FEDERAL POLYTECHNIC EKOWE

PMB 110, YENAGOA BAYELSA STATE

RESEARCH & DEVELOPMENT ANNUAL REPORTS

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BRIEF HISTORY OF THE FEDERAL POLYTECHNIC EKOWE, BAYELSA

Federal Polytechnic Ekowe, was conceived by the President Olusegun Obasanjo led Administration in 2007 as an institution meant to train middle level manpower as well as Technologist that is specific to the oil and gas environment. Work on the permanent site of the institution commenced in the old Government Technical College Ekowe in 2009 by the Late President Musa Yaradua after the appointment of the first substantive and pioneer Rector in the Person of Dr. Ineye Douglas Ekpebu. Full academic activities commenced in the institution in 2012 after the National Board for Technical Education (NBTE) accredited four programmes namely; Pre-National Diploma in Science and Technology, National Diploma in Computer Science, Statistics and Science Laboratory Technology all in the School of Applied Sciences.

From inception to date the institution has progressed with the mounting of more National Diploma Programmes in three other schools, as well as five Higher National Diploma Programmes in the School of Applied Sciences.

In August 2016, the Federal Government appointed Dr. Enetimi Seiyaboh Idah as the second Substantive Rector of the institution after three acting Rectors in two and a half years from January 2014 to August 2016. He handed over to his Deputy Rector (Admin) in the person of Dr. Iwekumo Wauton in July 2021 who handed over to the current and third Substantive Rector, Dr. Agbabiaka Lukman Adegoke in May, 2022. The Polytechnic had its first convocation in 2021 where sets of graduands were sent-forth to deploy acquired knowledge and skills in the market place. A successful accreditation programme was recently led by the Rector, Dr. Agbabiaka which led to full accreditation of most of the National and Higher National Diploma programmes for more students' intake to boost the population of the Polytechnic community with respect to learners.

The Entrepreneurship centre was also revived by the current Rector for programmes in welding and fabrication, bakery, food processing/packaging, other product development and much more for skill acquisition and business development. This will give our students better footing and preparedness for the labour market on graduation. The area of research was not left out as development and advancement is research oriented. The Directorate for Research and Development of the Polytechnic was also revitalized by the Rector, Dr. Agbabiaka who positioned it to engage in more active and transforming programmes and research activities that will align the institution to solve home based problems and impact the host communities and Nigeria at large for national and global relevance.

PROFILE OF THE DIRECTORATE

The Directorate for Research and Development of Federal Polytechnic Ekowe was established from inception of the Polytechnic as an integral part of the academic planning system. It was formerly under the Academic Planning Division of the Polytechnic before it was carved out as a standalone directorate by National Board of Technical Education (NBTE). It was set up to position the Polytechnic on a path that will birth innovative ideas, produce and showcase quality innovations that will contribute to development, knowledge exchange and advancement especially, in science/technology, engineering, skills and entrepreneurship for nation building through research. The Research and Development Directorate oversees research activities in the Polytechnic and ensures quality assurance in both students and staff research activities and also, drives development and innovation contents in the research processes and outputs.

The need to publish the research findings in the Polytechnic in accessible, readable and useable formats has birthed this technical report summary document to enable other researchers and students gain more knowledge and retrieve materials and methodologies for reference purposes and for further studies where necessary for knowledge advancement. These research outputs may be developed into products, prototypes and policy briefs. They have also been published in journals and conference proceedings, etc. to gain wider audience. They may evolve into industrial applications, fabrication of equipment, entrepreneurship/business developments for job creation and also into development of books and teaching aids.

THE EDITORIAL

PREFACE

R&D Annual reports is a compendium of technical reports on scientific and empirical studies conducted in the Polytechnic by academic staff who received the institution-based research grant from TETFund to conduct studies in their various fields of expertise to boost the research quality and activities in the Polytechnic. The directorate for Research and Development of the Polytechnic is ladened with the responsibility to ensure that quality standards are maintained in research conduct for both staff and students in the institution. Hence, the place of the directorate to ensure quality assurance measures is in place to monitor and evaluate research activities and output dissemination and management. To ensure that grants are properly used and results well disseminated for target beneficiaries to benefit to boost their research work, the directorate has developed the R & D Annual reports to compile all researches conducted in the Polytechnic with TETFund grants to publish and enhance visibility and output availability, accessibility in useable formats that will benefit both the Polytechnic academic community and other researchers and stakeholders. This document is therefore a collection of reports on TETFund IBR conducted from 2017 – 2021. The reference section contains the different research communication channels where the research works have been published by the researchers for more visibility and networking. This publication will be an annual work from the directorate to ensure constant publications of research outputs (technical reports) in the Polytechnic.

Dr. Blessing C. Okogbue
Editor-in-Chief
Director, R & D.

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Title/Lead Researcher

1. ECOLOGICAL STUDY OF THE NUN RIVER IN EKOWE, BAYELSA STATE

Department:
Fisheries Technology

Team members:
Blessing C. Okogbue - Lead Researcher
Ebinimi Ansa - Collaborator (ARAC)
Preye Ofunama - Co-Researcher/Enumerator
Emmanuel E. Omorwohwovie - Co-Researcher

Abstract
This study of the ecology of Nun River in Ekowe, Southern Ijaw Local Government Area of Bayelsa State was carried out over a period of twelve months beginning from January to December, 2017. The river was sampled for water quality, heavy metal, total hydrocarbon content (THC), planktons, fish and shell fish species analyses. The river water was analyzed for twelve physico-chemical parameters namely; dissolved oxygen, temperature, pH, conductivity, total dissolved solids (TDS), total alkalinity, total hardness, carbon (II) oxide, turbidity, nitrate, phosphate and salinity. The heavy metal analysis was carried out for iron, chromium, cadmium, arsenic, mercury and total hydrocarbon content (THC). The fish and shell fish species composition analyses were equally carried out from January to December. Eighty-five (85) species belonging to fifty (50) families and twenty-one taxonomic orders were identified and recorded from January to December. The plankton analysis also showed that several species of the Chlorophyceae class of phytoplankton are present with the Cyanophyceae predominant. Other species include Baccillariophytes, Crysophytes, Euglenophytes and Xantophytes. Training workshop was also conducted for fishermen in the fishing camp to educate them on aquatic resource management and stewardship. An extension guide was produced as an awareness and sensitization material for the project. Fish charts for Nun River was created and used as a teaching aid. Fish museum was also developed using the preserved species. A number of the results and data generated from this project have been published in academic journals and equally read in conferences. They are well referenced in this work.

Objectives of the study

1. To document the different fin and shell fish species present in the Nun River
2. To report the water quality status of the river
3. To provide data on the heavy metal contents of the river water
4. To provide data and information on the ecosystem goods and services
5. For historic documentation of the research output for academic work in the Department of Fisheries Technology.
6. To preserve materials that will help in developing the fish laboratory with instructional materials and aids for fisheries-based courses in the Polytechnic.

Materials and methods
To achieve the objectives of the study, sampling method was used in data collection; Census/questionnaires, visual observations and on-site sampling were adopted (FAO, 2012). Stratified random sampling was carried out on 2 sites (between Ekowe and Ayama communities). Each stratum represented a group and/or replicate for water

quality analyses. Local fishermen were used as potential source of primary data on fish species characteristics. Samples were preserved in formalin for the fish museum.
The equipment and materials deployed for the field work include, the Amscope microscope, the Hanna instrument and test kit, secchi discs, sample bottles, glass slides, cameras, refractometer, handheld GPS device, plankton net, life jackets, weighing scales and meter rules.

Summary of findings

This study on the Nun River revealed eight-five (85) species of aquatic macrofauna including fin and shell fishes. Seventy-five (75) fin fishes and ten (10) shellfish species. The predominant species were the Synodontis species, the Cichlid species, the Momyrids and the Catfishes. The predominant shellfishes were the Apple water snail, *Pila africana* and the Clam, *Egeria radiate* (See plates 1 & 2).
Results for planktons have also been published (see references). The diverse species of macro fauna of the Nun River all contribute to the goods the river can offer the stakeholders. The biodiversity can be threatened, endangered or protected. The knowledge of the environment and habitats helps to safeguard them. The red arrows pointing downwards (Table 1) show areas of ecosystem services the stakeholders of the Nun River are not maximizing. It was also observed that the aesthetic values are not appreciated. The rivers are turned to refuse dumping sites thus increasing the level of organic pollution. The tourism, recreational and economic potential of the river coupled with sport fishing are not well projected in the Nun River wetlands.

Plate 1: Fish chart showing the composition of the Nun River fish species

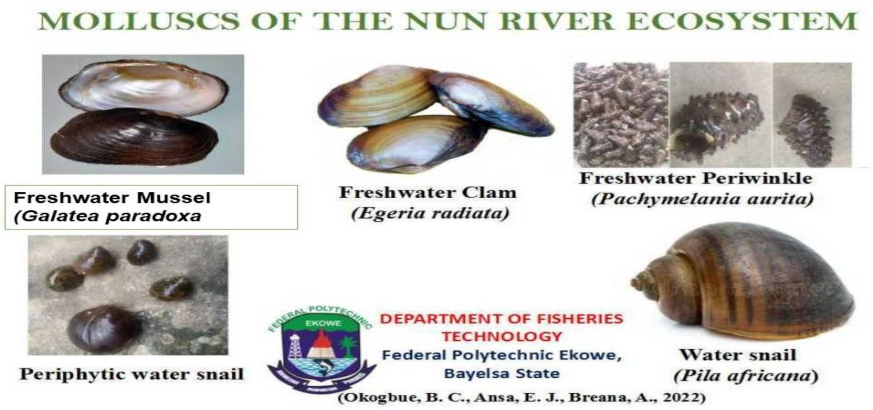

Plate 2: Shellfish chart showing the composition of the Nun River Mollusc species

Table 1: Tabular analysis of the ecosystem services of the Nun River (Okogbue, 2021)[1].

S/N.		SCALE
	PROVISIONING SERVICES	
1.	Food production from fishing	↑
2.	Water transport	↑
3.	Raw material – sand for building works	↑
4.	Freshwater for domestic use	↑
5.	Shells	↑
6.	Aquatic plants for fish food	↑
	REGULATORY SERVICES	
1.	Flood control	↑
2.	Water recharge	↑
3.	Microclimate regulation	↑
4.	Carbon sequestration	↑
5.	Nutrients recycling	↑
6.	Soil sedimentation	↑
7.	Moderation of river flow	↑
8.	Self-cleaning & purification	↑
	CULTURAL SERVICES	
1.	Tourism – Ecotourism	↓

2. Recreation
3. Boating pleasure
4. Swimming
5. Sport fishing
9. Aesthetic nature view
10. Floating structures on water

Note: Blue upward arrows mean positive services utilized by the stakeholders
Red downward arrow means services not optimally utilized by the stakeholders but have socio-economic values.

Table 2: Water quality parameters of the Nun River (Okogbue, B. C., 2021)[2]

PARAMETER	MONTHS													
	JAN	FEB	MAR	APRI	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	SEM	LOS
pH	7.28	7.69	7.96	7.53	7.52	7.43	7.45	7.13	6.96	6.97	7.67	7.41	2.15	NS
Temp. (0c)	30.30^{cd}	31.55^{ab}	29.35^{e}	30.40^{c}	30.30^{cd}	27.25^{k}	28.45^{f}	27.00^{kl}	28.15^{i}	29.50^{cg}	31.85^{a}	30.10^{cf}	0.32	*
DO (Mg/L)	6.75^{d}	7.70^{a}	7.45^{ac}	6.50^{e}	5.00^{ik}	7.50^{ab}	6.30^{ef}	5.85^{h}	5.50^{i}	5.35^{ij}	6.00^{g}	7.00^{c}	0.20	*
TDS (Mg/L)	47.00^{bc}	40.50^{de}	46.00^{be}	37.50^{f}	41.00^{d}	41.00^{d}	44.50^{bf}	37.50^{f}	36.50^{fg}	46.50^{bd}	67.00^{a}	49.00^{b}	2.35	*
Turbidity (cm)	28.75^{ad}	28.75^{ad}	27.50^{af}	31.25^{a}	30.50^{ab}	29.50^{ac}	7.40	5.75^{f}	5.25^{fg}	13.15^{e}	16.50^{d}	19.75^{c}	2.07	*
Cond (μ/s)	78.00^{g}	77.10^{gh}	94.50^{cd}	73.00	84.50^{ef}	88.00^{e}	70.00^{j}	70.00^{j}	75.50^{i}	96.50^{c}	123.50^{a}	102.00^{b}	4.42	*
CO_2 (Mg/L)	-	10.00	6.25	11.00	10.00	10.00	6.75	12.50	13.75	11.00	8.75	10.00	4.20	NS
Acidity (Mg/L)	-	35.00^{a}	12.50^{f}	25.00^{b}	25.00^{b}	20.00^{d}	10.00	25.00^{b}	25.00^{b}	15.00^{e}	25.00^{b}	5.00^{g}	2.03	*
TA (Mg/L	-	72.00^{a}	40.00^{h}	45.00^{fg}	37.50	54.00^{bc}	45.00^{fg}	37.50	48.00^{f}	52.50^{bd}	52.50^{bd}	57.00^{b}	3.52	*
TH (Mg/L)	-	34.50^{g}	52.50^{d}	42.00^{f}	52.50^{d}	51.00^{de}	52.50^{d}	67.50^{a}	60.00^{b}	52.50^{d}	60.00^{b}	60.00^{b}	3.86	*

($P<0.005$)

Table 2b: Analysis of phosphate, nitrate and salinity of Nun River

S/N	Parameter	June	July	Aug.	Sept.	Oct.	Nov.
1.	Phosphate (mg/l)	-	-	> 1.00	1.00	<1.00	<1.00
2.	Nitrate (mg/l)	-	-	< 10.00	< 10.00	<10.00	<10.00
3.	Salinity (ppt)	0.00	0.00	0.00	0.03	0.03	0.03

Table 3: Results of heavy metal analysis of the Nun River (Okogbue, B. C., 2021)

S/N.	METAL ANALYZED	DRY SEASON JAN - MAR		WET SEASON MAY - JULY		WHO/ATSDR Max. limit
		Range (mg/L)	Mean±SD	Range (mg/L)	Mean±SD	
1.	IRON	0.002 – 0.003	0.003±0.000	1.653 - 6.579	3.931±1.772	1.0
2.	ZINC	<0.005	0.005±0.000	0.026 – 0.275	0.135±0.105	15
3.	LEAD	<0.002	0.002±0.000	<0.002	0.002±0.000	0.1
4.	COPPER	<0.001	0.001±0.000	0.048 – 0.103	0.085±0.000	1.5
5.	CADMIUM	<0.001	0.001±0.000	<0.001 - 0.020	0.010±0.000	0.005
6.	CHROMIUM	<0.001	0.001±0.000	<0.001 – 0.030	0.019±0.000	<1.0
7.	ARSENIC	-	-	<0.001	0.001±0.000	NA
8.	MERCURY	-	-	<0.001	0.001±0.000	0.001

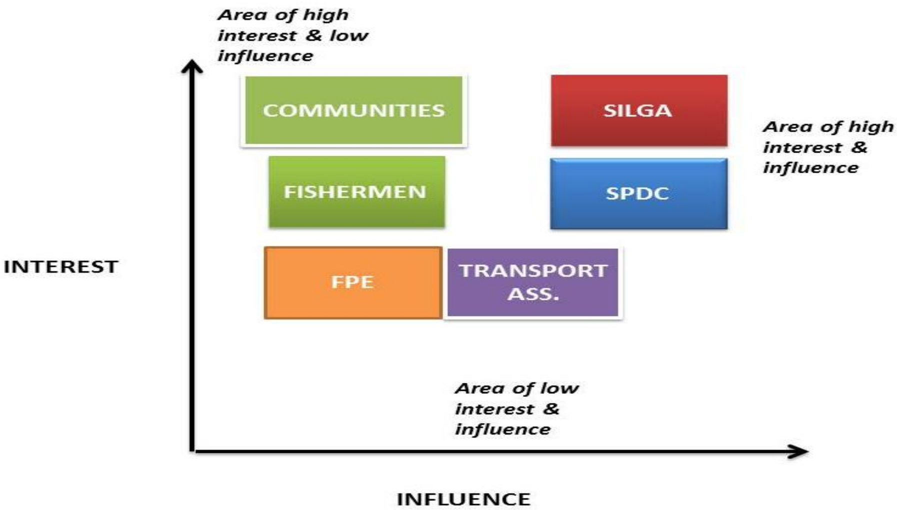

Figure 3: Matrix showing the stakeholders analysis of the Nun River ecosystem (Okogbue, 2021)[2] *(SILGA – Southern Ijaw LGA; SPDC – Shell Petroleum Development Company; FPE – Federal Polytechnic Ekowe)*

Stakeholder analysis is important in environmental projects. Involving indigenes/citizens in the ecosystem project planning by the government and non-governmental bodies enhances communication, cooperation and shared responsibility. It also creates awareness among the citizens and makes them better environmental stewards.

Conclusion

This ecological study of Nun River provides detailed information about the fish species composition, water quality status and its attendant effect on the physical, chemical and biological components of the aquatic ecosystem. Proper management of the aquatic resources of the Nun River ecosystem will leverage the potentials of biodiversity of the ecosystem for ultimate national economic and socio-economic development.

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2. ANALYSIS OF NUN RIVER BED SEDIMENT, MICROBIOLOGY, BIOCHEMICAL AND PROXIMATE COMPOSITION OF THE INHABITATING FISH SPECIE IN EKOWE, BAYELSA STATE

Department:
FISHERIES TECHNOLOGY/ SCIENCE LABORATORY TECHNOLOGY

Team members:
Blessing C. Okogbue – Team Lead
Seiyaboh E. Idah – Co-Lead
Preye Ofunama - Co-Researcher
Udeme Akpan - Enumerator
Beatrice Okocha - Lab. Technologist

Abstract
This study is focused on the biochemical, microbiological and proximate analysis of Nun River located at Ekowe in the Southern Ijaw LGA of Bayelsa State. The analysis was conducted to assess the health and safety implications of the water body and sediments on the consuming public. The parameters assessed from the river water and sediments include, heavy metals (Fe, Cr, Cd, Zn, Pb and Cu), total hydrocarbon content (THC) as well as the microbial community which include the total coliform, faecal coliform, the total heterotrophic bacteria (THB) and *Escherichia coli (E. coli)*. Two sampling sites were chosen from two points within the Ekowe community. The samples were collected at the Polytechnic Jetty and Community Jetty and designated as points A and B respectively. These analyses were tailored to ascertain the level of microbiological pollution in the river at both bulk and particulate (sediments) levels. The different fish species present in the river were equally analyzed for biochemical components. Twenty-eight (28) species of the fin and shell fishes were analyzed. The fish samples were analyzed for proximate and mineral compositions. The mineral elements analyzed were calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K), Iron (Fe) and Phosphorous (P). The results of the various tests indicates the presence of heavy metals in the sediments and also the quality nutritional status of the different fish species of the Nun River which indicates wealth of aquatic resources in the Nigerian wetlands. Results also show that the river sediment is loaded with hydrocarbons and iron. The outcome of these studies has buttressed the point that there is the need for ecosystem analysis and documentation of findings to enable researchers make references and academics develop teaching models and update lecture contents for teaching and learning activities in aquatic ecology and fisheries studies. A catalogue of the Nun River fish species and their ecological and nutritional information is currently developed for publication for teaching and research purposes.

Objectives of the study

1. To update the water quality status of the river with respect to heavy metal and THC analysis
2. To analyze the microbial load in the river for consumer safety
3. To provide data on fish proximate and mineral composition of some of the fish species in the Nun River
4. To develop a catalogue of the Nun River fish species for teaching and research.

Materials and methods

The project site is Ekowe which is located in the North-Eastern part of Bayelsa with a geographical coordinate of N04^0 42.464' E 006^0 05.590' and elevation of 4 meters below sea level. Echman grab was used to collect sediment samples from river bed. Sterilized bottles were used to collect samples for microbiological analyses. Fish samples were collected and their length and weight measurements were taken before proximate and mineral analysis were conducted. Gas chromatography was used for THC determination while atomic absorption spectrophotometer (AAS) was used for heavy metal analysis.

Summary of findings

The parameters analyzed include, total heterotrophic bacteria (THB), total coliform bacteria, feacal coliform bacteria and E. coli which were all present thereby contaminating the river water making it unfit for consumption without treatment. The heavy metal components determined were Iron (Fe), Zinc (Zn), Lead (Pb), Chromium (Cr), Cadmium (Cd) and Copper (Cu).

Table 1: Total Hydrocarbon Content analyses on Nun River water and sediment

PARAMETER	WATER (mg/l)				WHO LEGAL LIMIT
Month	1	2	3	4	
THC (mg/L)	4.663	39.61	7.07	6.222	10 mg/l
	SEDIMENT (mg/kg)				
Month	1	2	3	4	
THC (mg/kg)	48.472	6.306	<0.01	26.00	30 mg/kg

Table 2. Microbiological analyses on Nun River water

Parameters	Polytechnic jetty				Ekowe community jetty				EPA Limits for surface water
	1	2	3	4	1	2	3	4	
Total Heterotrphic Bacteria (THB) x10^3 cfu/ml	1.1	1.2	0.6	0.4	1.2	0.5	0.7	0.3	<100 cfu/100ml
Total Coliform MPN/100ml	280	>1600	220	220	350	280	350	240	<1cfu/100ml
Feacal Coliform MPN/100ml	43	920	94	47	47	170	140	94	<200 cfu/ml
E.coli MPN/100ml	27	350	17	17	33	110	33	27	<126cfu/100ml

cfu – colon forming units

MPN – Most probable number

Table 3: Mineral composition of some species of fishes from the Nun River in Southern Ijaw LGA

FISH SPECIES	PARAMETERS					
	Calcium (%)	Magnesium (%)	Potassium (%)	Sodium (%)	Iron (%)	Phosphorus (%)
Malapterurus beninensis	24.35[g]	1.84[g]	19.65[g]	44.23[c]	3.69[f]	14.62[f]
Gymnarchus niloticus	474.52[b]	1.18[i]	11.95[f]	21.95[f]	1.92[i]	5.30[j]
Clarias anguillaris	200.37[e]	3.42[c]	14.81[e]	13.31[f]	6.69[b]	19.44[c]
Bagrus bayad	23.89[g]	1.81[f]	33.09[a]	37.73[d]	3.69[f]	9.64[i]
Arius gigas	270.10[d]	1.76[g]	15.69[e]	28.22[e]	2.59[h]	10.02[i]
Schilbe intermedius	40.73[g]	2.12[f]	4.10[h]	40.26[d]	4.00[f]	14.61[f]
E. calabaricus	1272.56[a]	4.98[a]	20.66[d]	64.83[a]	7.39[a]	28.66[a]
Parachanaobscura	205.60[e]	2.87[d]	15.50[e]	28.91[e]	5.59[c]	15.88[f]
Hepsetus odoe	117.61[e]	2.06[f]	14.76[e]	3.59[g]	3.60[f]	11.92[h]
Phractolaemus ansorgii	365.36[c]	2.77[d]	8.91[g]	30.01[e]	5.09[d]	15.18[f]
Heterobranchusbirdosalis	129.58[f]	2.08[f]	11.73[f]	24.60[e]	3.32[g]	14.87[f]
Distichodusbrevipinnis	222.56[e]	2.89[d]	17.88[e]	36.68[d]	3.62[f]	15.07[f]
Tilapia zilli	451.19[b]	4.17[b]	4.48[h]	24.80[e]	3.88[f]	23.23[b]
Oreochromis niloticus	195.49[e]	2.20[f]	16.33[e]	35.14[d]	4.46[e]	2.87[k]
Citharinuscitharus	283.75[d]	0.06[k]	15.75e	23.14[e]	3.88[f]	17.58[d]
Alestes baremose	16.97[g]	1.10[j]	4.76[h]	36.17[d]	3.17[g]	12.21[h]
Brycinusmacrolepidotus	183.42[e]	2.42[e]	29.52[b]	16.03[f]	4.32[e]	14.07[f]
Gymnallabes typhus	102.62[e]	2.83[d]	14.99[e]	47.87[b]	4.43[e]	13.33[g]
Labeo senegalensis	100.70[e]	2.03[e]	28.20[c]	39.64[d]	4.11[f]	14.49[f]
*Machrobrachiumvollenhoveni (*shell)	146.75[e]	2.01[e]	20.37[d]	31.19[e]	2.32[h]	10.43[i]
Sesarmaspp(flesh)	166.02[e]	2.07[e]	18.52[e]	30.87[e]	329[g]	12.68[h]
*Machrobrachiumvollenhoveni (*flesh)	117.03[e]	1.58[h]	17.14[e]	20.24[e]	3.02[g]	9.69[i]

Sesarmaspp (shell)	149.87^{e}	1.29^{i}	15.34^{e}	3.42^{g}	2.42^{h}	10.67^{i}
SEM	37.72	0.15	1.07	2.03	0.19	0.78
LOS	*	*	*	*	*	*

LOS= Level of Significance; SEM= Standard Error of Mean

Table 4: Length and weight of the species samples analyzed for mineral composition

Fish species	Total Length (cm)	Weight (g)
Malapterurus beninensis	21.0	136
Gymnarchus niloticus	37.5	115
Clarias anguillaris	24.0	130
Bagrus bayad	25.0	64
Arius gigas	16.0	44
Schilbe intermedius	17.0	61
Erpethoichthyscalabaricus	29.0	37
Parachanaobscura	24.5	90
Hepsetus odoe	23.0	107
Phractolaemus ansorgii	16.3	49
Heterobranchusbirdosalis	16.5	27
Distichodusbrevipinnis	19.5	111
Tilapia zilli	14.3	54
Oreochromis niloticus	12.0	37
Citharinuscitharus	18.5	64
Alestes baremose	24.3	101
Brycinusmacrolepidotus	17.0	74
Gymnallabes typhus	23.5	30
Labeo senegalensis	19.0	74
M. vollenhoveni	14.0	37
Sesarmaspp	13.5	10

*= significant; abcd= significant difference among the species means

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3. A COMPERATIVE STUDY OF K-MEANS HEURISTIC CLUSTERING METHODS

Department: STATISTICS

Team members:
Oti Eric - Lead Researcher
Bethel E. Okpomu - Co-Researcher
Warebi K. Alvan - Co-Researcher
Franklin L. Sorgbara - Co-Researcher

Abstract

This research seeks to establish the comparative suitability of the modified k-means clustering method for effective updating of cluster centroids. In our simulation, the Normal (Gaussian) simulation which was generated randomly showed that when the number of clusters k = 2, the modified k-means method performed better than the existing methods with minimal standard deviation of 0.3263 and high accuracy of 86 percent. While when the number of clusters k = 3, the Likas' method outperformed the modified method and other existing methods with a standard deviation of 0.6780 and accuracy of 88 percent. For iris data set, when the number of clusters k = 2, the modified k-means method performed better than the other methods with standard deviation of 0.3414 and accuracy rate of 89.58 percent. When the number of clusters k = 3, the MacQueen's method performed best with standard deviation of 0.5983 and 91.50 percent accuracy. For the yeast cell cycle data set, the modified k-means also outperformed other methods when k = 2 with a minimal standard deviation of 0.2125 and high accuracy of 93.60 percent. When k = 3, the MacQueen's method performed better than other methods with standard deviation of 0.6395 and 75.15 percent accuracy. Summary of the findings for the enhanced k-means clustering method using Minkowski's distance as its metric are: From the simulation, with the number of clusters k = 2 and 3, the Likas' method outperformed the enhanced k-means and other methods with standard deviation of 0.3915 and 0.6780 respectively and accuracy of 85 and 88.6 percent respectively. For the iris data set and wine data set, the enhanced k-means method performed better than the other methods with standard deviation of 0.3325 and 0.2655 respectively; and accuracy rate of 89.70 and 92.15 when k = 2. While when k = 3, the Likas' method performed best in the iris data and MacQueen's method performed better than other methods in the wine data set. Our simulated data was generated randomly from a Gaussian (Normal) distribution with dimension of 250 rows and 2 columns (categories or attributes) that are divided into two and three clusters (that is, k=2, 3). We chose 250 true centers uniformly at random given the above dimension. The point from the Gaussian distributions has a variance of 1 around each true center.

Objective of the study

To propose new k-means clustering method (s) that will minimize total intra-cluster variance or the squared error function.

Table1: Summary results of simulated data when the number of clusters k = 2 and 3 respectively.

Methods	When K = 2			When K = 3			Combined Rank
	Mean	Std. Dev.	Rank	Mean	Std. Dev.	Rank	
Forgy	1.584	0.4949	4	2.248	0.7476	3	7
Lloyd	1.496	0.5020	6	1.920	0.8092	5	11
MacQueeen	1.504	0.5020	6	2.296	0.7831	4	10
Hartigan& Wong	1.504	0.5020	6	2.144	0.8299	6	12
Likas	1.776	0.4186	2	2.544	0.6780	1	3
Faber	1.760	0.4288	3	2.048	0.9233	7	10
Modified k-.means	1.880	0.3263	1	1.544	0.6898	2	3

From the above results of the simulation generated randomly, for the number of clusters k = 2, our modified k-means method performed better than the six existing methods with standard deviation of 0.3263, considering the fact that the variance (the total within-cluster sum of squares) is minimized; it measures the compactness (i.e. goodness) of the clustering which is meant to be as small as possible. Also, with the number of clusters k = 3, Likas' method performed best with standard deviation of 0.6780, followed by modified k-means method which performed better than the other five existingmethods with 0.6898 standard deviation. It was observed from the combined ranking that the modified k-means and the Likas' method had a tie in their performance with minimal intra-cluster variance of 3.

The iris flower data set is a multivariate data set with 150 rows (instances) which is divided into 3 instances each, where each class refers to a type of iris plant (iris setosa, iris versicolor, and iris virginica): the number of columns (attributes) is 4 which consist of sepal length, sepal width, petal length and petal width (Fisher, 1936).

Table 2: Summary results of iris data when the number of clusters k = 2 and 3 respectively.

Methods	When K = 2			When K = 3			Combined Rank
	Mean	Std. Dev.	Rank	Mean	Std. Dev.	Rank	
Forgy	1.3533	0.4796	4.5	1.560	0.8067	4	8.5
Lloyd	1.6467	0.4796	4.5	2.4933	0.7396	3	7.5
MacQueeen	1.3533	0.4796	4.5	1.9333	0.5983	1	5.5
Hartigan& Wong	1.6467	0.4796	4.5	2.080	0.8633	5	9.5
Likas	1.6333	0.4835	7	2.6533	0.7234	2	9
Faber	2	0	1.5	2.4667	0.9193	7	8.5
Modified k-means	1	0	1.5	1.9467	0.9031	6	7.5

From summary (Table 2) on iris data set, it is observed that for the number of clusters at k = 2, the modified k-means method and Faber's method with standard deviation of 0 performed better than Lloyd, MacQueen, Hartigan & Wong and Likas methods. When the number of clusters k = 3, the MacQueen's method with the lowest standard deviation of 0.5983 had the best performance among the all the methods tested, while the modified k-means method did better than Faber's method. From the combined rank, it was observed that the modified k-means and Lloyd's method had a tie of 7.5 which was better than Forgy's, Hartigan and Wong's, Likas' and Faber's methods.

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4. EVALUATION OF RENEWABLE SOLAR ENERGY IN EKOWE, BAYELSA

Team members:

Engr. Digitemie, Innocent Eteli (Lead Researcher)
Engr. Adukeh, Idoimo John (Geli Engineering Enterprise, Yenagoa)
Engr. Ezeliora, Chukwuemeka Daniel (Co-Researcher, Fed. Poly. Oko)

Department: MECHANICAL ENGINEERING TECHNOLOGY

Abstract

Study on the research and advancement of solar based energy resources available at Federal Polytechnic Ekowe was conducted. The objectives of this study were to collect real time solar data from the research site at Federal Polytechnic Ekowe, Southern Ijaw Local Government Area, for a period of one year, to evaluate the daily, weekly, and monthly energy available from the solar source and to evaluate the viability of solar energy as an alternate source of power in the Polytechnic and its environs. This report presents the assessed solar energy potentials of the Ekowe community, Bayelsa State, Nigeria. The study is a contribution in the general trend towards renewable energy and aims to give insight into the feasibility of solar power as a viable option for improving access to electricity in Ekowe in particular for the Federal Polytechnic, Ekowe. The average daily solar radiation is about 4.6 kWh/m², with an average daily solar hour of about 6.6 hours/day, indicating the development of a case for integrating solar energy within the power mix of the region. In the study, which was funded by the Tertiary Education Trust Fund, the real-time data on solar radiation for the year starting from July 1, 2023, and running up to June 30, 2024, was collected using a solar-powered data collection rig equipped with a Smart Wi-Fi Enabled Weather Station. It also identified some challenges to the adoption of solar energy, including inadequate infrastructure, relatively high capital costs, and prevalence of real-time data and community awareness. The paper thus concludes by appealing to the community outreach, financial incentives, and physical infrastructure that will help in the adoption of solar energy for improved access to energy, besides inspiring economic activities as well as sustainable lifestyles among members of the Ekowe community.

Aim and Objectives

The aim of this research was to evaluate the renewable solar energy resources available in Ekowe.

Objectives

The report also tends to accomplish the following:

1. Assess the solar radiation data for daily, weekly, and monthly energy availability in Ekowe exclusively. Besides, the data will be gauged with regional ones to understand the complete solar energy potentials of the area.
2. The report is also to provide certain specific and practical measures that would hope to increase the implementation of solar energy in Federal Polytechnic Ekowe and its environs. Such strategies will be peculiar to the particular needs and problems of the region.

Problem Statement

In developing countries such as Nigeria, rural areas like Ekowe hold vast sources of solar energy. The factors limiting the use of solar energy in this region are complex and multilevel in nature. These include a lack of infrastructures that need to be in place for any successful actualization of solar energy systems (Agbo et al., 2021). While many households and businesses are constrained by the high initial costs of acquisition and installation of these solar technologies, aside from that, the non-availability of real-time data on solar incidents in Ekowe, coupled with general unawareness among people there about the potential and feasibility of solar energy, the situation gets even worse. These are challenges that must be tackled if the full potential of solar energy is to be tapped in this region and further improve life for its residents.

Materials and Methods
Data Collection

Solar radiation data was gathered from the installed ambient weather station WS–2902A to assess the average daily solar radiation levels in Federal Polytechnic Ekowe from 1st of July 2023 to 30th of June 2024 and the collected data can be found in Appendix A.

Data Analysis

Statistical tools are employed to carefully examine the data that has been collected on solar radiation and this analysis involves using various statistical methods to gain insights into the patterns, trends, and variations in the solar radiation data, which can help in understanding the behaviour of solar radiation over time and across different locations.

Summary of Findings

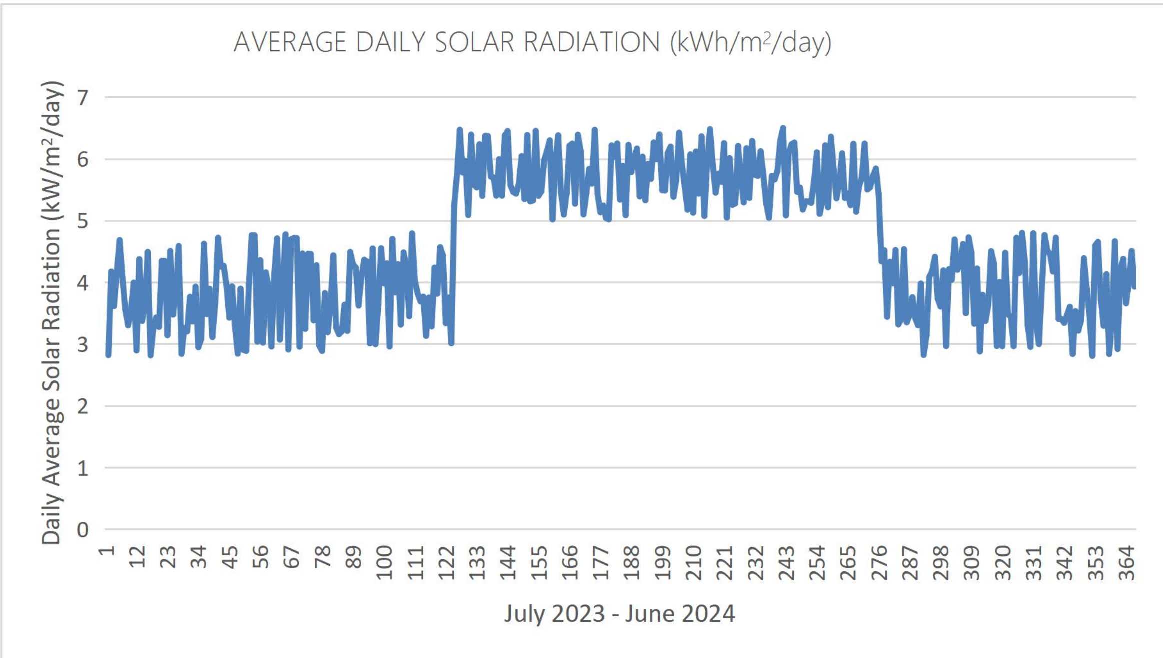

Fig. 1: Line Chart of solar radiation for July 2023 to June 2024

The data collected showed that Ekowe received an average daily solar radiation of approximately**4.6 kWh/m²**and an average solar hour per day of **6.6 hours**. The data displayed in the line chart showed that Polytechnic's solar radiation intensity increased from 3.8 to 5.2 **kWh/m²** in November 2023 and sustained the intensity till April 2024 with the maximum value at **6.5kWh/m²**. The average daily solar radiation data fluctuated from 2.8 to 6.5 **kWh/m²** in the one-year period. Chineke & Okoro (2010) used the “Sayighr Universal formula" to estimate the global solar radiation in the Niger Delta region of Nigeria with levels ranging from 1.99kWh to 6.75kWh. Also, according to Global Solar Atlas and RVO.nl, Nigeria has an annual solar energy potential of about 1,500 to 2,200 hours of sunshine butthe Polytechnic received a total of about 2,400 hours of sunshine during the period. These support the feasibility of solar energy systems integration into the power mix for the institution and rural electrification projects in Ekowe.

The current solar energy infrastructure has limited availability of panels and installation services, along with a lack of community-based renewable energy programs or initiatives (Mirzania et al., 2019).

Recommendations

Community outreach programs: The Polytechnic should design and implement a rigorous educative outreach programme in the Ekowe community to enlighten people on the potential environmental and economic benefits they can reap from the solar energy system. Furthermore, TETFund should make available appropriate practical training programs through Federal Polytechnic Ekowe in the installation and maintenance of solar energy systems, enabling them to acquire the required capability and know-how to adopt and utilize the technology once people are ready for its acceptance and use.

Financial Incentives: TETFund should develop strategic partnerships with other government agencies, banks, and nonprofit organizations through the development and implementation of financial incentive programs (subsidies and tax credits) that make the purchase of solar systems more possible for individuals and businesses.

Infrastructure Development: TETFund and the Polytechnic should pursue and work to promote and encourage investments in local infrastructure in support of new and expanded renewable energy projects, including specialized training centres for technicians with the direct skills and expertise to help the solar energy enterprises that will be located within our community.

Conclusion

This technical report comprehensively argues that Ekowe is among the communities with high solar radiation while possessing immense unexploited potential in respect of renewable solar energy resource exploitation. It then categorically outlines how Ekowe can cash in on her high ranking in terms of solar energy potentials by putting in place certain vital strategies to surmount some existing challenges. It would involve active community participation; create awareness of the benefits accruing from solar energy, right up to providing financial incentives in the form of subsidies or low-interest loans for installing panels, even to infrastructure development to lay a strong platform for renewable projects. The report goes on to say that such proactive steps on the part of Ekowe could increase access to energy, improve reliability, and spur local economic growth through the creation of job opportunities in the process, hence encouraging sustainable development practices that could have long-term benefits for the community. This approach, if taken far enough, might just be the transformational factor in livelihoods among residents while turning Ekowe into a benchmark in renewable energy adoption in the region.

Table 1: Solar radiation for July 2023 to Oct. 2023

DAY	AVERAGE SOLAR RADIATION ($kWh/m^2/day$)	AVG. UV INDEX PER DAY	AVERAGE DAILY BAROMETRIC PRESSURE (mmHg)	AVERAGE WIND SPEED (km/hr)	DAILY PRECIPITATION (mm)	MAX. DAILY OUTDOOR TEMPERATURE (ºC)	MIN DAILY OUTDOOR TEMPERATURE (ºC)	AVG DAILY OUTDOOR TEMPERATURE (ºC)	AVERAGE RELATIVE HUMIDITY (%)
7/1/2023	2.8	3	760.0	15.13	14.8	35.8	22.6	32.5	86.3
7/2/2023	4.2	1	764.0	10.88	5.1	35.8	22.6	32.5	91.2
7/3/2023	3.6	7	763.3	8.32	16.3	34.4	22.6	25.3	85.9
7/4/2023	4.2	4	761.6	15.46	9.8	36.4	22.4	27.4	81.7
7/5/2023	4.7	6	749.6	13.93	12.3	35.5	23.0	24.0	90.3
7/6/2023	4.1	6	766.3	14.55	8.9	35.1	22.9	22.7	79.9
7/7/2023	3.6	5	765.7	11.02	11.4	35.3	22.4	26.4	89.4
7/8/2023	3.3	5	765.2	14.66	7.9	36.4	24.7	26.2	90.7
7/9/2023	3.5	4	758.0	12.54	6.8	35.0	23.5	26.3	82.6
7/10/2023	4.0	6	766.5	14.84	12.7	35.3	22.5	25.6	83.5
7/11/2023	2.9	3	760.7	9.09	7.9	34.2	23.5	25.6	93.4
7/12/2023	4.4	7	752.4	9.65	9.7	35.4	22.8	25.6	87.9
7/13/2023	3.4	2	764.9	10.33	8.4	35.0	24.2	26.9	90.6
7/14/2023	3.7	6	760.5	10.06	14.9	36.7	23.4	30.3	82.4
7/15/2023	4.5	6	754.7	13.45	9.5	35.9	22.4	31.8	87.4
7/16/2023	2.8	5	763.6	15.34	16.6	36.7	23.8	34.7	81.1
7/17/2023	3.3	4	751.0	8.05	15.9	34.2	24.7	32.5	81.7
7/18/2023	3.4	1	762.9	8.43	16.0	37.0	22.4	32.6	86.5

7/19/2023	3.3	2	759.9	14.94	4.8	36.6	22.0	34.3	87.7
7/20/2023	4.3	5	748.9	14.50	13.7	34.3	23.2	31.4	86.0
7/21/2023	4.3	4	757.9	14.38	10.2	36.0	23.0	31.7	85.5
7/22/2023	3.1	6	759.7	10.96	8.4	35.0	23.4	23.2	84.6
7/23/2023	4.5	6	756.3	13.06	12.6	36.7	23.5	30.5	86.6
7/24/2023	3.5	3	761.4	15.99	2.5	34.2	24.1	29.1	90.4
7/25/2023	3.8	6	757.4	12.29	10.8	35.1	22.1	35.4	87.9
7/26/2023	4.6	2	757.4	14.57	3.9	36.8	22.9	27.3	84.4
7/27/2023	2.8	4	760.3	13.79	6.2	34.4	22.9	26.8	87.9
7/28/2023	3.3	6	751.4	10.13	5.1	36.4	23.3	28.8	87.6
7/29/2023	3.2	4	753.1	15.49	11.9	34.4	24.6	26.6	85.1
7/30/2023	3.8	6	766.8	14.94	8.9	35.3	22.5	26.0	88.8
7/31/2023	3.4	2	755.0	13.09	5.9	35.4	24.6	32.3	84.1
8/1/2023	3.9	5	752.5	7.16	5.4	30.9	20.7	27.1	79.8
8/2/2023	2.9	5	761.7	6.45	5.6	30.9	21.8	28.8	79.2
8/3/2023	3.1	1	761.2	4.04	2.0	30.3	20.8	27.8	91.9
8/4/2023	4.6	6	756.0	9.04	1.9	31.0	20.0	26.6	74.8
8/5/2023	3.5	5	754.2	6.06	0.9	31.3	20.5	26.7	82.3
8/6/2023	3.9	3	758.2	7.05	3.1	31.6	23.3	27.0	82.7
8/7/2023	3.1	4	751.8	6.89	5.9	30.8	20.3	26.7	81.5
8/8/2023	3.7	2	757.3	6.36	1.9	31.6	21.2	27.6	75.9
8/9/2023	4.7	3	755.9	10.47	5.5	30.4	22.3	27.6	86.9
8/10/2023	4.3	2	759.7	9.36	2.3	31.1	20.5	26.8	83.3
8/11/2023	4.3	6	760.5	7.23	5.0	30.1	22.7	27.0	85.2
8/12/2023	4.0	5	760.1	8.41	2.3	30.5	20.5	28.7	88.5
8/13/2023	3.4	3	748.0	8.17	5.6	30.2	22.2	27.4	77.3
8/14/2023	3.9	3	762.9	4.38	0.9	30.9	22.6	28.0	85.0
8/15/2023	3.3	7	765.6	8.71	2.7	30.1	22.0	27.3	92.5
8/16/2023	2.8	1	762.6	11.45	1.4	31.1	20.0	28.8	75.4

8/17/2023	3.9	3	758.0	11.14	1.1	31.5	20.7	27.4	84.5
8/18/2023	2.9	4	749.2	7.06	2.5	31.5	20.6	26.1	86.7
8/19/2023	2.9	2	762.3	10.69	4.7	31.9	21.3	27.7	76.9
8/20/2023	4.0	4	758.0	7.68	2.0	30.8	20.6	28.0	92.0
8/21/2023	4.8	3	754.1	10.97	2.6	31.9	22.1	27.2	85.9
8/22/2023	4.8	4	762.3	4.23	3.1	31.7	23.2	28.5	77.7
8/23/2023	3.0	1	752.2	4.88	4.9	31.6	23.2	28.7	69.4
8/24/2023	4.4	6	758.7	4.56	4.9	31.8	20.6	28.3	81.0
8/25/2023	3.0	2	762.8	7.79	2.4	30.4	20.6	28.1	70.5
8/26/2023	4.2	4	754.3	6.06	4.8	31.7	23.4	28.3	88.8
8/27/2023	3.9	2	758.4	8.51	1.1	30.2	22.9	28.7	84.8
8/28/2023	3.0	2	760.8	6.90	4.7	30.3	23.1	28.0	80.8
8/29/2023	4.1	3	755.9	10.62	1.7	31.8	23.5	27.8	83.2
8/30/2023	4.7	6	766.3	8.24	2.4	30.3	21.5	28.0	91.5
8/31/2023	3.1	7	758.8	9.85	1.9	30.7	22.5	26.4	83.8
9/1/2023	4.0	5	759.7	7.35	2.6	31.3	21.5	28.6	82.2
9/2/2023	4.8	3	765.5	9.58	2.7	29.1	19.3	26.7	87.3
9/3/2023	2.9	3	763.1	6.66	3.5	30.4	21.7	27.3	90.3
9/4/2023	4.7	6	757.9	9.13	9.7	31.1	22.6	28.1	86.0
9/5/2023	4.7	2	752.0	10.00	4.6	30.3	21.1	28.9	84.7
9/6/2023	4.7	5	763.1	6.21	3.3	33.6	19.0	28.0	84.3
9/7/2023	3.0	3	762.5	6.17	3.1	29.2	22.4	27.3	84.5
9/8/2023	4.5	2	766.0	6.96	9.5	30.1	23.1	27.8	88.3
9/9/2023	3.2	2	763.4	9.40	11.5	32.7	21.4	27.4	81.2
9/10/2023	4.5	4	762.5	5.37	3.4	34.0	22.8	28.0	87.6
9/11/2023	4.4	4	762.5	7.40	14.2	31.5	19.2	27.1	84.0
9/12/2023	3.4	7	765.6	6.44	15.9	32.6	21.8	26.5	84.2
9/13/2023	4.3	3	755.1	7.01	2.2	29.8	19.0	28.5	86.8
9/14/2023	3.0	6	762.0	8.06	16.9	31.4	21.8	28.3	77.4

9/15/2023	2.9	2	761.9	8.76	4.0	30.8	23.4	26.1	86.1
9/16/2023	3.8	2	753.8	7.47	6.9	32.8	20.8	28.1	87.8
9/17/2023	3.2	1	755.6	6.11	14.0	32.8	22.0	27.5	85.1
9/18/2023	3.6	5	763.7	7.89	8.5	31.1	22.1	28.8	86.9
9/19/2023	4.4	7	759.7	9.32	7.8	33.8	23.4	27.3	86.1
9/20/2023	3.3	6	755.7	9.72	4.4	33.8	19.2	26.1	87.8
9/21/2023	3.2	4	752.4	7.03	2.6	30.0	23.0	28.4	88.0
9/22/2023	3.2	3	754.3	6.49	15.4	33.3	20.5	28.1	85.4
9/23/2023	3.6	1	752.8	8.16	6.4	29.1	19.5	27.4	84.8
9/24/2023	3.2	3	750.8	5.31	9.5	33.6	21.2	27.3	86.3
9/25/2023	4.5	6	759.7	9.10	11.4	32.5	23.5	28.6	80.2
9/26/2023	4.3	6	760.7	9.27	0.0	29.3	23.1	26.9	88.7
9/27/2023	4.2	6	764.5	5.70	18.4	29.9	19.2	28.3	87.9
9/28/2023	3.6	7	752.6	8.81	16.6	32.4	20.4	26.6	88.2
9/29/2023	4.1	2	763.2	7.17	0.0	30.5	21.2	28.7	88.4
9/30/2023	4.4	3	749.7	7.84	5.9	29.1	23.5	28.2	81.3
10/1/2023	4.3	5	761.3	10.38	12.7	35.5	23.9	30.4	85.6
10/2/2023	3.0	7	753.6	9.52	11.5	33.2	23.0	28.9	80.0
10/3/2023	4.5	4	749.7	9.11	5.2	32.2	22.5	27.6	81.3
10/4/2023	3.0	7	749.6	7.40	4.8	34.9	22.8	30.3	76.9
10/5/2023	3.6	5	750.6	10.85	9.7	35.3	22.4	28.7	84.4
10/6/2023	4.6	5	749.2	8.46	13.2	35.6	21.9	28.3	86.8
10/7/2023	4.0	3	753.8	9.78	11.2	34.4	21.6	31.2	80.1
10/8/2023	4.3	5	748.9	8.68	13.1	35.5	24.8	29.0	75.1
10/9/2023	3.0	3	750.7	9.42	7.3	32.7	23.0	32.0	88.1
10/10/2023	4.7	3	752.9	10.04	15.1	34.9	23.9	28.4	79.8
10/11/2023	3.8	5	759.3	9.77	12.1	32.1	21.2	29.1	75.5
10/12/2023	4.3	7	750.0	7.05	9.8	33.6	21.7	31.3	84.7
10/13/2023	3.3	7	765.2	7.27	12.5	35.5	21.2	31.7	81.8

10/14/2023	4.5	2	759.9	8.78	9.1	34.4	22.6	27.5	79.3
10/15/2023	4.2	6	754.5	8.54	8.3	33.7	24.9	29.0	75.7
10/16/2023	3.5	2	749.0	9.62	10.8	34.6	22.2	28.1	85.2
10/17/2023	4.8	1	763.2	7.23	8.4	33.3	24.5	28.8	80.7
10/18/2023	4.0	7	750.8	7.64	12.3	32.8	22.2	30.7	82.4
10/19/2023	3.8	7	758.0	10.15	13.4	32.3	22.1	27.9	79.1
10/20/2023	3.7	5	756.5	7.26	6.6	33.2	22.3	29.5	83.1
10/21/2023	3.8	2	766.0	8.80	9.6	33.2	23.7	31.5	74.9
10/22/2023	3.1	3	749.8	10.18	12.2	32.0	24.3	28.0	77.5
10/23/2023	3.8	3	764.2	10.37	7.6	33.7	22.7	28.1	80.5
10/24/2023	3.3	4	759.3	7.11	13.2	34.6	22.0	31.6	81.4
10/25/2023	4.2	3	766.1	7.41	13.5	33.7	22.8	27.5	87.1
10/26/2023	3.8	5	754.4	9.14	7.6	35.7	21.9	29.2	85.4
10/27/2023	4.6	6	764.0	10.30	5.2	33.3	21.7	31.3	81.8
10/28/2023	4.4	3	754.0	9.56	13.6	34.8	22.2	28.6	78.9
10/29/2023	3.3	5	752.5	7.41	15.1	33.0	21.3	29.6	82.6
10/30/2023	3.8	2	759.5	10.91	8.6	32.8	22.2	27.7	80.0
10/31/2023	3.0	5	748.6	10.85	14.9	34.3	23.5	29.6	81.2

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5. UNEMPLOYABILITY OF THE NIGERIAN GRADUATE:THE EFFECT OF TERTIARY INSTITUTIONS-INDUSTRY DISCONNECT

Team members:
Markjackson Dumani - Lead Researcher
Ebikila Duke - Co-Researcher
Dinipre Angaye - Co-Researcher
Flint Sigah - Co-Researcher

Department:
BANKING AND FINANCE

Abstract

The main objective of the study was to examine the effect of tertiary institutions-industry disconnect in Nigeria. This was with a view to uncover the determinants of graduate unemployability in Nigeria. To achieve this, primary data was collated using a questionnaire from an online survey from five hundred and fifty participants. Descriptive and inferential statistical methods were employed to estimate the data. The descriptive statistical of the data collated shows that, about 61 % are employed; 94 % have ICT knowledge but with 50% above the average skill level; 56 % have an additional certificate; 35% current jobs matched school degree; 61 % are industrial related; 54% have attended the industrial workshop; 60% went for industrial training; 50 % were exposed to the practical aspect of their course of study; and most graduates had little years of experience. The binary logit estimates on the alignment of tertiary institutions' curriculum content with the workplace needs of employers shows that the coefficient of practical skill was positive but statistically insignificant, while industrial training and workshop were both found to be positive and statistically significant in enhancing once chances of employment. It is concluded that practical skills are a prerequisite for the chances of graduate employability in Nigeria. The binary logit estimates on the impact of the educational content on the workplace readiness of graduates indicated that grade point average, grade, and type of qualification were negative and statistically insignificant determinants of one's employability in Nigeria. The estimates further showed that practical skills like ICT knowledge and additional or professional certification have positive coefficients and are statistically significant in enhancing one's employability in Nigeria. In fact, the study finds evidence that the chances are 30 % and 31.4 % respectively in Nigeria. It is concluded that graduate employability is a function of practical ICT knowledge and additional or professional certifications in Nigeria.

Objective of the study
To examine the effect of tertiary institutions industry-disconnects in Nigeria.

Materials and Methods

Data collection and Analysis

Data were collected using questionnaires from an online survey from five hundred and fifty participants. Descriptive and inferential statistical methods were employed to estimate the data.

Results

This section presents the results of the regression estimates from the field work. The results are presented in tables and discussed subsequently.

Table 1. ***Data statistical properties***

Variables	Mean	Std.Dev.	Max	Min
Employed	0.609	0.489	1	0
ICT skill	0.935	0.246	1	0
ICT level	2.024	0.485	4	1
Additional certificate	0.558	0.497	1	0
Matches	0.354	0.479	1	0
Industrial related	0.605	0.490	1	0
Industrial Workshop	0.537	0.499	1	0
Industrial training	0.595	0.492	1	0
Practical skill	0.500	0.501	1	0
CGPA	3.583	0.632	4.93	1.50
Grade	2.459	0.699	4	1
Qualification	2.597	0.693	3	1
Age	2.980	0.905	4	1
Sex	0.541	0.499	1	0
Experience	4.624	4.322	27 Years	2 months

Table 1 depicts the descriptive statistics of the variables employed in this study. As Table 1 shows, about 61% are employed; 94% have ICT knowledge but with 50% above the average skill level; 56% have an additional certificate; 35% current jobs matched school degree; 61% are industrial related; 54% have attended the industrial workshop; 60% went for industrial training; 50% were exposed to the practical aspect of their course of study; average CGP is about 3.58; most students were barely above average, and most graduates are having a little year of experience.

Table 2. ***Dependent variable: Employment (Yes = 1, No = 0)***

Variable	Coeff. /Std.	Marginal
Practical skill	0.061	0.015
	(0.284)	(0.066)
Industrial training	0.508*	0.119*
	(0.290)	(0.066)
Industrial Workshop	0.846***	0.200***
	(0.258)	(0.059)
Constant	0.279	
	(0.219)	
Mc-Fadden R^2	0.033	
LR-Stat	12.986***	
BIC	388.541	

****** p < 0.01; ** p < 0.05; * p < 0.1***

Table 2 depicts the binary logit regression estimate to ascertain the alignment of tertiary institutions' curriculum content with the workplace needs of employers of labour in Nigeria. The result shows that the coefficient of practical skill (0.061) is statistically insignificant; this, however, contradicts the theoretical expectation as graduates who have a high level of skills have a higher likelihood to be employed. It is pathetic that most students only studied to get higher grades in examinations and not to acquire the skills required in the field. No wonder most employers prefer students with practical knowledge than the memorized knowledge. Students who could display their skill during the industrial training period are likely to be retained than their counterparts from the same or other fields who could not practicalized what they have acquired so far while in the school. This is supported by the regression estimate as having industrial training experience marginally increased the chance of gaining employment by 11.9%. Students have begun to realize the importance of attending workshops and seminars as most employers especially international organizations, corporate bodies, and industries now enlist it among the prerequisite for employment. It can be deduced from the result that industrial workshops marginally increased the chance of gaining employment by 20%.

Summary of findings

1. Practical skills have positive but insignificant work place needs of employers, while industrial training and workshop were both positive and significant in aligning the curriculum content with the workplace needs of employers.
2. Grade point average and type of qualification were negative and bear insignificant effect on educational content and workplace readiness. ICT skills and additional certification have a positive and significant effect on educational content and workplace readiness.

3. There is a 54% chance that employment matches the degree acquired. The estimates also indicate that the coefficient of practical skills is negative and insignificant, while industrial work experience exerts an eligible link between tertiary institutions and industry.

The results suggest that ICT and additional certificates increase employability by 32%-40% and 15.5%-27.9% respectively. Work experience drives employability by 6.4%.

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6. BIODIESEL PRODUCTION FROM WASTE VEGETABLE OIL USING A HETEROGENEOUS CATALYST SYNTHESIZED FROM CLAM MERCENARIA SHELL

Team members:
Iwekumo Wauton - Lead Researcher
Ambaiowei D.O. - Collaborator (Niger Delta Univ. Bayelsa)

Department:
CHEMICAL ENGINEERING

ABSTRACT

An investigation into biodiesel production from waste vegetable oil using a catalyst synthesized from waste clam (*Mercenaria mercenaria*)shells was carried out.The clam shells were thermally decomposed at 800 °C for 5 h and its properties were characterized with SEM and XRF. It is composed of 30.88 wt.% CaO and other basic oxides catalysts known to be active in transesterification; and a surface morphology indicating pores in the catalyst. The transesterification reaction was conducted and the effect of alcohol to oil molar ratio, catalyst concentration, reaction time and temperature on the yield of the biodiesel were determined. Maximum biodiesel yield of 76.18 wt. % was realized at 60 °C, 9:1 molar ratio of alcohol to oil, a catalyst concentration of 3 wt.% in a reaction time of 2 h. The FTIR studies of the biodiesel showed that it is composed of alkanes, aromatics, alcohols and the physiochemical properties, namely density, viscosity and flash point are 0.897 g/mL, 3.9 mm 2 /s and 152.8 °C, respectively; falls within the biodiesel ASTM specifications.

Objective of study

To produce biodiesel from waste vegetable oil using a catalyst synthesized from waste clam (*Mercenaria mercenaria*)shells.

Materials and Methods

Collection of Materials

Waste vegetable oil was obtained from restaurants in Yenagoa, Bayelsa State, Nigeria. The methanol (99.05 wt. % pure; 64.54 °C boiling point) was purchased from Doubra Scientific Instruments Nig. Ltd., Yenagoa, Bayelsa State, Nigeria. Waste clam shells were collected from a food vendor at Ekowe, Bayelsa State, Nigeria. Other chemicals used include sulphuric acid, sodium hydroxide, ethanol and phenolphthalein indicator. The chemicals were all of analytical grade.

Fig. 1: Waste clam shells before Washing/drying **Fig. 2: Waste clam shells after washing/drying**

The waste clam shells were washed thoroughly with tap water to remove dirt, then boiled for 15 min. and scrubbed with a brush to remove the surface coatings. The shells once again were washed using distilled water and then dried to a constant weight. Figures 1 and 2 present waste clam shells before and after washing and drying, respectively.The clean dry shells were oven baked at 200 °C for 1.5 h to increase brittleness. Then they were crushed and ground into powder form. The powder obtained was then separated with sieves to obtain particle sizes (≥ 0.3 mm). Calcination was carried out in a muffle furnace (Model: VECSTAR LF3) at 800 °C for 5 h for complete conversion of calcium carbonate ($CaCO_3$) to calcium oxide (CaO) as in Equation 1 (Nair *et al*.,
2012; Tshizanga *et al*., 2017)

Waste Vegetable Oil Sample PreparationWVO collected was allowed to settle at atmospheric temperature and pressure for 5 days and thereafter filtered by sieves of 100 nm diameter in order to remove entrained food particles; subsequently, it was heated at 105 °C for water removal.

The whole process involved catalyst preparation and characterization, oil pretreatment, determination of Ffree fatty acid concentration, biodiesel production and purification (Wauton, and Ambaiowei (2022).

$$CaCO_3 \rightarrow CaO + CO_2 \qquad (1)$$

The hot calcined samples were immediately transferred from the muffle furnace into a desiccator and left to cool to room temperature. The cooled samples in the desiccator were stored in an air tight glass bottle until they are needed to prevent moisture.

At the end of each reaction, the mixture was separated from the catalyst by decantation and then filtration. Thereafter, the filtrate was introduced into a separating funnel and allowed to settle overnight. The bottom layer composed of glycerol was separated from the biodiesel layer. The biodiesel produced was rinsed with approximately one-third its volume of warm water thrice inside theseparating funnel. The washed biodiesel was later heated to a temperature of 105 °C in an oven in order to remove any entrained water in the biodiesel.

$$yeild = \frac{mass\ of\ biodiesel}{mass\ of\ WVO} \times 100$$

Table 1: Chemical composition of clam shell catalyst.

Compound	Concentration (%)
CaO	30.88
K_2O	20.94
SiO2	14.76
Fe_2O 3	09.67
Ta_2O_5	07.62
TiO_2	03.44
Al_2O_3	02.72
WO_3	02.14
ZrO 2	01.86
MnO	01.66
BaO	00.71
MgO	00.59
Others	00.64

Table 2: % FFA composition after pretreatment steps.

Experiment	% FFA
Before pretreatment	2.61
1st pretreatment	1.39
2nd pretreatment	0.91

Table 3: **Physiochemical properties of waste vegetable oil (WVO) biodiesel**

Property	Unit	WVO biodiesel	**ASTM biodiesel standard**(Patil *et al.*,2012; Degfie *et al* . 2019)
Density @ 27 °C	g/mL	0.897	0.8 – 0.9
Viscosity @ 40 °C	(mm^2/s)	3.90	1.9 – 6
Moisture content	(%)	0.6	--
Pour point	(°C)	22.0	-15 – 16
Acid value	(%)	0.267	Max 0.80 *kg KOH/g*
Flash Point	°C	152.8	100 – 170

Summary of findings

The study conducted on the production of biodiesel from waste vegetable oil using a catalyst synthesized from waste clam (*Mercenaria mercenaria*)shells with a catalyst produced by the thermal decomposition of the clam shells. The composition of CaO in the synthesized catalyst is the highest, which was found to be 30.8787 wt. %. Other basic oxides known to be active catalysts in transesterification reactions were also present and a surface morphology indicating pores.

The composition of free fatty acids in the waste vegetable oil reduced from 2.61 to 0.91% after pretreatment, which is less than 1% as required for biodiesel production. The effect of esterification process parameters on the yield of biodiesel was investigated. A maximum biodiesel yield of 76.18% was observed at a reaction time of 120 min, 3 wt. % of catalyst, methanol to oil molar ratio of 9:1 and a temperature of 60 ºC. The characteristics or qualities of the biodiesel fall within the range of the ASTM standards.

Reference

Wauton, I. and Ambaiowei, D.O. (2022). Production of Biodiesel from Waste Oil using a Catalyst Synthesized from Waste Clam Shell. *Ife Journal of Science* vol. 24, no. 2 (2022). 199-212.https://dx.doi.org/10.4314/ijs.v24i2.3

7. COMPARATIVE ANALYSIS OF STIRGOLACTONE PRODUCTION IN BAMBARA GROUNDNUT AND COWPEA GENOTYPES

Team members:
Ibe Ahamefula Chigozie - Lead Researcher
Ologidi Charles - Co-Researcher (NDU)

Department: SCIENCE LABORATORY TECHNOLOGY

Abstract
A mixture of three strigolactones: orobanchol, orobanchyl acetate, and fabacyl acetate were detected by LC-MS/MS in the root exudates of all Bambara groundnut genotypes under investigation. Fabacyl acetate was not detected over 10-days of P-starvation. Two of these strigolactones, orobanchol and orobanchyl acetate were previously identified in cowpea. The levels of orobanchol and orobanchyl acetate secreted varied significantly between genotypes ($p<0.001$) and ($p<0.04$), respectively. Over 21-days of P-starvation, very low amounts of fabacyl acetate ($< 10_{-12}$ M) were detected in Bambara groundnut root exudates, and there was no significant difference between genotypes. Among all the genotypes studied, Mana was the highest producers of the strigolactonesdetected, while DodR was the genotype whose exudate contained the lowest amount of strigolactones. The relative proportion of orobanchol contained in the strigolactone mixture of root exudates were very high across all 12 genotypes. In the work reported here, the difficulties encountered were in obtaining enough Bambara groundnut seeds for the required number of replications and seeds of the parasitic weeds from collaborating research partners did not arrive early enough for the germination assay.
New knowledge on the production of strigolactone germination stimulants by the root exudates of Bambara groundnut, which triggers the germination of legume root-parasitic weeds *(Alectra* and *Striga gesnerioides*). The findings from this study have implication for the cultivation of Bambara groundnut in nutrient-poor soils and destruction by parasitic weeds.

Objective of study
To identify Bambara groundnut and cowpea genotypes that are resistant/tolerant to the root parasitic plants based on low germination stimulant production and an enhanced capacity to deploy resistance traits into breeding programmes effectively.

Materials and Methods
Twelve out of thirteen genotypes of Bambara groundnut originating from different African locations were used in the experiments. Bambara groundnut seeds were surface sterilized in sodium hypochlorite (70%) for 5 minutes. After thoroughly rinsing with demineralized water, the seeds were sown in 96 modules trays containing a mixture of sand and composting ratio of 1:1(v/v) for 7 days. Eight healthy seedlings from each genotype were grown on a custom-made aeroponics system operating with 4 litres of modified half-strength Hoagland solution with 100% phosphorus (P; 0.4 mM), replacing the nutrient solution twice a week. The experiments were conducted in a completely randomized design with three biological

replicates under controlled greenhouse conditions (28oC/25oC;450uM.m-2.s-1; 6h/8h photoperiod; and 60% relative humidity).
The LC-MS/MS analysis of strigo lactones was performed by comparing the retention time and mass transitions with those of 12 major authentic strigolactones standards (5DS, epi-5DS, orobanchol, ent-2'-epi-orobanchol, strigol, epistrigol, solanacol, orobanchyl acetate, sorgolactone, sogomol, oxoorobanchol and 7αhydroxyorobanchol) according to the method described by Kohlen et al., 2012 with some modifications.

Figure 1: Bambara groundnut plants at 21 days of P-starvation in aeroponic containers

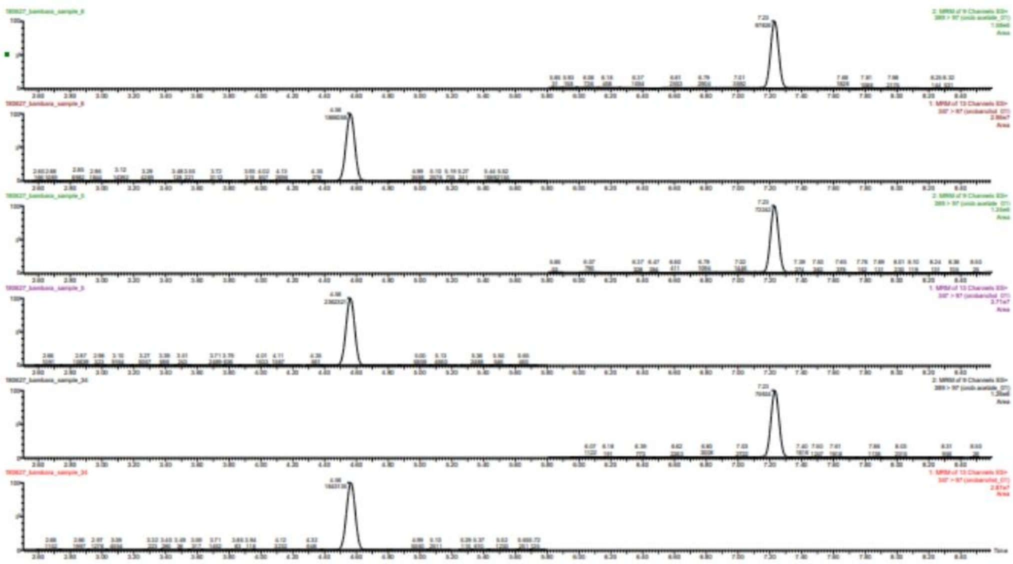


Figure 2: MRM chromatograms of roots exudates from the genotypes, Mana (a) and DodR (b).

There were significant differences (p<0.001). As the number of days of P- P-starvation was increased from 10 to 21, the amount of orobanchol and orobanchyl acetate detected were very high, and in strigolactone exudation by all the 12 Bambara groundnut genotypes in response to phosphorus deficiency fabacyl acetate that was not detected over ten days of Pstarvation was now detected in very low amounts (Figure 5a, 5b).

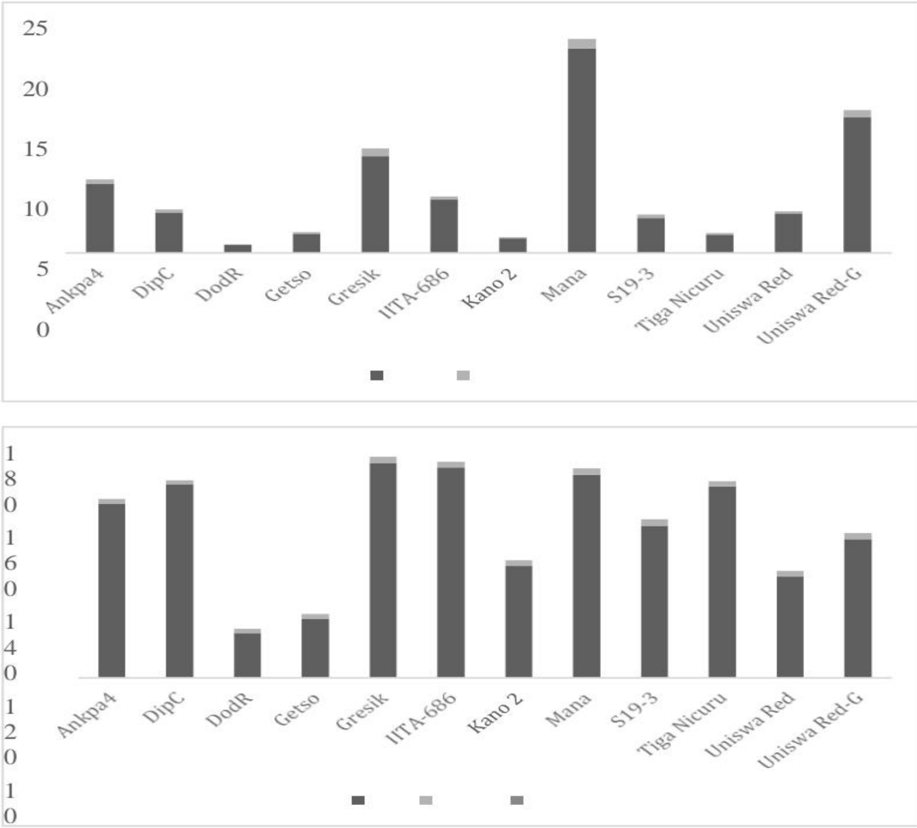


Figure 3: Levels of the three strigolactones, orobanchol (black filled), orobanchyl acetate (light) and fabacyl acetate (dark), detected in 12 Bambara groundnut root exudates over 10 days of starvation (a) and 21 days of P-starvation (b).

Summary of findings

These results indicate that a mixture of two significant SLs, orobanchol and orobanchyl acetate, at deficient concentrations (<10-12 M) are essential in root exudates to induce the germination of *Alectra* seeds, and a much higher level of orobanchol (10-9 M) will be needed to induce an appreciable germination of *S. gesnerioides* seeds.This germplasm characterization for resistance to Alectra and Striga gesnerioides based on low strigolactone production will contribute to developing improved Bambara groundnut cultivars with resistance to parasitic plants.

Reference

Ibe, Ahamefula Chigozie (2024). Comparative Analysis of Strigolactone Production in Bambara Groundnut and Cowpea Genotypes. *Akwapoly Journal of Communication and Scientific Research (APJOCASR), Vol. 8, No. 1, June, (2024).* 20-35.https://akwapolyjournal.org

8. PHYTOREMEDIATION POTENTIALS OF SELECTED PLANT SPECIES IN DRILL CUTTINGS CONTAMINATED SOIL

Team members:
Otele Ama - Lead Researcher
Elijah I. Ohimain - Collaborator
Godspower Charles - Co-researcher

Department: SCIENCE LAB TECH

Abstract

The following plant materials were screened; young and mature growth stages of *Heteropogon contortus* (spear grass), *Panicum maximum* (guinea grass), *Andropogon gayanus* (gamba grass), *Chloris virgata* (feather finger grass), *Axonopus compressus* (carpet grass), and *Pennisetum purpureum* (elephant grass) for reduction, growth response, physiological and biochemical response and uptake of contaminants (petroleum hydrocarbons and heavy metals) in oil-based drill cuttings contaminated soil. The project aimed at inferring phytoremediation potentials of the grass species and explore possible means of enhancing the phytoremediation potentials. The objectives of the study were to evaluate the degradation of petroleum hydrocarbon enabled by selected tropical grasses in oil-based drill cuttings contaminated soil, assess the uptake and stabilization of heavy metals by selected tropical grasses in oil-based drill cuttings contaminated soil, measure the growth response of selected tropical grasses to oil-based drill cuttings contaminated soil, determine the mechanisms of phytoremediation used by the selected plants in oil-based drill cuttings contaminated soil and finally, assess the bacterial count in response to oil-based drill cuttings contaminated soil.

Objectives of the study

I. Evaluate the degradation of petroleum hydrocarbon enabled by selected tropical grasses in oil-based drill cuttings contaminated soil.
II. Assess the uptake and stabilization of heavy metals by selected tropical grasses in oil-based drill cuttings contaminated soil.
III. Measure the growth response of selected tropical grasses to oil-based drill cuttings contaminated soil.
IV. Determine the mechanisms of phytoremediation used by the selected plants in oil-based drill cuttings contaminated soil.
V. Assess the bacterial count in response to oil-based drill cuttings contaminated soil.

Table 1: Baseline characteristics of uncontaminated soil, drill cuttings, and soil/drill cuttings mixture

Parameter	Uncontaminated soil	3:1 soil:drill cuttings	1:1 soil:drill cuttings	Drill cuttings
pH	5.86±0.01	6.85±0.01	8.45±0.01	9.64±0.01
TPH (mg/kg)	<0.001	475.87±5.46	682.70±4.51	1622.67±10.95
Copper, Cu (mg/kg)	1.33±0.015	4.22±0.08	11.05±0.05	11.69±0.19
Zinc, Zn (mg/kg)	16.19±0.076	12.79±0.04	23.68±0.03	31.62±0.02
Nickel, Ni (mg/kg)	<0.001	2.33±0.02	4.03±0.02	4.49±0.015
Total Nitrogen (%)	83.43±0.04	85.52±0.01	85.52±0.01	-
Sand (%)	83.62±0.25	85.52±0.01	85.52±0.01	-
Silt (%)	3.76±0.01	2.64±0.01	1.52±0.01	-
Clay (%)	12.76±0.01	11.84±0.01	12.96±0.01	-
Bacterial load	3.7×10^{5}	4.1×10^{5}	5.3×10^{5}	No Growth

pH: hydrogen ion concentration, TPH: total petroleum hydrocarbon, mg/kg: milligram per kilogram

2. Reduction of total petroleum hydrocarbon in soil

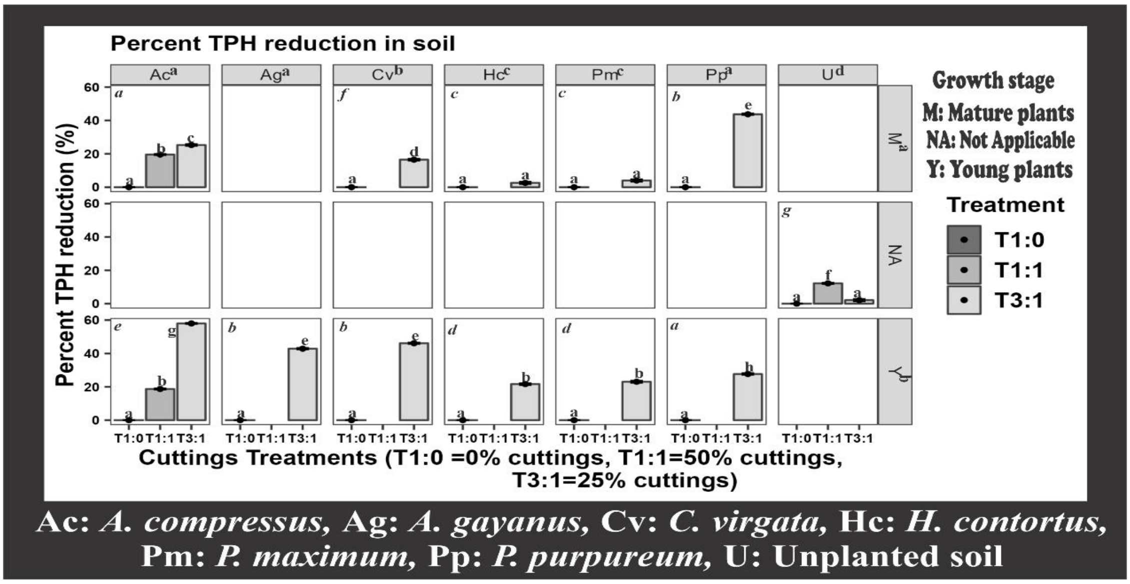


Figure 1: Petroleum hydrocarbons reduction

Different and the same superscripts and letters by plotted values show significant and insignificant difference in mean, respectively, at 5% probability level

3. **Reduction of heavy metal (copper, nickel, and zinc) concentration in soil**

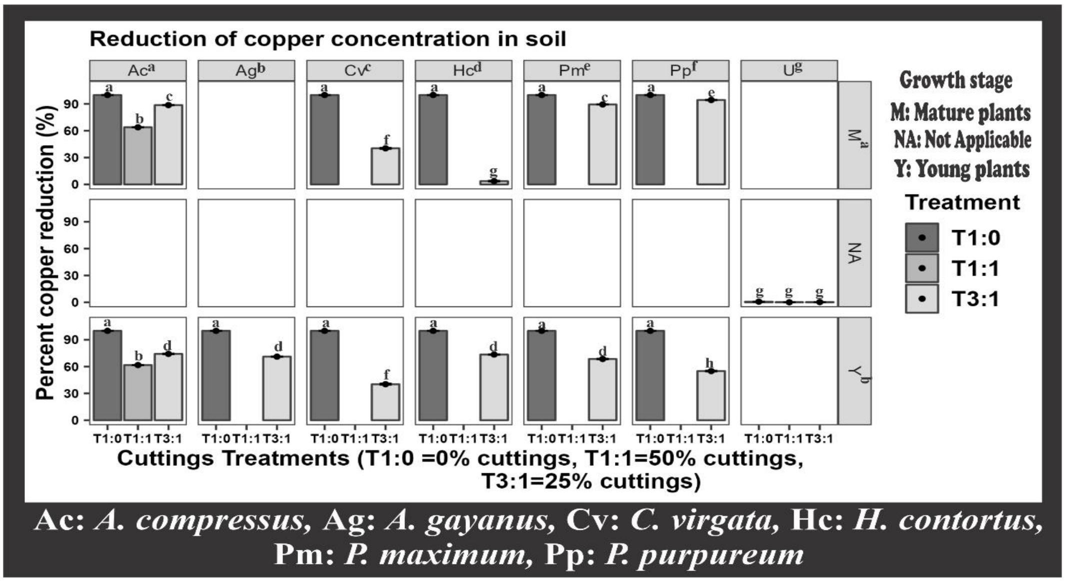


Figure 1: Percent copper concentration reduction in soils

Different and the same superscripts and letters by plotted values show significant and insignificant difference in mean, respectively, at 5% probability level

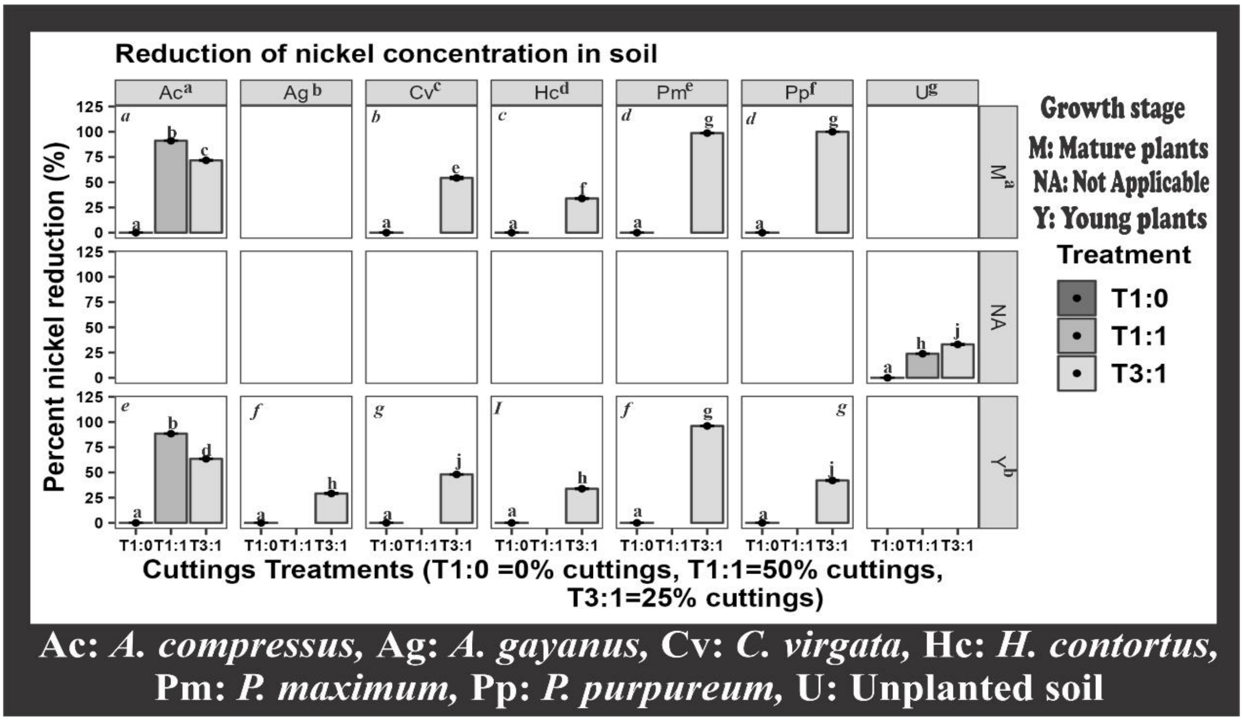


Figure 3: Percent nickel concentration reduction in soils

Different and the same superscripts and letters by plotted values show significant and insignificant difference in mean, respectively, at 5% probability level

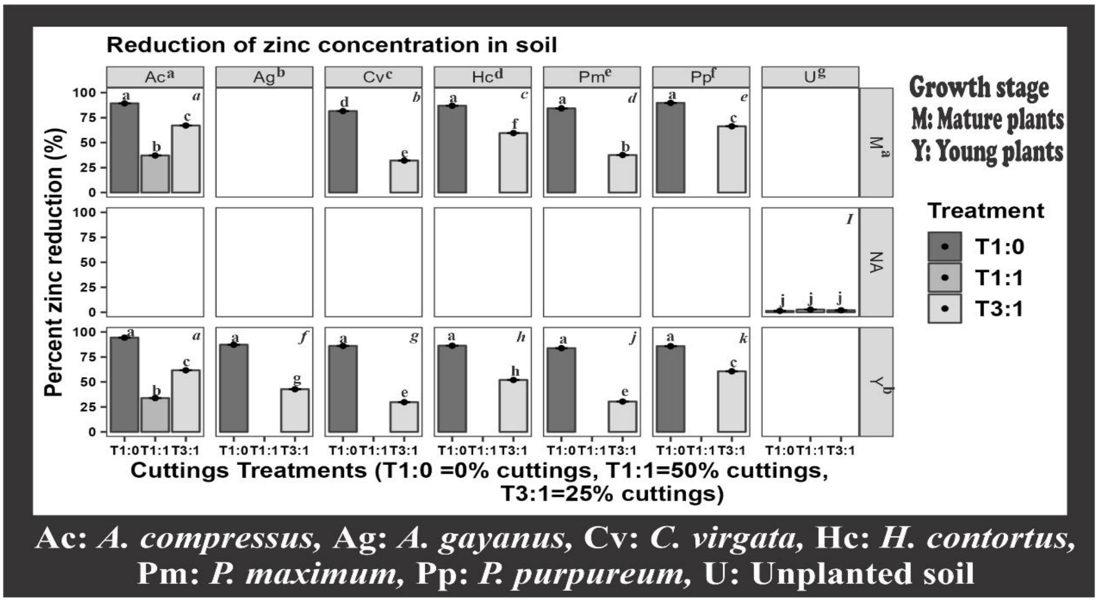


Figure 4: Percent zinc concentration reduction in soils

Summary of findings

The 50% treatment level was toxic to the grass species except *A. compressus* which, however, had impeded growth. The highest total petroleum hydrocarbons reduction (58.01%) was observed in 25% oily cuttings fouled soils planted with young *A. compressus*. Mature *H. contortus* and *P. maximum* had the least performance at 25% treatment level. Significant difference in bacterial load was noticed between day of planting and harvesting in each treatment level. Highest reduction of bacterial load was seen in 0% treatment level planted with *A. compressus, A. gayanus, young C. virgata, H. contortus, P. maximum*, and unplanted soils. The lowest reduction was observed in 25% treatment level of young *H. contortus* and *P. maximum*, which were not significantly different. *Micrococcus sp, Bacillus sp*., and *Staphyloccocus aureus* were found in soils of the three treatment levels at planting. In addition, *Protus sp* was seen in soils of 0% and 50% treatment levels. *Erwinnia sp* and *Escherichiacoli* was identified in 25% and 50% oily cuttings treated soils. *Klebsiella sp* was isolated from 25% oily cuttings treated soils. The species of bacteria seen at harvest was similar to the species of bacteria observed at planting in 0%, 25%, and 50% oil-based drill cuttings contaminated soils.

Reference

Otele A., Ologidi, C.G., Tanee, F.B.G., & Agbagwa, I. O. (2023). Heavy Metals Tolerance In Oil-Based Drill Cuttings Contaminated Soil Planted With Grass Species. Faculty of Natural and Applied Sciences Journal of Scientific Innovations Volume 4; Issue 1; March 2023; Page No. 149-166. Print ISSN: 2814-0877 e-ISSN: 2814-0923.www.fnasjournals.com

9. DETERNINATION OF THE GEOTECHNICAL CONDITION OF THE SUBSURFACE CONDITION OF EKOWE USING INTERGRATED METHODS OF GEOMATICS AND GEOELECTRIC SURVEY

Team members:
Oristebemigho Oristejolonesan Ulori - Lead Researcher
Ombu Righteous Emmanuel - Co-researcher

Department:
PHYSICS ELECTRONICS

Abstract

Five Vertical Electrical soundings were carried using ABEM SAS Terrameter 1000 in the Resistivity, induced polarization and Self Potential modes to identify the subsurface condition of the Main Campus of the Federal Polytechnic Ekowe with 150 m spacing for depths of at least 100 m. The results showed the lithology of the Study area being mainly consisting of clay soil with sandy soil identified at two points within the study area, that viable boreholes can be cited. The results were correlated with borehole log data and observation of the rate of water absorption during annual flooding in the area. The results showed clayey thickness of 18 – 30 m in line with chargeability results which is in tandem with the perception of the scientist that the overburden stratigraphy of the study area consists mainly of clayey soil whose porosity is very poor making it impossible to have clear underground water in most parts and the reason the annual flood in the area can only be abated by run off to the nearby rivers.

Viable borehole points were identified successfully at VES points 2, 3 and 4 which entails a deeper borehole to reach the sandy soil where potential aquifers exists within the study area. This study is meant to set out a blueprint for further geotechnical investigation for engineering construction and agro-geophysical studies to enhance agricultural revolution in the area. The works and physical planning divisions of the Polytechnic to exert more resources to drilling boreholes around points of viable aquifers as discovered from this work and for the drainage system around the built up areas of the Campus to be overhauled for effectiveness, this will reduce the cost implications arising from the thick clay in the subsurface of the area.

Objectives of the study

- To locate groundwater flow pattern within the study area to give relevant information that will guide borehole drilling.
- To map the general overburden stratigraphy of the study area.
- To develop a general conceptual model of the site of investigation.
- To Determine the subsurface condition of the Study Area
- To develop a credible lithology that will be useful for civil and structural engineering activities within the study area.

Materials and methods

The equipment used include ABEM Terrameter SAS 1000 using the resistivity mode, induced polarization mode as well as the self-potential mode. The Schlumberger array

was employed in carrying out vertical electrical soundings of one hundred metre spacing from each VES point to penetrate to depths of one hundred metres.
Auxiliary equipment for the survey is a global positioning system (GPS), to determine the resistivity survey locations and topography. Also, we have geophysical hammers for driving electrodes in to the ground, measuring tapes, layout tapes and cutlass for clearing.

The array geometry to be used is: AB/2; 1.5, 2.0, 3.0, 4.0, 6.0, 7.0, 8.0, 10.0, 12.0, 14.0, 15.0, 17.0, 20.0, 25.0, 30.0, 35.0, 40.0, 45.0, 60.0, 70.0, 100.0,

Data Analysis

The various data acquired is analyzed with Interpex, IP12WIN, and Microsoft word for clear lithological outlines.

Summary offindings

Lithology of the Study Area

Figure 5: Resistivity Pseudo section of VES 1

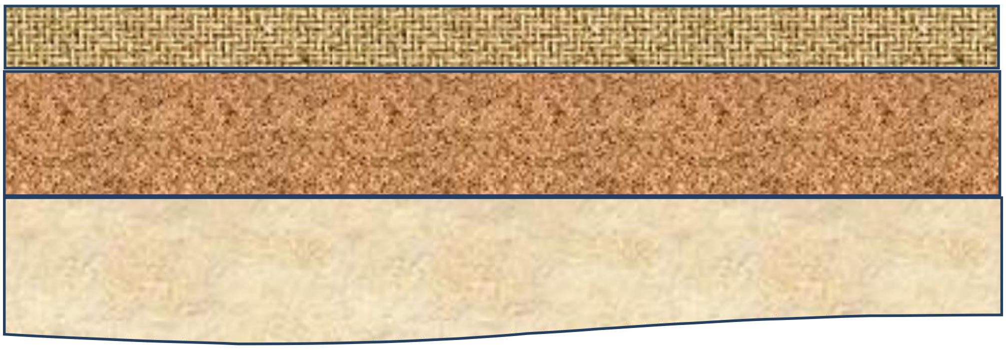
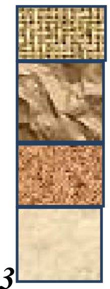


Figure 6: Resistivity Pseudo section of VES 2

KEY



Sandy ***Figure 7: Resistivity Pseudo section of VES 3***

Figure 8: Resistivity Pseudo section of VES 4

The study has primarily exposed the study area to the major reason for most of the challenges experienced in terms of structural failures, frequent water treatment and the presence of water long after rainfall and flood, as most of the built up area where the main infrastructures like boreholes, female hostel, and some offices is situated around VES 1 is heavily laden with subsurface clay. It is notable that ground (clay) swells with the effect of ground water rising to ground level and shrinks during a fall in the level of ground water (Wilson & Grace, 1942). This in essence means that except there is an effective drainage system rain/flood water would depend mainly on run off which is not good for the sanitary condition of the environment and the groundwater from boreholes in this area will have a lot of dissolved substances, necessitating regular water treatment schedules.

However, VES 2 and VES 3 are seen to be viable points for quality ground water (Aquifer) as it has the presence of sandy soil underneath the clay upon deeper drilling to depths of at least 30 – 37m at both points and 48m at points around VES 4.

Conclusively, the most outstanding conclusion that can be drawn from this work is for the works and physical planning divisions of the Polytechnic to exert more resources to drilling boreholes around points of viable aquifers as discovered from this work and for the drainage system around the built up areas of the Campus to be overhauled for effectiveness, this will reduce the cost implications arising from the thick clay in the subsurface of the area.

Reference

Oritsebemigho Ulori and Ombu Righteous Emmanuel (2023). Determination of the Geotechnical Condition of the Subsurface of Ekowe using Integrated Methods of Geomatics and Geoelectric Survey.African Journal of Environmental Sciences & Renewable Energy Vol. 10, No. 1 2023. 1-12. ISSN: 2617-3072X www.afropolitanjournals.com

10. DEVELOPING GENETIC MAPPING RESOUCES FROMLANDRACE-DERIVED GENEOTYPE THAT DIFFER FOR MORPHO AGRONOMIC TRAITS IN BAMBARA GRONDNUT

Team members:
Gbe-Emi Dieware K - Lead Researcher
Agogbua, J. U. - Collaborator (Niger Delta Univ. Bayelsa State)

Department: SCIENCE LAB TECH

Abstract

The objectives of this project were to use landrace-derived genotypes that differ for morpho-agronomic traits to create segregating mapping populations, and to carry out a genetic analysis in one of these mapping populations. This project focused on the creation of genetic mapping populations, and the construction and application of genetic linkage maps to facilitate Bambara crop improvement. Both objectives were achieved;

- F_1 hybrid plants with higher yields developed and confirmed using SSR markers
- Availability of 2 F_2 segregating mapping populations in Bambara groundnut
- Genotyping of F_1 hybrids and segregating mapping populations using microsatellite
  (SSR) molecular markers and linkage mapping

The findings above have implication for the application of marker-assisted selection (MAS) in Bambara groundnut breeding with the aim to unlock the genetic potential of this important African legume. During this study, there were technical difficulties encountered in making genetic crosses, the environmental conditions were not suitable since the greenhouse was not in the best condition, fruit abortion of successful genetic crosses, the long production cycle of Bambara groundnut (5 months from planting to harvesting) and the flooding situation in Bayelsa state hampered the evaluation of F2 segregating mapping populations.

Materials and methods

Plant growth and controlled crosses

Six genetically different parents of Bambara groundnut were used in this study, to generate F_1 hybrid seeds through controlled crossing.

Two plants per genotype were each grown in 10 L pots, 26 cm in diameter, maintained in a screen house condition in the Biological Sciences Department of the Niger Delta University. The soil mixture consisted of compost: sand in a ratio of 1:1, and irrigation was done manually in saucers by supplying 200 ml in two day intervals. Crossing was conducted from October to December 2022. At the time of flowering, Matured flowers for hybridization (2 to 3 days old from bud initiation and observed to have a creamy or yellowish petal colour) were used as female parents, while freshly opened matured flowers were used as male parents. Emasculation was carried out on mature flower buds (Female) just before pollination (Male), using two small pairs of sharp forceps and a pair of small scissors. The two small forceps were used to cut the keel petal in half, while the small pair of scissors was used to cut off the ten anthers/filaments bearing the un-shed pollen.

Results

Table 1: Cross combinations and number of artificial hybridizations performed in 2022 in the screen house at the Niger Delta University

Crosses	Number of crosses performed	Mature pods set
IITA-686 X Ankpa-4	30	3
IITA-686 X Lun T	25	2
S19-3 X Ankpa 4	20	2
Dip C X Ankpa 4	16	1
Ankpa-4 X DodR	15	1
Total	106	9 (8.5%)

Table 2. Seed coat color of parents and their F_1s, and number of F_2 seeds obtained from various crosses of Bambara groundnut

Parents/crosses	Seed coat of parents and F_2 seeds	Number of F_1 seed (putative F_2 plants)
IITA-686	Dark	
Ankpa 4	Brown	
Lun T	Cream	
Dip C	Cream with butterfly eye pattern	
S19-3	Dark	
DodR	Red	
IITA-686 × Ankpa 4	Segregating	3 (860)
IITA × Lun T	Segregating	2 (320)
Dip C × Ankpa 4	Segregating	1 (240)
S19-3 × Ankpa 4	Segregating	2 (380)
Ankpa 4 × DodR	Red	1 (100)

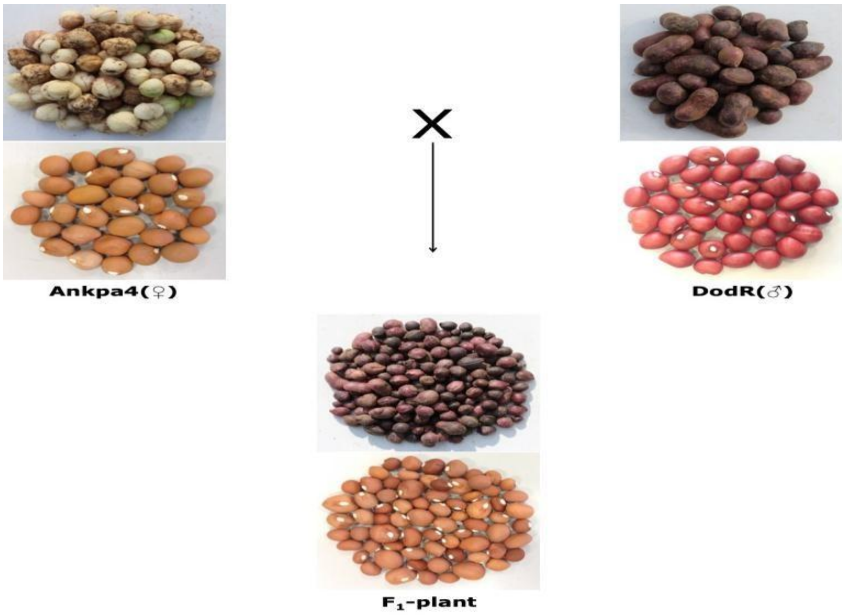


Figure 3: Fresh pods and seeds of maternal genotype Ankpa4, paternal genotype DodR and the F_1 plant.

Summary of findings

Fertilization was achieved by simultaneous emasculation and hand-pollination of flowers at different times of the day (07:00 – 18:00) for all cross combinations involving six Bambara groundnut genotypes (Table 1, Figure 1). Successful fertilization could be identified 3-5 days after hybridization when the pedicel bends backwards towards the peduncle (Figure 1c), while unfertilized flowers either abscise or desiccate within three days. Following hybridization there was a high rate of embryo and/or pod abortion (91.5%) as indicated by the number of pods produced at maturity (Table 1).

Reference

Dieware, G.K. and Kendabie, P. (2023). Genetic Crossing and Confirmation of F_1-Hybrids and F_2-Segregating Progenies of Bambara Groundnut Genotypes. *Nigerian Journal of Genetics. Volume 37: No. 1* (78-86). ISSN: 0189-9686.

11. UNLOCKING THE GENETIC POTENTIAL OF BAMBARA GROUNDNUT (*VIGNA SUBTERRANEA* L.) TO INCREASE LEGUME CROP PRODUCTION IN NIGERIA

Research team
Gbonhinbor, Joan (Lead Researcher)
Dr. K. Presidor, Agbogua, Josphine U. and Ologidi, C.

Abstract
Bambara groundnut (BGN) is an African native legume, rich in protein, able to fix nitrogen, highly drought tolerant and with reasonably good disease resistance that bears a rich food, nutritional and cultural history for the poor resource-base farmers in sub-Saharan Africa. This study was to unlock the genetic potential of this very important African orphan crop by constructing a high density genetic linkage map, determine the mineral element content and to enhance our understanding of the role of the Bambara groundnut bean-like cotyledon when grown in nutrient-poor soils. A dense genetic map was constructed in an F_2 population derived from two highly divergent parents (S19-3 and Ankpa4) based on SNP and DArT markers. The linkage map consisted of 1238 marker loci (859 SNPs and 379 DArTs), with good coverage (1185 cM spanning 11 linkage groups; one marker per 1 cM, on average). This genetic map is an invaluable resource for QTL analysis and represent qualitative advances in the genetic improvement of Bambara groundnut. ICP-MS analysis of a subset the F_2 individuals (n=48) shows that Bambara groundnut is rich in phosphorus (P) and other mineral elements, and that the S19-3 X Ankpa-4 F_2 population developed in this project is segregating for these mineral elements and therefore, a QTL analysis based on mineral element composition is possible if an ICP-MS analysis can be completed on the entire population (n=270). The results from cotyledon removal experiment suggest that the cotyledon contributes to the early seedling establishment of Bambara groundnut genotypes in nutrient-poor soils. These findings have implication for the genetic improvement of Bambara groundnut with the aim to unlock the genetic potential of this important African legume.

Objectives of the study

To construct of a high-density genetic linkage map, mineral element composition of some lines in the cross S19-3 X Ankpa-4 and a cotyledon removal experiment to facilitate Bambara groundnut crop improvement.

Materials and methods

For the linkage mapping project, an F_2 segregating mapping population (SN=263) derived from Bambara groundnut genotypic landraces (S19-3 and Ankpa-4) was used (Figure 1). These parental lines have been well characterised previously in daylength experiments, and are divergent in their response to extreme day length conditions (>12 h). From July – December, 2022, 6 plants of each parent and 121 F_2 lines of the cross S19-3 × Ankpa 4 were grown in a screen house at the Niger Delta University. Plant materials were grown in soil beds and planting distance of 25 cm x

25 cm between and within rows was maintained. Irrigation was supplied manually, once in two days in the morning or evening throughout the experiment period.

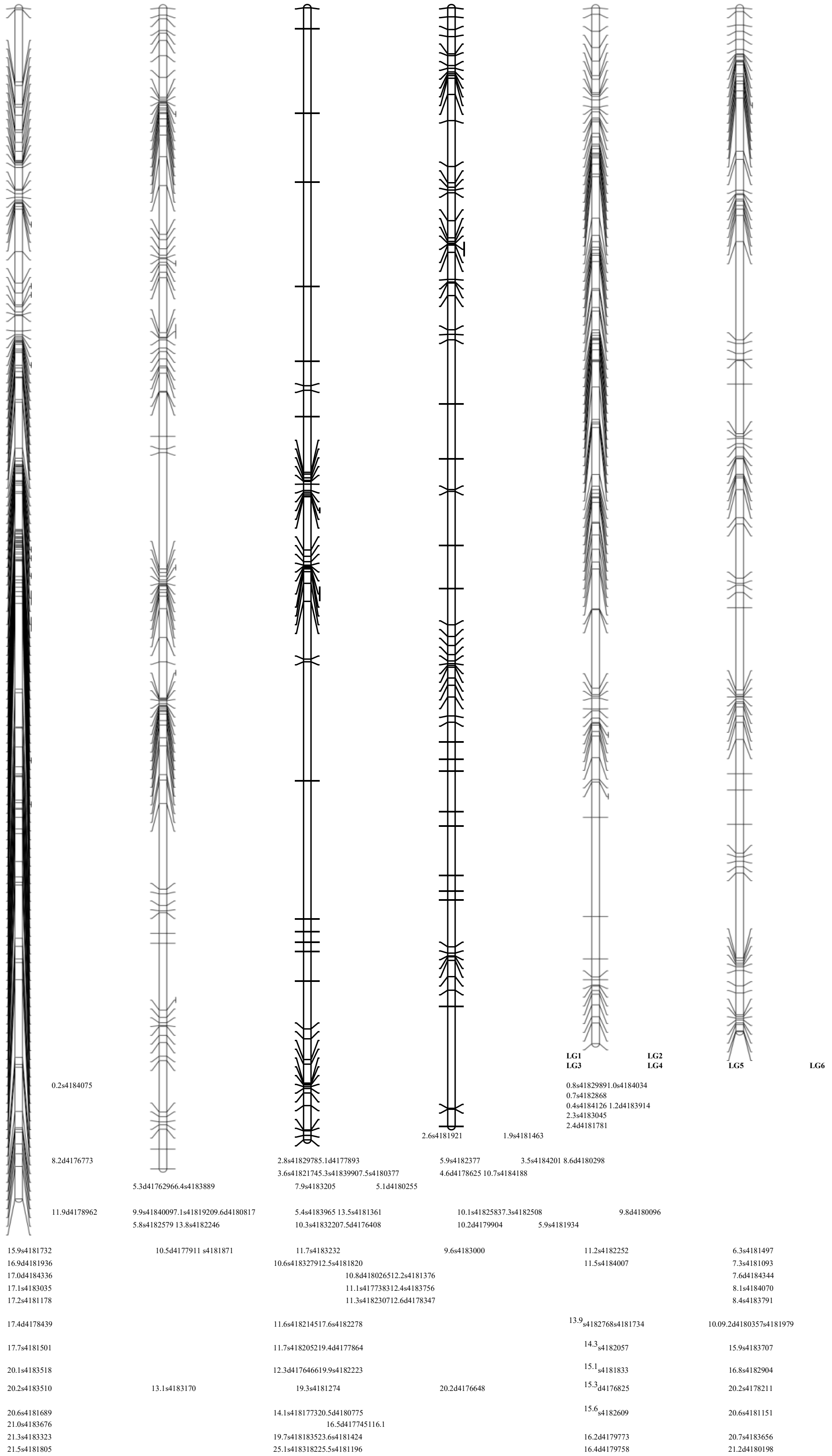
Summary of findings

Figure 1: Segregation for testa color in the cross S19-3 (Black) x Ankpa4 (Brown) at F_2 generation, SN18, SN44 and SN50 are three different populations derived from this cross.

Table1: Marker distribution across 11 linkage groups (263 F_2 lines): linkage groups and map lengths, number of mapped markers, and marker intervals

Linkage groups	Map length, cm	No. of loci	Average inter-marker distance, cm
LG1	132	150	0.88
LG2	128.67	113	1.14
LG3	125.49	57	2.2
LG4	123.97	73	1.7
LG5	114.8	102	1.13
LG6	113.51	91	1.25
LG7	109.54	59	1.86
LG8	89.58	112	0.8
LG9	87.17	67	1.3
LG10	80.63	73	1.1

LG11	78.31	112	0.7
Total	1184	1009	1.2



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22.0s4183470 27.4s418111126.2d4176823s4181929 d4176607 18.418.7d4179337s4182226 22.323.0s4181748s4182183
22.3s4182255 27.7d4178332
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36.2s4181453d4180568 31.3s4181188 37.2s4182190
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36.8d4179074 s4181776 38.1s4182807 39.2s418219735.7s4183642 39.1d4177920
36.9s4182062 38.9s418208936.0s4184171
37.0s4181891 39.7s4181377 41.9d417854436.3s4182506 41.7s4181585
37.1s4183953 39.9s4183208 42.4s418120136.6d4183981
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37.8s4181578 42.5d417833936.8s4183942
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43.4s418266352.5d4179090 53.4d4178171 45.9s4177359 50.0d4175794
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Figure 2: Genetic linkage map of 11 linkage groups (LGs 1, 2, 3, 4, 5 and 6).

This map was constructed using 263 F_2 lines derived from a S19-3 × Ankpa4 cross. Positions are given in centimorgan (Kosambi units) to the left of the linkage groups and the name of the marker the right. A total coverage of 1184 cM was obtained with 1009 markers (683 SNPs, 326 DArTs).

Bambara groundnut seeds and seedlings of genotypes Ankpa-4 and S19-3, as well as the ICPMS result for P, K, Fe and Zn are presented below:

Ankpa-4 seeds and 2-days seedling

S19-3 seeds and 2-days old seedling

Genotypes	100 seed weight (g)	P (mg/kg)	K (mg/kg)	Fe (mg/kg)	Zn (mg/kg)
Ankpa-4	60-80	3950	14840	56.94	28.55
S19-3	48-60	3846	15606	28.65	36.14

Construction of a detailed genetic map and QTL analysis relies on the identification of sufficient number of markers revealing polymorphism among parents used in a genetic cross, and the availability of relevant mapping populations. In the present study, the mapping population was based on a pair of genetically diverse genotypic landraces (IITA-S19-3 and Ankpa4), for which a high percentage of polymorphic markers (43.4% of SNPs and SilicoDArTs) with wide genome coverage were identified. The large genetic distance between the parental lines of the mapping population in the present study provided a high degree of polymorphism for markers across most of the linkage groups (Table 1).

Reference

Gbonhinbor, Joan, Dr. K. Presidor, Agbogua, Josphine U. and Ologidi, C. (2023). Unlocking the genetic potential of Bambara groundnut (*Vigna subterranea* L.) to increase legume crop production in Nigeria.*Akwapoly Journal of Communication and Scientific Research. Volume 7, Number 1 June, 2023*. ISSN; 2536-7633. E-ISSN; 2618-0773.

Conclusion

One of the major avenues to communicate research findings is through technical reports for scientific studies. It is imperative that the Polytechnic has a way of archiving its research outputs online and offline for easy referencing and retrieval. The Research & Development Annual Reports is the maiden publication of sponsored research outputs in the Polytechnic. This document presented various TETFund sponsored institution-based research that have been conducted in the Polytechnic by academic staff from 2017 to 2021. This research report documented objectives of studies, methodologies and summary of findings among other terms. It is therefore recommended that departments/schools take the IBR serious and engage in innovative research to make impacts in the society starting with the Polytechnic community to solve home-based problems and challenges via breakthrough research by both staff and students.

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