidence
- Improves the standard of the laboratories analytical process
- Demonstrates to clients, colleagues and accreditation bodies that there is a commitment to quality
- comparison of performance with that of other laboratories, nationally and internationally
- Educates staff, providing a better understanding of the impact of incorrect results
- Identifying staff competencies and training needs
- Identifying potential problems and determining corrective and preventive actions for the improvement of technical work.
- Offering an overview of the quality of specific analyses in a particular sector, country or region
- Providing confidence to customers
- Assisting laboratories in making informed decisions

and proper planning for equipment upgrades, where necessary

- It provides independent feedback on the quality of analytical results, enabling laboratories to monitor and improve performance over time
- Providing regular, objective and independent assessment of the quality of the routine analysis.
- Delivering comparative information on the performance of methods and instruments.

### LIST OF ACCREDITED PT/EQA PROVIDERS

- ↳ LGC AXIO Proficiency Testing-  
[www.lgcstandards.com/](http://www.lgcstandards.com/)
- ↳ ASTM-PTP
- ↳ Medical Laboratory Science Council of Nigeria-  
MLSCN NEQAL Laboratory, Zaria, Kaduna State, Nigeria
- ↳ IPAN-Not accredited yet
- ↳ Thistle South Africa
- ↳ EQAS, UK
- ↳ One world Accuracy, Vancouver, Canada  
[www.eptis.bam.de/](http://www.eptis.bam.de/)
- ↳ [www.aplac.com](http://www.aplac.com)
- ↳ [www.pta.asn.au/pta\\_home.html](http://www.pta.asn.au/pta_home.html)
- ↳ [www.eraqc.com](http://www.eraqc.com)
- ↳ [www.wadsworth.org](http://www.wadsworth.org)
- ↳ [www.absolutestandards.com](http://www.absolutestandards.com)
- ↳ [www.microcheck.com](http://www.microcheck.com)
- ↳ [www.aoac.org](http://www.aoac.org)

### PT AND ACCREDITATION

Proficiency testing and accreditation are distinct but interconnected processes crucial for ensuring the quality and reliability of testing and calibration activities. Proficiency testing involves laboratories comparing their results against an assigned value, while accreditation is a formal recognition of a laboratory's competence by a third-party body.

Proficiency testing is a crucial tool for assessing laboratory performance and demonstrating competence, which is a key requirement for laboratory accreditation to ISO/IEC 17025 or ISO 15189:2022.

Therefore accreditation is defined as a formal third-party recognition by an authoritative body (NiNAS) of the competence to work to a specified standard (carry out a specific conformity assessment work like inspection, testing, calibration or certification).

In Nigeria, ISO/IEC 17025:2017 accreditation is managed by accreditation body such as the Nigeria National Accreditation System (NINAS) for Testing and Calibration Laboratories. Laboratories seeking certification must undergo a rigorous accreditation process to demonstrate compliance with the standard's requirements.

The ISO/IEC 17025:2017 implementation process would involve several steps. Here, are the outline of the implementation process:



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### ISO17025: 2017 Implementation Certification Process



#### Initiation:

The first step for the ISO 17025: 2017 implementation process is to identify the need and benefits of ISO/IEC 17025 accreditation. Obtaining ISO 17025 certification will enhance the credibility and trustworthiness of your laboratory's testing and calibration services. It provides complete assurance to your clients, internal and external stakeholders, and regulatory authorities that the laboratory consistently delivers accurate and reliable results. Once you decide to go ahead with the accreditation process, the next step is to appoint an expert consultant, and a team of experienced personnel to oversee the implementation process.

#### Gap Analysis:

While planning ISO 17025 accreditation, whether you plan to undertake the process yourself or use the services of an expert consultant, it is essential that you identify and evaluate the gap that needs to be bridged to get your testing and calibration laboratory from where it is now to the standard of compliance needed to secure ISO 17025 accreditation. Evaluate current laboratory practices against ISO/IEC 17025 requirements and identify the areas of improvement. This is a thorough evaluation exercise.

#### Training and Awareness:

It is imperative to understand the importance of personnel competence in performing calibration and testing services. This is one of the key requirements for complying with the ISO 17025 standards. All the relevant documentation related to personnel training records, qualifications, competence assessments, responsibility, and task logs must be documented. This ensures, that all the laboratory personnel are well-trained and competent in their respective roles. At Laser, we provide training and awareness programs to our clients regarding ISO/IEC 17025 requirements, roles, and responsibilities. Contact us today to accelerate your team performance and achieve laboratory excellence.

#### Resource Allocation:

The ISO 17025 accreditation process needs proper

resource allocation. You must allocate necessary resources such as personnel, budget, and infrastructure, for the implementation process.

#### Documentation:

Documentation serves as a backbone of quality management systems for demonstrating compliance with the ISO 17025 requirements. It encompasses a wide range of documents such as Quality Manual, Procedures (such as sample handling, equipment calibration, SOPs etc), Work Instructions (such as safety manuals, sample preparation, data recording), and Record-keeping systems (test reports, calibration certificates, equipment maintenance logs, training records, and audit findings) required by ISO/IEC 17025. Proper documentation is of utmost importance to demonstrate the accuracy, reliability, and traceability of processes and data to comply with ISO 17025 standards. This is not one-time work but a continuous process.

#### Process Alignment:

Align all the laboratory processes with ISO/IEC 17025 requirements, focusing on accuracy, reliability, and traceability.

#### Internal Audits:

A critical aspect for ISO 17025 implementation is conducting internal audits to assess compliance with ISO/IEC 17025 standards. It's important to perform regular assessments of the laboratory's quality management systems to identify non-conformities and areas for improvement.

#### Management Review:

It is important to conduct regular management review meetings to evaluate the effectiveness of the Laboratory Quality Management System (QMS). Make decisions for continual improvement wherever necessary.

#### Corrective Actions:

Implementing corrective actions to address identified non-conformities and improve processes is an important aspect of compliance. This is a continuous process with a risk-based approach to identify, determine, evaluate, monitor, record, and address the non-conformities to adhere to ISO 17025 standards.

#### Preparation for Certification Audit:

Preparing for an external audit is the final and important step for your laboratory. An external audit by an accreditation body checks the efficiency and compliance of your laboratory QMS. The auditors check whether your documentation meets all requirements of ISO 17025 standards, whether all the procedures and processes are followed correctly, and whether all your staff and personnel are qualified, trained, and know their



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role in QMS. The result of the external audit will grant your certification to maintain compliance standards or your laboratory needs some corrective actions before becoming accredited. Being audited is time-consuming, costly, and requires meticulous efforts. .

### Certification:

You will receive ISO/IEC 17025 accreditation certificate upon successful completion of the certification audit.

### Post-Certification Support:

Post-certification, you must maintain compliance with ISO/IEC 17025 standards through ongoing monitoring, internal audits, and management reviews. Continuously improve the quality management systems (QMS) to enhance your laboratory performance.

This outline provides an overview of the ISO/IEC 17025:2017 implementation process. Each step may involve multiple sub-steps and activities, depending on the specific requirements of the laboratory and the complexity of its operations.

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## CENTRAL INSTRUMENT LABORATORY UNIVERSITY OF PORT HARCOURT CIL'S HALL OF FRAME

- Prof. Owunari A. Georgewill
- Prof. Iyeopu M. Siminialayi
- Prof. Clifford O. Offurum
- Prof. Kingsley I. Owele
- Prof. Chukwudi O. Onyeaso
- Prof. Onyewuchi Akaranta
- Prof. Ogbonna Joel
- Prof. Bourdillon O. Omijeh
- Prof. Chukwuemeka N. Ehirim
- Prof. Ikechukwu O. Agbagwa
- Prof. Eka B. Essien
- Prof. Gideon O. Abu
- Prof. Michael Horsfall Jnr.
- Prof. Ovire J. Abayeh
- Prof. Leo C. Osuji
- Prof. Peter J. Kpolovie
- Prof. Bolaji B. Babatunde
- Mr. Abiola Ogunrinde
- Mr. Yinka Ipadeola
- Mr. Paschal Ugwu
- Dr. Ekerette A. Daniel
- Mr. Harrison Wegwu
- Engr. Dr. Akuma Oji
- Prof. Mike Onyekaonwu
- Chief Engr. Sir Dr. Innocent Akuvue
- Hon. Sir Dr. Francis A Okoye
- Mr. Ramon Nasir
- Mr. Don C. Ezeani (Mayor)
- Pst. Mrs. Rose Okeugo
- Dr. & Dr. (Mrs) David Isiavwe
- Mr. Anthony I. Ibezim-Ezeani
- Mr. Saint-Peter
- Mr. Kingsley O. Wogwu



# UNIVERSITY OF PORT HARCOURT

**Prof. Bourdillon O. Omijeh**

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## Goodwill Message



On behalf of the Centre of Information and Telecommunication Engineering (CITE), I honourably extend my heartfelt congratulations to the Central Instrument Laboratory, University of Port Harcourt, as host for the 2nd International Conference on Laboratory Research and Technopreneurial Innovations, in commemoration of World Laboratory Day 2025.

This conference is significant as a platform for global intellectual exchange, innovation and collaboration. Its theme, "Research and Technopreneurial Advances for Climate and Global Issues," is visionary and critical for the time, to address the pressing challenges through interdisciplinary dialogue and actionable solutions.

The sub-themes are diverse, ranging from green energy and sustainable development to artificial intelligence and healthcare innovation, and highlight the importance of this landmark event.

I commend the organizers, keynote speakers, presenters, and all participants for their dedication to fostering meaningful dialogue and research collaboration. May the ideas that come from this conference be pioneering, transformative, and practical to shape the future of science and technology.

As we come together to share insights, inspire innovation, and forge partnerships, I am confident this event will leave a lasting legacy, further strengthening the role of laboratory research and technopreneurship in solving global issues.

Once again, congratulations to the organizing committee and everyone who contributed to making this conference a reality. I wish you all a successful and rewarding event.

Warm regards,  
Yours sincerely,



**Professor Gideon O. Abu**  
*Director, Central Instrument Laboratory*

# Historical Evolution

## OF THE CENTRAL INSTRUMENT LABORATORY (CIL)

### (I) APPOINTMENT OF DIRECTOR

July 2007 – Appointment of Ag. Director of the Central Instrument Laboratory of the University of Port Harcourt by the VC, Professor Don M. Baridam. The Terms of Reference (TOR) were spelt out, which included: To set up from scratch a state-of-the-art advanced research laboratory for teaching, research and consultancy.

Name: Dr. Gideon O. Abu

Rank: Senior Lecturer; (Professor - 2009.)

Education: BSc (Microbiology, ABU Zaria, Nigeria); PhD (Marine Microbiology, Maryland, College Park, Md. USA)

Experience at time of Appointment: Obtained PhD under a Central Research Laboratory setting at Maryland; did Post Doctoral Research at a Central Research Lab at Maryland; Served as HOD Microbiology, Uniport; had initiated a multifaceted Department (Environmental Remediation) at SPDC; had toured similar Laboratory settings in Europe and America.

### ACTIVITIES/ACHIEVEMENTS AT CIL

#### (I) SPACE ALLOCATION PRESENTATION/ HANDOVER OF DOCUMENTS

August 2007 - The Dean of Faculty of Science Professor C.M. Ojinnaka handed over keys to 2 rooms allocated to the Central Instruments Laboratory in Ofrima Hall.

#### (II) BUDGET APPLICATION AND APPROVAL

October 2007

#### (III) MOBILIZATION OF PERSONNEL

October 2007

Consulting Manager (Mr. A. R. Mumuni, HND; M.Phil; M.Sc.)

June 2008

Got a Lab Technologist – Gift Suotor (HND Physics Production Engineering)

July 2008

Got a driver - Innocent Amesì

December 2008

Got a Lab Attendant – Mr. Innocent K.G. Tom

August 2009

Appointment of Assistant Director – Miss Yewande O. Johnson

June 2010

- Secondment of Senior staff to CIL included
- 1 (No.) Chief Technologist – Mr. Nams Fiberesima
  - 1 (No.) Asst. Chief Technologist – Mrs P. Ejente
  - 1 (No.) Lab. Technologist II – Mr. Clinton Obele

### (IV) OVERHAUL OF EXISTING INFRASTRUCTURE/SPACE; CONSTRUCTION OF BLOCK WALLS TO REPLACE PLYWOOD

November 2007-November 2009

Desktop fact finding; Drawings, Scoping, Contract award for building of 2 Halls with dust-free rooms; installation of standard work benches;

March 2010 - Installation and connection to 250kva Gen Set at Ofrima Building Complex.

November 2010 - Pre-installation Training on PRISM equipment. (PRISM stands for: Procurement, Installation, Service and Maintenance, courtesy International Foundation for Science, IFS)

November 2010

Pre-installation in-house training

February 2011

Arrival of PRISM Project Equipment

### (VI) PUBLICITY

April 2008- Advertorial Poster of CIL at the 2008 Convocation

June 2008- LNG staff visited the lab ( c/o Professor J. Ebeniro)

September- 2008 Fact-finding visit from Local IFS PRISM project team

Jan 2009 – UNEP Officials visited CIL

March 2009 - IFS PRISM Project visited CIL

August 2009 - IFS PRISM Project (UNIPORT) attended Regional Training/Meeting in Kano

### ACHIEVEMENTS

The contributions of the Central Instrument Laboratory (CIL) to UNIPORT

The establishment of the Central Instrument Laboratory (CIL) was a great foresight by the university management.

The Central Instrument Laboratory is a specialized advanced instruments facility capable of carrying out investigations at the micro analytical scale such as parts per million/billion (ppm/ppb).

The John D and Catherine T MacArthur Foundation/Ifs Grant

The CIL has attracted equipment worth more than Four hundred thousand US dollars to the University through



the John D and Catherine T Mac Arthur Foundation administered by the International Foundation for Science (IFS) under a program codenamed PRISM project.

The Central Instrument Lab (CIL) has placed UNIPORT among six universities currently having a strong bilateral rapport with the John D and Catherine T. McArthur Foundation through the International Foundation for Science (IFS) in Nigeria. The IFS is arguably the biggest research granting body to the developing world. This bilateral rapport is therefore a mark of recognition for UNIPORT among its peers.

Through the MacArthur/IFS grant a total of 11 instruments and equipment with varying levels of sophistication were delivered at the Lab in February 2011, they include:

1. Gas Chromatograph (GC) 2. Atomic Absorption Spectrometer (AAS) 3. High Performance (Pressure) Liquid Chromatograph (HPLC) 4. Spectrographic Microscope 5. Epifluorescence Microscope 6. Microtox machine 7. Water Purification System 8. High Vacuum Filtration unit 9. Cooled benchtop centrifuge 10. UV/VIS Spectrophotometer 11. Five (5 No.) GPS receivers

All the necessary documentation with the ministry of Finance and the Customs Service for the clearance of these equipment have been filed. Both marine and in-house insurance covers on the equipment have been obtained and paid for. All the paper work necessary for radiation safety on the equipment have been filed with the national radiation regulatory agency.

#### **The ETF Grant**

The CIL has attracted a grant of some One hundred and fifty nine million naira to the university from the Educational Trust Fund (ETF). The funds are to be used to purchase another set of high level equipment for the central instruments laboratory. **These equipment are:**

- (1) Scanning electron microscope (SEM) with energy dispersive x-ray (EDX) analysis
- (2) Gas chromatograph/Mass spectrometer (GC/MS)
- (3) High Precision Anaerobic chamber

With these instruments we are equipped to carry out research in areas such as nanoscience experimentation including crystal building for solid state technology, molecular finger printing of substances including environmental pollutants, GIS-based data acquisition and anaerobiosis studies in medical and oil production facilities. The university is poised to be a veritable centre of excellence in nanoscience and biogeochemical information modeling for sustainable development of the Niger Delta.

**Other Achievements at the CIL in 2012 can be Summarized with the following entries.**

#### **1. LEVEL 1 ISO TRAINING FOR 20 TECHNOLOGISTS**

##### **Rationale**

The world over is seeking for best practices to attain efficiency and effectiveness in service delivery. The ISO system has arguably become a world standard for efficiency and effectiveness attainment in any service delivery.

The CIL in conjunction with the QA/QC Unit of the University trained 20 technologists from all the science-based departments on the ISO 9001: 2008 system, Level 1.

#### **2. INSTALLATION OF THREE TETFUND (ETF) FUNDED EQUIPMENT**

These are:

Scanning electron microscope (SEM) with energy dispersive x-ray microanalysis (EDX) i.e., SEM/EDX. Gas chromatograph/mass spectrometer (GC/MS). Double chamber Coy Laboratory Anaerobic Chamber.

#### **3. GROUND BREAKING OF CIL BUILDING**

This happened in the very last quarter of 2012. It is a major achievement.

The building was custom-designed with the end-user and equipment in view.

#### **CHALLENGES**

1. Power Supply – We need a steady supply of power because the equipment in the CIL are very sensitive and expensive equipment
2. IT Support - We need a robust IT support for all the equipment and for daily operations
3. Space - We need more space for the current and other anticipated equipment. Here the university administration has already stepped in to build the SCIENCE INSTITUTE where CIL would also be housed.
4. Human Capacity Building - We need a robust and expedited human capacity building to be able to man and maintain the equipment (this would include service contracts)

#### **FUNDAMENTAL ORIENTATION/ CORRECTIONS NEEDED TO ACHIEVE OUR OBJECTIVES**

1. The CIL should first be correctly perceived as a Centre of Excellence in Research which can lead to discoveries and contributions that would elevate the rating and ranking of our Institution
2. The CIL must operate with a competitive edge in research – that means robust funding for equipment and manpower capacity
3. The CIL should strive to be a revenue earning instrument by operating with modern business practices as a priority.



**Prof. Ovi Abayeh [PhD]**  
*Professor of Synthetic Organic Chemistry,  
Pure and Industrial Chemistry Department,  
University of Port Harcourt*

# Blue Hydrogen

## TOMORROW'S ENERGY AND ITS COLOR CODES

The trending position worldwide is towards carbon neutrality, as the clean energy of the future with zero emissions of carbon. Hydrogen happens to be one of the elements that can get us to this position, it is a colorless clean gas that emits only water when burnt. It has the potential to meet the world's energy needs. It is a colorless gas and it becomes puzzling why it should have color codes. In reality the hydrogen color codes are used to represent the different methods used to produce hydrogen; indicate its carbon emission level and the energy source used for its production.

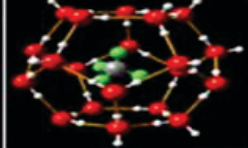
The color code tells the story whether it is climate friendly, example green-hydrogen is climate neutral; while gray-hydrogen is climate damaging. There are ongoing discussions about revising the present color code.

### The Color Codes are as follow:

- Green hydrogen:** This is made by using clean electricity from surplus renewable energy sources like wind or solar to electrolyze water. Electrolytes use electrochemical reactions to split water into its components of hydrogen and oxygen emitting zero carbon di oxide in the process. Hydrogen refers to the element, while green refers to hydrogen using renewable energy like wind or solar.
- Blue hydrogen:** This is Produced from natural gas using steam reforming which captures and stores the carbon emissions [sequestering].
- Gray hydrogen:** This is produced from natural gas using steam methane reforming but releases the carbon emissions.
- Black hydrogen:** This is Produced from bituminous coal using gasification, and releases the carbon emissions.
- Brown hydrogen:** This Produced from lignite [brown coal] using gasification and releases the carbon emissions.
- Turquoise hydrogen:** This is produced by splitting methane with solid carbon.
- Pink hydrogen:** Produced using electrolysis from nuclear energy.
- Red hydrogen:** Produced based on nuclear heat and water from thermolysis process.

The issues of climate change from consumption of fossil fuels dictate that we all work towards having a zero emissions carbon world. The World needs more energy now more than ever, so there should be a sustainable effort towards zero carbon and the potential solution is hydrogen. Combination of hydrogen with natural gas is the way to go towards achieving zero carbon emissions; especially in hard to decarbonize sectors such as heavy duty transport and power production. Hydrogen being a light molecule, can be liquefied at -254 C, but difficult and expensive to transport. The solution is to convert the hydrogen to ammonia which is cost effective to transport as blue ammonia. On getting to its destination it can be converted back and distributed. The industrialized world is presently experimenting on this option.





# Potentials OF METHANE CLATHRATES AS ALTERNATIVE SOURCE OF FOSSIL FUEL

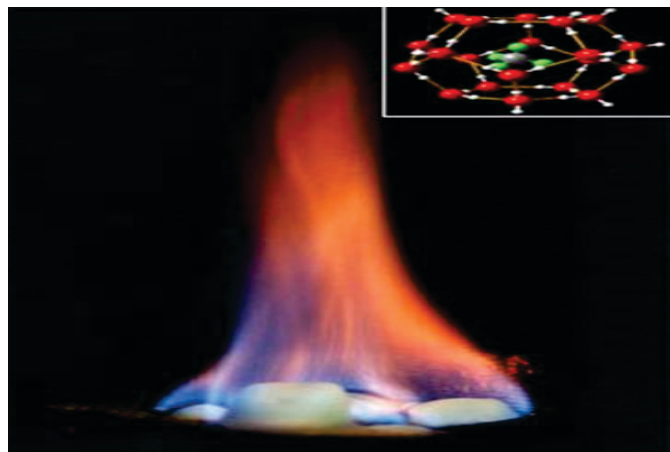
Leo C. Osuji

## ABSTRACT

This article reviews the existence of methane clathrates as a veritable source for methane and potential energy supplement to liquefied natural gas (LNG). These ice-like materials, which form at low temperature and high pressure, represent a huge hydrocarbon resource, which could supply the entire world for centuries. Clathrate hydrates were considered for many years as harmful by the oil and gas industry because of their annoying tendency to plug pipelines and damage to internal pipeline structure. However, they are now attracting renewed interest in many fields. Scientific knowledge of natural clathrate hydrates has grown enormously over the past decade. Contemporary research effort has shown that most of the deposits of methane clathrates also contain small amounts of other hydrocarbon hydrates which include propane hydrate and ethane hydrate. If existing equipment are used for its exploration, chances are that it will be

## INTRODUCTION

Methane Clathrate is a cage-like lattice of ice inside of which are trapped molecules of methane. It is found naturally under deep ocean beds and sedimentary rocks, under very low temperature and very high-pressure conditions. If either warmed or depressurized, it will revert back to water and natural gas. When brought to the earth's surface, one cubic meter of gas hydrate releases 164 cubic meters of natural gas. Hydrate deposits may be several hundred meters thick and generally occur in two types of settings: under Arctic permafrost, and beneath the ocean floor. Methane that forms hydrate can be both biogenic, created by biological activity in sediments, and thermogenic, created by geological processes deeper within the earth.



*clathrate structure. Source- United States Geological Survey].*

While global estimates vary considerably, the energy content of methane occurring in hydrate form is immense, possibly exceeding the combined energy content of all other known fossil fuels. However, future production volumes are speculative because methane production from hydrate has not been documented beyond small-scale field experiments. Most of the deposits also contain small amounts of other hydrocarbon hydrates which include propane hydrate

and ethane hydrate [1].

A study by United States Geological Survey USGS estimated that there are more organic carbon reserves around the earth found as Methane Clathrates than all other forms of fossil fuels. Methane hydrates have been known to scientists for about 200 years ago. It was until 1930 that it was realized that methane hydrates have been responsible for plugging natural gas pipelines. Interest in methane hydrate as an energy resource was initially ignited in the 1960's by Russian scientists who claimed contribution from hydrates during conventional gas drilling in the Messoyakha field, Siberia. The U.S. led several researches in this area in the 1970's. In mid-1990, two countries with large energy demand but limited resources Japan and India, began to explore the possibility of extracting methane from hydrates. The U.S. research effort got a big push in Year 2000 with the passage of the Methane Hydrate Research and Development Act.

Research shows that Methane Clathrate deposits occur in sediments as layers, nodules and inter-granular cements and are found in sediments and sedimentary rock unit below Arctic permafrost, sedimentary deposits along continental margins, deep water sediments of inland lakes and seas and under Antarctic ice. These locations have been proved to have temperature and pressure conditions suitable for its formation and stability. They have also been found to be much closer to high population areas than any natural gas fields in parts of the world [1-3].

## EXPLORATION AND EXTRACTION OF METHANE CLATHRATES

Some techniques through which Methane Clathrates can be extracted include:

- Gases can be collected by thermal stimulation: An influx of heated fluid or steam would partially melt the hydrate beds in ocean sediments or in permafrost



regions. As illustrated in Figure 2, the hot fluids would be pumped down into the hydrate layers and the liberated gases would flow to the bore hole where they ascend through the pipes up to the surface.

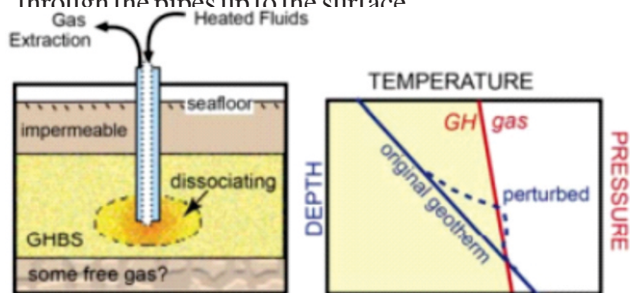


Figure 2: Thermal Stimulation of Methane Clathrate

- Depressurization of hydrates in sediments beds: As presented schematically in Figure 3, this process requires drilling deep into the clathrate bed where methane can exist in the free gas stage before being converted to hydrates to cause the gases to flow freely to a well head. This is a more economical process of Methane Clathrate extraction.

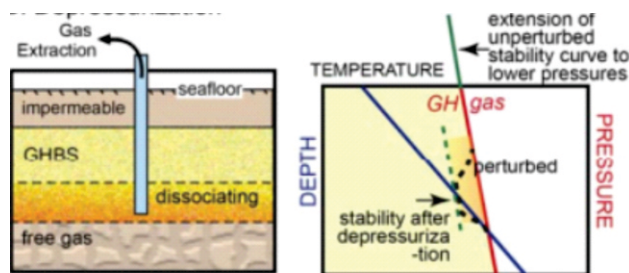


Figure 3: Depressurization of Methane Clathrate

- Injection of an inhibiting fluid into sediments bed via a well head: The inhibiting fluid will consist of solutions of methanol, ethanol, glycol or brine. They dissociate gas hydrates by altering the chemical composition of the local pre-water to no longer favour hydrate stability. These chemicals would lower the freezing point of water in the vicinity, free trapped gases and the gases would again be collected by the same well head. Figure 4 illustrates how this process takes place.

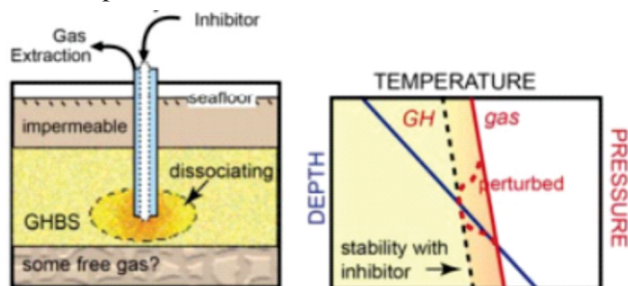


Figure 4: The inhibitor injection process for Methane Clathrate extraction

## POTENTIAL OF METHANE CLATHRATE

There are various reasons why Methane Clathrates can be considered as an alternative energy source, as illustrated in Figure 5, Methane Clathrate concentrates contain methane gas of about 160 times their natural gas volume at standard temperature and pressure, therefore these clathrates represent a highly concentrated energy source. If existing equipment are used for its exploration, chances are that it will be several times more economically viable than liquefied natural gas (LNG) because of the multiplying effect of the extract. If it is transported in the concentrated form, more methane gas

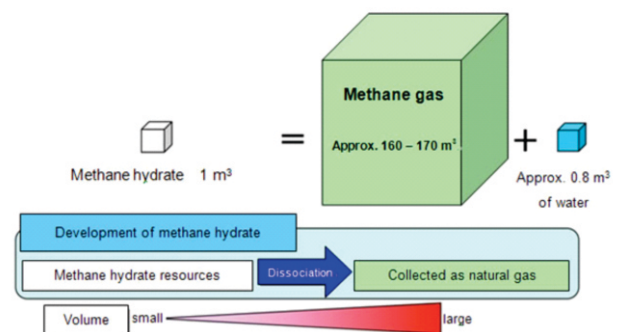


Figure 5: Illustration of the Methane Clathrate volume transformation when dissociated

Secondly, it has about 80% of the heat content of crude oil which is better than most other alternative energy sources. A barrel of methane contains 4.62 million BTUs of heat energy compared to a barrel of crude oil that produces 5.86 million BTUs of heat energy.

Finally, the combustion reaction for methane is much cleaner than most other hydrocarbon fuel sources. This is because when combusted in air, it produces lesser amounts of Carbon (IV) oxide  $\text{CO}_2$ , Carbon monoxide  $\text{CO}$ , Sulphur (IV) oxide  $\text{SO}_2$  and Nitrous oxide  $\text{NO}$ .

## Economic Viability

Walsh et al. reported that the price of natural gas has to stand at between \$7.50 and \$12.00 per Thousand Cubic Feet Mcf for its exploration to be economically viable. Another report by Moridis and Reagan stated that the additional costs linked with Methane Clathrate and conventional methane production are \$3.50 and \$4.00 respectively. However, the potential of natural gas can be said to be massive as its uses are numerous. Its uses include:

### Electricity Generation

- For domestic heating and cooking.
- In the form of compressed gas, it can be used as a vehicle fuel. It has been proved to be more environment friendly than other fossil fuels.
- In a highly refined form it is used as a fuel for rockets.
- It can also be used as a chemical feedstock for chemical industries.





- Usages like electricity generation, cooking, vehicle fuel and chemical feedstock if developed can drive Nigeria into a neo-industrialization era, as they are all essential needs which can be sustained by the country's population.

### LIMITATIONS

The hazards of the Methane Clathrates are similar to that of all volatile hydrocarbon energy sources. They are usually transported by tanker trucks or pipelines in liquid form. Any flame ignition or rupture around the vessel can result in massive explosions. A more serious transportation issue is moving the hydrocarbon from deep sea to the sea surface, this process will certainly require a lot of resources as some sea floors could be as far as 8,000 metres. To mitigate this, improved storage and transportation methods have to be devised.

Another limitation is the Methane Clathrates gun hypothesis, methane is one of the green- house gases responsible for global warming. Its release in the atmosphere could result in climatic change and mass extinctions. Also, methane's release in a marine environment would alter its Potential Hydrogen (pH) value, CO<sub>2</sub> proportion, solubility, carbonate formation and dissolved Oxygen O<sub>2</sub> levels. These effects can be mitigated by applying caution and high safety regulations in all the processes involved in its exploration and extraction. Another hazard peculiar to the Clathrate is that its extraction can result in the deterioration of the seabed which could result in submarine landslide.

### CONCLUSION AND RECOMMENDATION

The need for research on Methane Clathrate cannot be over-emphasized. The immense volumes of this hydrocarbon and the richness of its deposit could make it the next biggest feat in the search for alternate sources of energy. Its appearance in nature and the fact that it is a cleaner form of hydrocarbon also makes it more promising. Methane Clathrate has the potential of transforming countries like Japan and India, which depend on other countries to meet their energy needs, to become self-sufficient in energy. Japan and India are not the only countries in this race as so many countries that have these deposits are expected to soon begin exploration. The implication of this self-sufficiency is that several countries will be less dependent on others for their energy needs, they will also likely get involved in the exportation of natural gas resulting in a crash of price for the commodity. It is imminent that cleaner sources of energy like Methane Clathrate will be the future of the energy sector. Research should therefore be encouraged in the exploration of Methane Clathrate as a supplement to LNG. Some of the research should be aimed at detecting if any of these deposits are close to previous oil

exploration sites. Its closeness implies that some of the infrastructures already in use at these locations can be used in the Clathrate extraction, thereby keeping the cost of commercial exploration low. This will be a conservative way of starting commercial production.

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Leo Chigbu Osuji, a Fellow of the Academy of Science, is a Professor of Petroleum Chemistry and consultant environmentalist. He has over two hundred and fifty (>250) peer-reviewed articles in some of the world's finest journals (with over 2,000 citations). He served as the Pioneer Head of Research and Development (R & D) at the Nigerian Content Development and Monitoring Board (NCDMB) from 2014 to 2018, where he spearheaded the development of innovative solutions to drive Nigerian content development in the oil and gas industry. In addition to his role as Head (R&D), he served as Manager (R & D) for 3 years during which he acted as General Manager Planning, Research and Statistics, providing strategic leadership and overseeing research initiatives and policy planning. Under his leadership, NCDMB achieved several milestones, including the development of new technologies, capacity building for Nigerian entrepreneurs, institutionalization of Centres of Excellence for the incubation of local content, et cetera et cetera.

# CHEMICAL SOCIETY OF NIGERIA RIVERS CHAPTER

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## Goodwill Message



I heartily rejoice with the Director of the Central Instrument Laboratory, University of Port Harcourt, Prof. M.U. Ibezim-Ezeani and her entire team, on the occasion of the 2<sup>nd</sup> International Conference on Laboratory Research and Technopreneurial Innovations, to commemorate 2025 World Laboratory Day.

Chemical Society of Nigeria (CSN), Rivers Chapter is happy to be associated with you. The theme of this year's conference, 'Research and Technopreneurial Advances for Climate and Global Issues' is in line with the interests and goal of CSN, whose pursuit is to ensure good Teaching and Practice of Chemistry in Nigeria.

Globally, the importance of Research and Technopreneurial Advances cannot be over emphasized. Research and Technology rule the world. I am happy that this year's conference will be preceded with a Workshop - which will be hands-on training on **Gas Chromatography**, in partnership with APEX ANALYTICS LTD, a corporate member of CSN, Rivers Chapter. This will be highly beneficial to all researchers.

I wish all the participants a fruitful conference that will truly enhance Research and Technopreneurial Advances in the world.

**Dr. (Mrs) N.J. Maduelosi**  
Chairman, Chemical Society of Nigeria, Rivers Chapter.  
FCSN, MICCON, MOWSD





**PROF. BENARD BOLAJI BABATUNDE,**  
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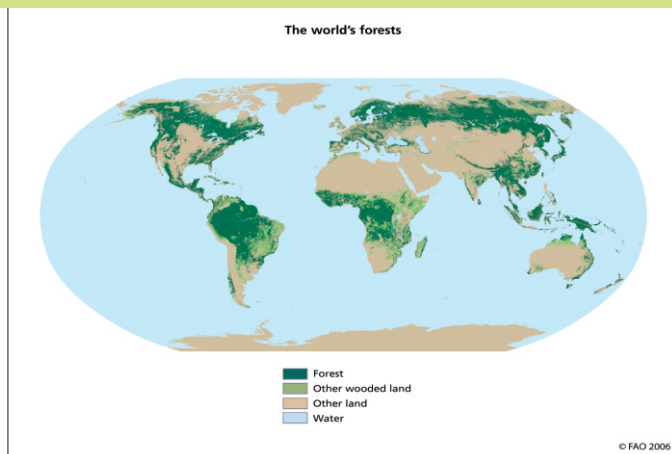
# Celebrating

**FORESTS AND FOOD GROWING GREEN FUTURES:  
INVESTING IN FORESTS FOR PEOPLE AND PLANET**

## BOREAL FORESTS

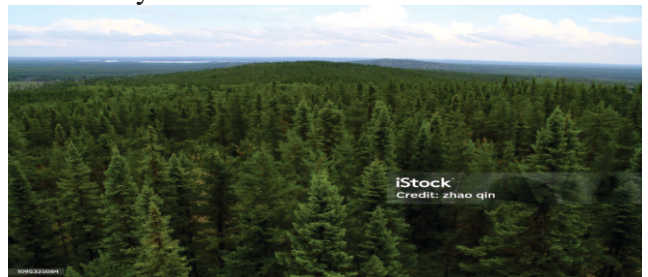
- Boreal forests, or taiga, are found between 50 and 60 degrees latitude in:
- North America, Asia, and Europe.
- Beneath boreal forests is land shaped by glaciers that left a legacy in the geology, hydrology, and soils of the area. Boreal forests' bitter cold climate makes it difficult for life, leading to low species diversity compared to temperate and tropical forests.
- The plants and animals that do live in boreal forests are specially adapted to cope with short growing seasons and cold temperatures. Due to their vastness and remoteness, boreal forests are important stores of carbon.
- Almost 80% of boreal forests are on top of permafrost, a layer of soil that remains frozen throughout the year.
- Climate change is a major threat to boreal forests.

## SOME BASIC FACTS OF A FOREST

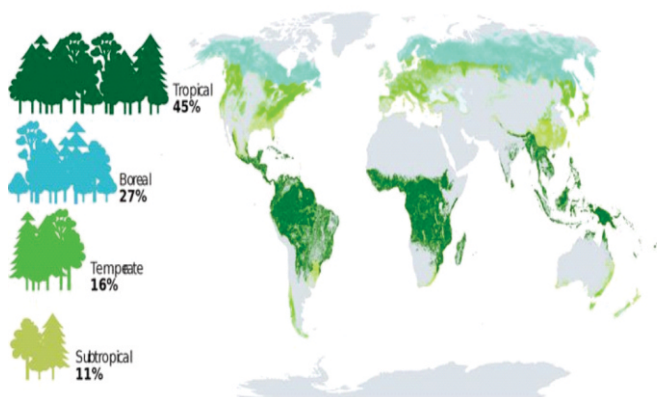


## BOREAL FOREST TYPES

- Open Canopy Boreal: Also known as lichen woodland, open canopy boreal forests occur at higher latitudes and have lower species diversity.



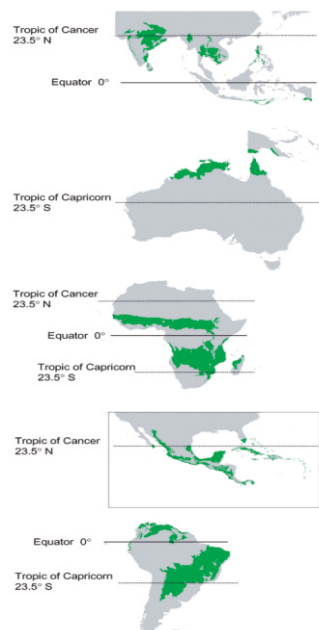
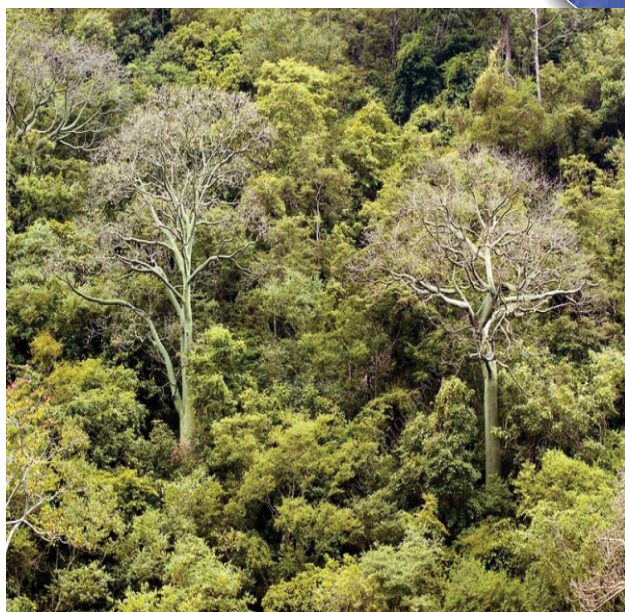
## TYPES OF FOREST



Closed Canopy Boreal: Found at lower latitudes, closed canopy boreal forests have richer soil and denser tree stands that allow little light to reach the forest floor. Less harsh conditions, however, lead to greater species diversity.







## Mangrove Forest Distribution



## Benefits of Forests

- Forests provide numerous ecosystem services, including regulating climate, maintaining biodiversity, providing clean water and air, and offering resources like timber and food, all of which are crucial for human well-being and the health of the planet.
- About 1.6 billion people around the world depend directly on forests for their livelihoods, to provide Food, shelter, jobs and security.

### Ecosystem Services

#### 1. Provisioning Services:

- **Food:**  
Forests provide a variety of food sources, including fruits, nuts, seeds, and edible plants and insects.
- **Timber and Wood:**  
Forests are a primary source of timber and wood for construction, fuel, and other uses.
- **Fibers:**

Forests provide fibers for textiles, paper, and other products.

- **Medicines:**

Many plants found in forests have medicinal properties, providing natural remedies and potential sources for new drugs.

- **Genetic Resources:**

Forests are a storehouse of genetic diversity, providing raw materials for agriculture and other industries.

- **Freshwater:**

Forests help to regulate water cycles and provide clean water resources





## Temperate Forests

- Temperate forests are located at mid-latitudes, which gives them their characteristic four seasons. Very few patches of old-growth temperate forest remain; the zone is dominated by secondary forests.
- Temperate forests are inhabited by species adapted for seasonality.
- Deciduous trees like maples, hickories, oaks, and many others drop their leaves and become dormant in the fall and winter to save energy.
- Bears, bobcats, squirrels, and deer make their homes in temperate forests and can store food, adapt their diet, or hibernate to cope with the lack of nutritious foods in the winter.

## Temperate Forests Types

### Deciduous:

- Characteristics: Dominated by trees that lose their leaves annually during the colder months, like oak, maple, beech, and hickory.
- Climate: Experience distinct seasons, with warm, moist summers and cold, frosty winters.
- Examples: Eastern North America, eastern Asia, and western Europe.



### Evergreen Forests:

#### Characteristics:

- Dominated by trees that retain their leaves year-round, such as pine, spruce, and hemlock.
- Location:** Found in regions with high, year-round rainfall, like New Zealand, South America, and parts of Australia and the Mediterranean region



## Tropical Rainforests

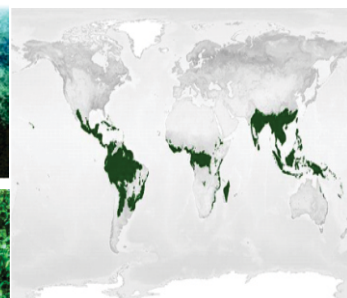
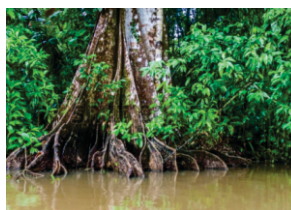
- Tropical forests are characterized by the greatest diversity of species. They occur near the equator, within the area bounded by latitudes 23.5 degrees N and 23.5 degrees S. One of the major characteristics of tropical forests is their distinct seasonality: (rainy and dry).

*Cilazine 2025*

- These forests cover only a tenth of the surface of the planet, yet harbor half of all species Encyclopedia of Life Sciences, 2014. They are also some of the most threatened by human activities.
- Tropical forests have relatively stable conditions that have allowed life to thrive. They are the warmest and rainiest forests on Earth.
- Tropical forests are known for their extraordinary biodiversity. The Amazon rainforest, for example, is home to 10% of the world's described species.

## Types of Tropical Forests

- **Evergreen Rainforest:** Often thought of as “real” rainforest, these are the wettest (about 80 inches of rain per year) and most biodiverse tropical forests.
- **Tropical Moist Forest:** Further from the equator than evergreen rainforests, tropical moist forests experience less rainfall overall and bigger differences between seasons.
- **Tropical Dry Forest:** Receive very little rain between four and six months out of the year. Plants and animals have specific adaptations to deal with this period of water scarcity.
- **Mangrove:** Coastal tropical forests with trees adapted to live in brackish water with changing levels. Mangroves protect the coast from storms and act as nurseries for aquatic species.



### 2. Regulating Services:

- **Climate Regulation:**
  - Forests play a vital role in regulating the climate by absorbing carbon dioxide (a greenhouse gas) and releasing oxygen. Globally, forests absorb approximately 16 billion metric tons of carbon dioxide (CO<sub>2</sub>) annually, making them a vital carbon sink and a crucial tool in combating climate change.
- **Water Regulation:**
  - Forests help to regulate water cycles by absorbing rainfall, preventing soil erosion, and maintaining water quality.
- **Air Quality Regulation:**
  - Forests help to purify the air by absorbing pollutants and releasing oxygen.





- **Erosion Control:**
  - Forest vegetation helps to prevent soil erosion and landslides.
- **Disease Regulation:**
  - Forests can help to regulate the spread of diseases by providing habitats for natural predators of disease vectors.
- **Fire Regulation:**
  - Forests can help to regulate the spread of wildfires
- **Pest Regulation:**
  - Forests can help to regulate pest populations

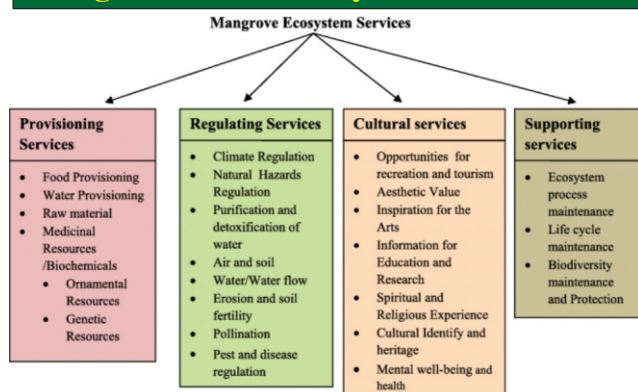
### 3. Supporting Services:

- **Soil Formation:**
  - Forests contribute to soil formation and fertility through the decomposition of organic matter and nutrient cycling.
- **Nutrient Cycling:**
  - Forests play a crucial role in nutrient cycling, ensuring the availability of essential nutrients for plant growth and other ecosystems.
- **Pollination:**
  - Forests provide habitats for pollinators, which are essential for the reproduction of many plants, including crops.
- **Seed Dispersal:**
  - Forests support seed dispersal, which is essential for the establishment and regeneration of plant populations.
- **Habitat Provisioning:**
  - Forests provide habitat for a wide variety of plants and animals

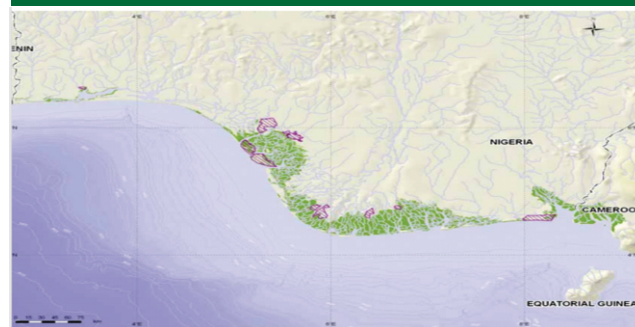
### 4. Cultural Services:

- **Recreation and Tourism:**
  - Forests provide opportunities for recreation, tourism, and spiritual enrichment.
- **Aesthetic and Spiritual Values:**
  - Forests have aesthetic and spiritual values that contribute to human well-being.
- **Cultural Heritage:**
  - Forests can be important sites of cultural heritage, providing knowledge and inspiration.
- **Education:**
  - Forests are important for education and research

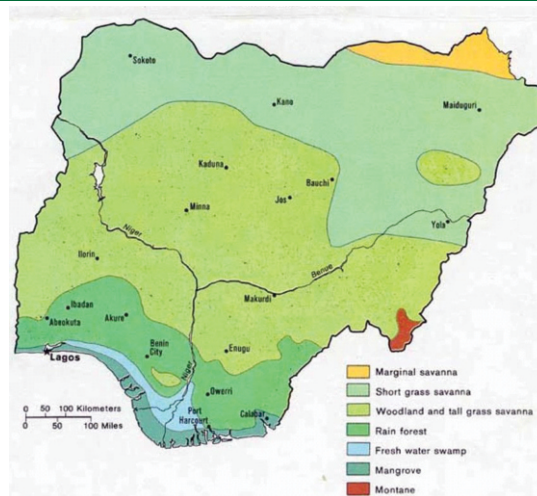
## Mangrove Forest Ecosystem Services



## Nigeria Mangrove Forest



## Map of Nigeria showing Forest Areas



## FOREST RESERVES:

1. Afi River Forest Reserve: Located in Cross River State.
2. Akure Forest Reserve:
3. Edumanom Forest Reserve: A habitat for endangered chimpanzees.
4. Idanre Forest Reserve:
5. Ise Forest Reserve: Located in Ekiti State.
6. Ngel Nyaki Forest Reserve: An impressive stand of montane/sub-montane forest.
7. Okomu Forest Reserve:
8. Oba Hills Forest Reserve: A forest reserve and national park in Iwo, Osun State.
9. Olokemeji Forest Reserve:
10. Oluwa Forest Reserve:
11. Omo Forest Reserve:
12. Stubb Creek Forest Reserve:
13. Upper Orashi Forest Reserve:
14. Mamu River Forest Reserve:
15. Shasha River Forest Reserve:
16. Zamfara Forest Reserve:
17. Sanga River Forest Reserve:
18. Okeluse Forest Reserve:
19. Mbambe Forest Reserve:
20. Mount St. Catherine Forest Reserve:
21. Mountain Pine Ridge Forest Reserve:
22. Mukura Forest Reserve:
23. Gujba Forest Reserve:
24. Akure Ofosu Forest Reserve:





### List of national parks of Nigeria

Chad Basin National Park  
Cross River National Park  
Gashaka Gumti National Park  
Kainji National Park  
Kamuku National Park  
Okomu National Park  
Old Oyo National Park

### NIGERIA'S FOREST

- Nigeria's forests are home to an estimated 22,090 animal species, including
- 285 mammals,
- 864 birds,
- 203 reptiles,
- 117 amphibians,
- over 775 fish species,
- Around 20,000 species of insects.
- Other: over 4,715 vascular plant species.
- Many endemic species like the white throated monkey and;
- Many more undocumented species likely existing.

### CHALLENGES OF TROPICAL RAINFOREST

- Human activities such as logging, land clearing for agriculture, and poaching are a threat to the future of tropical forests. In 2023 alone, nearly 4 million hectares of tropical forests were lost, according to the World Resources Institute.
- Many charismatic tropical forest species are threatened with extinction. For example, the African forest elephant, found in West and Central Africa, is listed as Critically Endangered by the IUCN due to habitat loss and poaching.
- Primates live almost exclusively in the tropics, and most live in tropical forests. In some Brazilian forests, as many as 13 kinds of primates live in the same area.

### IN NIGERIA

- Over the past 50 years (from 1975 to 2025), Nigeria has lost a significant amount of its forest cover, with estimated loss of around 35.7% of its forest cover, or approximately 6.145 million hectares, Other reports say 55.7% of its primary forests is lost.
- According to the Woldbank, Nigeria forest cover has reduced from 45% to 10%
- In 2020, Nigeria had 20.4 Mha of natural forest, extending over 22% of its land area. In 2023, it lost over 207,000 ha of natural forest, equivalent to 118 Mt of CO<sub>2</sub> missions

### CHALLENGES OF EXTINCTION



- While a precise number of extinct animal species in Nigerian forests is difficult to pinpoint, some species like
  - cheetahs,
  - giant elands,
  - pig-nosed hippopotamuses,
  - giraffes and;
  - black rhinoceroses
- Are known to have become extinct in Nigeria in the last half-century due to habitat loss and other factors such as uncontrolled pouncing.

#### 1. Climate Change:

- Increased Risk of Forest Fires:
  - Rising temperatures and altered precipitation patterns can lead to drier conditions, increasing the risk and severity of wildfires.
- Changes in Species Distribution and Abundance:
  - As climates change, some species may struggle to adapt, leading to shifts in their distribution and potentially causing declines in certain populations.
- Increased Pest and Disease Outbreaks:
  - Warmer temperatures and altered weather patterns can create conditions more favorable for pests and diseases to spread and thrive, impacting forest health.

#### 2. Deforestation and Habitat Loss:

- Conversion for Agriculture and Development:
  - Forests are often cleared to make way for agriculture, urbanization, and other forms of development, leading to habitat loss and fragmentation.
- Industrial Logging:
  - Large-scale logging operations can damage or destroy forests, leading to biodiversity loss and ecosystem degradation.
- Unsustainable Resource Extraction:
  - Overexploitation of forest resources, such as



timber and minerals, can have detrimental effects on forest ecosystems and their ability to regenerate.

### 5. Other Challenges:

- **Natural Disasters:**
  - Extreme weather events, such as floods, droughts, and storms, can cause significant damage to forests and disrupt ecosystems.
- **Poverty and Hunger:**
  - In some regions, people depend on forests for their livelihoods, and unsustainable practices can exacerbate poverty and hunger.
- **Invasive Species:**
  - The introduction of non-native species can disrupt ecosystems and outcompete native species

## LOSS OF MANGROVE FOREST

- Nigeria has experienced significant mangrove forest loss, with estimates suggesting a loss of around 35% in the last 20 years, or about 1% per year, and a total loss of approximately 400 square kilometers.
- The degradation of mangrove forests not only impacts biodiversity but also jeopardizes the livelihoods of coastal communities that depend on these ecosystems for food and resources. The disappearance of mangroves leaves communities vulnerable to tidal inundation and extreme weather due to the loss of natural defenses.

## Growing Green Futures: Investing in Forests for People and Planet

- Nigeria is actively pursuing a "greener future" through initiatives like diversifying its energy mix with renewables, investing in sustainable infrastructure, and implementing policies to reduce carbon emissions, aiming for a net-zero future by 2060.
- The Nigerian government is actively addressing deforestation and promoting forest conservation through initiatives like the REDD+ strategy, the National Forest Investment Plan, and by enforcing bans on illegal timber trade, aiming to reduce emissions and enhance forest resilience.
- **Forest Programme.** NCF deliberately developed an Initiative – Green Recovery Nigeria (GRN), as the flagship programme of the Foundation. The forest programme has its focus on conserving and recovering Nigeria's forest cover which is being depleted at an alarming rate.
- The implementation of the National Afforestation Programme through the Pan African Great Green Wall (PAGGW) initiative and other nationwide afforestation and reforestation activities programmes have resulted in the restoration of over 1.5 million hectares of degraded forests and other landscapes, President Bola Ahmed Tinubu.

- The president also said the initiative has led to the establishment of over 1,428.9 kilometers of Shelterbelts covering 4,286ha.
- To facilitate strict compliance and enforcement of environmental laws as well as ensure that the benefits of conservation and sustainable development are protected and equitably distributed among all segments of society, Nigeria developed Wildlife Crime Rapid Reference Guide for Investigators, Prosecutors, and Judges aimed at harmonising the existing Legal Framework in enforcement and prosecuting environmental criminal syndicates.
- "The Guide is to help reduce unnecessary lengthy investigation and prosecution processes. Agencies such as the National Parks Services have been strengthened and made to collaborate with other Law enforcement agencies such as the Army, Police, Customs, and Immigration Services to combat crimes such as terrorism and banditry in our forests.
- "Currently our Endangered Species Conservation and Protection Bill, 2024, National Forestry Bill is being enacted to address gaps in the subsisting laws and legislations and to strengthen the country's legal framework as well as accelerate progress in the fight against wildlife crimes as well as protection and conservation of our biological resources in our forests."
- Nigeria was collaborating with global communities to address forest-related challenges.
- "Recently, Nigeria signed a Memorandum of Understanding (MoU) with Cameroon on cooperation Framework Agreement on Transboundary Ecosystem Conservation and Sustainable Management of Forestry and Wildlife Resources aimed at facilitating cooperation and coordination through the establishment of a joint transboundary Forest management framework for the conservation and sustainable management of our common forest and wildlife resources," he added.

## WHAT MORE NEEDS TO BE DONE

- **Protect Forests:** Combat deforestation and habitat loss through conservation efforts.
- **Promote Sustainable Farming:** Encourage farming practices that integrate forests and biodiversity.
- **Raise Awareness:** Increase understanding of the role of forests in sustaining agriculture and human health.
- **Advocate for Change:** Support policies that promote sustainable forest management and food systems.
- **Individual Action:** Choose sustainable products, reduce your carbon footprint, and support organizations that defend Indigenous land rights and forest defenders.





# Photos



CIL Staff at the Capacity building workshop in Entrepreneurship & Innovation Ecosystem



Thanksgiving ceremony of Prof. G. O. Abu at 70



Child dedication of CIL staff (Mr. O. Nnodim)



An award presented to Prof. C. O. Onyeaso by CIL Staff



IT students with the staff of CIL



An award presented to Prof. Mike Onyekaonwu by CIL Staff





# Photos



LNG Gas Research Centre Team visit to CIL



Certificate presentation to IT student



An award presented to Dr. T. Blanchard By CIL



Visit of NUC accreditation team to CIL



The director receiving an award from chemical society of Nig. R/S Chapter



Certificate presentation to IT student



41 Certificate presentation to IT student



IT students with their certificate



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