



## Start-up case study on building green chemistry laboratories in University of Uyo, Nigeria



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### ABSTRACT

Having identified the need to put in place a laboratory infrastructure for research, innovation and enterprise in sustainable chemistry, we embarked to set up Green Chemistry laboratories in International Centre for Energy and Environmental Sustainability Research (ICEESR) in the University of Uyo, Uyo, Akwa Ibom State, Nigeria. This communication reports on the status of the project, the envisaged contributions to sustainable chemistry and the support needed to ensure success while also sharing the lessons learnt to encourage SC start-ups in Africa.

### 1. Introduction

Most industrial and economic activities in Nigeria rely mainly on products and services that are imported although Nigeria is blessed with abundant natural resources and a growing population of young adults. For example, most of the catalysts used in petroleum refining and crude oil drilling are imported whereas there are huge deposits of clay minerals across the country. It has been estimated that the catalysts imported are over 500,000 t at the cost of about 5 billion naira (approximately 14 million USD) (Babalola et al., 2015). One of the major causes of this dependence on imported products is the deficiency of the tertiary institutions in Nigeria to produce personnel with the relevant skills needed in industries as well as producing research products that meet industry needs. An underlying factor is the lack of specialised laboratories infrastructure in tertiary institutions for teaching and practice of green chemistry as well as to support sustainable chemistry start-ups. In addition, the curriculum for teaching chemistry at undergraduate and postgraduate levels seldom includes green chemistry modules but is focused on traditional and core module like physical, organic, inorganic or analytical chemistry. Consequently, green chemistry modules are not prioritized when it comes to allocation of limited laboratory infrastructure (Jumbam, 2015).

The implications of lack of green chemistry laboratories are enormous. For example, the research outputs and innovations in green and sustainable chemistry are few from Nigeria and Africa (Jumbam, 2015). This impacts on the scientific advancement and development of the region. The principles of green and sustainable chemistry are not promoted or advocated in national policies and Nigeria was unable to meet some relevant targets of the Millennium Development Goals (MDGs) (Nigeria, 2015) and may be unable to meet the Sustainable

Development Goals (SDGs).

In view of this, we embark on building green chemistry laboratories with potential to scale-up to regional innovation hub for sustainable chemistry. Specifically, this project aims to set up dedicated green chemistry laboratories for teaching, research and innovation. We also aim to use the project to launch sustainable chemistry products and services into Nigerian market to contribute to the attainment of the sustainable development goals in Nigeria.

#### 1.1. About the project

The project involves the building of the laboratories on a land measuring 1.72 ha (17,200 m<sup>2</sup>) provided by the University of Uyo, Nigeria for the development of the International Centre for Energy and Environmental Sustainability Research (ICEESR) (Plates 1 and 2). The project hopes to raise funding through equity and donations. It is our goal that upon operationalization, the laboratories would operate on the principles of green chemistry and provide sustainable chemistry products and services to the people of the Niger Delta region of Nigeria and Sub-Saharan Africa at large. The laboratories, when completed will offer world class environment to conduct research, innovate and create opportunities sustainable chemistry start ups across Sub-Saharan Africa. It would provide training and capacity building in green and sustainable chemistry as well as serve as launch pad for green and sustainable chemistry products and services into Nigerian market.

This initiative will open new and exciting prospects to tap into the vast and unexplored material resources available in the Sub-Saharan African region (Jensen and Wantchekon, 2004). The initiative has potential to be upscaled to include several specialized laboratories in green and sustainable chemistry and can be replicated in other

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Plate 1. Land clearing of allocated site for the building.



Plate 2. Current stage of the building.

Universities in other regions.

### 1.2. The anticipated contribution to green and sustainable chemistry

- Provision of laboratory infrastructure to conduct research, innovate and create opportunities in green chemistry across Nigeria and Sub-Saharan Africa is the drive behind this initiative and start up. While countries are investing in green technologies, Nigeria and most African countries are lagging in this direction. This start up would serve as a spring board to initiate the implementation of sustainable chemistry.
- The facility would provide professional development training and capacity building in green and sustainable chemistry for researchers and businesses from government, industry, and user communities. This will provide the impetus towards the development of green chemistry curriculum for entrenchment in chemistry education at the tertiary level.
- The initiative would be a launch pad for sustainable chemistry products and services into Nigerian market. Nigeria has a population of over 182 million people and is an emerging market economy (Nigeria National Population Commission (NPC), 2018).

Specifically, the laboratory will provide support for scaling up on-going research projects on:

- Valorization of agriculture biomass for waste water treatment:* The aim of this is to examine the effectiveness of using activated carbon obtained from locally-available agro-biomass for abstraction of colour from dyes. If successful, these products may be commercialized for use in waste water treatment.
- Utilization of biochar from sewage sludge for clean-up of contaminated soils:* The Niger Delta region of Nigeria has had over 5000 incidents of oil spills which has resulted in millions of barrels of spilled oil into the environment (Nigeria National Oil Spill Detection and Response Agency NOSDRA, 2018). The estimated cost of clean-up of the Niger Delta runs into billions of US dollars. The aim of this research project is to develop environment-friendly products from locally-available materials and commercialize same

- Cost-effective clay composites for application in chemical and petroleum industry:* The Nigerian industrial sector and the petroleum industry in particular, are in need of indigenous technology at best possible cost (Oyodele and Hameed, 2013). The objective of this research project is to develop local clay composites from Nigerian local clays by chemical modification to enhance its surface properties and catalytic efficiency possible for application in the Nigerian petroleum industry.

## 2. The start-up approach

Nigeria is among countries with low funding of the education sector, the education budget is still less than 10% of total budget. The United Nations recommends a 25% allocation to education sector as such the funding to Universities for infrastructure are grossly inadequate (Ekundayo and Ajayi, 2009). Also the University of Uyo is affected by the lack of funds leading to insufficient laboratory infrastructure for specialised research work. In this project, the approach used was the public-private partnership model, where private funders who may be business angels, venture capitalists or investors were invited to partner with the university in co-developing this project. The advantage of this approach is that it allows for funding from multiple sources through a well-established memorandum of understanding while also giving end users opportunity to contribute to product development.

### 2.1. Project structure

The project adopts a public-private partnership approach. The structure of the project is presented in Fig. 1.

This structure follows standard best practices,<sup>1</sup> was adapted because of the need to overcome the barriers of funding and to promote institutional and managerial efficiency. Given the need to have research and innovation outputs that are market-driven, the centre where the

<sup>1</sup> The World Bank's African Centre of Excellence project proposes templates for the establishment of Centres of Excellence for research in African Universities.

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