

Impacts of Climate Change on Residents of Eti-Osa West and East Local Government Areas, Lagos, Nigeria

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ABSTRACT

Against the background of incessant climate change, this paper examines the causes, impacts, as well as residents' measures of adaptation to climate change in Eti-Osa West and East Local Government Lagos State. The study utilizes both primary and secondary sources of data. A total of 222 questionnaires were administered to the respondents using random sampling techniques. Data collected were analyzed using both parametric and non-parametric statistical analytical tools. Likert scale was used to examine the causes, evidence/impact and mitigation against the impacts of climate change. Also, ANOVA was used to determine the variation of climate change impact across wards in the study area while Pearson correlation analysis was utilized to determine the dependability of residents' awareness on their level of education. Climate records of Lagos from NIMET were also utilized to examine change in climatic parameters. The study reveals that the most prominent cause of climate change is deforestation (RAI 3.60), while the major impacts of climate change are high rise in sea level (RAI 3.87), fluctuation in the period of rain fall (3.22) and increase in temperature (RAI 3.22). The result of Analysis of Variance (ANOVA) reveals fluctuation in rainfall, disappearing of water bodies, temperature increase, extinctions of plants and animals and water scarcity have a coefficient of 0.00, 0.015, 0.034, 0.022 and 0.00 respectively. This implies that the stated effects above are significant and vary across the wards in the study area. The result of correlation analysis reveals negative correlation with $r = -0.135$, which implies that residents awareness is not determined by their level of education. It also showed positive low correlation between average annual temperature and years when $r = 0.342$ and between annual Rain rainfall and year $r = 0.22$. The study recommends that residents should provide green space around their building premises, maintain adequate set back and relocate from water fronts before overflow of bank. Government should discourage developments towards the coastline and also embark on planting of trees to serve as buffer zones at coast line region.

Keywords: Climate change, measures of adaptation, green space

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Introduction and Background to the Study

It is no longer a “scam” that the earth’s climate is changing (IPCC, 2007). Climate change is a topical issue worldwide because of its attendant problems that are threatening the sustenance of man and its environment (Nicholas, 2003). Thus, there is a wide consensus that climate change is real and rapidly advancing. Its widespread threat facing humanity made scientists to present evidence and texted models to substantiate this truly alarming fact (Chaundry and Aryal 2009). Therefore, climate change is typically discussed, researched and studied in global terms, and its effects vary and escalate dramatically among different regions in the world (IPCC, 2001)

Climate change has been defined as a phenomenon created by human beings and nature, which devastates the earth and causes hardship of unprecedented magnitude to living (IPCC 1990). Also Omotosho (2007) defined climate change as a change of climate that is attributable directly or indirectly to human activities and, which alters the composition of the global atmosphere, in addition to natural climate variability observed over comparable time periods.

Climate change is induced by both natural and human factors. This was remarked by CEP (2009), that climate change is attributed directly or indirectly to human activity that alters the composition of the atmospheric gases. These activities include both formal (industrialization, automobile engine, among others) and informal (informal enterprises). It is also a fact that pollution has been the major cause of climate change (Hart, 2005). For instance, and most especially in the recent time, pollutants released from increased anthropogenic activities worldwide have undoubtedly contributed to the high increase in the rate of gaseous emission into the atmosphere. The concentration of carbon dioxide (CO₂) has increased by about 25 per cent since the mid-19th century, following increased human activities such as the burning of oil and coal and the destruction of forests which has been removed either by

diffusion into the oceans or by photosynthesis of plants on land (Woodwell, 1992; 2004; WDR, 2003 Etuonovbe, 2007).

The effect of this phenomenon becomes worsened when people migrate to already overstressed urban centers and consequently forced to live in dangerous areas. As a result of this, many construct their homes in informal settlements, on floodplains, in swamp areas and on unstable hillside. The most devastating adverse impacts of climate change in Nigeria and other subtropical countries includes frequent drought, increased environmental damage, increased infestation of crop by pests and diseases, depletion of household assets, increased rural urban migration, increased biodiversity loss, depletion of wildlife and other natural resource base, changes in the vegetation type, decline in forest resources, decline in soil conditions (soil moisture and nutrients), increased health risks and the spread of infectious diseases (Ishaya and Abaje 2008). Consequent on this, issues on adaptation and mitigation strategy should be given adequate attention.

Adaptation is a process through which communities prepare to cope with an uncertain future climate. Although, adaptation is often treated on continental basis or based on geographical demarcations thereby bringing generalizations on the way and methods of combating climate change (IPCC, 2001). This suggests that specific measures on climate change should vary greatly across sectors, ranging from physical land use plans that limit development in hazard areas, to protecting and preserving certain ecosystems. (e.g. flooding and erosion). Similarly, mitigation activities help to reduce the rate and/or magnitude of climate change by helping reduce human-generated greenhouse gas emissions. Climate change mitigation action helps to reduce the intensity of radioactive in order to reduce the effects of global warming. Adaptation does not mean that the negative impacts of climate change will be completely avoided, only that they will be less severe than if no planning had occurred (United Nations HABITAT 2010).

In developing nations, very few people are concerned about the consequences of such natural and human actions and or inaction that constitute threat to climate. This was remarked by Adeboyejo *et al* (2011) that vast majority are less concerned on the causes, effects and probably the control measures necessary to salvage the future from the looming dangers of environmental degradation. Although Nigeria recognized climate change as the greatest challenge to sustainable development particularly in most cities of which Lagos State is among those that are vulnerable to the impacts of climate change. Consequently, concerted and urgent action should be taken to forestall its widespread on ecosystem degradation, disruption of socio-economic development and the welfare of the people (BNRCC 2012).

Therefore, the need to conduct research for such specific areas like Eti-osa located along the coastline is justified and mandatory because of: Its location to the coastline, its exposure to the threat of sea level rise and the risk of storm surges; its predominantly low-lying topography makes it susceptible to submergence and widespread flooding, it also possesses fragile ecosystems, such as lagoons, swamps and freshwater bodies, thus the water table in large parts of the state is high. The state also has a large and rapidly growing population. Against this background and coupled with its associated negativities on residents of Eti-Osa, the paper investigates how residents are vulnerable to this subject in the study area. This is the major thrust of this research work.

2. Literature Review

Climate change is a growing global problem and has become one of the most heavily researched subjects in science (Ogundipe, 2008). Until now, issues on climate change have been examined severally: climate change impacts, (Odjugdo 2003 2009, 2010, WHO, 2009 UN Habitat 2010, Abdulhamid, 2011), Climate Change and Society Vulnerability (Bohle *et al* 1993), Climate change and human health (Wood *et al* 1998, WHO 2009) climate change and building green productive cities, (Gbadegesin 2011). The impacts of climate change are no more potential. It is complex in nature, because there is no component of the ecosystem (biotic or abiotic) that is left out of the impact in its severe and intricate side effects on man and his environment. These are unprecedented since the early 1900's even until recent time (Adger, 1996).

The impact of climate change varies from region to region. Its menace came into limelight in Nigeria when the fluctuations gendered by global warming resulted into incessant water shortages, increasing temperature, loss of land and soil fluctuations in production of supply of foods (Olamiju, 2008). This is coupled with rise in sea levels and reduction of temperature, increase amount of rainfall, sunshine intensity, abnormality in the duration of weather condition and pattern irrespective of location, (GPDD, 2009). The Intergovernmental Panel on Climate Change (IPCC, 2007) recognizes the Nigerian coast as one of the low-lying coasts in Western Africa which is likely to experience severe effects from flooding as a result of rising sea levels and climate change. Similarly, Adelekan (2009) established that coastal regions like Lagos state, is not left out in the adverse effect of climate

because of the presence of beaches/water bodies. The change often manifested through fluctuation in rainfall, frequent flooding, land reclamation due to flood, soil erosion, high rise in sea level, rise in temperature, among others. The effect of climate change such as; great loss of life and property has been an issue of debate particularly towards its adaptation and mitigation.

Adaptation to climate change involves initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects (IPCC, 2007). Adaptation to climate change is the adjustment in natural or human systems in response to actual climate effects, which moderates harm or exploits beneficial opportunities (UNFCCC, 2009). Successful adaptation maybe possible if people take collective responsibilities of human systems, and to some extent the natural systems on which they depend must adapt in response to the present and future effects of climate change (Rogeli *et al*, 2009). In contrast, climate change mitigation scenarios involve reductions in greenhouse gases, either by reducing their sources or by increasing their sinks.

3. Research Methodology

In this study, both the primary and secondary data were utilized. The primary data constitutes major information required for the empirical analysis. The sample frame comprises ten (10) political wards in “Eti-Osa West and East Local Government Area. This is presented in Table 1. The population figure for all political wards in the study area according to 2006 Nigeria Population Commission (NPC) was projected to 2014 using the annual growth rate of 3.2% because the study area is one of the states that experience unprecedented population growth. The sample size of this research work was determined using 0.06% of the total population projected for the study area. Thus, the sample frame and size was used to determine the number of questionnaires administered (0.06% of the total population (370,259) = total no of questionnaires administered (222)

In selecting the respondents from all the wards, level of education and number of years spent in the area was considered. This is presumed on the need to affirm to a reasonable extent that the respondents have a considerable knowledge of the issue under discussion. However, residents were approached randomly and those that fulfilled the stated criteria were sampled. This process was repeated until the stipulated quota in each ward was reached. The secondary data were obtained from Lagos State Climate Change Adaptation Agency (LAS-CCAS) and NIMET which provided background information as regards climate parameters such as; rainfall and temperature. This was extracted to determine changes that might have occurred to climatic parameters (i.e. rainfall and temperature) for the past ten years.

Table 1. Projected Population of the Study Area

S/N	Names of Wards	2006 population Enumeration	Projected Population 2014 (Sample Frame)	Sample Size of 0.06%
1. 1	Ikate / Lekki	24,893	32,027	19
2. 2	Ajiran / Osapa	30,081	38,702	23
3. 3	Maroko / Okunaifa	30,358	39,058	23
4. 4	Igbo-Efon / Maiyegun	32,056	41,243	25
5. 5	Ilasan / Orire	30,529	39,278	24
6. 6	Aja	22,784	29,313	18
7. 7	Sangotedo	28,631	36,836	22
8. 8	Addo / Okeira	31,220	40,167	24
9. 9	Badore / Langbasa	28,286	36,392	22
10. 10	Okunajah / Okunmopo	28,947	37,243	22
TOTAL		287,785 (1)	370,259 (2)	222

Source 1: NPC, 2006 Source 2: Author’s Compilation (2014)

Both descriptive and inferential statistics were employed for the analysis. Descriptive statistics was employed for nominal variables. Likhert’s Scale was used to analyze perception of residents’ on causes of climate change, its evidence/impacts and also the various ways of mitigating climate change. Inferential statistics like Pearson

correlation and ANOVA was employed to test whether there is variation between the level of education and resident's awareness on climate change and also to test on whether the impact of climate change vary across wards in Eti-Osa West and East Local Government Area.

4. Study Area

Lagos is located on the blight of Benin (an arm of the Atlantic Ocean), on latitude 6.27N and longitude 3.28N. Lagos is the chief port, and principal economic and cultural centre. It served as Nigeria's capital until 1991, when the seat of Federal government was moved to Abuja, in central Nigeria. Lagos has a very diverse and fast-growing population, resulting from heavy and ongoing migration to the city from all parts of Nigeria as well as neighboring countries. The climate of Lagos State is the wet equatorial type influenced by its nearness to the equator and the Gulf of Guinea. It is affected by atmospheric interactions in which the Inter-Tropical Convergence Zone (ITCZ) is a controlling factor. The northward movement of the ITCZ is associated with the coming onshore of a warm, humid maritime tropical air mass, while its retreat is associated with the hot and dry continental air mass from the interior. These two air masses gives Lagos two contrasting seasons; a rainy season, which usually lasts from April to October; and a dry season, which lasts from November to March. The rainy season has two peak rainfall periods: May to July and September to October, with rainfall being heaviest during the first peak period. Floods usually occur during these periods of peak rainfall. These floods are aggravated by the poor surface drainage systems of the coastal lowlands.

Lagos State has consistently high temperature, with the mean monthly maximum temperature of about 30 degrees Celsius. The state experiences the highest temperatures in November to December and February to March, while the lowest temperature occur in June to July, which coincides with the middle of the first period of peak rainfall.

Lagos state experiences two rainy seasons with the heaviest rain falling from April to July and a weaker rainy season in October and November. There is a relatively dry spell in August and September and a long dry season from December to March. Monthly rainfall between May and July averages over 400mm (16in), while in August and September it is down to 200mm (7.9in) and in December as low as 25mm (0.98in). The main dry season is accompanied by harmattan winds from the Sahara desert, which between December and February can be quite strong. The highest maximum temperature ever recorded in Lagos was 37.3°C (99.1°F) and the minimum 13.9°C (57.0°F)

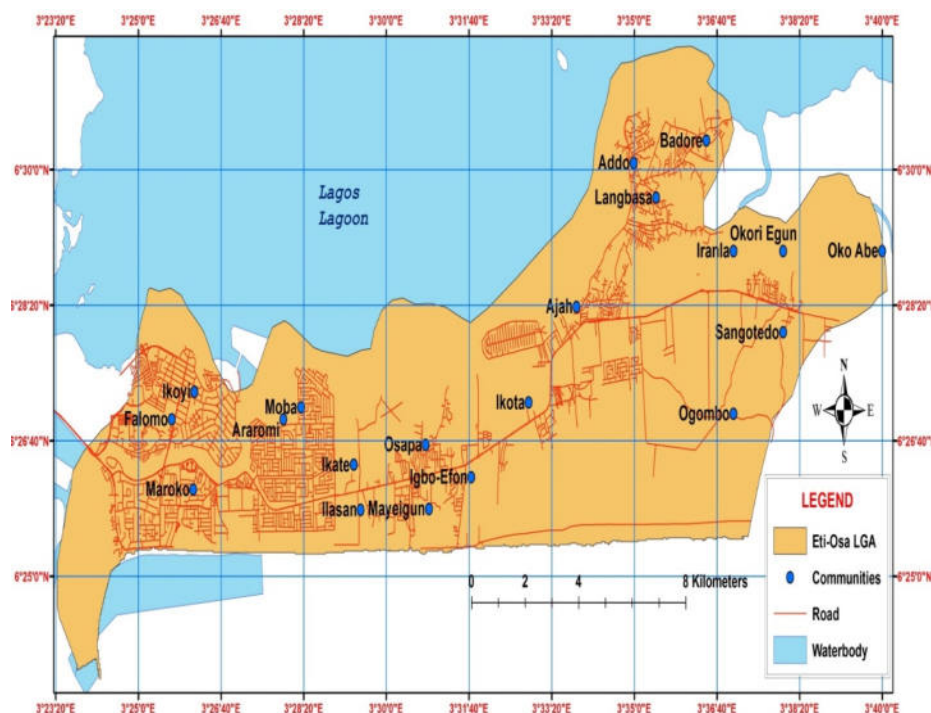


Figure 1: The Map of Eti-Osa Local Government
Source: Google Earth Pro, (2015)

4. Result and Discussion

4.1 Residents Awareness on Climate Change

It was observed from the study and Table 2 that, residents' knowledge of climate change is determined by the duration of their stay in the study area. Since more than half (55.4%) of the respondents have stayed for more than ten years, with respect to their response to awareness on climate change in all the sampled areas, a larger proportion (95.5%) are aware that climate is changing, while just 4.1% of the total residents sampled indicated that climate is not changing. The 100% of response recorded for those that have stayed above 15 years also explains that the longer the duration of stay the more residents get aware of the changes caused by climate in the study area. Table 3 summarizes the correlation coefficient between the residents' awareness of climate change and their level of education. It reveals little or no negative correlation with $r = -0.135$. This implies that residents' level of awareness is not determined by their level of education but by their duration of stay in the study area.

Table 2: Resident's duration of stay and Response to Awareness on Climate Change

		Awareness of Climate change		
		Aware	Not Aware	Total
Count	1-5 yrs	46	2	48
% within row		95.8%	4.2%	100%
% of total		20.7%	0.9%	21.6%
Count	6-10 yrs	47	4	51
% within row		92.2%	7.8%	100%
% of total		22.2%	1.8%	23.0%
Count	11-15 yrs	52	3	55
% within row		94.5%	5.5%	100%
% of total		23.4%	1.4%	24.8%
Count	above 15 yrs	68	0	68
% within row		100.0%	0.0%	100%
% of total		30.6%	0.0%	30.6%
Count	Total	213	9	222
% of total		95.9%	4.1%	100%

Pearson Chi-Square = 5.035^a, Df = 3, P value = 0.169

Source: Author's Field work, 2015

Table 3: Pearson Correlation on Residents' Awareness of Climate Change

		Awareness of Climate change	Level of education
Awareness of Climate change	Pearson Correlation	1	-.135*
	Sig. (2-tailed)		.045
	N	222	222
Level of education	Pearson Correlation	-.135*	1
	Sig. (2-tailed)	.045	
	N	222	222

*. Correlation is significant at the 0.05 level (2-tailed).

Source: Author's Field work, 2015

4.2 Causes of Climate Change

The study reveals that climate change is mostly induced by both natural and human factors (60.8%) (Figure 2). The natural factors could be as a result of change in solar output and the earth orbit around the sun, while human factors could be burning, industrial pollution and also the conversion of forestry and sea side for physical development. It is

observed that deforestation has the highest positive index of 3.60, which is above the RAI mean of 3.40. This implies that deforestation is the greatest causes of climate change.

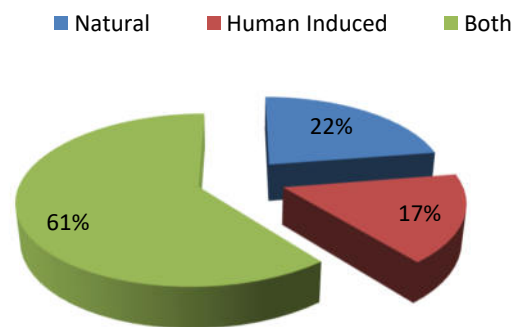


Figure 2 Perceived Causes Climate Change in the Study Area

Source: Author's Field work, 2015

4. 3 Effects of Climate Change

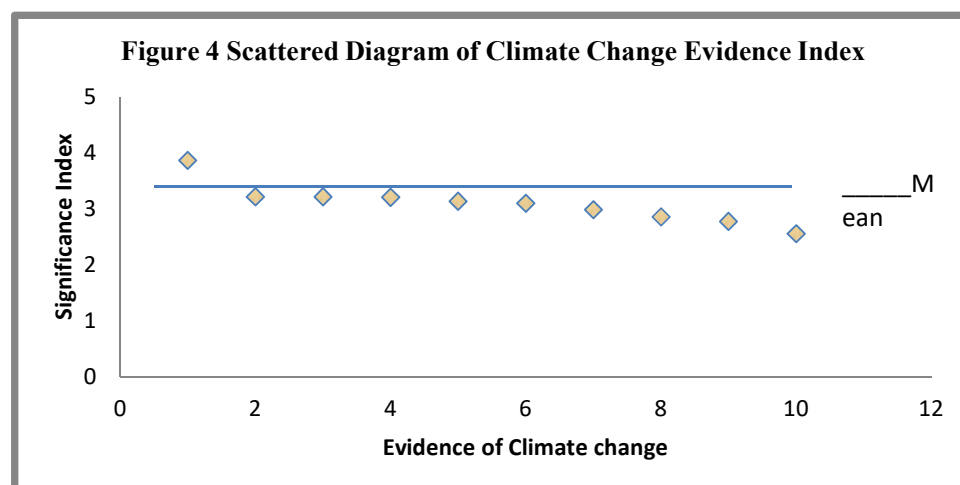
The study reveals that high rise in sea level, increase in temperature and fluctuation in the period of rain fall has the highest positive index of 3.87, 3.22, and 3.22 respectively which is far above the RAI mean of 3.08 as presented in Table 4. This implies that high rise in sea level is the greatest evidence of climate change in the study area being a coastal part of Lagos state, followed by increase in temperature and fluctuation in the period of rainfall. This is presented in Table 4.

Increase or rise in sea level occurs when the concentration of greenhouse gases in the atmosphere causes an increase in the temperature, heat released is thereby transferred from the atmosphere to the sea or water bodies in the study area. The consequence of rise in sea level includes; threat to coastal communities (study area) by putting lives and property at risk and also coastal areas are particularly vulnerable to contamination of freshwater supplies. Increased temperature is caused by deforestation in the study area. The result of Analysis of Variance (ANOVA) was employed to compare the variation between effects of climate change across wards as shown in Table 5 reveals fluctuation in rainfall, disappearing of water bodies, temperature increase, extinctions of plants and animals and water scarcity have a coefficient of 0.00, 0.015, 0.034, 0.022 and 0.00 respectively. This implies that the stated effects above are significant and vary across the wards in the study area, while incessant flooding and fluctuation in quantity of food supply with a coefficient of 0.107 and 0.260 respectively are not significant and does not vary across wards in the study area. The study reveals further that fluctuations in rainfall and water scarcity are major impact of climate change that occurs in the study area.

Table 4: Respondents Perception of Effects of Climate Change

S/N	EFFECTS/ EVIDENCE OF CLIMATE CHANGE	RANKING				N	EWV	$\frac{EWV}{N}$	\bar{X}	X- \bar{X}	(X- \bar{X}) ²
		4	3	2	1						
1	High rise in sea level	195	27	-	-	222	861	3.87	3.08	0.79	0.6241
2	Fluctuation in the period of rain fall	81	109	32	-	222	715	3.22		0.14	0.0196
3	Increase in Temperature	79	107	34	2	222	715	3.22		0.14	0.0196
4	Frequent Flooding and Erosion	79	110	30	1	220	707	3.21		0.13	0.0169
5	Loss of life and property through flooding	34	184	4	-	222	696	3.14		0.06	0.0036
6	Loss of Land due to flooding	29	183	8	-	220	681	3.10		0.02	0.0004
7	Outbreak of diseases like malaria, cholera, typhoid etc.	24	173	24	1	222	664	2.99		-0.09	0.0081
8	Food Scarcity due to extreme weather conditions that affects the growth of plant and animals	23	143	55	-	221	631	2.86		-0.22	0.0484
9	Water Scarcity due to fluctuation of rainfall and extreme dryness	36	102	79	3	220	611	2.78		-0.3	0.09
10	Excessive Dryness	44	69	75	33	221	566	2.56		-0.52	0.2704

Source: Author's Field work, 2015



Source: Author's Field work, 2015

Table 5: Analysis of Variance (ANOVA)

S/No	Impact of climate change		Sum of Squares	Df	Mean Square	F	Sig.	Remark
1	fluctuation in rainfall	Between Groups	5.080	8	.635	4.265		
		Within Groups	28.440	191	.149		.000	S
		Total	33.520	199				
2	disappearing of water bodies	Between Groups	4.046	8	.506	2.467		
		Within Groups	38.342	187	.205		.015	
		Total	42.388	195				S
3	temperature increase	Between Groups	3.659	8	.457	2.143	.034	
		Within Groups	40.341	189	.213			
		Total	44.000	197				S
4	extinction of plants and animal species	Between Groups	4.494	8	.562	2.304	.022	
		Within Groups	45.831	188	.244			
		Total	50.325	196				S
5	water scarcity	Between Groups	11.054	8	1.382	9.466	.000	
		Within Groups	25.253	173	.146			S
		Total	36.308	181				
6	Incessant flooding	Between Groups	2.443	8	.305	1.676		
		Within Groups	34.431	189	.182		.107	NS
		Total	36.874	197				
7	Fluctuation in quantity of food supply	Between Groups	2.468	8	.308	1.274		
		Within Groups	45.050	186	.242		.260	NS
		Total	47.518	194				

Source: Author's Field work, 2015

4.4 Residents Adaptive Measures towards Climate Change

The study reveals the level of coping strategies or adaptive measures during incidences related to climate change such as; the most adopted coping strategy during flooding is Relocation of affected resident (26.6%), the use of mosquito net and insecticides for the prevalence of malaria (23.9%) during outbreak of diseases like malaria, relocation or migration of resident (39.6%) during property loss through flooding.

The study also explains that residents has been coping with increased temperature through use of energy saving bulb (30.2%) and the use of fan (30.0%) since the residents could afford it, while some of the residents plants trees around their buildings to get fresh air during the period of increased temperature. The major adaptive measure adopted in the study area is the creation of parks and garden (86%) to combat heat in the study area. Furthermore, the study reveals that the limitation/problems to measures practiced against climate change in the study area is inadequate finance from Government to provide functional measures against climate change (92.8%) (Table 6)

Table 6: Impacts/Adaptive Measures to Climate Change

Impacts		Coping Strategies		Frequency	Percentage
A	Flooding	1	Relocation of affected resident	59	26.6
		2	Financial or property donation	15	6.8
		3	Community support	25	11.3
		4	Use of canoe for transportation	34	15.3
		5	Use of rain boot in flooded plain	46	20.7
		6	Channelizing and clearing of drainage system	43	19.4
		TOTAL		222	100
B	Outbreak of Diseases		Creating awareness during outbreak of diseases	45	20.3
			For prevalence of malaria, the use of net and insecticides	53	23.9
			Removal of stagnant water where mosquitoes breed	46	20.7
			Washing hands after involving in dirty activities to prevent cholera	40	18.0
			Self-medication	6	2.7
			Regular visit to the hospital during ailments	32	14.4
TOTAL		222	100		
C	Property loss or damage		Fund raising from family or community	38	17.1
			Donation from NGO	29	13.1
			Government intervention through donation	62	27.9
			Relocation residents'	88	39.6
			Property insurance	5	2.3
Total		222	100		
D	Temperature Increase		Use of fan	51	30.0
			Use of umbrella	4	1.8
			Use of energy saving bulb	67	30.2
			Use of air condition	27	12.2
			Avoid bush and refuse burning	31	14.0
			Tree planting around building premises	42	18.9
TOTAL		222	100		

Source: Author's Field work, 2015

4.5 Approach to Mitigate/Control the Impact of Climate Change

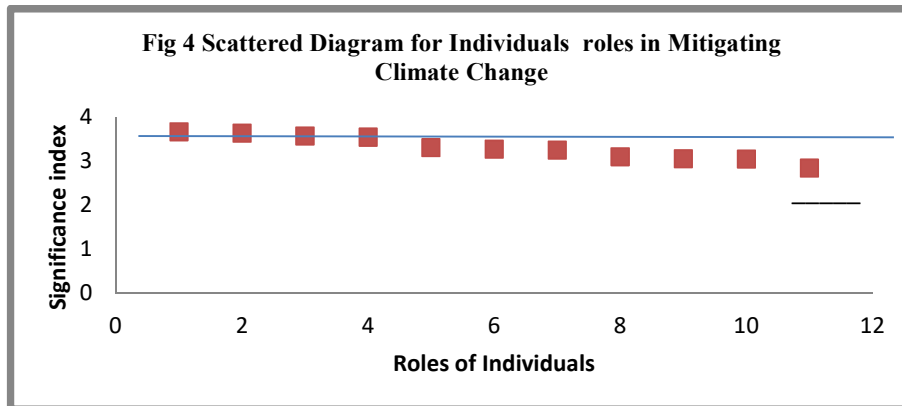
Table 7 summarizes the various suggestions for individuals on combating climate change issues in the study area. It can be observed that the respondent opined that burning of refuse and use of appropriate waste disposal technique has the highest positive index of 3.66 which is far above the mean of 3.30. This implies that burning of refuse can reduce heat and carbon dioxide in the study area. Also the use of appropriate waste disposal technique by individuals will also help to mitigate the effect of climate change experienced in the study area. This follows 'decreasing order by Relocation of residents on water front's with adequacy index of 3.63, Immediate report to the Government if problems such as dilapidated bridges occurs with an index 3.57, Construction of drainage around buildings for easy flow of water (3.54) while prevention of dumping of waste into water bodies has the lowest positive index of (3.30). However, Filling of potholes with sand or broken blocks has the highest negative index of -2.84 which implies that it contributed less to the combating climate change issues in the study areas. This is

followed in decreasing order with Regular servicing of generators and automobiles to reduce the emission of CO₂ with negative index of 3.04, Gas should be used in place of firewood and charcoal to cook for reducing emission of CO₂ with 3.05, Provision of green space in their compounds i.e. planting of flowers with 3.10 and adequate set back should be observed from water area/front (negative index 3.30). The scattered diagram illustrates calculated index of the individuals' roles index around the mean. The standard deviation score recorded is 0.26182 while the variance is 0.068554 and the coefficient of variation is 2.077.

Table 7: Roles towards Mitigating Climate Change Effects

S/N ^o	INDIVIDUALS MITIGATION TO CLIMATE CHANGE	RANKING					N	IWV	$\frac{IWV}{N}$	\bar{X}	X- \bar{X}	(X- \bar{X}) ²
		4	3	2	1							
1	Detest burning of refuse and use appropriate waste disposal technique	146	76	-	-	222	812	3.66	3.30	0.36	0.1296	
2	Relocation of residents on water fronts	147	66	8	-	221	802	3.63		0.33	0.1089	
3	Immediate report to the government if any problem occurs	127	93	1	-	221	789	3.57		0.27	0.0729	
4	Construction of drainage	122	97	3	-	222	785	3.54		-0.050	0.0025	
5	Detest from dumping of waste into water bodies	67	154	1	-	222	732	3.30		0.00	0.000	
6	Individual to observe adequate set back from water area/front	63	154	3	-	220	720	3.27		-0.03	0.0009	
7	Engage in sanitation practice by removing waste from blocked drainage	76	130	12	4	222	722	3.25		-0.05	0.0025	
8	Provision of green space in their compounds i.e planting of flowers	22	200	-	-	222	688	3.10		-0.20	0.04	
9	Gas should be used in place of firewood and charcoal to cook for reducing emission of CO ₂	24	184	14	-	222	676	3.05		-0.25	0.0625	
10	Regular servicing of generators and automobiles to reduce the emission of CO ₂	23	185	14	-	222	675	3.04		-0.26	0.0676	
11	Filling of potholes with sand or broken blocks	23	140	52	3	218	619	2.84		-0.46	0.2116	

Source: Author's Field work, 2015



Source: Author's Field work, 2015

4.6 Nigeria Meteorological Agency (NIMET)

Climate record data was collected for this research work. This include: Rainfall (mm), Maximum Temperature (°c) and Minimum Temperature (°c). The meteorological data were obtained from NIMET office. The data collected was used to examine variation in climate parameters for the past ten years (2003-2012).

4.6.1 Rainfall in Eti-Osa West and East Local Government Area

Figure 5 shows that over the past 10 years in Eti-Osa West and East Local Government Area, average annual rainfall fluctuate but high in year 2011 with the value 174.89mm and low in year 2010 with the value 115.2mm. The relationship between the annual rainfall and the years was verified using Pearson Product Moment Correlation Analysis. The result shows positive low correlation or relationship between average annual rainfall and years ($r = 0.222$). This implies that even though there is observable fluctuation in rainfall quantity the relationship is established to be positive with increasing year.

Figure 5: Average Annual rainfalls of Eti-Osa West and East Local Government Area (2003-2012)

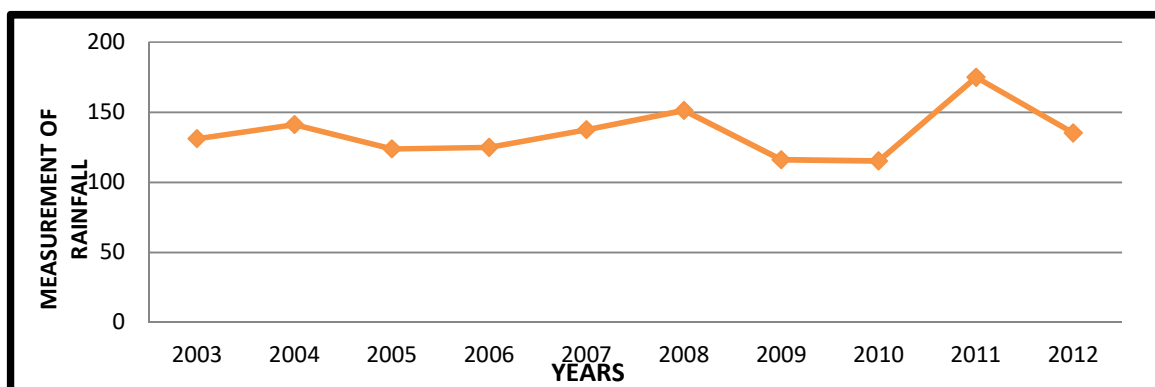


Table 8: Summary of the statistical Analysis for Rainfall (mm)

YE AR	JAN	FEB	MA R	APR	MA Y	JUN	JUL	AU G	SEP	OCT	NOV	DEC	Total	Averag e rainfall
2003	53.4	79.1	308.1	157.4	320.7	69.5	18.5	185.2	141	184.8	Trace	Trace	1571.7	130.975
2004	45.7	122.8	291.1	306.2	213.5	94.5	68.5	321.2	160.9	49.4	20.5	0	1694.3	141.1917
2005	Trace	93.1	78.2	94.1	185.3	392.3	225.3	15	194.2	94.8	96.4	16.2	1484.9	123.7417
2006	44.2	10.7	121.8	26.4	294.3	264	52.8	65.7	327.6	191.3	95.3	4.6	1498.7	124.8917
2007	0	0	76.1	31.6	253.7	367.7	228	287.9	160.1	120.3	118.3	5.4	1649.1	137.425
2008	0.8	3.3	69.6	96.8	230	365	442.7	134.3	226.8	98.8	98.9	49	1816	151.3333
2009	1.6	16.3	33.9	115.5	154.2	463.4	119	12	84.1	342.7	48.7	0	1391.4	115.95
2010	37.2	42.4	68	126.9	159.3	368.7	30.8	190.6	235.7	122.8	0	0	1382.4	115.2
2011	0	87.2	21.6	74.7	17.6	751.9	476.9	43.7	175.3	209.3	240.5	0	2098.7	174.8917
2012	10.5	122.2	78.1	124.7	134.9	478.8	152.1	34.3	214.1	148.9	123.2	0	1621.8	135.15

Source : NIMET 2012

4.6.2 Temperature of Eti-Osa West and East Local Government Area

Figure 5 illustrates the trend of average annual minimum temperature of the study area over the past 10 years. It shows that year 2011 has the highest average minimum temperature rate of 25.95°C and year 2009 with the lowest average minimum temperature rate of 23.93°C. The relationship between the average annual minimum temperature and the years was verified using Pearson Product Moment Correlation Analysis. The result shows positive low correlation between average annual minimum temperature and years ($r = 0.342$). This implies that even though there is observable fluctuation in minimum temperature quantity, the relationship is established to be positive with increasing year. Year 2009 had the lowest minimum temperature rate of 23.93°C and increased in 2011 to 25.95°C, which depicts a decrease in cold and an increase in heat. This changed could be ascribed to the increased rate of deforestation.

Table 9: Summary of the Statistical Analysis for Minimum Temperature (°c)

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Total	Average Temp
2003	25.6	25.8	25	25	23	23.2	23.4	23.4	24.1	24	24.2	23.5	290.2	24.18333
2004	25	25	25	24	23	23	23	23	23	25	25	23.6	287.6	23.96667
2005	22.6	25.7	25.3	25.3	24.6	23.7	23.3	22.9	24	24	24.6	24.7	290.7	24.225
2006	25.1	25.2	25	25.3	24.1	23.4	23.5	23.6	23.9	23.7	24.8	24.3	291.9	24.325
2007	24.6	25.8	25.7	25.6	23.8	23.4	23.3	23.3	23.3	23.3	24.2	24.3	290.6	24.21667
2008	24.7	24.8	25	26.1	24.4	23.1	23.5	23.2	23.4	23.4	24.5	23.5	289.6	24.13333
2009	23.9	25	25.3	24.7	24.2	23.2	22.4	22.7	23.1	23.1	24.8	24.8	287.2	23.93333
2010	23.8	25.1	24.7	24.7	24.2	23.3	23.7	22.9	23.5	23.5	24.4	23.7	287.5	23.95833
2011	25.6	27.4	27.8	26.9	26.8	24.9	24.6	24.6	24.7	25.8	26.2	26.1	311.4	25.95
2012	24.2	25.1	25.8	24.7	24.5	23.8	22.8	23.6	23.2	23.6	24.7	23.9	289.9	24.15833

NIMET(2012)

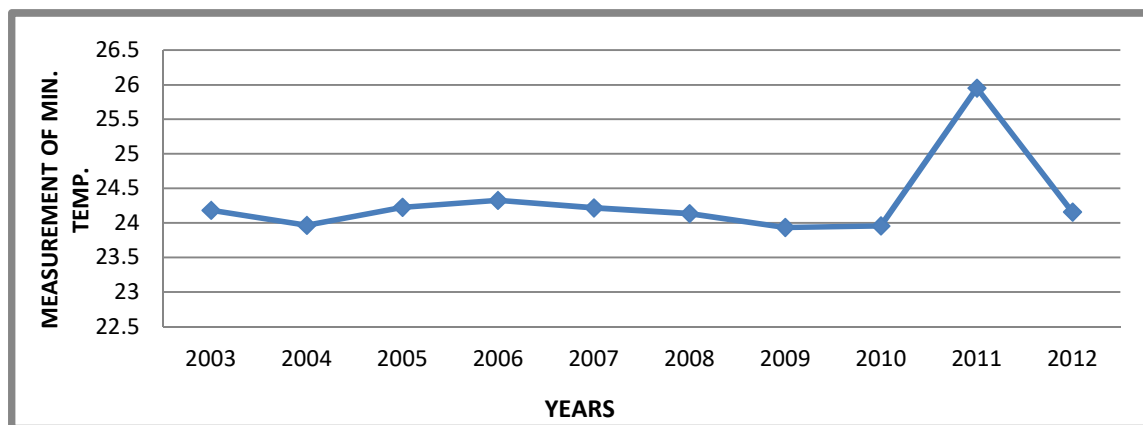


Figure 6 Average Annual Minimum Temperatures of Eti-Osa West and East Local Government Area (2003-2012)

Source: NIMET(2012)

4.7 Average Annual Maximum Temperatures of the Study Area (2003- 2012)

Figure 7 shows the trend of average annual maximum temperature of the study area over the period of 10 years. Year 2012 has the highest average maximum temperature rate of 32.19°C and year 2010 has the lowest average maximum temperature rate of 29.52°C. The relationship between the average annual maximum temperature and the years was verified using Pearson Product Moment Correlation Analysis. The result shows a negative coefficient of ($r = -0.204$). This implies that even though there is observable fluctuation in the amount of maximum temperature the relationship is established to be negative with increasing years. This depicts that in year 2012, there was an increased in heat.

Table 10: Summary of the Statistical Analysis for Maximum Temperature (°c)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	total	Average Max Temp
2003	32.4	33.6	33.9	32	32.3	29.5	29.2	29.3	29.3	31.2	32.5	33.5	378.7	31.55833
2004	33	34	32	31	30	29	28	29	30	32	33	33.6	374.6	31.21667
2005	33.2	33.4	33.4	32.9	31.1	29.4	28.3	28.6	29.5	30.6	32.4	32.7	375.5	31.29167
2006	32.5	33.8	33.3	33.9	31.4	30.7	29.1	28.8	28.6	30.7	33.3	33.6	379.7	31.64167
2007	31.8	32.5	30.9	31.3	31	28.9	26.8	27.3	28.3	29.4	30.9	31.2	360.3	30.025
2008	33.3	35.3	33.5	33.1	31.7	30	28.9	29.1	29	31.2	33.9	33.2	382.2	31.85
2009	31.1	30.7	31.2	31.3	30.2	29.1	27.4	27.6	28	28.9	30.3	30.8	356.6	29.71667
2010	31	30.9	31.4	26.1	30.3	30.2	27.7	27.4	27.9	29	30.8	31.6	354.3	29.525
2011	31	32.2	32.2	31.8	31.2	29.7	29.1	29	29	30.6	31.4	31.7	368.9	30.74167
2012	33	33	33	31.2	30	30	29	39	31	32	32.4	32.7	386.3	32.19167

Source : NIMET 2012

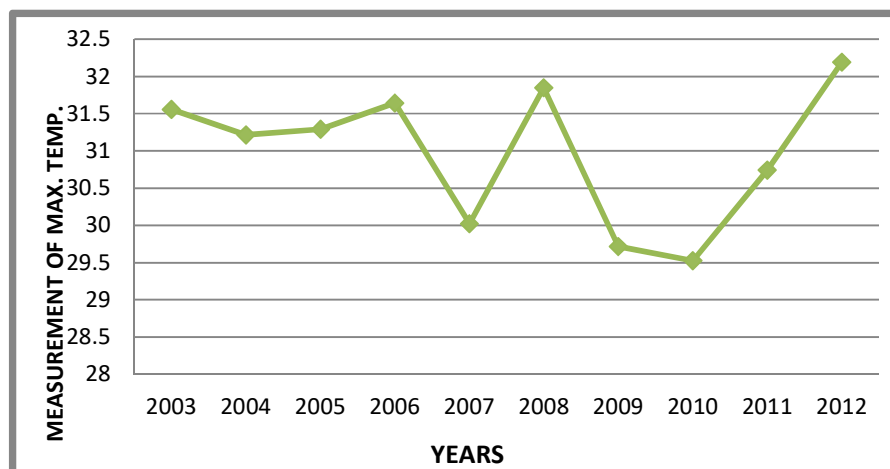


Figure 7 Average Annual Maximum Temperatures of the Study Area (2003- 2012)

Source: (NIMET 2012)

6. Conclusion and Recommendations.

The paper has shown that climatic parameters, specifically rainfall and temperature experienced observable changes within 2003-2012. This has significant impact on the residents' in the study area. The impacts vary from high rise in sea level which often results to flooding. The resultant effects of this include loss of life and property, loss of land outbreak of diseases among others. Consequently most of the residents' adapt to this changes and its effect by constructing drainages, engage in constant sanitation practices through removal of waste from blocked drainage among others. The study reveals further that fluctuations in rainfall and water scarcity are major impact of climate change that occurs in the study area. This was also established from the meteorological data that there is observable fluctuation in both rainfall and temperature between 2002-2012 The study further recommends that residents' should provide green space in their building premises, maintain adequate set back and relocate from water front's before and during overflow of bank. Government should establish sectors or institutions linked with researchers to provide weather updates and also address issues concerning climate change, discourage developments towards the coastline and also embark on planting of trees to serve as buffer zones at coast line region. It is also suggested that the three-tiers of the government in Nigeria should provide or allocate fund to climate change research and towards combating its effects.

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