INTERNATIONAL ANNUAL CONFERENCE

OF SOCIETY FOR AGRICULTURE, ENVIRONMENTAL RESOURCES AND MANAGEMENT (SAEREM)

BOOK OF ABSTRACTS
RIVERS2022

THEME:

IMPACTS OF CLIMATE CHANGE AND OIL POLLUTION, ON ENVIRONMENTAL RESOURCES, FOOD PRODUCTION, BIODIVERSITY AND ECONOMIC Growth

13th-17th Nov, 2022

IGNATIUS AJURU UNIVERSITY OF EDUCATION, PORT HARCOURT, NIG.

RIVERS2022 BOOKS OF ABSTRICTS

Theme: Impacts of Climate Change and Oil Pollution, on Environmental Resources, Food Production, Biodiversity and Economic Growth

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Welcome and Opening Remarks at the 5th International Annual Conference of Society for Agriculture, Environmental Resources and Management (SAEREM)

BY Prof. E. M. Agu (National President)

The Vice Chancellor Prof. Okechukwu Onuchuku & His Team,

Chairman-in-Council ,Prof. Austin Otegbulu

With Profound gratitude to God Almighty I welcome all of you to the 5th International Annual Conference of Society for Agriculture, Environmental Resources and Management (SAEREM). I thank the Central Organizing Committee, Conference Editorial Committee, Local Organizing Committee and all participants in this event. SAEREM is a peer-reviewed open access interdisciplinary research-based organization, which provides a wider view on topical issues as addressed by the central theme of this year's conference"
Impacts of Climate Change and Oil Pollution, on Environmental Resources, Food Production, Biodiversity and Economic Growth

After brainstorming, we hope to come out with holistic results, for policy formulations and workable recommendations. However, SAEREM is non-Conventional society but with a clear cut paradigm shift in line with global best practices. Our cord mandate is to encourage interdisciplinary peer-reviewed research-based. Our conference proceedings material comes in two forms both hard copy and soft copy posted on our web site for access to global academic community.

However, it is worth to know, as organization, we have been able to provide a welfare package to our members affected the ASSU strike. We have also launch an essay competition with the theme "politics, Energy and Climate change Concept in Nigeria" open to all undergraduates in Nigeria.

Nigeria's situation with regards to climate change is serious, but not hopeless. If Nigeria is to effectively tackle the enormous challenges to food security presented by climate change, then innovation and awareness of climate change impacts should be cultivated in all parts of the agricultural ecosystem. Food security is a significant step in ensuring a life of dignity for every Nigerian. Given its vast resources, Nigeria has the opportunity to become a global leader in building a productive and resilient agricultural system for the 21st century.

The major threat to the agricultural sector is not just the insecurity from both the Boko Haram and Fulani herdsmen, but oil pollution, gas flaring, flooding, ete, we strongly believe that this year conference shall provide good roadmap to address these challenges.

Finally, I wish to appreciate the V.C, our keynote Speaker for this year conference, Prof. P. C. Mmom, Hon. Commissioner for Education in Rivers State, and the Lead Speakers, Prof. E. R. Daka, and Prof. O.M. Adesope for their great work. Thank you all.

LEAD PAPER 1

Impacts of Climate Change on Food Security, Nutrition, and Economic Growth

By

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PAPER PRESENTED AT THE 5TH INTERNATIONAL ANNUAL CONFERENCE OF SOCIETY FOR AGRICULTURE, ENVIRONMENTAL RESOURCES AND MANAGEMENT (SAREM) HELD FROM NOVEMBER 15 TO 17, 2022 AT IGNATIUS AJURU UNIVERSITY OF EDUCATION, PORT HARCOURT, NIGERIA

Introduction

Climate change is impacting various aspects of human existence and its supporting systems. It threatens the various socio-economic and environmental progress made over the years with the potential to cause global impact. Climate change is impacting human survival and health, their livelihood food security. According to World Health Organization (WHO, 2021), climate change is estimated to lead to about 250,000 deaths/year between 2030 and 2050 due to malnutrition, malaria, diarrhea and heat stress alone with a relative damage cost of 2-4billion USD. The present cause of climate change can be linked to the anthropogenic extension of greenhouse gas production or release into the atmospheric system (International Panel on Climate Change [IPCC], 2014). The released greenhouse gases lead to the greenhouse effect and progressively caused global warming.

Human actions such as extraction and burning of fossil fuel are the leading agent of greenhouse gases.

The impact of climate change on food security is increasingly recognized across various nations and continents including the African continent. The African continent is recognized by many scholars and organizations as the most vulnerable to various climate change impacts (IPCC, 2007; World Bank, 2016; Ani et al., 2022). Some of the predicted impacts are linked to instability/reduction in agricultural productivity which spontaneously affects food security. IPCC (2007) reported a 9-21% reduction in agricultural productivity by 2080 while it is also expected a decline in the arable land due to excessive or lack of rainfall in sub-Saharan Africa (Ani et al., 2022). Nigeria is among the sub-Saharan African nations noted to be vulnerable to climate change phenomenon (Ughaelu, 2017) and such impacts have been noticed in recent environmental disasters including the 2012 flood event and those after. Some parts of the nation are witnessing excessive rainfall leading to the destruction of crop production while other parts received less amount of rainfall leading to a decline in production. Both situations are

leading to the present-day challenge of food security, nutrition and economic growth.

Climate change's impact on food security will eventually affect the nutritional availability and economic growth of individuals involved in the production and their value chains (Raj et al., 2022). According to Food and Agriculture Organization (FAO, 2020), there has been an increase in the population of individuals affected by hunger across the world even though the world has also witnessed a double increase in food production in the last 3 decades. Over the course of 2019 "two billion people, or 25.9% of the global population, experienced hunger or did not have regular access to nutritious and sufficient food" (FAO, 2020). Many factors can influence food insecurity among the human population; such factors include a decline in agricultural production, disaster

impact, economic power-play among nations, migration and limited value and supply agricultural chain (Raj et al., 2022).

Climate Change and Food Security: The Need for National and Global Attention

Food security means access to basic nutritious food. Food security according to the United Nations Committee on World Food Security means that "all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their food preferences and dietary needs for an active and healthy life." Food security as defined in the 1974 World Food Summit means the "availability at all times of adequate supplies of basic foods stuffs to sustain a steady expansion of food consumption and to offset fluctuation in production and prices." Food insecurity according to FAO exists when "all people do not have adequate physical, social or economic access to food."

Climate change threatens to exacerbate existing threats to food security and livelihoods due to a combination of factors that include the increasing frequency and intensity of climate hazards, diminishing agricultural yields and reduced production in vulnerable regions, rising health and sanitation risks, increasing water scarcity, and intensifying conflicts over scarce resources, which would lead to new humanitarian crises as well as increasing displacement (IPCC, 2007; Masipa, 2017). Undernutrition remains one of the world's most serious but least addressed socioeconomic and health problems (Horton et al., 2009; Krishnamurthy et al., 2012). The human and socioeconomic costs of undernutrition are enormous, falling hardest on the poorest, especially on women and children (Horton et al., 2009; Krishnamurthy et al., 2012). Millions of the world's people who have experienced undernutrition early in life face many challenges as they grow up. They encounter an increased risk of illness and death when young, experience difficulties at school,

and are often not able to make a total contribution to the social and economic development of their households, communities and nations when they become adults (Nabarro, 2010). Climate change is expected to affect all of the components that influence food security: availability, access, stability and utilisation **(Figure 1).**

The overall availability of food is affected by changes in agricultural yields as well as changes in arable land. Changes in food production, together with other factors, could impact food prices, which would affect the ability of poor households to access food markets and could reduce dietary diversity (Krishnamurthy et al., 2012). Decreased water availability and quality in some areas could result in increased health and sanitation problems such as diarrheal disease which, together with changes in vector-borne disease patterns, has the potential to increase malnutrition, and negatively affect food utilisation (Krishnamurthy et al., 2012). Extreme weather effects disrupt the stability of the food supply as well as people's livelihoods. Increases in extreme weather, such as floods and drought, as a result of climate change, would exacerbate this trend and could harm livelihoods that depend on climate-sensitive activities such as rain-fed agriculture and livestock rearing. Schmidhuber & Tubiello, 2007; Krishnamurthy et al., 2012).
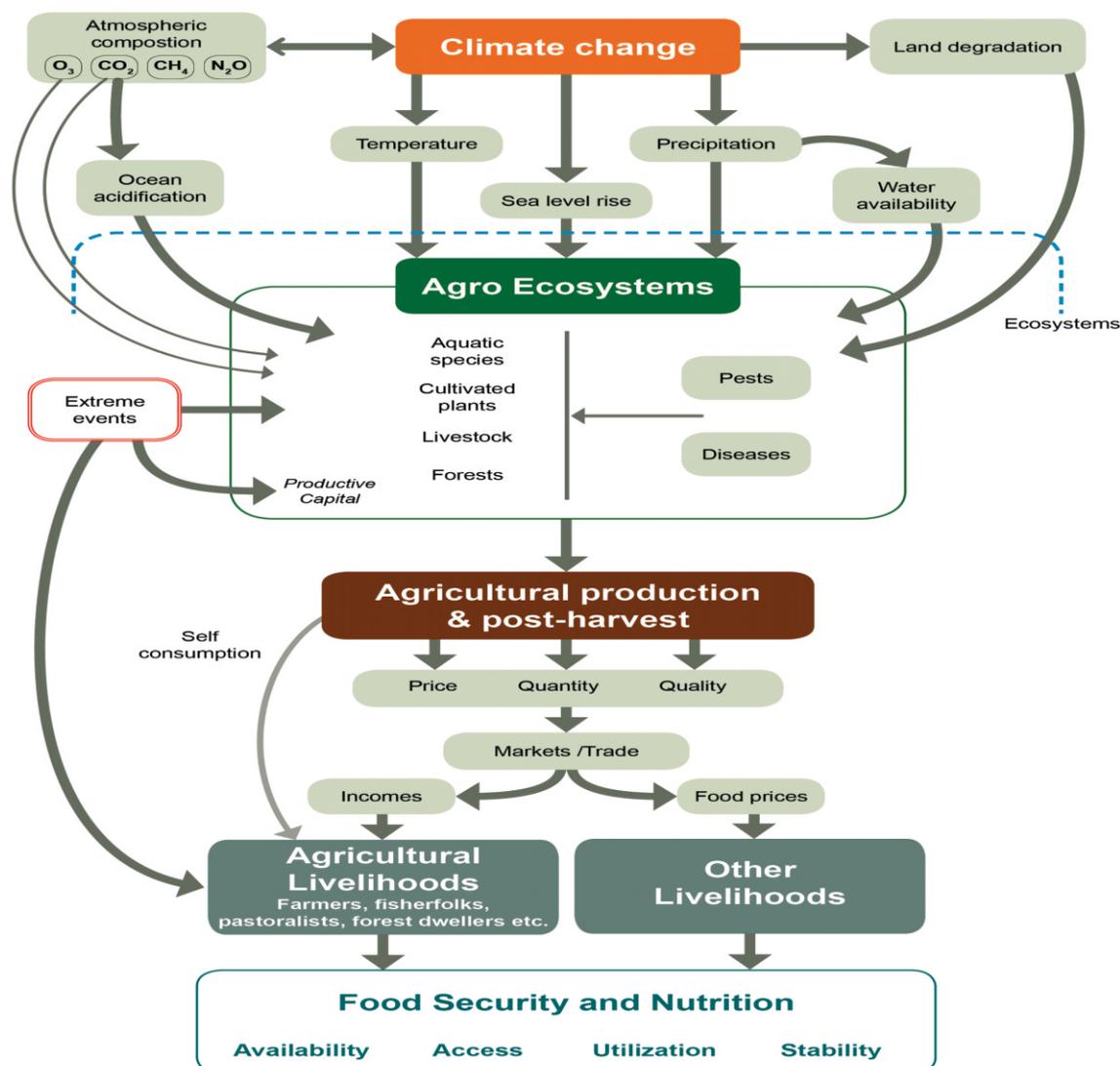
Figure 1: Schematic representation of the cascading effects of climate change impacts on food security and nutrition

Source: FAO/UN (2015)

According to the IPCC report (2007), rising temperatures and precipitation are likely to reduce the production of staple foods by up to 50%. In Tanzania, Pedram et al. (2011) reported that by 2050, the projected increase of 2 °C will reduce the average production of maize, sorghum and rice by 13%, 8.8% and 7.6%, respectively. In South Africa, Hendriks (2005) argues that South Africa is nationally food secure; however, between 58% and 73% of households experience food insecurity (Masipa, 2017).

In Nigeria, extreme climatic conditions that manifest as desertification, high rainfall and flooding have very adverse consequences for food production (Uwazie, 2020). The reason for the food security crisis currently faced in Nigeria is not far-fetched; climate has been identified by researchers as the subtle causative factor for these (Uwazie, 2020). The persistent fall of rainfall gradient in parts of northern Nigeria has increasingly rendered the affected areas unfit for crop and animal production through the use of natural resources (Wossen et al., 2018). Also, persistent flooding of coastlines and the southernmost part of Nigeria has led to crop damage, loss of soil fertility, toxicity, and disruption of the soil ecosystem (Wossen et al., 2018). The World Bank and the Food and Agricultural Organization have through their various publications warned that climate change will continue to pose a danger to sustainable food production in Nigeria (World Bank, 2016; FAO, 2017). Onuoha and Ezirim (2010) and Ani et al. (2022) stated that "the livelihood of some 15 million pastoralists in northern Nigeria is threatened by decreasing access to water and pasture shortages linked to climate change."

Global warming will have significant negative effects on food security, with estimates of an additional amount of between 5 and 170 million people at risk of hunger by the year 2080 (Statistical Review on World Energy 2016). To mitigate the impact of CO2 emissions on food security, Barrett (2002) suggests that there should implementation of a policy targeting the reduction of greenhouse gas emissions, as well as maintenance and recovery of soil in areas affected by climate change.

Climate change threatens to reverse the progress made so far in the fight against hunger and malnutrition. As highlighted by the latest assessment report of the Intergovernmental Panel on Climate change (IPCC), climate change augments and intensifies risks to food security for the most vulnerable countries and populations. Four out of the eight key risks induced by climate change identified by IPCC AR5 have direct consequences for food security:

i.   Loss of rural livelihoods and income

ii.   Loss of marine and coastal ecosystems, and livelihoods

iii.   Loss of terrestrial and inland water ecosystems, and livelihoods

iv.   Food insecurity and breakdown of food systems
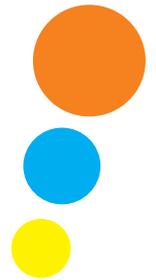
Climate change will affect everybody, but some population groups and settings are more vulnerable than others. In terms of food and nutrition security, certain regions in Europe may be particularly at risk, e.g. the Arctic and Mediterranean. In all countries, certain groups in the population may be more at risk, e.g. the elderly, children, migrants and those who are already ill (Fears, 2020).
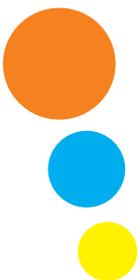
Matters Arising

How really serious is the government with the climate change issue? We have documented policies but implementation has been far from realized. According to European Commission (2018), Nigeria is located in one of the most sensitive areas to climate change in the world as it is globally ranked the 7th most vulnerable country (Verisk Maplecroft's Climate Change Vulnerability Index 2016). It was noted further that Nigeria is ranked 44th greenhouse gas (GHG) emitter out of 200 countries and with the pace at which the country's population and economy is growing, the GHG emissions will equally continue to grow. It was observed that GHG emissions are primarily produced from land use change, and forestry (38.2 % in 2014). The energy sector is also a main contributor (32.6% in 2014) of GHG (Nigeria's Second National Communication 2014).

The waste sector is contributing more to GHG emissions than expected in the First and Second National Contribution reports, representing 14% of GHG emissions. Nigeria ratified the Paris Agreement (PA) on Climate Change on 16 May 2017. In-line with the PA, Nigeria pledged to reduce its GHG emissions as follows: Unconditional reduction of GHG emissions by 20% by 2030, Conditional reduction of GHG emissions by 45% by 2030 (European Commission, 2018)

In July 2021, Notre Dame Global Adaptation Index ranked Nigeria as the 53rd most vulnerable country and the 6th least ready country in the world to adapt climate change. Does this show political will?

Conclusion

There are many reported evidence and projections for various consequences of climate change on food security and its resulting nutritional and economic impact. The consequences are directly or indirectly connected to other socio-economic and environmental actions. However, there is an increasing political interest in these issues, but developing informed options for policy-making requires better awareness and use of the evidence base. Climate change constitutes a growing risk to food security in Nigeria. The variability of climatic elements in recent times has gradually and increasingly altered the food production system in Nigeria. Therefore, there is a needs to adopt and implement some adaptive strategies that would enable nations to cope with the challenges of climate change to ensure food availability through a sustainable agricultural system.

Recommendations for action

- Proper implementation of the climate change policy
- Advocacy. General awareness starting from the grassroots level. Schools, radio and television
- Ensure adaptation strategies are taken seriously. Rethink planting dates
- Increase diversity to maintain the ecosystem
- Drought resistant varieties
- Improved fertilizer usage
- Watershed management to reduce water stress during drought. Channel water to several tributaries to reduce flooding
- Research on design and development of new varieties of crops
- Remote sensing capacity should be increased to enhance pest and disease forecasting and control, high precision climate change modelling
- Improved agronomic practices

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LEAD PAPER 11

Impacts of Climate Change and Oil Pollution on Aquatic Resources and Biodiversity in Nigeria

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INTRODUCTION

Climate change is a global phenomenon which also affects Nigeria. This presentation is a review of climate change and oil pollution in Nigeria with emphasis on impacts on aquatic resources and biodiversity.

CLIMATE CHANGE

According to United Nations Framework Convention On Climate Change (UNFCC, 1992),"Climate change" means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCC, 1992). The UN Intergovernmental Panel on Climate Change 2021 Report (IPCC, 2021) states that the average surface temperature of the Earth will cross 1.5 °C over pre-industrial levels in the next 20 years (By 2040) and 2°C by the middle of the century without sharp reduction of emissions. In 2018, the IPCC's Special Report Global Warming of 1.5°C had estimated that two-fifths of the global population lived in regions with warming above 1.5°C. Carbon dioxide (CO_2) Concentrations are the highest in at least two million years. Humans have emitted 2,400 billion tonnes of CO_2 since the late 1800s. Most of this can be attributed to human activities, particularly the burning of fossil fuels. The effect of human activities has warmed the climate at a rate unprecedented in 2,000 years. The world has already depleted 86% of it's available carbon budget. It also states that sea-level rise has tripled compared with 1901-1971. The Arctic Sea ice is the lowest it has been in 1,000 years. Coastal areas will see continued sea-level rise throughout the 21st century, resulting in coastal erosion and more frequent and severe flooding in low-lying areas. Every additional 0.5 °C of warming will increase hot extremes, extreme precipitation and drought. Additional warming will also weaken the Earth's carbon sinks present in plants, soils, and the ocean.

There is evidence of impacts of climate change on Nigeria arising from increases in temperature, variable rainfall (decreasing rainfall amount in the continental interiors, increasing rainfall in the coastal areas), sea level rise, flooding and erosion, drought and increasing desertification; land degradation; extreme weather events (thunderstorms, lightning, landslides, floods, droughts, bush fires); and affected fresh water resources and loss of biodiversity (Haider, 2019). In 2021, Nigeria is a signatory to the UNCFCC and promulgated the 2021 Climate Change Act, which provides a framework for climate actions at the national level. Most of the initiatives envisioned in Nigeria's new Climate Change Act build on prior climate change policies, most of which were adopted in 2021 (i.e., the Revised National Climate Change Policy; national climate change programmes; the 2050 Long-Term Low Emission Vision; the First Nationally Determined Contribution.

Historical impacts of Climate Change in Nigeria

Precipitation patterns between 1941 and 1970 show that late onsets of rains occurred in only a few areas of Nigeria. However, from 1971 to 2000, late onset and early cessation of rains had spread to most parts of the country, shortening the length of the rainy season. Nigeria has also experienced climate extremes in recent years . Floods are the most common, recurring disaster in the country. The durations and intensities of rainfall have increased in the last three decades, producing large runoffs and flooding in many places. Rising sea level and ocean surge in Southern Nigeria has submerged villages in Lagos and some places in the Niger Delta. In Northern Nigeria, a flood in 2010 affected 2 million people in Jigawa State Severe nationwide floods in 2012 resulted in unprecedented damage and losses to human settlements located downstream.   The recent flood in 2022 surpassed the 2012 floods and reportedly affected about 33 states.

Droughts have also been a constant in Nigeria. In the Nigerian Sahelian region, there has been a 25 percent decrease in precipitation on average in the last 30 years . The drying up of Lake Chad from around 4000 sq.km to around 3000 sq.km between 1960 and 2007, respectively, is attributable to the effects of climate change in that part of the country. Other lakes, particularly in Northern Nigeria, are also in danger of disappearing.

Temperatures have risen significantly above normal since the 1980s, with relatively higher figures in 1973, 1987 and 1998. Temperature increases of approximately 0.2 to 0.3°C per decade have been observed in the various ecological zones of the country. Minimum temperature in the country has increased slightly faster than the maximum temperature, resulting in smaller temperature range. This warming of the environment is most significant between June and November each.

Projected Impacts of Climate Change in Nigeria

Climate projections for the coming decades reveal a significant increase in temperature over all the ecological zones). It is predicted that there will be a temperature increase of 0.4 to 1°C over the time period 2020-2050 due to climate change, and an increase of up to 3.2°C by 2050 under a high climate change). Regional variations are expected, with the highest increase (4.5°C by 2081-2100) projected in the Northeast (Figure 1)
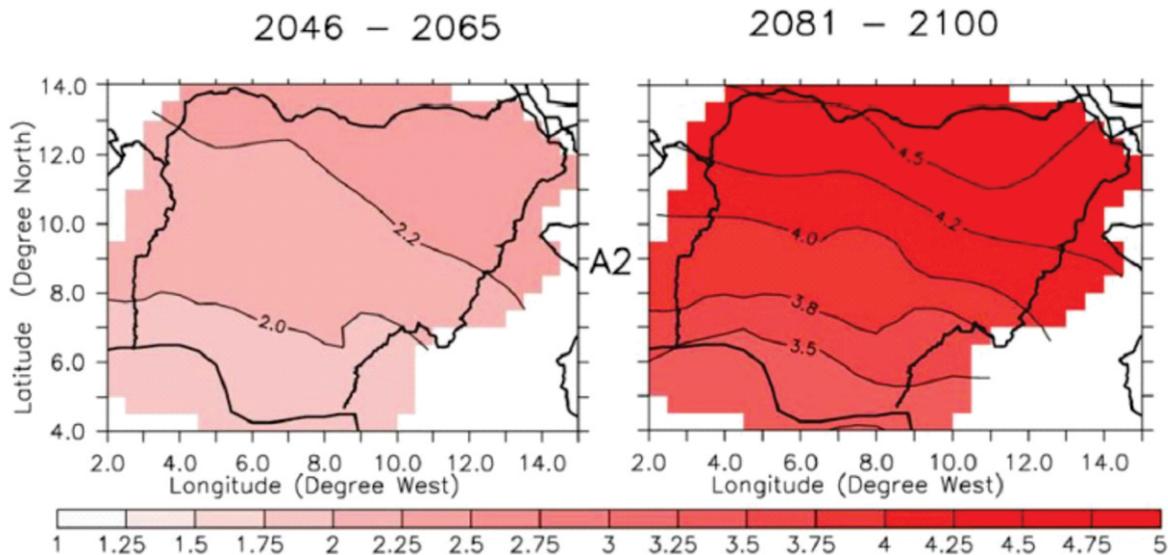
Figure 1: Projected Increases in Maximum Daily Temperature across Nigeria, presented in °C relative to the Present Day Climate
Source: BNRCC, 2011

Nigeria has a tropical climate with two precipitation regimes: low precipitation in the North (shortgrass and marginal savanna) and high precipitation in parts of the Southwest and Southeast (rainforest and mangrove). This can lead to aridity, persistent drought and desertification in the north; and erosion and large scale flooding in the south. Therefore, while climate change is a national phenomenon, the challenges associated with the climate change vary across the country (Federal Ministry of Environment, 2014; Herder, 2019).
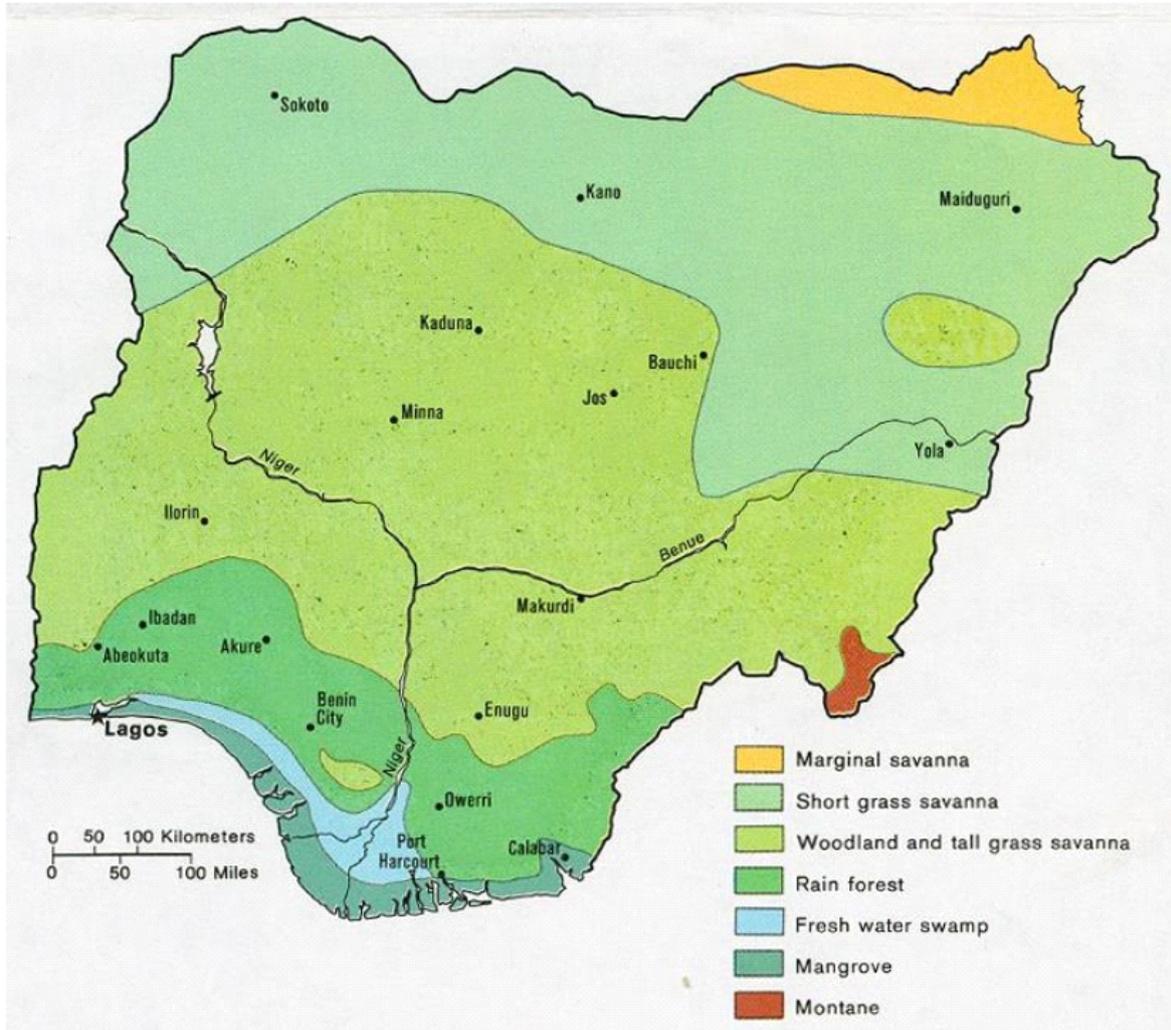
Figure 2: Agro-ecological Zones in Nigeria

Source: BNRCC, 2011

Table 1: Summary of Projected Trends by Ecological Zone

Climate variables	Mangrove zone	Rain forest	Tall grass (savanna)	Short grass (Sahel)
Temperature	↑	↑	↑	↑
Rainfall amount	↑	↑	↓	↓
Rainfall variability	↑	↑	↑	↑
Extreme rainfall events - droughts	Likely	Likely	↑	↑
Extreme rainfall events – storms and floods	↑	↑	Likely	Likely
Sea level rise	↑	NA	NA	NA

Legend: ↑ likely increase or increase; ↓ likely decrease or decrease; NA not applicable

Source: BNRCC, 2011

Impacts on Freshwater Resources, Coastal Water Resources and Fisheries

Climate change will affect the nature and characteristics of the freshwater resources on which Nigerians depend. The impacts will vary between eco-zones, exacerbating existing problems of too much water (floods), too little water (droughts) and reduced water quality (e.g. salt water intrusion). Climate change impacts, including sea level rise and extreme weather, will also affect Nigeria's coastal and marine areas, home to 25% of the country's population and to Nigeria's economically important petroleum industry. These impacts on freshwater and coastal water resources will also affect fisheries, a main source of livelihoods and protein for riverine and coastal rural communities.

Higher surface water temperatures that may lead to habitat loss for some temperature sensitive organisms, and increased abundance of undesirable species (e.g. algal blooms). Impacts on fisheries, including drying up of breeding habitat in wetlands and changes in species composition and abundance

Increased incidence of high intensity (extreme) rainfall events could lead to flooding and associated impacts such as siltation leading to reduced capacity of lakes/reservoirs, rivers filled with silt (entering cycles of flooding followed by drying), delta accretion, and smothering of mangroves. This could also lead to contamination of surface and groundwater, including fish habitat.

Drought induced by reduced rainfall can lead to desiccation and death of rivers, lakes and wetlands. Drought could reduce or eliminate dry-season habitat critical to sustaining fish populations through the dry season to the next wet season Greater frequency and severity of coastal storm/sea surge could impact mangroves, which constitute critical breeding habitat for many fish species.
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Impacts on Biodiversity

Increased aridity, increased intensity and variability of rainfall, and sea level rise all have impacts on organisms, species, and habitats. Temperature increases will have impact on all ecological zones. Increased aridity in the Sahel may reduce species numbers through die-off and decreased available habitat for species that are drought/heat intolerant. Rainfall changes will have an impact on all ecological zones. Flooding and

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water logging will affect biodiversity as a result of loss or change of habitat for water intolerant species. Variability in rainfall disrupts species behavioural patterns, such as nesting habits, and can threaten species survival. The impact of a single extreme event on biodiversity is generally less significant than the expected impact of long term changes in temperature and rainfall, but extreme events can lead to loss of local habitat and of individual species. Sea level rise will cause loss of habitat on a large scale along Nigeria's coastline. This will contribute to loss of individual species and lowered abundance of threatened/endangered species.

OIL POLLUTION

Oil and gas together constitute over 90% of Nigerian foreign-exchange earnings. The Niger Delta is the main seat of oil and gas production in Nigeria (Figure 3) It is a fact that all aspects of oil and gas exploration and exploitation have deleterious effects on the local ecosystem and biodiversity.
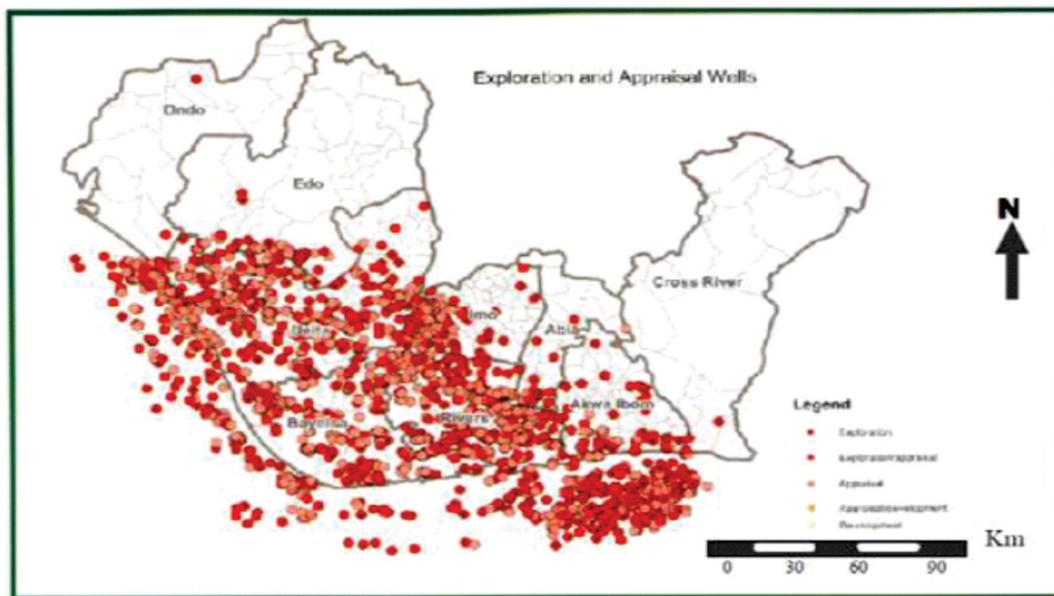
Figure 3: Niger Delta Showing the Distribution of Onshore and Offshore Oilfields

Source: Kadafa (2012)

Oil spills may be due to releases of crude oil from tankers, offshore platforms, drilling rigs and wells, as well as spills of refined petroleum products (such as gasoline, diesel) and their by-products, heavier fuels used by large ships such as bunker fuel, or the spill of any oily refuse or waste oil (Odiete, 1999, Ekpo et al., 2018). In Nigeria, 50 % of oil spills is due to corrosion, 28 % to sabotage and 21 % to oil production operations. One percent of oil spills is due to engineering drills, inability to effectively control oil wells, failure of machines, and inadequate care in loading and unloading oil vessels (Nwilo and Badejo, 2006'Ekpo et al., 2018). The main sources of oil spill in the Niger Delta are: vandalization of the oil

pipelines by the local inhabitants; ageing of the pipelines; oil blow outs from the flow stations; cleaning of oil tankers on the high sea, disposal of used oil into the drains by the road side mechanics, tanker accidents, ballast water discharge, etc. (Nwilo and Badejo, 2005). Oil spill risks and responses are usually classified according to size, characteristics and proximity of spill to response source (Table 2).

Table 2: Oil Spill Classification

Category	Spilled Volume (Barrels)		Responding Organization
	Inland Water	**Land & Offshore**	
Tier 1 (Minor)	Less than 25	Less than 250	The Spiller/Company
Tier 2 (Medium)	25 – 250	250 – 2500	Mutual Aid Basis, CNA
Tier 3 (Major)	Above 250	Above 2500	NOSDRA activates NOSCP, OSRL

Spill Incidents

Records between 1976 and 2001 alone indicate that 6,817 oil spills occurred in Nigeria resulting in the loss of approximately three million barrels of oil (UNDP, 2006 cited in Ekpo et al. 2018). This represents an average of 273 oil spills and 115,000 barrels/year spilled in the Niger Delta during the aforementioned period. Some notable oil spills recorded in Nigeria include Bomu 11 oil well blowout (1970), GOCON's Escravos spill (1978), Forcados Terminal spillage (1980), Oyakama pipelines spill (1980), Texaco Funiwa 5 blowout in (1980), Abudu pipeline spill (1982), Ikata pipeline spill (1984), Okoma pipeline spillage (1985) and Oshika pipeline spill (1993), Eket Mobil platform (1998), the massive Oloibiri Well 14 oil spill (2004), Bodo oil spills (August 2008 and February 2009) and K. Dere spill (April 2009) (Zabbey, 2009 cited in Ekpo et al., 2018). The number of spills and volumes spilled between 1976 and 2021 are presented in FRecords between 1976 and 2001 alone indicate that 6,817 oil spills occurred in Nigeria
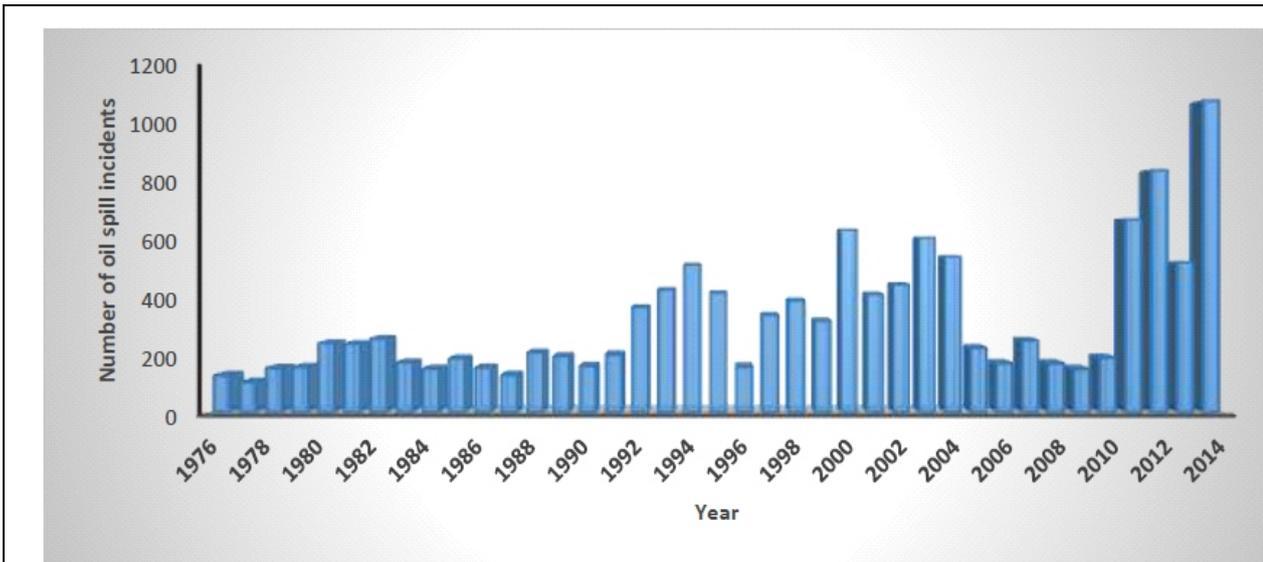
Source: Ekpo *et al..* (2018)
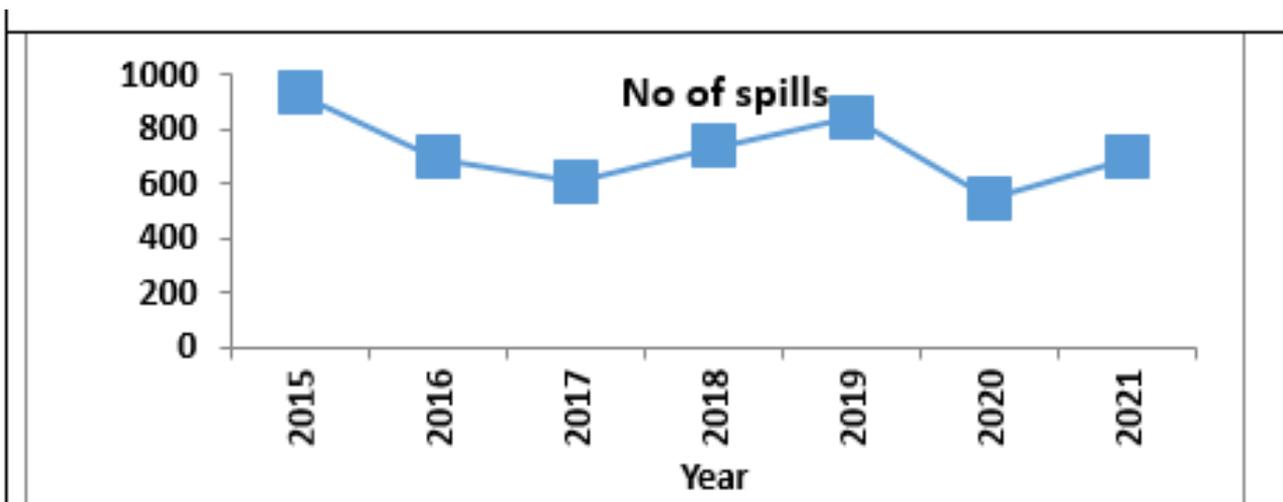
Source: NOSDRA Oil Spill Monitor

Figure 4: Number of Spill Incidents from 1975 to 2021
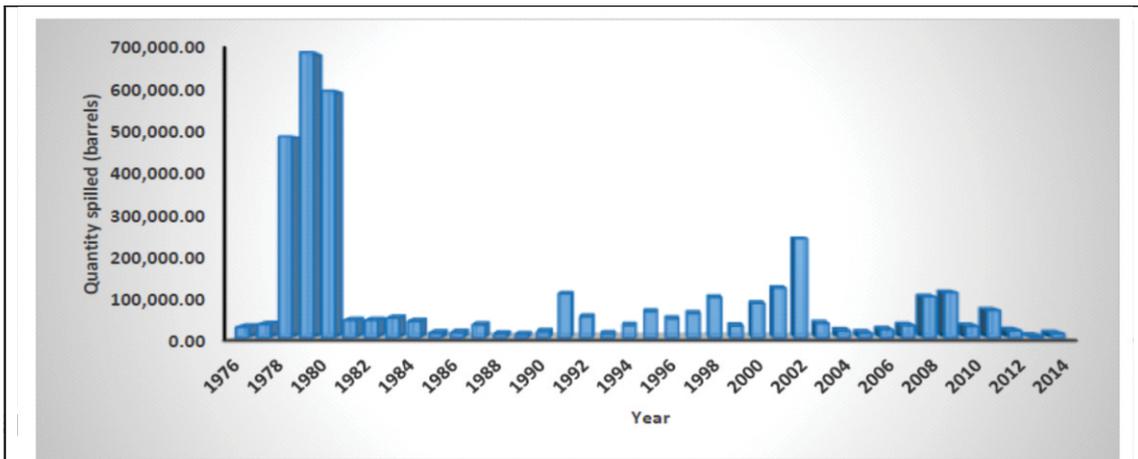
Source: Ekpo et al.. (2018)
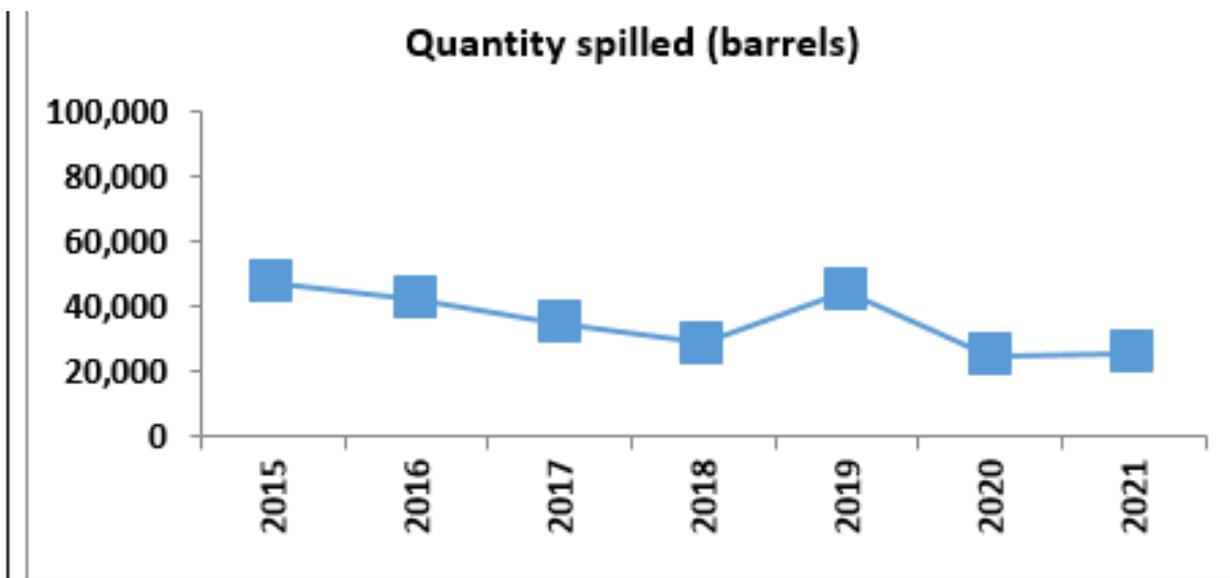
Source: NOSDRA Oil Spill Monitor

Figure 5: Quantity of Oil Spilled s from 1975 to 2021

Fate of Spilled Oil at Sea

Light oils seldom reach the shore. They tend to dissipate relatively quickly, particularity, if sea surface is being disturbed by winds and waves (Odiete, 1999). Henry oils invariably seem to break up into large lumps and arrive on the shores in the form of isolated lumps or tar balls. The major weathering processes are Evaporation, as much as 50% of the spilled oil may evaporate due to the volatile fractions. Spreading, the oil becoming thinner thus facilitating evaporation and other physical processes. Sinking, by heavier crude oil fractions adhering to heavy particles in water. Forming tar balls, some of which may sink, Emulsification of oil and water, Dispersion of water soluble fractions (aroma tic and naphthenes), Oxidation of hydrocarbons, and Microbial degradation (Odiete, 1999; ITOPF, 2014).

Mechanisms for oil spill damage

Oil may impact an environment by one or more of the following mechanisms: physical smothering with an impact on physiological functions; chemical toxicity giving rise to lethal or sub-lethal effects or causing impairment of cellular functions; ecological changes, primarily the loss of key organisms from a community and the takeover of habitats by opportunistic species; indirect effects, such as the loss of habitat or shelter and the consequent elimination of ecologically important species (ITOPF, 2014). The nature and duration of the effects of an oil spill depend on a wide range of factors. These include: the quantity and type of oil spilt; its behaviour in the marine environment; the location of the spill in terms of ambient conditions and physical characteristics; and the timing, especially in relation to the season and prevalent weather conditions. Other key factors are the biological composition of the affected environment, the ecological importance of the component species and their sensitivity to oil pollution. The selection of appropriate clean-up techniques and the effectiveness with which operations are conducted can also have a significant bearing on the effects of a spill (ITOPF, 2014).

Impacts of Crude Oil Spills

There were several cases of oil spillage in Nigeria even before the first export of crude oil in 1958, but scientific investigation into the effects of oil pollution in Nigeria only began recently after the Shell BP Bomu II blowout of July 1970 (Odu 1981). A survey by Baker into the effects of the Funiwa-5 oil well blowout of January 1980 revealed defoliation of some Rhizophora mangrove seedlings, death of crabs and some winkles (Ekekwe 1981). Ekekwe (1981) also reported that Gililan and Teas carried out a study 14 months after the spill. They found that 863 acres of mangrove were killed, most of the prop roots had been killed by oil and a parasite Spheroma and oil also appeared to have killed adult oysters in the impact zone.   It was concluded that there was an adverse impact on the local fishing industry as the mangrove serves as an important breeding ground for some marine fish. IPS (1983) followed plankton dynamics at Oshika to assess the environmental impact of the Oshika oil spill of August 1983 guided by observations that the plankton dynamic followed a seasonal cycle of abundance. Results showed that Cyanophyceae has a mark difference between the spill area and the control. It was concluded that this was an indication of stress. Massive embryonic mortalities affecting mostly advanced embryos of shrimp were also observed. Snowden and Ekweozor (1987) studied the effect of spill from a barge that sank in the Bonny Estuary, spilling 250 barrels of Nigerian crude oil. The incident occurred in an area where a baseline survey was already in progress. These data, plus additional studies at the spill-site enabled the impact of the incident to be determined. At the spill-site there was a near to total elimination of the littoral infauna and a highly significant oyster mortality, plus a 30% oiling of mangrove prop roots and 32% oiling of seedlings, which resulted in partial defoliation and death of seedlings within a 500 m^2 area.

Leucelli & Akani (2003) evaluated the effects of oil spillage and consequent pollution on the abundance, complexity and functioning of freshwater turtle communities of the Niger Delta, by comparing the turtle fauna found in two areas with similar environmental characteristics, one unpolluted and the other polluted by a case of oil spillage in 1988 at Baki Creek inBayelsa State. The study revealed both direct and indirect effects of oil pollution on the complexity and habitat use of Nigerian freshwater communities of turtles. The main direct effect was a considerable reduction in the specific diversity of the turtles; 50% of species were lost after oil spillage and there was a very strong decline in the numbers of turtle specimens also for those species which were able to survive the catastrophic pollution event.

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Ewa-Oboho and Asuquo (2006) studied the Exxon Mobi oil spill of January 2018 that oiled over 700km of onshore including mangroves as far as Forcados, Brass, Escravos and Lagos (Figure xx. Spilled oil moved rapidly ashore and into river mouths, and estuaries and their mangals shortly after the spills.They reported that planktonic organisms in the track of the oiled area showed reduced counts when compared to non-oiled zones within 24hrs of the spill. The pelagic food fish (Pseudotholitus elongates) and shellfish (Callinectes amartum) such caught from the area one week after the spill had high concentrations of petroleum hydrocarbons in their muscles. Quantitative surveys of the intertidal macro-fauna were conducted by Ewa-Oboho & Oladimeji (2007) during September-October 1998 along transects established at various locations along the Nigeria coastline. Samples were taken within impacted areas and at control unpolluted sites approximately 5 km to the east of the Idoho off-shore platform. They reported that biomass of macrofauna in the impacted areas tended to decrease with level of oiling, as the mean abundance decreased rapidly to about 50% of that found on the control unpolluted sites. Edible gastropod, mainly species of Tympanotomus fuscatus, and the brachyuran decapod, Uca tangeri, typically consumed by coastal inhabitants, had reduction in mean densities (up to 62%) in the oiled Bonny, Brass, Lagos and Forcados than in the non-oiled areas of Imo, Andoni and Cross River.
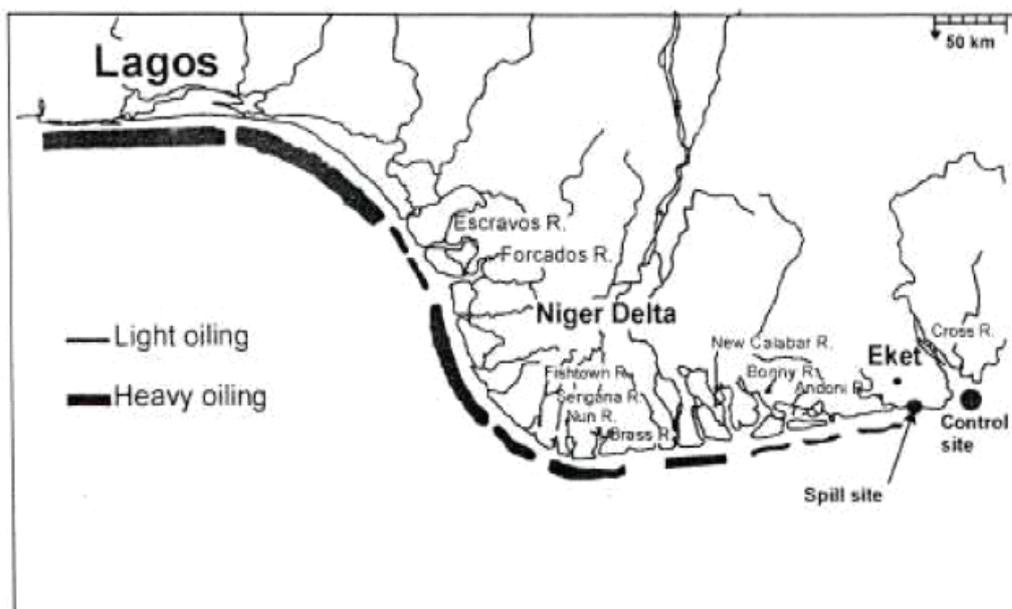
Figure 6 Shoreline oiling map from aerial video survey on 16, 17 and 28 January 1998 showing oiled areas along the Nigeria coastline
Source: Ewa-Oboho & Oladimeji (2007)

CONCLUSION AND RECOMMENDATIONS

Government should ensure implementation of actions to mitigate and adapt to climate change as enunciated in the Climate Change Act of 2021.

Operators in the oil industry should ensure that procedures to avoid pollution are in place. Environmental management systems should be put in place and judiciously implemented. Government must enforce environmental legislation strictly as well as address the issue illegal refineries.

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ORDER OF PROCEEDINGS FOR TECHNICAL SESSION
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IAUE/LS/TS/OMA	Impacts of Climate Change on Food Security, Nutrition, and Economic Growth By Prof. O.M. Adesope	RIVERS2022/IAUE/LS/TS/B1
11:00:11:30AM 25 MINUTES	Impacts Of Climate Change And Oil Pollution On Aquatic Resources And Biodiversity In Nigeria. By Prof. E. R. Daka	RIVERS2022/IAUE/LS/TS/B2
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SAEREM/IAUE2022/TS/LO	A Review of Some Impacts of Oil Pollution 0n Biodiversity 0f The Niger -Delta, **Nigeria** Louis Uchenna Onyeneke	RIVERS2022/IAUE/TS/036
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The Varietal Effect on the Nutrient Quality and Fungal Flora of Guava (Psidium guajava)

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ABSTRACT

Studies on the varietal effect on the nutrient quality and fungal flora of two varieties of guava (Psidium guajava): red variety and white variety were carried out in the Department of Plant Science and Biotechnology, Rivers State University. Proximate composition Analysis showed that the Red variety had higher values for moisture (76.25±0.00%) Ash (3.50±0.02) and Protein (1.80±0.001%) while the white variety had higher contents of lipid (0.6±0.00%) fibre (5.5±0.04%) and carbohydrate (13.25±0.00%). Mineral assessment revealed the presence of calcium, iron, magnesium, phosphorus, potassium, and sodium. However, lower concentration of calcium (16.13±0.02mg/100g) higher iron (1.00±0.00mg/100g), lower magnesium (29.5±0.01mg/100g], lower phosphrous value (33.05±0.06mg/100g), higher potassium (105±0.00mg/100g) and sodium (251.5±0.02mg/100g) were recorded in the red guava. Vitamins A, C and thiamine were found in both the red and white varieties of guava. Four fungal isolates (Mucor sp., Candida sp. and Saccharomyces sp. were isolated and associated with the spoilage of red guava at varying incidences. The white guava however, harbored only Mucor sp. and Aspergillus sp. This research has shown that guava is rich in essential nutrients that are known to be very beneficial to man. However also contaminated by several fungal organisms which may be detrimental to humans when consumed.
Keywords: Guava, variety, nutrient and fungi flora

Climate Change Adaptation by Rice Farming Input Sellers in Ebonyi State. Robert Ugochukwu Onyeneke*, Mark Umunna Amadi and Chukwudi Loveday Njoku

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Abstract

The paper explored climate adaptation strategies by rice inputs selling business in Ebonyi State using cross sectional data from rice farming inputs sellers across the State, and employing multivariate probit model to analyse the data. The climate risk management measures adopted by rice inputs sellers include reliance on climate information to make input supply decisions, buying and selling good quality inputs, storing inputs appropriately, and livelihood diversification. Income, education, cooperative membership, and ownership of motorcycle were the major determinants of adaptation in rice inputs selling business. The various findings have important policy implications for the policy makers and the rice inputs sellers. Local adaptation practices are important as first line of action against adverse climate change events but the capacity of these economic units must be built-on through government support owing to the lack in individual capital resources.

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THEME: IMPACTS OF CLIMATE CHANGE AND OIL POLLUTION, ON ENVIRONMENTAL RESOURCES, FOOD PRODUCTION, BIODIVERSITY AND ECONOMIC GROWTH

Key words: rice farming inputs; adaptation; cross sectional data; multivariate probit regression; Ebonyi State

Characterization And Classification of Soils Of Kolokum a/Opokuma Local Government Area of Bayelsa State Southern Nigeria.

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ABSTRACT

The characterization and classification of soils derived from flood plain soils in the humid tropics of the Niger delta of South South Nigeria was studied. Soil morphology, physical and chemi cal characteristics such as texture, drainage, effective soil depth, nutrients status and were employed and evaluated. The pedons were designated as KO 1 -12. Soils are deep and massive in structure and moderately drained to seasonally poor. Textural cla ss of the soils are sandy clay loam, clay loam, loamy sand to sand clay with dominate textural class of sandy clay loam. The overall pH results show that the soils are moderately acidic 4.5—6.0, Organic Carbon varies from 0.009 to 17.87 g/kg, irregularly d ecreasing down the profiles. Effective cation exchange capacity (ECEC) ranged from 1.85 to 31cmol/kg. The soils are classified according to USDA Soil Taxonomy and correlated with FAO/UNESCO soil map of the world reference base (WRB)Soil Legend. Three soil Orders were present, Alfisols/Lxisols (KO 4 and 12), Inceptisols/Cambisols (KO 2, 3, 5, 6, 7, 8, 9, 10 and 11) and Ultisols/Acrisols (KO 1).

Keywords: characterization, classification, Bayelsa State

Analysis of Technical Efficiency a nd Effect of Climate Change on Periwinkle Harvesters i n South-South, Nigeria.

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ABSTRACT

This study examines the analysis of technical efficiency and effect of climate change on Periwinkle Harvesters in Akwa Ibom State. The objectives were to assess the socioeconom ic characteristics of the periwinkle harvesters, determine technical efficiency of periwinkle harvesters, determine the effect of climate change on periwinkle harvesters.. Purposive sampling technique was used to sample 8 fishing communities from four loca l government areas of Oron, Mbo, Udung Uko and Urue Offong/Oruko. Snowballing technique was used to select 10 respondents from each community, giving a total sampling

size of 80. Analytical methods used included, descriptive statistics, four - point likert scale and multiple regression. The results showed' that majority of periwinkle harvesters were female (63%), 46.30% of the respondents were married, 42.59% were single and 11.30 % were divorced. A total of 55% had secondary education, 28.8% had primary education and 16.3 % had no formal education. Majority of the respondents engaged in periwinkle harvesting as their major occupation, 47.4% earned above the mean income level of 36,962.50. From the results, handpicking was the most commonly used method of harvesting. The respondents were all aware of the existence of climate change but only a few of them had knowledge about the nature of effect, climate change has on harvesting. From the findings the major constraints faced by the harvesters was sea rise a nd presence of predators, like snake. The results of the perceived effect of climate change on periwinkle output showed that the salt content of the sea has no effect on the quantity of periwinkle harvested. Furthermore, the result showed that an increase in rainfall leads to decrease in the catch rate of periwinkle. The study recommends, amongst others; that policy makers and NGOS should create an awareness on the nature of the effect of climate change on periwinkle harvesting.

Key Words: t ś'n⃝ᵬ⃞ Ă⃠rōśsters, Technical Efficiency, Climate Change,

Farmers' Apraisal of Crude Oil Pullution on Poultry Production in Nembe, Bayelsa State.

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ABSTRACT

The study examined the effect of crude oil pollution on poultry farming in Nembe Local Government Area, Bayelsa State. Four specific objectives and four research questions were used to guide the study. The population for the study comprise d of all poultry farmers in the study area. A sample size of two hundred (200) poultry farmers was drawn through a multi - stage sampling technique. The instrument for data collection was a structured questionnaire validated with a reliability coefficient 0 .80, obtained through a test-retest technique. The data collected were summarized and subjected to descriptive statistics (mean and percentage). The findings show that poultry farmers in the study area posses varying socio -economic characteristics, females more males, majority had formal education mostly secondary education and are married. The population was youthful with average age of about 45 years, most kept poultry species chicken/fowl with small flock, many people kept less than one hundred birds; ma jor source of capital is personal saving and return on investment is low. The findings also show some causes and sources of crude oil pollution as vandalizing of oil pipelines, corrosion of pipes and loading tanks/vessels. Crude oil pollution was found to affect poultry farming negatively in feeds and feeding, low productivity, poor returns on investment, outbreak pests and diseases. The recommended strategies to enhance poultry farming in crude oil polluted areas include, proper monitoring of facilities, e valuation and impact assessment of oil producing communities, planting of shaded trees in the farms and installation of ventilators in farms and assisting poultry farmers to support their farms through financial assistance.

Key words: Crude oil, Pollution , Poultry farming, Nembe.

Influence of Strain on Heamatological and Serum Biochemical Indices of Broiler Chicken Raised in Humid Tropics.

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Different strains of broiler chickens are usually imported into Nigeria and little is known about haematological and biochemical indices of these chickens to provide a means of assessing their health status which is also as an indicator of their performance. A study was conducted to examine the influence of three strains (Arbo Acre Ross 308 and Cobb 500) of broiler chicken on haematology and serum biochemistry with the view of identifying the best strain. A total of 144 birds (48 per strain) were used. Each strain was further replicated four times with 12 birds per strain per replicate. The haematological indices studied were packed cell volume, haemoglobin, red blood cell, white blood cell, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, while serum biochemistry indices were total protein, total cholesterol, albumin, globulin, alkaline phosphatase, calcium, potassium. The data obtained were subjected to analysis of variance and significance means were separated using Duncan multiple range test. The result indicated that haematological and serum indices of the bird studied were within the normal range. However, RBC, PCV, Hb were significant ($p < 0.05$) higher in cobb 500 (4.13, 4.13, 14.47 respectively), than Arbo Acre (3.83 , 3.82, 13.62 respectively) and Ross 305 (3.85, 3.85, 13.93 respectively). The effect of strain on blood biochemical profiles were not significantly ($p > 0.05$) differences between the three strains. The results of this study indicate that Cobb 500 has significantly better haematological profiles (RBC, PCV and Hb) and these could lead to better productive performance. Thus, Cobb 500 could be recommended to farmers for increased productivity.

Key words: Broiler chicken, strain, heamatology, serum biochemistry,

hḝt Ŏ̦¡TÆŎ̦ Remediation and Compensation in Nigeria: A Critical Look at the Ogoni Unep Report and the Nosdra Act, 2006

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ABSTRACT
Oil production in Nigeria has brought with it, devastation of the environment of the oil producing communities, bringing to the fore the need for remediation and payment of adequate compensation to the impacted communities. The environmental devastation of Ogoniland and the subsequent agitation by the citizens brought about the popular UNEP Report - a scientific study on the nature and level of the devastation. The Report recommended a number of remediation measures and has so far, been hailed by many. This work, through literature review has however, identified a gap it has left in the effort to ensure adequate compensation for the affected communities. The work finds that the international best practice

enough for compensating the victims, was not carried out. The work, wit h review of literature, has as well, identified The National Oil Spill Detection and Response Agency (NOSDRA) as the government agency that should carry out the said economic valuation. Analysing the law setting up the agency - The National Oil Spill Detec tion and Response Agency (NOSDRA) Act, 2006 - this work also identifies a hole in it, namely, its limitation of the work of the agency to only "major or disastrous" oil spills, without a definition of what level of spill amounts to "major or disastrous" – a situation which gives the agency a loophole in addressing all the myriad oil spill cases that occur in the oil producing and distributing communities of Nigeria. The work therefore recommends that (1) NOSDRA should carry out her statutory duty of using t he Ogoni Report to determine the monetary value of the environmental effects of oil pollution in Ogoniland to enable payment of adequate compensation to the victims and (2) the NOSDRA Act should be amended so that all oil spill compensation assessments in Nigeria are carried out.

Keywords: Oil Pollution; Compensation; Nigeria; Ogoni UNEP Report; NOSDRA

Energy Transition in Nigeria: The Challenges and Solutions

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Abstract

In Nigeria, the consequences of environmental pollution caused by the burning of fossil fuels is gradually becoming an overbearing problem to the populace. One of the key solutions proffered so far globally is the energy transition. E nergy transition is the ongoing process of ǾŇŐŰŃŌŇ ŊĊĚŌŉPŇŎE with ǾŎR ŃŸŃŎŏ ŇŎŇŇŏŇř sources Ŏ h ■ Ă ┼ś■ś'n ⌐ ■■Ŝρ ś■ś'n ┬ ĊŃĂ■ℓ┗■ ╫ Ă ℓ╫┼Z╫Ă┗ċ ℓ ĠĴ l'Ç'nĂ l'Ă■┼ e in an ŇŎŇ řͬ system regarding Ċ乒ŌŎ řMŎŇ ŇŎŎĊ乒Ŏ ŐŔŎŎ ŎΒ ■Ŏśŏ'nρ┗■ b ┼śín Ă ℃ś ♪■ℓ'śℓℓ ■ź'ś■ś'n┬ĊŃĂ■℮┗■ ╫ ℓ℮┗┼ Ă huge challenge to surmount. This is the essence of this paper. The paper looked at the challenges confronting Nigeria with respect to energy transition, and proffered appropriate solutions. Globally, the paper portrays energy transition as one of the industrial revolutions of the present times. It expatiated on the fundamentals and origin of energy transition. The paper also reflected on the causes and consequences of environmental pollution, which brought about this ongoing industrial revolution called energy transition. In Nigeria, the paper pointed out the challenges confronting energy transition, and proffered solutions that will enable the country be on the part of developing her own ener gy transition based industries. Finally, it made some recommendations of which one of them is for the federal government to engage the academics and the industries to the task of research -based energy transition.

Keywords: *Industry, Revolution, Energy, Tra nsition, Environment, Pollution, Fossil, Fuels, Climate, Change.*

Biosecurity Measures Employed In Small – Scale Poultry Production In Rivers State, Nigeria.

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Abstract

The study evaluated biosecurity measures employed in poultry production in Rivers state. The design of the study was descriptive survey. A multistage sampling technique was used and a sample size of three hundred (300) poultry farmers was used for the study. T he result showed that most of the respondents were males and the mean age of respondent was 40.5 years and experience in poultry f arming was 18 years. All the respondents had formal education. Major bio-security measures employed by poultry producers include: constant cleaning of poultry house and surroundings and disinfection, *washing of hands before and after handling poultry birds/products, providing foot -dip with disinfectant, proper washing of feeding/water troughs, Ensure adequate ventilation for the birds, isolation and quarantine of sick and infected birds etc. Based on the findings of the this study, it is recommended that aggressive sensitization of the poultry producers through seminars, workshops and conferences by relevant authorities on the advantages of adoption of biosecurity measures in their farms and encouraging fellow farmers to do so.*

Key words: Adoption, biosecurity measures, poultry producers, practice, disease outbreak

Evaluation of Yield and Agronomic Traits of 7 Rain -fed Maize (*Zea mays* L.) accessions

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Abstract

Maize is an important cereal crop in Nigeria. It is grown in almost all agroecological zones for its chief source of carbohydrate and protein. Maize average grain yield in Akwa Ibom State is low compared to yields across Nigeria. This study assessed the g rowth and yield parameters of 7 maize accessions for their optimum performance in the study area of Obio Akpa, Oruk Anam Akwa Ibom State. The maize accessions included 6 exotic accessions TZM 386, TZM 85, TZM 16, TZM 109, TZM 392, TZM 1330 and 1 local variety 'Uwep' commonly cultivated in Oruk Anam local Government of Akwa Ibom State. Agronomic parameters measured were grain weight, ear number/ha, ear weight (husked and dehusked). The fresh weight of dehusked ears were in the range of 1.33 -6.9 tons/ha. Grain yields from all accessions were lower than 1 ton/ha (0.1165-0.525 tons/ha) with accession TZM 386 producing a weight of 0.525 tons/ha; P=0.003. This study revealed grain yields to be low and short of meeting the predicted demands of climate change. However, TZM 386 appeared to outperform other accessions and shows promising performance.

Economic Development.

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Before the discovery of petroleum as the source of Nigeria's economic growth and foreign exchange, agriculture was the main stay of the economy. The role of agriculture in the nation's economic development became more apt following the recent recession which was due largely to the mono economic structure built on crude oil. Vegetable production is one aspect of agriculture which has provided jobs for Nigerians at small, medium and large scale levels. Despite this, Vegetable production in Nigeria is still facing some challenges. In a bid to boast production and to meet the supply needs of the rapidly increasing population, farmers have adopted a lot of technologies which have resulted in overexploitation of the environment and this has threatened the ability of the agricultural sector to provide enough food and income on sustainable basis to the people. Hence, this paper disc ussed the role of green technologies in promoting sustainable vegetable production in Nigeria. The paper reviewed the major green technologies in crop production and their impacts on sustainable vegetable production and national economic development; the c hallenges facing adoption of green technologies and approaches that could enhance their adoption. It was concluded that green technologies promote sustainable vegetable production, but farmers lack the knowledge of the benefits of green technologies and th e material resources necessary for adoption among technologies and provided with subsidies to promote adoption.

Keywords: green technologies, sustainable, productivity, economic development.

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Abstract

The occurrence of extrafloral nectaries (EFNs), in Pentaclethra macrophylla Bentham which are sugar - producing glands found outside the flower or in the plants vegetative org ans was reported for the first time in this research work. The glands occurred at the node of the plant. Morphological, anatomical and preliminary phytochemical studies were carried out to confirm their presence, structure and function. Interest in EFNs in Pentaclethra macrophylla started after noticing the frequent visits by nectar -seeking ants to the node of the plant. Medi -test strips were used to confirm the presence of sugar. Photomicrographs were made from stained and unstained sections in 50% glyceri ne. Colour change observed from the test strips indicated the presence of sugar (whose concentration was greater than 500mg/dl). It is recommended that the leaves of six to seven weeks old Pentaclethra macrophylla that has stop producing the exudates should be analyzed for certain metabolites content like tannin and compared to the tannin content on the leaves of a younger plant (two to three weeks old) to see if it is been used by the older plant as a chemical defense against further herbivore attack.

The Role of Mophormetric techniques and Dna sequencing in solving taxonomical problems: a case study of the Amaranths.

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Abstract.

The Amaranth flowering plants are of Amaranthaceae family. Amaranths species show remarkable diversity linked to their extensive adaptability to diverse eco -geographic situations leading to the occurrence of several eco –types acclimatized to diverse ecologica l parameters, because of their protracted cultivation history in different phytogeographic areas and thereby making classification and identification difficult. The related morphological likeness of Amaranthus in Rivers state and Nigeria as a whole often leads to misunderstanding in species classification and detection . This study on the Role of Mophormetric techniques and Dna sequencing in solving taxonomical problems was conducted using three species of the genus Amaranthus namely; A. hybridus L., A.virid is L. and A. spinosus L. from the three senatorial district of Rivers state. DNA characterization and sequencing of the species were done through plastid Ribulose - 1,5biophosphate Carboxylase large chain (rbcL) genetic marker. The sequence figures were firs tly compared on Basic Local Alignment Sequence Tool for validation. Phylogenetic and molecular evolutional analysis was conducted using MEGA version 7. For the Mophormetric techniques, 52 quantitative and qualitative characters were achieved from morpholog ical and anatomical characters and applied for construction of a dendogram using the Paleontological statistics (PAST) software. Results from both Phylogenetic tree and the dendogram clearly shows identified Amaranths species aligning on the tree, based on their level of similarity and differences. It is recommended that Ribulose biphosphate carboxylase large subunit (rbcL) be used in collaboration with the plastid marker Maturase K (MatK) and the nuclear ribosomal internal transcribed spacer (ITS) genetic marker.for more effective results. For the mophormetric techniques, it is recommended that more taxonomic lines of evidence be utilized to generate more characters to arrive at good taxonomic conclusion.

Impact of Sabotage, Oil Theft and Illegal oil Bunkering Activities on the Nigerian Environment and Economy

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Abstract

This research work examined the rising cases of sabotage, oil thefts and illegal oil bunkering activities in the Niger Delta region of Nigeria. The aim was to critically examine the impact of sabotage, oil theft and illegal oil bunkering activities on the Nigerian environment and economy. The location of the study is the Niger Delta region of Nigeria. The study was timed within the period of January 2020 to November 2020. Secondary data were generated for the study, while content analysis was used for data interpretation and analysis. The study revealed that activities of sabotage, oil theft and illegal oil bunkering impacted negatively on the environment and the national economy. The study also revealed that different individuals and groups were involved in sabotage, oil thefts and illegal oil bunkering activities. The study further proved that persistent sabotage and illegal oil bunkering activities in the Niger Delta region is due to the systemic corruption by Nigerian elites, government's inappropriate policies, high level of youth unemployment, ineffective and corrupt law enforcement agencies and international crime collaborations. Although the Nigerian government has made some efforts over the years to curb the problem by the establishment of a special security outfit, militarization of the Niger Delta region and reviewing of amnesty programs, but the persistent cases of the sabotage, oil thefts and illegal oil bunkering activities recorded in recent times clearly indicate that success has not been achieved. In the bid to ensure that this upsurge of sabotage, oil thefts, and illegal oil bunkering activities were put under control in order to make Nigerian economy robust and position the country to be a business friendly environment for both local and international bodies: It was recommended that the government should be sincere in its fight against sabotage, oil theft and illegal oil bunkering and should formulate policies that are geared towards embarking on mass literacy and educational programmes on poverty eradication as this will re-orient Nigerians and eradicate this concept of "get rich quick syndrome" and thereby sustaining the environment and economy.

Significance of Numerical Taxonomy in Plant Classification Studies

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Abstract

Numerical taxonomy is a veritable and useful tool in plant classification and identification studies especially in cases where classification becomes very difficult to achieve. However the potentials and opportunities offered by this field has not been maximally harnessed in plant systematics. This study demonstrated the significance of numerical taxonomy in plant classification studies by using species of Euphorbiaceae as a case study. Numerical taxonomy differs from conventional taxonomy in the sense that the later (conventional taxonomy) equate taxonomic relationships with evolutionary relationships whereas the former (numerical taxonomy) views and treats them in three ways which includes: Phenetic-based on overall similarities; Cladistic- based on a common line of descents and Chronistic- temporal relation among various evolutionary branches. Usually, the objects to be classified are called Operational Taxonomic Units (OTUs). The OTUs may include species, genera, families and/or other

characters were recorded in the form of appropriate numbers in a manner that indicate that the differences among them are proportional to their dissimilarities. In this study, seven species of euphorbiaceae were subjected to cluster analysis using 60 diagnostic characters which are more in number compared to previous reports found among the family Euphorbiaceae which made use of fewer characters in similar studies as it is already an established concept among taxonomists that the more characters used in numerical taxonomic studies, the more efficient the result would be. The Numerical taxonomic methods adopted to analyze these characters drawn from morphological, epidermal and anatomical lines of evidence proved effective as results validated previous systematics. This is because all operational taxonomic units (OTUs) belonging to same genus were clustered as a group indicating that they are more related to each other. Recommendation was made for numerical taxonomy to be applied to other groups of plant for classification studies.

Impact of Climate Change on Soil Physicochemical Properties of Vegetable Farmland Under Poultry Manure Applications in Port Harcort Region

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Abstract

Climate change will have an effect on soil processes and properties because, soils are connected to atmospheric/climate systems through the carbon, nitrogen and hydrologic cycles. The study examined the impact of climate change on soil physicochemical properties of vegetable farmland under poultry manure applications in Port Harcourt region, Nigeria. The study adopted experimental research design. The nature and source of data was through the primary and secondary sources. The sample frame for the study was gotten from 625m^2 of parcel of vegetable farmland which was divided into a grid system of 5x5 inside each 25m^2. Thus, 2.5 of smaller plots formed the sample frame for the study from which the sample was taken. By using four treatments with three replicates, the study used table of random numbers to select 12 samples. Twelve samples or experimental plots of 5m x 5m was selected from the sample frame. Four levels of treatment 0kg/25m^2, 50kg/25m^2, 100kg/25m^2 and 150kg/25m^2 of poultry manure were applied to the experimental plots using completely randomized design. The method of data collection involved soils being collected 9weeks after the application of the poultry manure (treatment). The soil samples were collected at a depth of 0-30cm using a soil auger. This was done by taking 4 composite samples from each of the plots. The four composite samples were thoroughly mixed while a sample was taken for analysis for all experimental plots with a standard method for physicochemical parameters. Data acquired from the laboratory was subjected to Analysis of Variance (ANOVA) statistical technique. The study showed that the mean soil p^H prior to application of manure was 5.06, indicating an acidic soil. The soil EC mean was 290µs/cm, calcium carbonate was 10mg/kg, organic matter was 1.21%. Mean of total nitrogen was 0.061%, phosphorus 0.14mg/kg. Mean Potassium was 12.73mg/kg, calcium was 12.85mg/kg, magnesium was 65.41mg/kg, iron was 3022.10mg/kg, manganese was 101.63mg/kg,

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soil p^H, total nitrogen (N), phosphorus (P), magnesium (Mg), iron (Fe) and manganese (Mn). In all the parameters analyzed, it can be inferred that there was a significant difference in the treatment effects on soil physicochemical properties. The study recommended that soils which have been acidic due to climate change and anthropogenic activities should be corrected with poultry manure that are alkaline in composition; poultry manure should be applied to sandy loamy soil to reduce heavy metal contents; Regular soil test and manure analysis.

Keywords: Climate change, Soil, physicochemical properties, vegetable farmland, poultry manure, region.

A Sustainable Environmental Management Education Curriculum Development for Schools in Oil Bearing Communities in Rivers West Senatorial District

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Abstract
The study investigated the need for environmental management education curriculum development for schools in oil bearing communities in Rivers West Senatorial District. The study covered all the 83 public secondary schools, 526 school teachers and 175 principals in both Rivers State Universal Basic Education programme and the senior secondary schools in Rivers State within this educational zones. The study adopted the multistage sampling procedure at the first stage, cluster sampling technique was used to group all the schools within the educational district, the local government Area were properly arranged in different order, then stratified random sampling was employed to list both the male and the female teachers who are likely to teach this subject. In this study 231 was male teachers while 294 was the female teachers. Descriptive research design was used to carry out four null hypothesis, A 5 – point rating scale was designed to obtain data for the study. Data generated from the research question were analyzed using t-test to test the hypothesis. A self-structured instrument titled sustainable Environmental Management Education Curriculum Development (SEMECD) were used, face and content validities were made by the research experts in science education, measurement and Evaluation department of the faculty of Education, Rivers State University Port Harcourt. A reliability coefficient value of 0.82 was obtained through a test – retest method. The findings indicated that the present nature of environmental degradation and ecological crisis in Niger Delta demand for such curriculum, but that the bulk of the curriculum implementers who are usually the classroom teachers are in-adequate, accompanied with facilities, teaching aids are all lacking. So the implementation of effective environmental management education curriculum is defective, hence there is no existing policy or regulation supporting the implementation of environmental management education in Rivers West Senatorial district, Teachers need to be trained and re-retrained for such purposes. Based on the findings, it was recommended among

curriculum for schools in Rivers West senatorial district so as to increase the level of awareness in Environmental Management and Safety Education in oil bearing communities.

Keywords: *Sustainable, Environmental – Management, Education, Curriculum, Rivers West Senatorial district.*

Impact of gas explosion on water qualities and soil properties in Obotim Nsit, Nsit Ibom L. G. A, Akwa Ibom State.

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ABSTRACT

Impact of gas explosion on water qualities and soil properties in Obotim Nsit, Nsit Ibom L. G. A, Akwa Ibom State were investigated. The aim was to establish baseline information on the impacts of gas explosion in water and soil properties. Soil samples were collected from three points and bulked to form composite sample at depth of 0-15 and 15-30 cm using soil auger within the vicinity of explosion and along the pipeline corridor. Also, soil samples were collected 300m away from the gas explosion vicinity to serve as control. A total of 7 composite soil samples were collected for laboratory analysis. Undisturbed soil samples were equally collected using core ring for the determination of permeability and bulk density. Rain and stream water were collected within the vicinity of explosion. The samples were properly bagged, labelled and taken to the laboratory for analysis. The study revealed that, in comparison with the control, gas explosion increased sand fraction, bulk density and reduced clay fraction, permeability and total porosity. Gas explosion reduced soil pH, soil organic matter, total N, available P, exchangeable bases (Ca, Mg, Na and K), cation exchange capacity and raised electrical conductivity and exchangeable acidity. Gas explosion also increased the concentrations of Cd, Cr, Pb and Ni in the soil, water qualities affected by gas explosion were temperature, pH, turbidity, chloride, Cd, Ni and Cr. These parameters were raised by gas explosion in the area. Therefore, gas explosion is responsible for the fast decline in soil and water qualities in the vicinity.

Use of Bio-Fertilizer Produced from Fermented Organic Waste in the Production of Local Maize.

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ABSTRACT

The inherent ability of the soil to provide all the necessary nutrients for crop production especially in the southeast is becoming impossible as farmers now rely majorly on soil amendments for productive yields. With the high cost of obtaining inorganic fertilizers and recently with the increased demand for organic fertilizers, farmers in the southeast need to come up with as many alternatives to enrich the soil as possible. Hence the search for different organic inputs at the most minimal cost for crop production. This

Polytechnic Nekede Owerri to investigate the use of bio-fertilizer produced from fermented organic waste in the production of local maize. The broad objective of the work was to determine the effect of bio-fertilizer produced from fermented organic waste on the growth and yield of local maize. The seed was planted at the depth of 2-3 cm in plot measuring 2m by 3m at the rate of 2 seed per stand using a spacing of 75cm x 50cm. The experimental design was laid out in a randomized complete block design (RCBD) the treatments include: groundnut husk (T1)) legume plant extraction (T2), kitchen waste (T3) control (T4). The treatments were replicated 3 times. The result obtained showed that fermented kitchen waste showed significant difference at 5 % probability level for most measured parameters such as plant height, leaf area , grain yield, number of grain per cob, cob weight . fermented plant extraction also showed significant difference in some parameters measured and produced the highest yield of maize when compared with the other treatments local farmers to produce best yield in local variety of maize. This experiment has shown that local maize can be grown successfully with improved yield by using readily available organic waste at the right proportion.

Key words: Bio fertilizers, Maize, Yield, Fermented organic waste

A Review of Some Impacts of Oil Pollution 0n Biodiversity 0f The Niger-Delta, Nigeria

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ŎŎŘÑŎÑÑÞ́ÑŎÑŎŎMĔ̆ ŅŎ MⱭŃŎ̈ Ŏ̊Þ́ŃŎÑŎ̃Þ́ŒȄ̆ŘMⱭŎ̈Ŏ̈BⱭ́ŎŎ̈

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Gas flaring, explosions/fire outbreaks, oil leaks/spills from transport lines, chemicals and effluent discharges into the environment have adversely affected the balance in the distribution and population of biodiversity, especially the endangered fauna and flora species within the region. Apart from urbanization, climate change, and tree felling, the excessive extraction and production of oil and gas are the most responsible for the disturbance and loss of biodiversity in the Niger Delta. This paper summarizes the adverse implication of the oil/gas prospecting and production on biodiversity and the actionable framework put in place by the government for the protection of the environment and conservation of biodiversity in the Niger Delta region of Nigeria.

Impact of Flood Mitigation Approaches on Residential Buildings for Economic Growth and Sustainability in Rivers State.

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Abstract

The study analyzed the different approaches used to mitigate the impact of flood on residential buildings for economic growth and sustainability in Rivers State, Nigeria. Three objectives and three research questions guided the study while three null hypotheses were formulated and tested at .05 level of significance. The study adopted a survey design and, the population of the study is comprised of all building designers and developers working with the 69 state approved building construction industries in Rivers State. The sampling technique was the stratified random technique, the 4 local government areas in Rivers State were sampled and the one with the highest number of building construction industries (Obio/Akpor) was picked, it has 25 building construction industries with 65 building designers and developers. Structured questionnaire titled 'Impact of Flood Mitigation Approaches on Residential Buildings in Obio/Akpor (IFMARBOA), was used to derive information, the instrument was validated by two experts, and the internal consistency of the research instrument was established by using Cronbach Alpha reliability method to determine internal consistency of the questionnaire items and overall reliability co-efficient of .85 was obtained. Results revealed that the approaches: Spatial planning approach, Participatory planning and implementation approach and Legal and institutional framework approach had very great impact in mitigating the effect of flood on residential buildings in Rivers State. Based on the findings of the study the following recommendations were made: innovative and cutting edge building material technology is highly required.

Words: Mitigation Approaches, Flooding, Residential Buildings, Design and construction

Technical Efficiency Analysis Among Small Scale Watermelon Farmers in Uyo Local Government Area Akwa Ibom, Nigeria

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Abstract

The study examined technical efficiency (TE) among small-scale watermelon farmers in Uyo Local Government Area Akwa Ibom state, Nigeria. The data were collected with well-structured questionnaire and assisted with interview schedule, through a random sampling of 100 respondents in the study area. Data analysis was carried out with the use of descriptive statistics and stochastic frontier production function. The result of the analysis showed farmers mean age of 41 years, 83%of them were married, with mean farming experience of 4 years. Majority(97%) of the farmers had training in formal educational, with a mean household and farm size of 6 person and 0.8 hectare respectively. The regression analysis showed that the farmers were operating at an increasing return to scale. All the production factors jointly and positively correlated with farmer's outputs; but only farm size, planting materials and depreciation that were statistically significant at 5%. Technical efficiency ranged from 0.004-0.915 with a mean value of 0.7339, an indication that the farmers were operating at about 26.6% below the frontier, which also indicated an efficiency gap among the farmers in the study area. Farmer's socio-economic characteristics contributed positively to their Technical efficiency. It is concluded that farmers should expand their scale of watermelon enterprises to enjoy economics of scale in production. Policies of governments should be directed at socio economic factors to enhance their TE in the study area and assist farmers with irrigation facilities.

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Effects of Fungal Filtrates on Seed Germination and Seedling Growth of Maize(Zea mays (L), in Rivers State Nigeria.

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Abstract

Investigation on effects of fungal filtrates of Fusarium oxysporium, Macrophomina phaseolina and Culvularia lunata on percentage germination of maize seed and growth of seeding using blotter and potted soil methods was carried out. F. oxysporium, M. phase olina and C. lunata which were used as test fungi were isolated from maize seeds. Healthy maize seeds were soaked in culture filtrate of each test fungus for twenty-four (24) hours. The experiment was laid out in a complete randomized design in three repli cates. Results of effects of fungal culture filtrates showed significant reduction in germination, shoot length and root length of maize seedlings (P=0.05) grown on both blotter and potted soil methods. F. oxysporium culture filtrate caused the highest re duction in germination of maize (50.0%; 39.7%), followed by C. lunata (38.6%; 32.3%), while M. phaseolina caused the least germination reduction (23.6, 22.6) for both blotter and potted soil methods respectively. A similar observation was made in shoot and root length reduction, with F. oxysporium taking the lead (51.0;55.8%) in shoot length reduction and (96.1; 54.3%) in root length reduction for blotter and potted soil methods respectively. However, M. phaseolina caused the least shoot length reduction (1 4.3;35.1%) while C. lunata caused the least root length reduction (20.5, 33.2%) for blotter and potted soil methods respectively. F.oxysporium also caused the highest reduction in vigour index, followed by C.lunata, while M. phaseolina did not show any sig nificant reduction in vigour index. of maize seedling. This study concludes that fungal contamination have pathogenic effects on the growth of plants and can cause potential health hazard on human.

Key Words: Zea mays, seedling, culture filtrate, fungi.

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Abstract

The study was carried out with the aim of comparing the nutrient quality and post -harvest rot of sweet and Irish potatoes. Fourteen tubers of sweet and Irish potatoes were purchased from mile 3 market in

Portharcourt . Nutrient and antinutrient analysis were carried out in Rivers State University, Portharcourt. Result for proximate composition revealed that Irish potatoes had high values for moisture (70.57 0±.06%) and lipid (0.740±0.02%) while sweet potatoes had high values for ash (2.330±06%), Fibre (1.33± 0.01%), carbohydrate (34.390±0.02%) and protein (6.44±0.06%) respectively. Mineral composition result showed that sweet potatoes had higher values for calcium (25.83±0.) , iron (1.270±0.06), magnesium (0.94±0.01), phosphorus (27.67 ±0.58) and potassium (506.67± 1.1629mg/100g). Antinutrient compositions showed no significant (p<0.05) difference in glycosine, oxalate , carotenoid , polyphenols and lignant respectively. Mycological studies revealed that Candida sp. , Penicilium sp. and Aspergillus niger to be present in Irish potato while sweet potato recorded Candida sp only. Conclusively, this research revealed that sweet potato nutrient quality is higher than Irish while Ir ish antinutrient composition were higher than sweet potato and they are prone to fungal contaminations. Proper care should be taken during and after harvest to reduce fungal contaminations.

*Keywords: **Nutrient quality, post harvest rot, sweet and Irish pot atoes.***

! ŷŷőŷŷĻ őĻ΄A Ǒť΄ t Ĕζ΄ΆǑ-Remediation Quotient of Locally Consumed Waterleaf Talinum Triangulare Plant Grown in Soil Contaminated with Sodium Arsenate Pesticide.

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ABSTRACT

The potential of Waterle af Talinumtriangulare to abstract and consequently remediate As from As - contaminated soil was investigated by pot experiment and the concentration of As in the plant and soil was determined through mass plasma atomic emission spectroscopy (MP -AES). The composite soil in two separate groups of pots was spiked with 50 mg/kg and 70 mg/kg disodium arsenate pesticide and stands of Waterleaf were grown on them over a 9weeks growth period. The plant parts (leave and root) and soil after harvesting were pretreated, acid digested and subjected to MP -AES analysis. The results depicted that As concentrations in the plant parts differ at all the treatment levels over the graded period of growth   for frequency of harvest and time of harvest and exceeded the maximum permissible limit established by FAO/WHO, and makes the plant unfit for human and animal consumption. The experimental results revealed a statistically significant difference (p<0.05) in the bioaccumulation of As over the graded p eriod of growth at all the treatment levels. The Bio -accumulation factor (BAF) and Bio -concentration factor(BCF) were generally greater than unity (BAF > 1 and BCF > 1) in all treatment levels at the time of harvest which indicates that Waterleaf is suitab le for phytoextraction and phytostabilization. However, BAF < 1 and BCF < 1 were observed in the 3 [rd] week and 9th week in the frequency of harvest. Furthermore, Translocation factor(TF <1 and TF > 1) were observed for frequency of harvest and time of harve st, implying that the plant can serve as a bad and good accumulator of As in contaminated soil for phytoremediation if the plant is frequently harvested or allowed to fallow. TF > 1 means that the vegetable will be suitable as a good phytoextractor. It ca n, therefore, be concluded that Waterleaf can be used for commercial and environmental friendly phytoremediation technology (Green technology) to clean up As polluted sites and environmental monitoring.

Key Words: BAF, BCF, TF, Phytoextraction and phytosta bilization and As contamination

Women Empowerment in Rural Areas Through Poultry Farming in Delta State, Nigeria

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Abstract

This study was designed to investigate the capacity of poultry farming to empower women in the rural areas of Delta State. The study specifically described the socioeconomic characteristics of the women poultry farmers, and identified the poultry farming activities engaged by the women, their level of empowerment, the initiatives or training women attend, and the constraints to women empowerment. A random sampling technique was used to select 144 respondents for the study collected using a structured questionnaire administered by personal interview. The data were analyzed using descriptive statistics involving frequencies, percentages and means. The findings showed that respondents had a mean age of 45 years and were mostly married (61.20%), 29.10% of them had secondary education, a mean farming experience of 20.20 years, 52.90% lived in standard houses with a mean household size of 7 persons. About 79.20% had no contact with the extension agent; the average income was N49,750. The majority (74.27%) of the women were selling eggs, and 66.99% were involved in poultry products. Empowerment facilities accessed by the women were microcredit, training and input. Microcredit was sourced from self-help groups; the Government gave Training. The women were mostly empowered through their various functional groups. The majority of the women could adequately feed their family (mean = 3.05), most of the women were able to plough back their capital into their business (mean = 2.88), train their children in school (mean = 2.83), and capable of clothing their children adequately (convey 3.05). The majority also could purchase household utilities from their savings (mean = 2.89). The empowerment index of 0.74% shows that 74% of the women were empowered. The hypothesis states that poultry farming is profitable. The constraints identified were lack of government assistance 80.58%, lack of good inputs (40.29%), lack of adequate finance (70.39%), insecurity (6.80 %) pests and diseases (42.72%), and high cost of feed (11.20%). It was recommended that the Government train the women in the rural areas and provide them with microcredit and inputs to empower them further; Government should employ and post more extension workers to the rural areas.

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CⱭúⱭŷⱭt uⱭÑTIJⱭŷп! Tool for Phytomedicine and Economic Security in Etche Ethnic Nationality, Rivers State, Nigeria.

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Abstract

The study investigated forest products as a tool for phytomedicine and economic security in Etche ethnic nationality of Rivers State, Nigeria. Descriptive survey design was adopted for the study. The population of the study consisted 786 registered farmers in Etche Ethnic nationality consisting of Etche and Omuma Local Government Areas. 270 and 90 registered farmers in Etche and Omuma Local Government Areas respectively were selected as the sample size, through random sampling techniques. Three research questions were answered. Data were collected through the administration of self-structured questionnaire which was validated and a reliability coefficient of 0.75 obtained and complimented with interview schedule for illiterate farmers. Data obtained were analyzed descriptively using mean and standard deviation. Results showed that most of the forest products were available for collection and utilization in the study area. The mean response showed that most of the forest products were utilized in the form of stimulants, spices,, medical plants and animal products. Respondents opined that forest products would not only sustain their health, but would also enhance and improve their economic security. However, they remarked some constraining factors to the effective utilization of the forest products such as lack of power supply, processing facility, unfavorable market projections, deforestation among others. Based on the findings, it was recommended that deforestation should be discouraged and forest based activities, particularly processing of forest products should be prioritized by government and others stake holders to enhance the economic security of rural farmers.

Keywords: Forest, economic, security, Etche, phytomedicine.

Phytochemical Components and Fungal Flora of Water Yam (Dioscorea alata)

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ABSTRACT
Study on the phytochemical and fungal flora of water yam were carried out in the Department of Plant Science and Biotechnology, Rivers State University. The phytochemical screening of the sample was carried out using standard laboratory method described by Association of Official Analytical Chemist (AOAC). The cultural laboratory technique was used for fungi isolation, characterization and identification. The quantitative screening for phytochemicals revealed that the plant contains Tannins (2.87±0.52mg/100g), Phylate (9.8±1.23mg/100g), Oxalate (0.57±0.22mg/100g), Flavonoid (14.1±2.7mg/100g), Phenol (34.51±0.72mg/100g) and Alkaloid (9.65±0.75mg/100g). Two fungal isolates Mucor species and Candida species at 30% and 70% incidence respectively were isolated and implicated to be responsible for the spoilage of water yam. Generally, the plant is rich in phytochemical and the presence of fungal organisms give more concern for proper hygienic measures.
Keywords: Water yam, phytochemical and fungi.

Eefect of Fungal Contamination on the Weight of Brown Cowpea Sold in Port Harcourt Metropolis .

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ABSTRACT

The effect of fungal contamination on the weight of Brown Cowpea sold in major markets in Port Harcourt was investigated. Brown cowpea seeds were purchased from Mile 1, 3, Town market and Rumuokoro market. The cowpea seeds were taken to the Department of Plant Science and Biotechnology, Rivers State University. Isolation, characterization and identification of fungi isolates were done using the cultural laboratory method in accordance to Association of Official Analytical Chemist (AOAC). Assessment of pathogenicity of fungal isolates on weight of brown cowpea was carried out to ascertain that the fungal isolates were actually responsible for the weight loss. Three fungal genera: Aspergillus flavus, A. niger, Rhizopus and Mucor were isolated from the cowpea seeds. The percentage occurrence of the fungal isolates was A. niger (29.4%), A. niger (17.6%), Mucor sp (29.4%) and Rhizopus sp (23.5%). The weight of the brown cowpea deviated from the original weight of 0.423±0.10g after being exposed to fungal isolates and the weight loss recorded as a result of pathogenicity of A. flavus, A. niger, Rhizopus sp and Mucor sp on the brown cowpea seeds was 0.12±0.36, 0.22±0.26, 0.07±0.07 and 0.10±0.13g, respectively. The weight loss recorded could be due to the activity of the fungal isolates and these could lead to the loss in quality of cowpea seeds as well as affect the rate of germination. Furthermore, the presence of these fungal isolates especially with recorded mycotoxin production could be a public health challenge.
Keywords: Cowpea, fungi and pathogenicity.

Evaluation of Macro-Aggregate Stability Under Different Land Use Types On Coastal Plain Sands in Southeastern, Nigeria.

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Abstract

The study was carried out in Coastal plain Sands, Southeastern Nigeria to evaluate Macro-aggregate stability under three land-use types; Rubber Plantation (RP), Oil Palm Plantation (OPP) and Forest plot (FP). Random soil and core samples were collected in five locations in each of the three land-use types, given a total of 15 samples, bulked for physical and chemical analyses. Aggregate Separation was done using a nest of four sieve sizes. Macro-aggregate Stability indices, means weight diameter of dry and wet (MWDd and MWDw), water stability aggregate (WSA), aggregated Clay (AC), exchangeable sodium percentage (ESP) and aggregated silt plus Clay (ASC) were calculated. The data generated were fitted into 5x3 factorial experiment in a complete randomized design. The data were subjected into descriptive statistics and correlation Matrix. The result indicates that sand was the dominant particle size fraction. Macro-aggregate stability indices result revealed that MWDw recorded highest value at RP (1.128) and lowest at FP (0.963). WSA and AC had highest mean value at RP (26.82) and OPP (11.562) and RP (4.85), mean value at OPP (1.54) and OPP (13.35) and lowest value of RP (1.22) and FP (7.35) respectively. Aggregated silt plus clay increases flocculated of soil aggregate while exchangeable sodium percentage causes disintegration of soil aggregate.

Keywords: Soil structure, Macro-aggregate stability, Land-use types, Acid Soils, Aggregate- Stability indices.

Examination of Solubilizing Effects of Trichoderma koningii and Trichoderma harzianum and Impact on Growth Parameters and Yield of Zea mays .

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Solubilizing effects of Trichoderma koningii and Trichoderma harzianum and impact on growth parameters and yield of Zea mays was examined. Trichoderma species were isolated from contaminated mushroom (Pleurotus ostreatus) at Dilomat Farms and Services Limited, Rivers State University. The experiment consisted of four treatments namely: T. harzianum+soil, T. koningii+soil and T. koningii +T. harzianum+soil, and Soil only which were replicated thrice and at three different levels of concentration (5ml, 10ml and 15ml). The soil was analyzed for physicochemical properties of the soil before planting and 10 weeks after treatment. Data on number of leaves, stem height, leaf length, leaf area and yield were collected and subjected to Anova. Ducan's Multiple Range Test (DMRT) was used for mean separation at 5% level of probability. Trichoderma spp. decreased the pH and temperature of the soil, and increased the moisture content and NKP of the soil at the various concentrations and weeks when compared to the control. Solubilised minerals varied amongst the treatments at the various concentrations. Trichoderma spp. had higher growth parameter and yield of Zea mays at their various levels of concentration when compared to the control (soil only). Highest percentage yield (%Y) increase was observed at 5ml T. koningii+T. harzianum with 61% increase in yield followed by 15/ml T. harzianum with (40%) and 15ml T. koningii with (37%) yield increase.

ħÑŘ R ŎŹΝÈ *Ċⁿⁱ˒⫿▨Ăkoningii, Trichoderma harzianum, Zea mays*, **Yield, Growth parameters.**

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Abstract
The study evaluated the effects of climate change and adaptation measures used by women vegetable crop farmers in Ikwerre L.G.A of Rivers State, Nigeria. The specific objectives of the study were to; describe the socio - economic characteristics of women vegetable farmers in the study area, perceived effects of climate change on vegetable crops production in the study area, identify adaptation strategies employed by women vegetable c r o p farmers on climate change effects. Simple random sampling technique was used to select respondents for the study. Data were analyzed using simple descriptive statistics (percentage, frequency and mean). The result of the study showed that majority of the respondents (33.3%) were within the age bracket of 41 – 50 years with an average age of 48 years, majority were married (80.0%). A large proportion of the respondents had formal education (83.3%). Reduced yield of vegetable crop and reduction of family income were among the major effects of climate change on vegetable crop production. Diversifications (farm and non – farm) and mixed cropping and

crop farmers should be assisted to procure innovations (technology) and secure loans to enable them in their climate resilience, since majority of the farmers are educated, efforts should be geared towards the effective use of information a nd communication technology (E – extension) in enlightening and educating the women vegetable crop farmers about climate smart agricultural practices to enable them increase their adaptive capacity and women vegetable crop farmers should be encouraged to g o into other viable income generating agricultural and non agricultural activities to cushion the effects of climate change on their means of livelihood.

Key words: Climate change, effects, vegetable crops production, Adaptation strategies

Growth Inhibitory Effect of Different Concentrations of Native Trichoderma harzianum Metabolite on some Postharvest Pathogens of Cassava .

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Abstract

The growth inhibitory potential of native Trichoderma harzianum metabolite at different concentrations against some post harvest fungi of cassava (M. esculenta) roots was examined in vitro. Rotting and fresh cassava roots were obtained from three vendors each from three different markets in Ibadan. Cultures of isolated fungi were prepared and severally sub -cultured to obtain a pure cultures maintained in Agar medium. The fungal isolates were Botryodoplodia theobromae, Aspergillus flavus and Penicillium notatum. Selected fungi were inoculated onto sterile PDA plates containing different concentrations (10%, 25%, 50% and 100%) of T. harzianum metabolite and incubated at $28\pm2\ ^0C$ for 7 days and radial growths of the fungi were measured daily. All data were analyzed using SAS (version 9.3) and separated using Least . . . . $_{0.05}$). T. harzianum metabolite exh ibited significant at ($p \leq 0.05$) inhibitory potential against the selected fungi at all concentrations. Inhibitory activity of the metabolite was concentration dependent. B. theobromae (3.3011) was mostly inhibited, followed by A. flavus (3.8518) and P. notatum (3.4921) at the various concentration levels. T. harzianum metabolite had higher inhibition impact on the test fungi at 100% concentration. T. harzianum metabolite could therefore be said to possess effective antifungal potential against fungi associ ated rotting of cassava.

Key words: *Botryodoplodia theobromae, Aspergillus flavus, Penicillium notatum* and *Trichoderma harzianum,* Rotting and Fresh roots, inhibition and concentration .

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ABSTRACT

In many regions of the world, climate change is perceived as posing a serious threat to the viability of numerous species, ecosystems, and livestock production systems. Several effects result from the increase in world average temperatures. These outcomes result in various regional and worldwide climatic shifts. Due to the dominance of rural economic structures and sectors focused on developing livestock breeding, the livestock sector in Nigeria is the one that is most significantly impacted by the global climate change. Environmental sustainability depends heavily on the health and welfare of the animals used. Extreme occurrences and seasonal variations harm animal wellbeing, reduce productivity, and impair reproductive efficiency. The goat is an animal that can utilise pasture to its fullest potential throughout the entire year. Climate change will inevitably have significant negative consequences on the natural resources that are the foundation for animal production such as goats in addition to its effects on ecosystems. The availability of pasture and other resources for goats throughout the year is significantly influenced by climatic factors including temperature and precipitation patterns. However, with the attendant effects of climate change goat breeds that are resistant to heat stress can be created by finding genetic markers for heat tolerance to increase productivity.

Keywords: Climate change, Goat, Heat stress, Animal health

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Abstract

In 2015, the United Nations agreed on a set of 17 Sustainable Development Goals (SDGs), SDG 6 focuses on water and encompasses a range of values for water, with sub-goals centered on water quality, equitable access, efficient use by various sectors, improved governance, and the protection and restoration of water-related ecosystems, including rivers, streams, lakes and ponds. The Niger Delta region was blessed several freshwater bodies such as rivers, streams, lakes and ponds before the advent of oil exploration. The commencement of exploration and production activities by International Oil Companies (IOCs) herald the pollution and contamination of this freshwater bodies which hitherto have serve as sources of water supply for the host communities for drinking, cooking, washing and other domestic use, thereby rendering this water bodies unable to provide their hitherto eco-services. This study therefore was carried out to examine the impact of Oil Spill Pollution on freshwater ecosystem and infant mortality in impacted communities in the Niger Delta. The study adopted the survey research design and make use of both secondary and primary data.Non parametric analytical tool and descriptive statistical technique including; tables, simple percentages and charts were employed to analyze the data for the study. The results of the analyzed data show a strong negative relationship between oil spill pollution and fresh water bodies of streams, rivers, and lakes sources of water supply for drinking, cooking, washing and bathing in the Niger Delta. The study further indicates that there exists a high

concludes that oil pollution impact negatively on freshwater bodies of streams, rivers, lakes and ponds used for drinking, cooking, washing and bathing as well as the health and mortality of women, nursing mothers and infants in the Niger Delta, leading to the lac k of access to sources of freshwater supply for drinking, cooking, bathing, washing and other domestic use, as well as reproductive health imbalance and women and infant mortality. The study recommends that the management of oil companies in the Niger delt a should put in place adequate measures that will make their operations eco -friendly to protect and preserve freshwater ecosystem and forestall further environmental pollution and carry out regular pipeline inspection and maintenance integrity to avoid rup ture (corrosion/equipment failure) that will lead to oil spillage. Again, the study, recommends that the IOCs make provision for alternative and sustainable source of water supply for their host communities, establish health registry to identify the health status of nursing mothers and their infants and also built and equip health facilities in the host communities to mitigate the rate of women and infant mortality in the region.

Key Words: Oil Spill Pollution, Freshwater Bodies, Women and Infant Mortality

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Agricultural Education Graduates for Food Security in Rivers State, Nigeria.

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Abstract:

The study was carried out to investigate on the acquired skills required in agricultural crop processing and marketing among graduates of agricultural education for food security in Rivers State. Two objectives and two research questions were formulated to guide the study.The study adopted descriptive survey research design. The population of the study comprised of 30 agricultural education graduates in the two universities offering agricultural education in Rivers State.Due to the manageable size of the po pulation, the entire population was used through census method of sampling technique. The instrument used was subjected to face content validation by two experts from each of the universities used for the study. The reliability of the instrument was determ ined, using Cronbach Alpha Coefficient and a reliability index of 0.82 was obtained. Thirty (30) copies of the questionnaires were administered and were all retrieved. However, they were properly filled by the respondents which was used for data analysis. Data was analyzed using mean statistics and standard deviation.Findings show that agricultural education graduates are of high extent on the acquired skills required in agricultural crop processing and marketing for food security in Rivers State.However, it is recommended that government at all levels should give agricultural education graduates access to agricultural loans/grants to enable them establish their crop processing/marketing enterprise as to contribute to food security in Rivers State.

Keywords: Agricultural Education, Crop Processing Skills, Crop Marketing Skills and Food Security.

Biosecurity Measures Adopted by Poultry Farmers in Rivers State, Nigeria

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Abstract
This study ascertained the biosecurity measures adopted by poultry farmers in Rivers State, Nigeria. The objectives of the study were to: ascertain the socio - economic characteristics of poultry farmers; identify sources of information on biosecurity measures; ascertain biosecurity measures adopted by poultry farmers; determine factors influencing adoption of biosecurity practices used. A survey research design was employed and multistage sampling technique was used to select ninety (90) poultry farmers for the study. Descriptive statistics and binary logistic regression analysis were used to analyse data and present results for the study. The mean age of respondents was 44 years while farming experience was 16 years. All the respondents had formal education. The majority of the farmers mainly sourced biosecurity information from farmers association or co-poultry farmers (94.4%) and veterinary officers (83.3%). Major bio-security measures used by farmers include: Washing of hands before and after handling poultry birds/products, Providing foot-dip with disinfectant, Separation of birds according to age, Proper washing and disinfection of feeding/water troughs, Ensure adequate ventilation for the birds, isolation and quarantine of sick and infected birds etc. Age, cooperative membership, experience in poultry farming, training, farm size, education and access to credit significantly influenced the adoption of biosecurity practices in the study area. Any increase in the level of these variables would increase the level of adoption of biosecurity practices for disease prevention and control in the study area. Based on the findings of the this study, it is recommended that aggressive sensitization of the poultry farmers through seminars, workshops and conferences by relevant authorities on the advantages of adoption of biosecurity measures in their farms and encouraging fellow farmers to do so.

Key words: Adoption, biosecurity measures, poultry farmers, practice, disease outbreak

An Assessment of Climate Variability on Cassava Output in Nigeria: Potential Impacts and Opportunities.

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Abstract
Climate variability is perhaps one of the most severe, unpredictable challenge of our timen and it widely threatens agricultural productivity globally. Since it affects all reg ions worldwide; its evidence is seen in decrease in crop yield and consequently results in increase in the risk of food security most especially in

Nigeria. Therefore, this study deals with assessment of climate variability on cassava output in Nigeria along with its potential impacts and opportunities. Annual time -series of cassava output, annual average temperature and precipitation from 1991 to 2020 were used. The study used Mann -Kendall (MK) test, Augmented Dickey -Fuller (ADF) unit root test, Johansen C ointegration test and Runs (R) test to analyze the data. MK test result indicates increasing (positive) trend with non -significance level trend with p -value greater than 5% for both temperature (0.8723) and precipitation (0.1868). ADF unit root test result reveals that all variables were exclusively stationary at the first different orders I(1) at both at intercept and intercept with trend at 1% level of significance. Johansen cointegration test result indicates the presence long-run relationship among the variables possessing three cointegrating equations of (r = 2). Autocorrelation function (ACF) and partial autocorrelations function (PACF) shows a good fit and Runs (R) indicates normally distributed of data. The study therefore recommends some measures of adaptation strategies such as planting of drought tolerant cassava stem, irrigation practices and crop diversification; as well as crop insurance on cassava and othe r crops could be adopted to reduce the risk and losses associated with climate variability.

Keywords: Cassava output, Mann -Kendall test, precipitation, temperature, trend analysis

Overview of Crude Oil Spill Remediation Approaches

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Abstract

Overview of remediation some approaches was done. Among these remediation approaches were; Air sparging, Bio remediation , Bioreactor, Bioventing, electrokinetic fracturing Hydrolic fracturing, circulating wells, Blast enhanced fracturing, Insitu soil flus hing, chemical oxidation, Mult -phase extraction, A permeable reactive Barrier, and Phytoremediation.

Keywords: Remediation, phytoremediation and Spill

A comparative analysis of fish catch composition in crude oil polluted and non - oil polluted communities in Ogoni, Rivers State, Nigeria

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Abstract

The study compared fish catch composition in crude oil polluted and non -oil polluted in Ogoni, Rivers State, Nigeria. A total of 120 fisher folks were randomly selected from the st udy area. Structured questionnaire and scheduled interviews were used for the data collection. Descriptive statistics, net farm income model, regression analysis and t -test were the analytical tools used. Linear, semi -log, exponential

and double log were u sed. Double log functional form was used as the lead equation because it had the highest R^2 of 56.9%. All the respondents were male and 46.7% of them were within the age of 30 -50 years. Tilapia and mullet fish species were the most commonly fish species fo und during the study period. Revenue from the non-oil polluted location was higher than that of the oil polluted area, with a t -value of -7.38 which implied that mean revenue of the two areas was statistically different at 1% level. Labour variable was significant and showed negative influence on the fishers' net income. Fish type was significant and positive. Community crisis and oil pollution were the major constraints faced by the fishermen in the two Local Government Areas. It is recommended that fisher men from the oil polluted area should consider fish farming as an alternative means of livelihood in order to increase the quantity and availability of fish in the area.

Keywords: Fish catch, composition, crude oil, polluted, non -oil polluted communities

Does Climate Change influence Sustainable Food Production? Evidence from Ebonyi State

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Abstract

In recent times, food shortage and supply had been recorded as a result of climate change exacerbating agricultural production. The study evaluated, if climate change does influence sustainable food production in Ebonyi State. Multi-stage random sampling was used to select 224 crop farmers who cultivated different food crops. Data obtained were analyzed using descriptive statistics such as the mean, frequency and percentage and inferential statistics such as ordinary least square multiple regression technique. Results showed that 57.1% of the food crop farmers were females, married, 71%, and relatively educated, 56% and experienced. Age, gender, household size, education, farming experience, farm size, and extension contacts were positive and significantly influenced food crop pr oduction. Climate variables such as temperature, rainfall, number of rainy days were negative while sunshine hours and relative humidity were positive, both significantly influenced food crop production in the state. Inadequate capital, land fragmentations , and inadequate information concerning climate change were perceived as major production and climatic constraints. Intensive awareness on climate change and provision of climate information and/ or early warning signals to the knowledge of the crop farmer s were recommended.

Keywords: Climate Change, Sustainable Output, Food Production, Crop farmers.

Impact of Climate Change on Agricultural Extension Servi ces Delivery in Southern Region of Kebbi State, Nigeria .

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Abstract

This article analyses the Impact of Climate Change on Agricultural Extension Services Delivery in Southern region of Kebbi State, Nigeria. The specific objectives for the Study were to describe the socio -economic characteristics of respondents, identify evidence of climate change on extension service delivery, and determine the impact of climate change on extension services activities and to describe adaptation strategies adopted by extension agents when delivering services. A Simple random sampling technique was used to select one hundred and thirty (130) respondents. Data were collected with the aid of a structured questionnaires designed in line with the study objectives. The instrument was given out to thirty (30) ADP staff and one hundred (100) contact farmers. Data were analyzed using descriptive statistics. The results showed that the most observed evidence of climate change in the study area after comparing responses from agricultural extension staff, ADP staff and contact farmers was flooding, and the most se rious impact observed on extension services delivery was failure in implementation of farm management and new farm technologies. One of the successful adaptation strategies to climate change practices by extension agent was participatory planning and imple mentation of agricultural extension projects. It is therefore recommended that extension agents should educate and enlighten their clientele regularly on climate change adaptation strategies for improved agricultural output.

Influence of Carrot Leaf Ext ract on Carcass Characteristics and Organ Weights of Finishers Broiler Chickens in Kebbi State, Nigeria.

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ABSTRACT

An experiment was carried out to study the effects of carrot leaf extract (CLE) supplementation as sources of vitamins and minerals in finisher broiler chickens. A total of two hundred and eight (208) 7 day old birds were used. The birds were grouped into four (4) treatments of fifty -two (52) chicks, each replicated four times with thirteen (13) chicks in a completely randomized design (CRD). Parameters m easured and evaluated included feed intake, body weight, body weight gain (BWG), feed conversion ratio (FCR) and mortality. The effects of CLE on carcass characteristics and organs weight were also evaluated. Significantly (P<0.05) higher daily feed intak e (92.13g/b) was recorded on the birds received 80ml of CLE compared to any other treatments. The best weight gain was observed on birds served 80ml levels of CLE per litre of water compared to vitalyte (1831.25g/bird) and control (1418.75g/birds) groups. Result showed no significant difference (P>0.05) for the carcass parameters evaluated except for dressing percentage. On the organs weight, no significant effect on heart, pancreas, lung, intestine and spleen were recorded (P>0.05). Based on the result of the study, it could be concluded that giving CLE at 80 ml/litre to finisher broilers in drinking water resulted in better weight gain, feed efficiency and increases feed intake, body weight and carcass yield without adverse effect on the organs and can be used in place of conventional vitamin-mineral premix.

Keywords: *Carcass, organs, vitamins, minerals and carrot*

Effect of Plant Population And The Rate of NPK Mixed With Poultry Manure on The Yield of Sunflower in Ndele, Rivers State.

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Abstract

A field trial was conducted in the 2020 planting season at the Teaching and Research Farm of the Ignatius Ajuru University of Education, Ndele Campus, Rivers State to determine the effect of plant population and rate of NPK (20:10:10) mixed with poultry manure (PM) on the yield of Sunflower (Helianthus annus L) in Ndele, Rivers State. The experiment was arranged in a 2 x 5 Factorial fitted into a Randomized Complete Block Design with three replicates. The treatment consisted of two plant spacings as F actor A (60cm x 50cm and 50cm x 50cm) and rates of mixture of inorganic fertilizer (NPK 20:10:10) and poultry manure as Factor B (NPK 60kgha^{-1} + PM 10tha^{-1},NPK 60kgha^{-1} + PM 15tha^{-1}, NPK 90kgha^{-1} + PM 10tha^{-1}, NPK 90kgha^{-1} + PM 15tha^{-1} and a control (no fertilizer application). The yield parameters determined were Head diameter(cm) at 8 and 14 weeks after planting (WAP), Flower head (g), Number of seeds, weight of seeds (g/plant) at 14 WAP, Dry Matter Accumulation at 4 and 8 WAP and Relative Growth Rate. Data collected were subjected to the analysis of variance (ANOVA) and means separated using the New Duncan Multiple Range Test (DMRT) at p 0.05. Bigger head diameter was obtained with the application of 60kgha^{-1} of NPK mixed with 15tha^{-1} of PM at a spacing of 50cm x 50cm at 8 and 14 WAP. Greater number of seeds was with the application of NPK 60kgha^{-1} mixed with 15tha^{-1} of PM at a spacing of 60cm x 50cm while greater seed weight/plant was by applying 90kgha^{-1} of NPK mixed with 10tha^{-1} of PM. This work therefore, recommends that application of NPK 90kgha^{-1} + PM 10tha^{-1} at a plant spacing of 60cm x 50cm will give a better yield of sunflower at Ndele.

Effect of Climate Change and Oil Pollution on Food Security in Agricultural Zone 1, Rivers State, Nigeria.

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ABSTRACT

This study investigated the impact of climate change and oil pollution on agriculture and food security in Ogoni Rivers State. Three objectives, research questions and hypotheses guided the study. The study adopted the survey design. The population of the study consisted of 4,566 registered farmers comprised of farmers from Khana (331), Gokana (2,536), Tai (252), and Eleme (1,447) Local Government Areas of Rivers State that make-up Ogoni land. The sample size consisted of 368 respondents based on the derivation of the Taro Yemen Sampling formula while simple random sampling was used to select the respondents. A Climate Change and Oil Pollution on Agriculture and Food Security Questionnaire (CCOPAFSQ) was used for data collection. The instrument had a reliability index of 0.84, determined through the Cronbach Alpha Statistic. Mean and standard deviation were used to answer the research

revealed that there is no significant difference in the agriculture and food security situation across the four local government areas of Ogoni, Rivers State, there is no significant difference in the impact of climate change on agriculture and food security amo ng the four local government areas of Ogoni, Rivers State and there is no significant difference in the impact of oil pollution on agriculture and food security among the four local government areas of Ogoni, Rivers State. The study recommended amongst oth ers that approaches to tackling the challenges in agriculture and food security situation in Ogoni must seek to deploy new approaches to agricultural practices, adaptability of agricultural practices to changing environment and regulation of anthropogenic factors that trigger climate change and pollution of farmlands and to address the challenges posed by climate change on agriculture and food security more robust and comprehensive strategies that would address the root causes of vulnerabilities and emergin g risks need to be addressed.

Keywords: Climate, Climate Change , Oil, Pollution, Agriculture, Food Security , Ogoni.

Bioaccumulation of Arsenic by Waterleaf Talinum triangulare from Soil Contaminated with Sodium Arsenate Pesticide and Health Risk Assessment via Consumption of the Plant

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ABSTRACT

Through a pot experiment, the As concentration in the Waterleaf T. Triangulare plant grown in As - contaminated soil was examined at two treatment doses of 50 mg/kg and 70 mg/kg. After being harvested, the plant's leaves and roots as well as the soil around them were pre -treated, acid-digested, and analyzed for As content using mass plasma atomic emiss ion spectroscopy (MP-AES Model 42100). The results from this analysis were used to determine the health risk posed by ingesting the plant. The study revealed that in all treatment levels for frequency of harvest and time of harvest, the concentration of A s in the plant grew continuously over the graded period of growth (between 3 and 9 weeks). Additionally, the increase in As content seen in the plant (leaf) exceeded the permissible limit of 0.1 mg/kg or 0.5mg/kg in vegetables as set by FAO/WHO and Lombi e t al., from the third week of growth through the ninth week. The results of this investigation have demonstrated that Waterleaf's edible portions can bioaccumulate As to a great extent. Health risks results depicted that the estimated daily intake of As (E DIM) averages were below 1.0mg/kg/day and the FAO/WHO -recommended permissible tolerated daily intake of 0.002 mg/kg/day for inorganic arsenic. Similarly, the target health quotient (THQ) was below unity (THQ <1), indicating that there is no expectation of a health danger from ingesting the plant. However, HRI or HQ was greater than unity (HRI or HQ > 1) and target cancer risk (TCR) was within the permissible predicted lifetime risk of getting cancer (1 ù ùÙ^6 to 1 ù ùÙ^4), thus, suggesting the possibility of c ancerous disease. In addition, the ratio of HRI to RFD indicates that consumption carries a very high risk for health of cancer. The overall result indicates that a serious health issue of public health concern either now or in the future may arise from the consumption of the vegetable, based on the HRI and TCR which indicates the possibility of developing cancer during a lifetime.

Keywords: Bioaccumulation, Waterleaf plant, Arsenic Contaminated soil, Health Risks

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Climate Change Impact and Mitigation Strategies on Livestock Production in Nigeria: A Review

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ABSTRACT

Global demand for livestock products is expected to double by 2050, mainly due to improvement in the worldwide standard of living. Meanwhile, climate change is a threat to livestock production because of its impact on quality of feed crop and forage production, water availability, animal and milk production, livestock diseases prevalence, animal reproduction, and loss in biodiversity. This study reviews the global impacts of climate change on livestock production, the contribution of livestock production to climate change, and specific climate change and mitigation strategies in the livestock sector. The livestock sector contributes 14.5% of the global greenhouse gas (GHG) emissions, driving climate change further. Hot environment impairs production (growth, meat and milk yield and quality, egg yield, weight, and meat quality) and reproductive performance, metabolic and health status, and immune responses. Regarding livestock systems, it will be strategic to optimize productivity of crops and forage (mainly improving water and soil management), and to improve the ability of animals to cope with environmental stress by management and selection. To guide the evolution of livestock production systems under the increase of temperature and extreme events, better climate smart mitigation strategies is needed regarding biophysical and social vulnerability, and this must be integrated in agriculture and livestock components.

Key words: Climate change, Greenhouse gas, Livestock production, Performance, Mitigating strategies.