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Socio-economic Impacts of Climate change in Lagos State, Nigeria

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Abstract
Studies on effect of climate change on coastal communities have been inadequate despite their vulnerability and inadaptive capacity. This article bridges this knowledge gap by examining the social and economic impacts of climate chassssnge in Lagos State. Using a qualitative methodology, in-depth interviews were conducted to collect data. The findings show that the topographical features of Lagos State such as the flat topography with an elevation that is above sea level; with less than 1.5m wetlands and water bodies of approximately 40 percent make the city vulnerable to climate change. The study found that climate-sensitive sector of the economy such as agriculture, transport operations, energy production, road construction, and oil and gas operations have been adversely affected by climate change. There is a rise in waterborne diseases such as hepatitis A, Typhoid, Cholera, and the revenue that accrue to the government through forestry has reduced due to forest loss. The study concludes that the adverse impact of climate change have contributed significantly to unemployment, poverty, food shortage and widening inequality in Lagos State.

Keywords: Climate Change, Vulnerability, Adaptation, Coastal communities, Sea Level.

1. Introduction

Climate change refers to a change and observable variations of the climate system that persists over a period, usually decades or longer (IPCC, 2018). Since year 2000, there has been a consensus among climate scientists and scholars that the world is experienc ing rapid climate change due to human induced activities (Stern and Kaufmann, 2014). Projecting the extent of climate change impacts with certainty is problematic because several uncertainties exist on how the climate changes and the socio-economic factors that are affected by the degree of such changes (IPCC, 2018). Climate change is arguably one of the most urgent political, environmental and scientific challenges in recent times following the frequent reports and news of climate-related havocs. Globally, in 2018, over 5000 people died and 28.9 million needed emergency assistance due to extreme weather events (Jetten *et al.,* 2021). International dialogues and meetings, scientific findings have placed the climate issue at the top of the international agenda and made it of utmost interest to the public (Markkanen, and Anger-Kraavi, 2019).

Scholars and practitioners of climate governance have for the past decades witnessed processes of emerging scientific predictions about the causes, consequences, and the increasing concern that climate change presents a difficult challenge for global governance (Cole, 2015, Van der Heijden, 2018). The latest report of the Intergovernmental Panel on Climate Change (IPCC) predicts that emission of greenhouse gases (GHGs) may increase granted that the international community is too slow in taking definitive action and conscious attempt in emission reduction (IPCC, 2018). However, even if GHGs are reduced in the coming years, sea level rise and increase in temperature may still occur. Meanwhile

the impacts of climate change will be felt disproportionately across different parts of the world, but developing countries due to their heavy reliance on climate sensitive sectors are at greater risk (Adenle *et al.,* 2017).

The vulnerability of Lagos State to climate change stems from its proximity to the coast and the abundance of wetlands and water bodies which cover approximately 40 percent of the land area making it prone to flooding (LSG, 2016). Meanwhile, several studies such as Omitoyin and Tosan, (2012), Samson and Oluwatoyin (2012), Ayeni *et al.,* (2016) have examined the challenges posed by climate change in Lagos State. These studies focused on specific sectors of the economy, such as waste management, agriculture, livelihood, transportation, health etc. For instance, Omitoyin and Tosan, (2012), examined the potential impacts of climate change on livelihood and food security. Ayeni *et al.* (2016), analysed the impacts of climate change on the water sector and Samson and Oluwatoyin (2012) focused on the waste management sector. In addition, studies like that of Oloke et al. (2013); Nkwusi, Adeaga and Ajejuyo (2015) have attempted to study the local community awareness and perceptions about climate change. Nevertheless, none of these studies have examined the impacts of climate change on coastal communities and their adaptation strategies., studies delineating the effects of climate change specifically on coastal communities in Lagos State is scarce.

Against this backdrop, this article represents one of the few studies to look into the socio-economic impacts of climate change in coastal communities in Lagos State and their adaptation strategies. A review of the current state of existing knowledge is done to bridge the gap in literature and outline the possible effects of climate change in coastal communities and their coping strategies. Hence, this article seeks to achieve the following objectives:

i. To analyse the social and economic impacts of climate change in Lagos State
ii. To examine the climate change adaptation strategies in Lagos State.

The study analyse these objectives based on the generally accepted perception that there are "winners" and "losers" in the climate change processes. For instance, developing countries due to the lack of adequate technology and infrastructure are most vulnerable to climate change impact than their counterparts in developed countries (Mikulewicz, 2018). This has more impactions for people living in coastal communities who are likely to experience the adverse effects of climate change more than their urban counterparts.

Climate change impacts can be categorised under three headings which include ecological impact, social impact and economic impact. The ecological impact includes loss of biodiversity (Nunez *et al*. 2019); deterioration of land cover (Pervez and Henebry, 2015), destruction of aquifers and eco-systems (Sojobi *et al.* 2016), reduction of water availability (Ayeni *et al.* 2016), stresses from water borne diseases, and pests and wildfire (Williams *et al.* 2019). The social impact of climate change may include impact on human health, risk distribution, loss of settlement (Markkanen, and Anger-Kraavi, 2019). Lastly, the economic impact includes reduction in agricultural productivity (Akpodiogaga-a and Odjugo, 2010), forest loss (Lamsal *et al.* 2017), destruction of infrastructure (Ede and Oshiga, 2014), industry and commerce (Tol, 2020). However, this article focuses only on the socio-economic impacts of climate change in coastal communities in Lagos State.

The article is organised in the following manner: the first section presents the literature review, the second section deals with data and methods of data collection, the third section

analyse the social and economic impacts of climate change in coastal communities, the fourth section examines the climate change adaptation strategies by the Lagos State government and the last section concludes the study.

2. Literature Review

Several studies have examined the challenges of climate change from different perspectives (Mikulewicz, 2018; Nunez et al., 2019; Williams *et al*., 2019). These studies can be categorized under three areas which include ecological impacts (Nunez *et al.,* 2019), social impacts (Williams *et al*., 2019) and economic impacts (Lamsal *et al*., 2017). The study of Nerem et al. (2019), submitted that sea level rise which is a consequence of climate change, has worsened coastal erosion. This has increased flood incidence, destruction of ecosystems and intrusion of seawater into freshwater sources with grave implications for fisheries, agriculture and other means of livelihoods (Nerem *et al.,* 2019). Similarly, Stern and Kaufmann, (2014) argued that the earth is getting warmer because of climate change. Global warming triggers a rise in sea level in two significant ways: the melting of glaciers and ice sheets which is adding water to the ocean, and the volume of the sea is expanding as the water warms.

In their study Nkwusi *et al.* (2015) argued that there is strong connection between sea-level rise and incidence of flooding. In their study of coastal areas, they submitted that that the increase in the incidence of flood globally is a direct impact of climate change. Also, Adelekan and Aisyanbi (2016) concluded that flood has had severe implications for the health of people in coastal communities. Floods also destroy the inadequate infrastructure of state and posed a huge challenge to the survival of people most especially the urban poor. While emphasizing the impacts of flood, Abdullahi and Oyinlola (2020), submitted that flood has social economic costs which arise from damage to infrastructure such as roads, cars, culverts, bridges, and buildings. For instance the cost implication of the infrastructure and properties destroyed in the 2020 flood incident in Lagos State was put at three million dollars. While the problem of flooding is compounded due to poor urban planning, the indiscriminate building of houses and industries on drainage channels and flood prone areas has increased the vulnerability of the people to flooding (Adelekan and Asiyanbi 2016).

While most of the above studies focused on the ecological impact of climate change, studies on the socio-economic impacts are few. Prominent among such studies include Markkanen and Anger-Kraavi, 2019 which focus on climate change impact on human health, risk distribution, and loss of settlement. In the same vein, Lamsal et al. (2017) argue that climate change posed a huge threat to forest and that forest loss is on the increase due to desertification.Tol, (2020) concluded that climate-sensitive sector such as agricultural and mineral resources are the worst hit sectors. Studies on the impacts of climate change is increasing due to the challenges posed by the adverse impacts of climate change. Meanwhile, studies on climate change impact on costal communities and the adaptation strategies are still few, hence, the need for this study. The study examines the socio-economic impacts of climate change in Lagos State and the adaptation strategies of the subnational government.

3. Data and Method

A qualitative research methodology was used as it proved to be the most appropriate. The choice of qualitative method was motivated by the intent to collect information from a small sample drawn from the larger population on the social and economic impacts of climate

change in Lagos State. Six local government areas were purposively chosen out of the 20 LGAs in the state. These LGAs are Alimosho, Ojoo, Surulere, Ajegunle-Ifelodun, Ikorodu and Eti-Osa. These LGAs were selected for the study due to their proximity to the coast and the high rate of flooding incidences. The study adopted a non-probability and purposive sampling technique. This is because the study involves the collection of non-numerical data from participants that have robust knowledge of the phenomenon under investigation. Twelve participants were purposively selected for the study. Six participants were selected from the Lagos State Ministry of Environment, Lagos State Special Climate Change Unit, Lagos State Environment Protection Agency (LASEPA), Lagos State Waste Management Authority (LAWMA), Lagos State Emergency Management Agency (LASEMA). Six participants were also selected in the six local governments, with one in each local government. The participants were selected because they have adequate knowledge and understanding of the social and economic impacts of climate change in Lagos State. Primary data were collected through interview. The non-numerical data collected from the interviews were transcribed and analysed using content analysis where themes and sub-themes were generated and analysed.

4. Data Analysis and Discussion of Findings

4.1 Socio-economic impacts of climate change in Lagos State

As it is the purpose of this article to divulge the socio-economic impact of climate change in coastal areas, specifically Lagos state, it is inevitable that the above-mentioned geographical features and links to climate change are discussed in relation to socio-economic implications. This discussion begins with the economic aspect. Data from the interviews revealed the effects of climate change on different sectors of the economy in the state.

4.1.1 Impact on Agriculture and Food Security

Agriculture accounts for over 30 percent of Nigeria's GDP, and it is also an essential means of livelihood and survival for Nigerians (Ladan, 2014). Meanwhile, the sector is sensitive to the negative effects of climate change, and it is threatened by climate change (Nkwusi et al., 2015). Climate change affects both subsistence and commercial farming. While commercial farming can still adapt to the adverse effect due to technology, adaptation seems difficult for subsistence farming, especially for smallholder farmers. An increase in rainfall has posed a significant challenge for agriculture and a substantial threat to food security (Malcolm et al., 2015). Flooding affects soil quality, destroys farmland and leads to crop failure. This causes food shortages which posed a major threat to food security. This has a grave effect on the economy of the state because majority of those living in the coastal communities are farmers. Flooding has made farming difficult and this has led to increase in the prices of food in state, loss of jobs because some farmers laid off their workers due to low productivity. This has further worsened the unemployment rate, poverty rate and resulted in an increase in the level of inequality in the state (Nkwusi *et al.,* 2015).

4.1.2 Impact on Water and Water Resources

Water is a critical commodity for human survival; if it is too much, it affects production and destroys properties, and if it is insuffient, it also has dire implications for food production and other sectors (Tol, 2020). Lagos State is experiencing two opposite extremes of climate change impacts: an increase in rainfall duration, which leads to flooding and an extreme increase in temperature leading to dry seasons and drought. These two extremes are already

having significant impacts on the quantity and quality of available water for use. For example, intense and frequent floods destroy water infrastructure in the form of pollution, and extreme dryness reduces river discharge and flow. In the words of a participant:

> *Pollution of water resources and loss of wetlands have a devastating effect on the means of livelihood and biodiversity resource. This is because wetlands provide habitats for marine animals, fish, a variety of plants, shrimps, crabs, and other endangered species.*[1]

The water sector is being affected by climate change due to the high water table, which is prone to flooding, pollution of groundwater and surface water with saltwater intrusion, human waste, and industrial waste. Moreover, adverse impacts of climate change affect water resources that people in coastal communities depend on for food and commercial activities. This affects the economy of fish farmers and their means of livelihoods is at risk (Ladan, 2014).

4.1.3 Impact on Health

Drought leads to an outbreak of diseases such as malaria, meningitis and dengue. On the other hand, flooding also causes contamination of water, affecting the health of people who drink such contaminated water (Adelekan, 2016). A participant said that: "*After the 2014 flood, there was an outbreak of waterborne diseases such as hepatitis A, typhoid, shigellosis, cholera and giardia in Alimosho local government area of the state"*.[2]

Flooding also increases breeding sites for mosquitoes, leading to yellow fever, malaria, dengue, and storm surge, which can lead to loss of lives (Adelekan 2016). Saltwater intrusion, which is a consequence of sea-level rise, affects the quality of drinking water which is dangerous to people's health. Furthermore, flood and windstorm can also lead to loss of lives, for instance, after the 2015 flood in Lagos State over twenty people were reportedly killed, and several others sustained injury (Abdullahi and Oyinlola, 2020). The incidence of typhoid, leplosprosis and dengue also increased after the 2018 flood in Owonronshoki, Bariga and Ketu areas of the state (Abdullahi and Oyinlola, 2020).

4.1.4 Impact on forests and forest resources

Lagos state has five forest reserves which cover approximately 11,295 hectares. This is in great danger due to climate change.[3] One of the participants affirmed that:

> *Heat stress reduces forest productivity, and it leads to a reduction of timber for food, medicine, and fuelwood. It also increases forest fire and reduction of soil microbes by delaying soil fertility.*[4]

The economic impacts of flood on forest resources are enormous, this is because forest products are essential items needed by people to aid their survival. Fuelwood is required for cooking, wood poles for the building of houses and fences in rural communities in Nigeria, while in the urban centre, forest products are needed for medicine, food, and construction. All these benefits of forest resources are threatened due to climate change. The data from the

[1] An interview with an official at Lagos State Environmental Protection Agency
[2] Interview with a community leader in Alimosho local government area
[3] Interview with an official of Lagos State Environmental Protection Agency
[4] Interview with an official of Special Climate Change Unit of the Lagos State Ministry of Environment

Lagos State Ministry of Natural Resources states that between 2010 to 2018 the state has lost over ten thousand trees to flooding (LSG, 2016). This affects the revenue that would have accrued to the government through forest resources and it has a significant impact on financing the budget of the state.

4.1.5 Impact on transportation and communications

The inadequate transportation infrastructure in Lagos State is under a significant threat because of climate change impacts; flooding leads to the destruction of bridges, deterioration of roads and an increase in automobile accidents. The majority of Lagos population depend on road transportation for movement of goods and services. However, flooding and erosion damage roads. Apart from the hardship that bad roads cause for the people, it also has huge impact on the economy of the state, this because money that ought to have being spent on other issues will be used to repair the roads and brigdes damaged by floods (Ede and Oshiga, 2014). For instance, after the 2018 flood incidence, the Lagos State government had to borrow six billion naira to reconstruct the brigdes and roads destroyed by the flood (Abdullahi and Oyinlola, 2020). This further heighten the domestic debt of the state which is currently the highest in Nigeria.

Windstorm and heavy rainfall also destroy communication facilities such as the internet, microwave transmission, telephones, Television, and radio satellite. Extreme weather event will lead to road closure, flight disruption, and loss of communication systems. This affects the movement of goods and services resulting in huge losses for aviation companies who have to cancel flights due to bad weather, while delivery companies would also suffer loss for not being able to deliver on time.[5] This also has huge negative economic impact not only on the government but also on the industries operating in the state (Adelekan, 2016).

4.1.6 Impact on industry and commerce

Lagos State houses most industries in Nigeria, making it the economic hub of the country, and it accounts for more than 20 percent of the Value Added Tax that goes into the federation account. Most of these industries derive their raw materials from the climate-sensitive sector, such as agriculture, transport operations, energy production, road construction, and oil and gas operations.[6] Extreme weather events destroy the facilities of these companies. It disrupts their production and leads to huge losses. It increases investment in maintenance cost and causes low productive capacity. The products of some industries are weather dependent. For instance, the windstorm is detrimental to offshore oil and gas drilling and fisheries industries which are dominant in Lagos State. Industries that depend on climate-sensitive sectors for raw materials which include, agricultural products, wood, domestic animals, mineral resources, water and pharmaceutical companies, are exposed to climate change impacts. Moreover, the transportation of finished goods and raw materials are affected by the bad road, which is a consequence of erosion and flooding. Extreme weather events like windstorm lead to the destruction of hydroelectric and thermal generation, which affects electricity supply and limits production. The economic loss occasioned by climate change impacts also affect the tax revenue of the state government (Ebele and Emodi, 2016).

[5] Interview with an official at the Lagos state Ministry of Environment
[6] Interview with an official of Lagos state Environmental Protection Agency

4.1.7 Impact on Human Settlements

Sea level rise and coastal flooding pose a huge threat to human settlements most expecally for people who are living very close to the coast. The situation is worse in Lagos State because over 40 percent of the land area are water bodies. The 2014 floods affected, destroyed and damaged several homes and businesses built on the flood plains in Ijora-Badia, Owode-Elededе, Iwaya, Kuramo beach, Alpha beach, and Ajegunle areas of the state (Abdullahi and Oyinlola, 2020). This led to the displacement over a thousand people, taking shelter in camps provided to them by the state government. The ceasation of business activities during this period drastically undermined the income of the affected household and their general welfare. One solution is relocation away from flood prone areas but the socio-econmic condition of poor people limits their capacity to relocate (Abdullahi and Oyinlola, 2020).

4.2 Climate Change Adaptation Strategies in Lagos State

The vulnerability of Lagos State to the adverse climate change impacts is extraordinary as revealed above. According to IPCC, vulnerability is explained as the extent to which people are prone to and incapable of coping with the adverse impacts of climate change (IPCC, 2018). There is a seeming consensus among climate governance experts that developing countries are more prone to climate change when compared with developed ones, hence the need for ambitious adaptation goals (Mikulewicz 2018; Markkanen and Anger-Kraavi, 2019). In partnership with the Building Nigeria Response to Climate Change project (BRNCC), the Lagos State government developed the Lagos State Climate Change Adaptation Strategy (LAS-CCAS) 2011, saddled with the responsibility of detailing the adaptation measures and strategies that will enhance the state's adaptive capacities and resilience on the adverse effects of climate. The central objective of the plan is to establish and put into robust operation measures that will enhance people's adaptive ability to the negative impacts of climate change. This will be achieved by mainstreaming adaptation issues into the processes of development planning (see LAS- CCAS, 2011). The policies aim to: (i.) reduce vulnerability by building social, economic and environmental resilience. (ii) conduct a periodic vulnerability assessment and (iii) impact monitoring on crucial sectors of the economy by reducing over-dependence on climate-sensitive sectors by promoting diversification of the economy. The policy objectives will be achieved through the following:

Providing support for the establishment and implementation of adaptation strategies and plans; developing resources for mobilisation plan and implementation of adaptation strategies and plan of actions; collaborating with the federal government to implement strategies recognised in Nigeria's National Communication to the UNFCCC; provision of an enabling and conducive institutional and legal framework to advance climate adaptation; and mainstreaming climate change adaptation into development planning in key sectors of the economy.

For effective implementation of the adaptation strategies, the government has specific measures for each sector of the economy, which is shown in Table 1.

Table 1: Adaptation measures by sectors in Lagos State, Nigeria

Key sector of the economy	Climate Adaptation Measures
Water	Protection of water resources from pollution through institutional and legal instruments. Promoting sustainable use of groundwater resources through the creation of cofferdams, artificial recharge of aquifers and regulation of abstraction of water resources. Develop legal measures to discourage wastage of water and illegal tapping. Distribution of water-efficient technologies. Investment in water storage facilities such as dams, man-made for reservation of water for use during dry seasons. Enhance water security through the protection of watersheds. (Improve water resource conservation and sustainable and efficient water resources exploitation and use).
Wetlands and Fresh Water Ecosystems	Promoting sustainable use and management of wetlands to the advantage of the present and upcoming generations. Implement a classified inventory of the state wetlands and refine management and conservation needs as a way of enhancing quantity and quality of information on wetland ecosystems in the state. Protection of wetlands by constructing defences such as dykes and barriers. Increase awareness campaign on the worth and significance of wetlands in erosion, sediment and flood control, climate stability, pollution abatement, fisheries and food production. Survey wetlands to know those that will need the construction of barriers and dykes, which will serve as artificial protection against the impacts of rising sea level.
Agriculture and Food Security	To improve food security through enhanced agricultural productivity, food storage and food distribution networks. Promote research on the potential impacts of flooding on agriculture to inform the creation of abatement measures such as the construction of culverts, bridges and drainage infrastructure. Support the use of suitable technologies such as culverts, bridges and drainage for flood reduction. Promote research and development and the distribution of salt and water-tolerant crops. Promote heat and drought tolerant and fast-maturing crops in areas with low rainfall. Strengthening of early warning system for farmers. Promote agriculture extension services as a way of passing important information to farmers on how they can cope with climate change. Support agro-processing and food storage capacity. Promote crop diversification as an adaptive and resiliency strategy.
Land Use, Forestry and Biodiversity	Promote the conservation and suitable use of forest and other natural resources as part of ecosystem-based adaptation. Encourage afforestation programmes by distributing fast-maturing tree and conservation of forested areas. Support the establishment of timber plantations and sustainable timber production. Promote alternative sources of energy to minimise the reliance on biomass for energy in both rural as well as urban locations. Enforcement of laws on forest conservation. Support collaborative management of forest. Execute pest control and forest fire control measures. Creating awareness on the importance of forest among community members. Human Settlements and Economic Infrastructure. Establish and support climate change proofed infrastructural codes and standards. Promoting the integration of potential risk osf climate change into housing development policies. Raise awareness among engineers and architects on the need to put climate change into consideration in their profession.
Human Health	To ease the susceptibility of the people to climate-related diseases and enhance the health sector capacity to respond to climate-induced diseases. Provide health equipment, facilities and medicine to assist in early discovery and treatment of climate-induced diseases. Provide healthcare services to vulnerable groups such as women, children and old people. Development of early warning systems and emergency health measures for climate-induced diseases. Build the capacity of health practitioners to respond effectively to climate change-induced diseases.

Source: Lagos State Climate Change Adaptation Strategy, 2011.

Table 1 shows the strategies for adapting to climate change for the key sectors of the economy that are prone to the impacts of climate change in the state. If the above measures are effectively implemented, it will strengthen the economy's adaptive capacity to climate change impacts and reduce the susceptibility of the state to climate change shock. This is because climate change policy has shifted from concentrating on adaptation responses to the strengthening of adaptive ability, which is the capability and potential of a sector to change to a more desirable state when confronted by climate change impacts. The shift becomes important because strong adaptive capacity allows the flexibility required to respond to the uncertainties of climate change (Adelekan and Asiyanbi, 2016).

Lagos State government's approach to adaptation, as pointed out in the Climate Change Adaptation Strategy, is anticipatory by putting specific measures in place to take into account the adverse impacts of climate change. Anticipatory adaptation is always viewed as the sole responsibility of the government acting on behalf of the people by preparing for possible climate change impacts (Araos *et al.*, 2016). However, despite the ambitious sectoral adaptation measures by the Lagos State government, implementation remains a daunting task due to the inadequate financial and technological capacity of the state. The response from the interview supports this position. An official of the Special Climate Change Unit on the barriers for climate adaptation in the state affirms that:

> *Funding is a major challenge for the effectiveness of this unit, the budgetary allocation to the ministry of environment has drastically reduced in the past years due to the drop in the global oil market which has affected the economy of the state.*[7]

The major issue affecting the implementation of the strategy is inadequate funding. For example, Table 3 shows the budgetary allocation for the Ministry of the Environment between 2011 and 2019.

Table 2: Budgetary Allocation for Environmental Protection in Lagos State (2011-2020)

S/N	Year	Total Budgetary Allocation	Budgetary Allocation for Environmental Protection (in Billion)	Percentage
1.	2011	N450.775 billion	N36.390	8.2%
2.	2012	N491.941 billion	N44.227	9.1%
3.	2013	N507.105 billion	N44.131	8.87%
4.	2014	N489.690 billion	N39.727	8.11%
5.	2015	N489.690 billion	N34.953	7.1%
6.	2016	N662.587 billion	N53.043	8.01%
7.	2017	N812.998 billion	N56.569	6.96%
8.	2018	N1.046.118 trillion	N54.542	5.22%
9.	2019	N873.532 billion	N48.252	5.52%
10	2020	N1.168.56 trillion	N66.54	5.69%

Source: Compiled by the Authors, see: Lagos State Ministry of Economic Planning and Budget, (2020)

Table 2 shows a downward reduction in the budgetary allocation for environmental protection in the state between 2015-2020. This shows that the commitment to financing

[7] Interview with an official of the Lagos State Special Climate Change Unit

climate mitigation and adaptation through the establishment of agencies are not financially supported. This is critical in ensuring the agencies achieve their stated goal. Little wonder, a government official that participated in the interview stated that "*One of our major challenges is funding; the agency lacks the adequate budgetary provision to performs its responsibilities in ensuring a safe and clean environment"*.[8] Any policy document without the necessary financial provision to ensure implementation is doomed to fail. Hence, the Lagos State government needs to commit more financial resources to the implementation of climate change policy. The state can take a clue form South Africa in which provincial governments of Kwazulu-Natal and Western Cape increased their budgetary allocation to environmental protection between 2005 and 2010 (Roberts, 2010; Taylor, 2016).

This finding corroborates the study of Adenle *et al.* (2017), which identify the high level of poverty, low level of economic development, limited financial capacity as major impediments to strong adaptive capacity to climate change in Africa. Hence, technology and adequate finances are crucial to building and strengthening the adaptive capacity to climate change.

5. Conclusion

The findings indicated that the geographical features of Lagos State, which include flat topography with an elevation that is above sea level with less than 1.5m, wetlands and water bodies cover of approximately 40 percent of the land area, make the city to be highly vulnerable to the adverse impacts of climate change. The findings specified that climate change impacts affect areas of the economy such as agriculture and food security, water, and water resources, ecosystem services and biodiversity, transport, industry, land use, human health and human settlements. The rainfed agricultural sector is at a greater risk because flood incidence affects the soil quality, destroys farmland and causes crop failure. The study discovered that the climate change adaptation strategies developed by the Lagos State government are not being supported by adequate funding. The study concludes that technology and funding is critical in ensuring the realisation of the adaptation objectives of the critical sectors of Lagos State economy to climate change.

References

Abdullahi, H. I., & Oyinlola, O.A. (2020). Flood disaster and national security: A criminologists exploration of Lagos metropolis, Nigeria. *African Social Science and Humanities Journal* 1(5), 71-81. http://journals.jfppublishers.com/asshj/article/view/21/15

Adenle, A.A., Ford, J.D., Morton, J., Twomlow, S., Alverson, K., Cattaneo, A., Cervigni, R., Kurukulasuriya, P., Huq, S., Helfgott, A. & Ebinger, J.O. (2017). Managing climate change risks in Africa-A global perspective. *Ecological Economics*, 141, 190-201. https://doi.org/10.1016/j.ecolecon.2017.06.004

Adelekan, O. (2016). Flood risk management in the coastal city of Lagos, Nigeria. *Journal of Flood Risk Management* 9(3), 255-264. https://doi/epdf/10.1111/jfr3.12179

Adelekan, O., & Asiyanbi, A.P. (2016). Flood risk perception in flood-affected communities in Lagos, Nigeria. *Natural Hazards* 80(1), 445-469. https://doi.org/10.1007/s11069-015-1977-2

Akpodiogaga-a, P., & Odjugo, O. (2010). General overview of climate change impacts in Nigeria. *Journal of human ecology*, 29, 47-55.

[8] Interview with an official of Lagos State Environmental Protection Agency

https://doi.org/10.1080/09709274.2010.11906248

Araos, M., Lea Berrang-Ford, Ford J.D., Austin, S.E., Biesbroek, R., & Lesnikowski, A. (2016). Climate change adaptation planning in large cities: A systematic global assessment. *Environmental Science & Policy* 66 (4), 375-382. https://doi.org/10.1016/j.envsci.2016.06.009

Ayeni, A.O., Omojola A.S., & Fasona M.J. (2016). Urbanization and water supply in Lagos State, Nigeria: The challenges in a climate change scenario. In *7th International Water Resources Management Conference of ICWRS*, 18-20. http://iwra.org/member/congress/resource/PAP00-5503.pdf

Cole, D. H. (2015). Advantages of a polycentric approach to climate change policy. *Nature Climate Change*, *5*(2), 114-118. https://doi.org/10.1038/nclimate2490

Creswell, J. W. (2021). *A concise introduction to mixed methods research*. SAGE publications. https://pdfs.semanticscholar.org/pdf

Ebele, N. E., & Emodi, N.V. (2016). Climate change and its impact in Nigerian economy. *Journal of Scientific research and Reports*, 5(2), 1-13. https://doi.org/10.9734/JSRR/2016/25162

Ede, A. N., & Oshiga, K. (2014). Mitigation Strategies for the Effects of Climate Change on Road Infrastruture in Lagos State. *International Journal of Science Commerce and Humanities* 2(1), 173-184. https://core.ac.uk/download/pdf/95550381.pdf

Elias, P. and Omojola, A. 2015. Case study: The challenges of climate change for Lagos, Nigeria. *Current Opinion in Environmental Sustainability* 13, 74-78. https://doi.org/10.1016/j.cosust.2015.02.008

IPCC, (2018). *Summary for Policymakers on Global Warming*. https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/ .

Jetten, J. F., Crimston, K.S., Mols, F. and Haslam, S.A., (2021). Responding to Climate Change Disaster. *European Psychologist* 26(5), 161-171. https://doi.org/10.1027/1016-9040/a000432

Ladan, S. I. (2014). An appraisal of climate change and agriculture in Nigeria." *Journal of Geography and regional planning* 7(9),176-184. https://doi.org/10.5897/JGRP2013.0405

Lagos State Government (2016). *Geographical features of Lagos State*. https://www.britannica.com/place/Lagos-Nigeria.

Lagos State Climate Change Adaptation Strategy (LAS-CCAS, 2011), been prepared for the Commissioner for Environment, Lagos State, by the Building Nigeria's Response to Climate Change (BNRCC) project.

Lagos State Ministry of Economic Planning and Budget, (2020). *Budget documents*. https://mepb.lagosstate.gov.ng/budget-documents/.

Lamsal, P., Kumar, L., Atreya, K., & Krishna P. (2017). Vulnerability and impacts of climate change on forest and freshwater wetland ecosystems in Nepal: A review. *Ambio* 46(8), 915-930. https://doi.org/10.1007/s13280-017-0923-9

Malcolm, N., Malcolm, W., & Nkwunonwo U. (2015). Flooding and flood risk reduction in Nigeria: Cardinal gaps. *Journal of Geography & Natural Disasters* 5(1) 112-141. https://doi.org/10.4172/2167-0587.1000136

Markkanen, S. &s Annela, A. (2019). Social impacts of climate change mitigation policies and their implications for inequality. *Climate Policy*, *19*(7), 827-844. https://doi.org/10.1080/14693062.2019.1596873

Mikulewicz, M. (2018). Politicizing vulnerability and adaptation: On the need to democratize local responses to climate impacts in developing countries. *Climate and Development* 10(1), 18-34. https://doi.org/10.1080/17565529.2017.1304887

Nerem, R. S., Beckley, B.D., Fasullo, J.T., Hamlington, B.D., Dallas & Gary T. M. (2018). Climate-change–driven accelerated sea-level rise detected in the altimeter

era. *Proceedings of the national academy of sciences* 115(9), 2022-2025. https://doi.org/10.1073/pnas.1717312115

Nkwusi, G., S., Ayejuyo, A.S., & Annuk, A. (2015). Climate change; Farmers' awareness, perceptions and responses in Lagos State. *Applied Ecology and Environmental Sciences* 3(4), 95-99. https://links/5763e70f08ae421c447f41b8/Climate-Change-Farmers-Awareness-Perceptions-and-Responses-in-Lagos-State.pdf

Nunez, S. E., Alkemade, A.R., Verwer, C., & Leemans, R. (2019). Assessing the impacts of climate change on biodiversity: is below 2° C enough?. *Climatic Change* 154(3), 351-365. https://doi.org/10.1007/s10584-019-02420-x

Omitoyin, S.A. & Tosan, F. B. (2012). Potential impacts of climate change on livelihood and food security of Artisanal Fisherfolks in Lagos State, Nigeria. *Journal of Agricultural Science*, *4*(9), 20-32. http://dx.doi.org/10.5539/jas.v4n9p20

Oloke, C. O., Ijasan, K.C., Ogunde, A., Amusan, L.E., & Tunji-Olayeni, P. (2013). Improving urban residents' awareness of the impact of household activities on climate change in Lagos State, Nigeria. *Journal of sustainable development* 6(4), 56-69. https://links/567d476c08ae1e63f1e5fa0f/Improving-Urban-Residents-Awareness-of-the-Impact-of-Household-Activities-on-Climate-Change-in-Lagos-State-Nigeria.pdf

Pervez, M. S., & Henebry, G.M. (2015). Assessing the impacts of climate and land use and land cover change on the freshwater availability in the Brahmaputra River basin. *Journal of Hydrology: Regional Studies* 3(6), 285-311. https://doi.org/10.1016/j.ejrh.2014.09.003

Roberts, D. (2010). Prioritizing climate change adaptation and local level resilience in Durban, South Africa. *Environment and Urbanization* 22(2), 397-413. https://doi.org/10.1177%2F0956247810379948

Samson, A.O., & Oluwatoyin, R. O. (2012). Challenges of waste management and climate change in Nigeria: Lagos State metropolis experience. *African Journal of Scientific Research* , *7*(1). https://Challenges_of_Waste_Management_and_Climate_Change_in_Nigeria_Lagos_State_Metropolis_Experience

Sojobi, A.O., Isaac, I.B., & Adebayo, W.S. (2016). Climate change in Lagos state, Nigeria: what really changed?. *Environmental monitoring and assessment* 188(10), 1-42. https://doi.org/10.1007/s10661-016-5549-z

Stern, D. I., & Kaufmann, R.K., (2014) Anthropogenic and natural causes of climate change. *Climatic change* 122(22), 257-269. https://10.1007/s10584-013-1007-x

Taylor, A. (2016). Institutional inertia in a changing climate: Climate adaptation planning in Cape Town, South Africa. *International Journal of Climate Change Strategies and Management*. 8(2). https://doi/10.1108/IJCCSM-03-2014-0033/full/html

Tol, S.J. (2020). The economic impacts of climate change. *Review of Environmental Economics and Policy.* 12(1). https://doi.org/10.1093/reep/rex027

Van der Heijden, J. (2018). Cities and Sub-national Governance: High Ambitions, Innovative Instruments and Polycentric Collaborations. In Jordan, A. et al. (eds), *Governing Climate Change: Polycentricity in Action*. Cambridge: Cambridge University Press. https://dx.doi.org/10.2139/ssrn.3762544

Williams, A. P., Abatzoglou, J. T., Gershunov, A., Guzman Morales, J., Bishop, D. A., Balch, J. K., & Lettenmaier, D. P. (2019). Observed impacts of anthropogenic climate change on wildfire in California. *Earth's Future*, *7*(8), 892-910. https://doi.org/10.1029/2019EF001210