

# **MAINSTREAMING SUSTAINABLE TRANSPORT INFRASTRUCTURE PLANNING INTO CLIMATE CHANGE REGIME IN METROPOLITAN LAGOS, NIGERIA.**

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## **ABSTRACT**

The geographical location of Lagos along the coastline of the Atlantic Ocean makes it susceptible to some of the attendant effects of climate change such as ocean surge, rising sea level, storming weather, flooding as a result of heavy rainfall. In climate change literature, it is asserted that these identified externalities impact negatively on the immediate human environment. For instance transport infrastructure, a major component of the human environment that facilitates and guarantees mobility and accessibility to and from spatially distributed resources, suffers a significant damage, depreciation and disruptions in its operation as a result of the attendant effects of climate change. Noticeable examples in this regard in the Lagos environment include washed away bridges and rail track, collapsed road embankment, waterlogged and pot-hole roads.

This paper assessed the statutory mandate of government institutions especially in the Transport; and Environment sub-sectors in terms of the threat climate change attendant effects posed on transport infrastructure in Lagos. This is with a view to determining the level of preparedness of these agencies; and how past environmental challenges on transport infrastructure have been coordinated by them. However, the traditional institutional problems of overlapping responsibilities and functions among agencies, dearth of human capacity, budgetary constraints as well as disjointed institutional framework that primarily focuses on territorial protection are identified as institutional problems that may aggravate the despair state of transport infrastructure in Lagos as the globe gets warmer.

In conclusion, the paper recommends the adoption of a holistic planning approach, whereby all agencies concerned could work as a team under the climate change regime, towards mitigating the effects of climate change on the transport infrastructure in Lagos. Also, it suggests appropriate climate change mitigation strategies in transport infrastructure designs, construction and maintenance in the State.

## 1.0 INTRODUCTION

Flooding, a globally acclaimed major effect of climate change, threatened the liveability of cities across the world. According to Douglas, (2007) [1] flooding as to be seen as one of the factors preventing poor people from improving their quality of life. It greatly aggravates poverty. Because, according to Douglas (2007), it denies many people access to work for a long periods. The people denied access, as a result of flooding; suffer income and possible jobs loss. Satterwaite, (2008) [2] equally corroborates Douglas (2007) thus: cities in poorer countries have a large and growing proportion of the world's population at risk. He states further that countries like India, China, Bangladesh and Vietnam have large urban population in coastal zones vulnerable to sea- level rise and storm.

In Africa context, the Metropolitan Lagos in Nigeria with her population of about 15 million is similar in attributes with the cities mentioned above. Because of its geographical location in low coastal region, and consistently growing population; the city is as vulnerable to risk of flooding induced by global climate change effects, as cities in the countries mentioned above. Also, the steady growing in the Lagos Annual Mean Rainfall and Annual Mean Maximum Temperature in the last decade further confirmed the vulnerability of Lagos to risk of flooding (Table 1).

Table 1 - Annual Mean Rainfall and Temperature in Lagos (Ikeja)

<b>Year</b>	<b>Annual mean rainfall</b>	<b>Annual minimum temperature</b>	<b>Annual mean maximum temperature</b>
2004	141.8	24.0	31.2
2005	123.7	24.3	31.1
2006	124.9	--	31.6
2007	235.2	24.1	31.4
2008	167.2	22.5	31.7

Source: National Bureau of Statistics, 2009 (pp7-9)

The aim of this paper, therefore is to highlight the accessibility problem often been created by both climate change and local induced flooding on major road network in Lagos, Nigeria. This is with a view to mainstreaming in transport plans climate induced challenges such as flooding, which are capable of disrupting mobility and accessibility needs of the people.

## 1.1 Flooding in the Lagos Metropolitan Area

The geographical characteristics of Lagos which comprise of coastal zone separated by long sand spits that spread over 100km, lagoons and wetland areas are major factors that contribute immensely to the susceptibility and vulnerability of the Metropolitan area to the risk of flooding and storming waters, especially during the yearly wet seasons that span between April and July. The perennial flooding during the annual rainfall peak of April- July, for a very long time has remained a regular occurrence in the Metropolitan Area for a very long time. And, one of the critical transport infrastructures threatened annually by flooding and storming water is road.

Roads that are expected to offer access to spatially located land uses and urban resources in any human settlement are yearly been inundated by rain water, overflowing rivers and rise in the sea level in Lagos. The Ahmadu Bello Way, which is few metres away from the coastline, is a notable example. Prior the authority coastline intervention through provision of wave water breaker on the shoreline at the Victoria Island, the dual carriage way in question was submerged by water and sands from the sea. Consequently, cut of the area from other parts of the Island.

The reoccurrence of the above presented problem in vulnerable parts of the city, often responsible for the problem of reduced accessibility; and mobility problem in Lagos annually. In other words, the perennial Lagos flooding disrupts free-flow of traffic (Fig 1).



Figure 1 - Road Traffic Disruption by Flood in Ikorodu, Lagos

It is also responsible for collapse bridges, culverts, and rough road surfacing and deep pot-holes while the asphalted road surface is washed-away. Deep pot-holes, heavy traffic congestion are usually the final resultant effects of highway flooding in metropolitan area of Lagos (Fig. 2).



Figure 2 - Inundated Road Shoulder and Drainage

This paper, however, presents and analyses 2 prominent case studies of highway flooding in Lagos Metropolitan Area, in 2010. The case studies are: LASU- Ojo-Iba Road; and Mile 12 –Ikorodu Road. The choice of these roads is based on the fact that these are dual carriage highways that are very important in the socio-economic activities of the Metropolitan area, because they link diverse important land uses across the city. Also, the locations are located in fragile terrain, near river bound, wetland and floodplain.

Qualitative observatory survey method is used to determine the coping and adaptation strategies adopted by road users and the city authority during and after the emergency periods. Again, secondary data on rainfall and temperature are used to investigate the trend in rainfall trend in Lagos over the years. The empirical data collected are presented in Tables, photographs and map.

## **2.0 CONCEPTUAL FRAMEWORK: VULNERABILITY, ADAPTATION AND MAINSTREAMING IN CLIMATE CHANGE**

On the vulnerability of continent of Africa to a huge risk of climate change Osman-Elash (2007) [3] asserted that 'Africa is, it is clear, already under pressure from climate stresses and this increase the continents vulnerability to further climate change and reduces its adaptive captivity. Floods and droughts can occur in the same area within months of each year. With further climate change, climate in Africa is predicted to become more variable and extreme weather and events more frequent and severe. There are likely to be large regional differences in changes in rainfall, for example an increase in the western parts of the continents and a decrease for the northern part. The expected climate change would undermine growing development, increasing poverty and delaying or preventing the realization of the millennium developments goals'.

Conceptualizing adaptation in climate change discourse, Taylor et al (2010) [4] disagree with the erroneous interchanging of “adaptation” with “coping”, using a comparative approach (Table 2).

Table 2 - Characteristics of ‘Coping and Adaptation’

S/N	Coping	Adaptation
1.	Short-term and immediate	Oriented towards longer-term livelihood security
2.	Oriented towards survival	A continuous process
3.	Not continuous	Results are sustained
4.	Motivated by crises; reactive	Involves planning
5.	Often degrades the resource base	Uses resources efficiently and sustainability
6.	Prompted by a lack of alternative	Combines old and new strategies and knowledge.
7.		Focused on finding alternatives

Source: Taylor et al (2010) pp 12

In a nutshell, while ‘coping’ is short term unsustainable reactive approach, ‘adaptation’ is a more proactive and sustainable approach in minimizing cost-effectively the attendant effects and risks of climate change in any society.

Moreover, the above conceptualization by Taylor et al is further expanded by Lane et al (2005) [5], using the Intergovernmental Panel on Climate Change (IPCC) benchmark to identify the two types of adaptation strategies, namely: ‘autonomous and planned’. They add further that planned adaptation can either be ‘passive’ or ‘anticipatory. Lane et. al. (2005), affirm that anticipatory adaptation has policy potential. It could include technical actions such as buying more efficient irrigation equipment, engineering seeds and building higher bridges and dams. It could also include policy actions such as establishing networks to disseminate climate information and suggest adaptive actions, creating insurance mechanisms or paying the disadvantaged groups. Good policy coordination on a range of anticipatory adaptations can help avoid mal adaptation Lane et at, added.

However, passive adaptation is said to be reactive in nature. It is a situation whereby disaster is allowed to occur, before actions are taken. For example, it is such a situation whereby make-shift bridges are hurriedly provided to cope with the accessibility problem created by a collapse bridge and/or road. In other words, passive adaptation, according to Lane et al (2005), is rarely smooth or instantaneous as it is often assumed. It often leads to mal-adaptation which is often consequential.

In sum, going by the definition given to ‘coping’ and ‘adaptation’ by Taylor et al (2010); and Lane et al (2005) definition of ‘planned’ adaptation which is sub-divided into ‘passive’ and ‘anticipatory’ adaptation, it is possible for one to deduced that passive adaptation implies coping strategy, while ‘anticipatory’ adaptations stands for the real sustainable approach towards managing the climate change induced risks.

## 2.1 Mainstreaming in Climate Change

According to Koenders (2007) [6] climate risk management is not new. He metaphorically highlighted that “no engineer would build a bridge without considering river currents...” Mainstreaming, in other words entails adequate planning and integration of adaptation strategies into the national and/or regional plan of actions towards minimizing or forsaking climate change induced risk to human settlement. Consequently, targeted planning and budgeting will abate climate risks.

Effective “mainstreaming” according to Jallow (2007) [7], requires that National Adaptation Programmes of Actions (NAPAS) policies and measures are integrated into national and regional development policies and processes. Thus, Jallow added that it requires cross-sectoral cooperation interdisciplinary approaches and considerable political will. In a nutshell, an adaptation strategy will only be successful, when it is integrated with other policies such as disaster preparedness, land use planning, coastal management, environmental conservation and national plans.

The necessity of safe guarding lives and properties, pre and post climate change induced disaster is motivating countries globally, according to Sunderland et al (2005) [8] to consider the possibilities of “mainstreaming” or incorporating climate change adaptation strategies into national policy and programme frameworks. The approach is consequently responsible for the global growing awareness in the need to prioritize the following:

- Adaptation research
- Adaptation planning
- Climate observation and modelling
- Capacity building through training
- Climate change resilience needs integration in new projects.

### 3.0 FLOOD IMPACTS ON ACCESSIBILITY AND MOBILITY AND ROAD TRANSPORT INFRASTRUCTURE IN SELECTED METROPOLITAN LAGOS ROADS.

The case studies – Isheri-Olofin / Iba-LASU road (A-B) is located in the South-West; while the Ikorodu-Mile 12 road (C-D) is located in the Northeast of Metropolitan Lagos (Fig.3 )

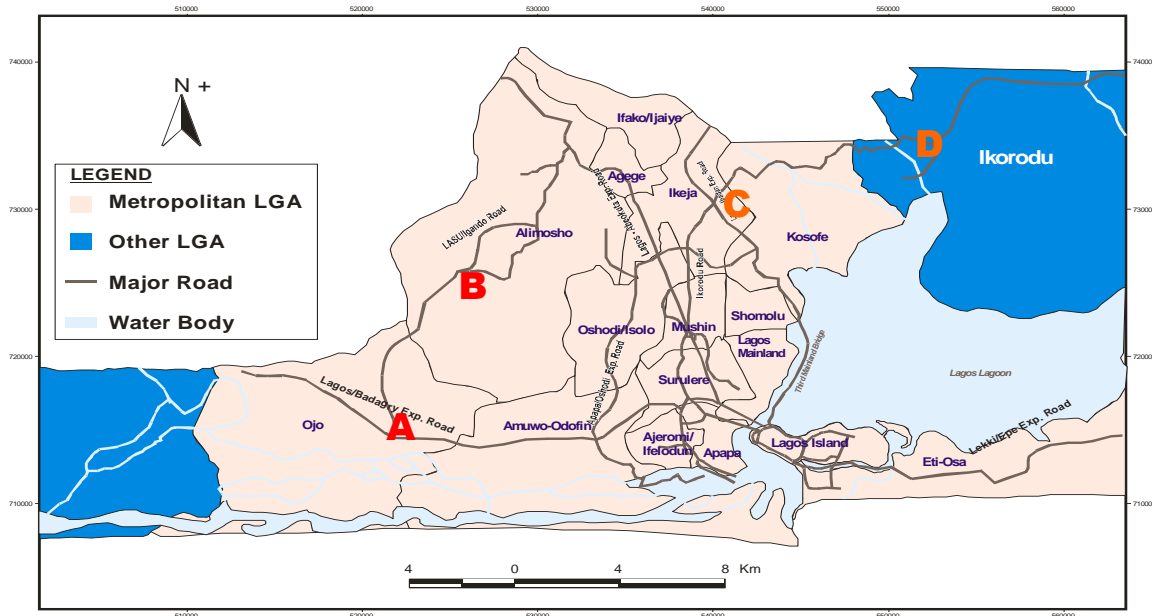


Figure 3 - Section of Administrative Map of Lagos showing the Metropolitan area

These roads are dual carriageways roads that carry traffic to and from the sub-urb of Ikorodu and Alimosho areas of the metropolis. Table 3 shows a qualitative analysis of the disruption caused on these roads by flooding, during the 2010 wet season. The analysis in Table 3 is sub-divided into five parts namely:

- (i) Settlement pattern and terrain of the study areas neighbourhood
- (ii) Cause(s) of flooding
- (iii) Impact of flood on mobility needs of road users
- (iv) Extent of damage and repairs and duration of repairs.
- (v) Coping and Mitigation Strategies adopted by the authority and road users.

Table 3 - Qualitative Analysis of Flood Disruption of Free-Flow of Traffic on Selected Metropolitan Lagos Roads

Variables	Case Studies	
	Ikorodu – Mile 12 Road	Isheri–Olofin – LASU Road
(i) Terrain	<ul style="list-style-type: none"> <li>Flood Plain /River boundary (Majidun)</li> </ul>	<ul style="list-style-type: none"> <li>Wet Land</li> </ul>
(ii) Settlement Pattern	<ul style="list-style-type: none"> <li>Heavily Populated Slum Area</li> </ul>	<ul style="list-style-type: none"> <li>Sparsely populated new development area</li> </ul>
(iii) Land uses link by the study area	<ul style="list-style-type: none"> <li>Metropolitan CBD and sub-urban Ikorodu town</li> </ul>	<ul style="list-style-type: none"> <li>Education land use (Lagos State University)</li> <li>International land border with Benin Republic (Seme)</li> <li>International market (Alaba)</li> <li>Apapa premier seaport</li> <li>Ultra modern Trade Fair Complex</li> </ul>
(iv) Traffic Flow Implications	<ul style="list-style-type: none"> <li>Heavy traffic congestion</li> <li>Sub-merged vehicles and houses (fig 1,2 and 3)</li> <li>Drastic change in transport fares</li> <li>Diversion of traffic</li> </ul>	<ul style="list-style-type: none"> <li>Same as previous column</li> </ul>
(v) Physical Impacts of Flood on roads Infrastructure	<ul style="list-style-type: none"> <li>Flooded road (fig 1)</li> <li>Collapse road, culverts and drains</li> </ul>	<ul style="list-style-type: none"> <li>Bridge collapse</li> <li>Flooded road</li> <li>Blocked drains</li> </ul>
(vi) Repairs types on road Infrastructure	<ul style="list-style-type: none"> <li>Re-channelization of water</li> <li>Draining of excess water, and</li> <li>Repair of collapse drains</li> <li>Removal of dirt (solid waste)</li> </ul>	<ul style="list-style-type: none"> <li>Re-construction of collapse bridge</li> <li>Re-channelization of bridge</li> <li>Evacuation of excess water</li> <li>Removal of dirt (solid waste).</li> </ul>
(vii) Duration of Traffic Disruption	<ul style="list-style-type: none"> <li>More than 2 weeks -</li> </ul>	<ul style="list-style-type: none"> <li>Same -</li> </ul>
(viii) Observed causes of flood	<ul style="list-style-type: none"> <li>Heavy down pour</li> <li>Location of road along a river basin channel</li> <li>Poor drainage system</li> <li>Built-up flood plain</li> <li>Poor solid waste management</li> </ul>	<ul style="list-style-type: none"> <li>Heavy down pour</li> <li>Poor waste blocked drains</li> <li>Poor channelization</li> <li>Conversion of wet land to drain land uses</li> </ul>
(ix) Mitigation Strategies by the authority	<ul style="list-style-type: none"> <li>Immediate deployment of traffic controllers</li> <li>Commencement of repairs      Passive</li> <li>Relocation of residents</li> </ul>	<ul style="list-style-type: none"> <li>Deployment of traffic controllers</li> <li>Immediate commencement of repairs      Passive</li> </ul>
(x) Road Users observed coping strategies	<ul style="list-style-type: none"> <li>Detouring</li> <li>Wait in line in flood</li> <li>Choice of alternative routes</li> <li>Total withdrawal from the corridor</li> </ul>	<ul style="list-style-type: none"> <li>Same</li> <li>Choice of alternative route further away e.g. diversion of Lagos bound traffic through Sagamu, a distance of about 30-40 kilometers</li> </ul>
(xi) Average travel time in crossing the affected part of the road	<ul style="list-style-type: none"> <li>More than 5 hours at peak period</li> </ul>	<ul style="list-style-type: none"> <li>More than 2 hours at peak period</li> </ul>
(xii) Impact intensity on road users	More intense (Fig 3)	Intense
(xiii) Socio-Economic Impact of Traffic Disruption	Total disruption of diverse journey purposes e.g. journey to schools, to work, hospitals, markets etc.	<ul style="list-style-type: none"> <li>Same –</li> </ul>

Source: Odeleye, J.A (2010)



### 3.1 Institutions and Mitigation Policy Mainstreaming in Lagos Nigeria

The Lagos authority is currently playing a foremost role in climate change activities in Nigeria. The city is a very good reference point as regards the level of its commitment to climate change issues. It has been able to put in place programmes and institutions that are sensitizing the populace as well as enforcing environmental legislations. Again, the authority has been able to put in place series of planned 'anticipatory' mitigation strategies, notable among these is the popular tree planting (sequester) across the metropolitan area, waste management, and provision of breakwater facility on the coastline.

But the multisectoral component of climate issues in terms of policy planning, budgeting, enforcement of mitigation strategies, as it relates to the impacts and contributions of other sectors of the economy such as transport to the climate change risk in Lagos area is still been accord less recognition. Therefore, the multisectoral approaches in planning, budgeting, enforcement of mitigation strategies as recommended in NAPAS, is yet to be achieve adequately in Lagos.

Notably, more than 70% of environmental programmes are handled by the Ministry of Environment, with little or no contributions from other sector of the economy such as Transport, Regional planning etc. Although, this is not peculiar to Lagos, it is a National problem that needed to be addressed, if Nigeria is to achieve well planned and sustainable anticipatory mitigating strategies, rather than the current "passive" mitigating approach that prevails in the system.

## 4.0 DISCUSSION OF FINDINGS AND RECOMMENDATIONS

This paper has been able to confirm that Lagos level of preparedness for extreme climatic change effects, especially as it affects transport infrastructure, is insufficient. For, the case studies analysis in Table 3 shows that "passive" mitigating strategy currently being adopted in Lagos, such that response to climate change induced risks is motivated by crises is insufficient and unsustainable for the Metropolitan areas. The analyzed "reactive" approach by the authority in the selected case studies is an indication that the Metropolitan Lagos is yet to adequately prioritize the vulnerability of the city to climate change risks, such as flooding, in its regional plan.

Therefore, the city needs to use the lesson learnt in the previous sudden disruption to mobility and accessibility in the study areas as highlighted in this paper, with a view to considering the prioritization of the adoption of anticipatory mitigating strategy in the mega city. Application of the "anticipatory" approach should endear the city towards mapping of vulnerable zones across the city, such that transport infrastructure that are highly susceptible to flooding like bridges, culvert, drains and roads in the identified locations would be multi- sectorally discussed, planned and budgeted for by the authority. Centralization of climate change administration, beyond a singular government department portfolio, would also help the city to realize in no time the integration of anticipatory adaptation to all climate change induced risks in Lagos and its immediate regions

The “anticipatory” approach in this regard, will help the city authority to save scarce financial resources, which are annually been wasted on emergency services, bridge, culverts, drains and roads reconstruction in vulnerable areas of the city. It is only the anticipatory adaptation approach that can save the Metropolitan Lagos from the projected doom/challenges of climate changes effects on developing countries worldwide. There are indications that the warmer the world climate, cities thus stands the risk of flooding.

For, studies have shown that as the water levels in the world’s ocean are estimated to rise significantly; cities bordering the coastline such as Lagos will be badly affected by the rising sea. Again, floods is expected to rise when there is a strong low pressure and prolonged heavy winds, and increasing seasonal rain together with rising air temperatures are capable of exacerbate distress on pavement surfaces and structures. According to Lane et al (2005) IPCC projected that by 2100, the planet would warm by between 1.4° and 5.8°c. And the likely climate change impacts of this change in the world temperatures as listed by IPCC include:

- More frequent heat waves and less frequent cold spells;
- Bigger storms and more weather related damage;
- More intense floods and droughts;
- Rising sea levels which could immediate coastal areas biodiversity loss
- Fast disease transmission

Hence the needs for prioritization of multi-sectoral climate change mitigation plan, strategies and goals in Lagos.

## **5.0 CONCLUSION**

The perennial disruption of mobility on major traffic corridors of Metropolitan Lagos, due to heavy downpour, need to inform further reinforcement of bridges, culvert and road surfacing, so as to mitigate the immobility effects of flooding on people and existing transport infrastructure in the identified areas of Lagos. Therefore, the reinforcement and re-engineering of the road transport infrastructure in these areas would enable the authority to save money in the long run; as well as save human life which would have been lost due to sudden collapse of bridges, roads and culverts as a result of flooding in the study area. However, this particular objective of road transport infrastructure reinforcement would only be achieved, if concerned agencies in Environment, Public Works, Transport and even Finance would agreed to see the problem as one of the climate change induced challenges that required multi-sectoral approach and attention in the study area.

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