Water and disaster management in Nigeria: the real estate sector perspective

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Abstract

Buildings and the built environment play a key role in supporting human activities and delivering economic prosperity. At this basic level, buildings are designed to provide comfort and act as barriers to environmental hazards. Water disasters are major environmental hazards world-wide and they vary from place to place. In Nigeria, the growing occurrence of extreme weather conditions due to global warming has increased the risk of water disasters both in terms of their frequency and severity. This paper therefore analyzed the causes of the disasters, consequences it has on the real estate sector and disaster management plans to be undertaken by property managers and building engineers to mitigate its effects and uncertainties in the foreseeable future. Using the regression analysis, result of findings indicated that excessive rainfall during the raining seasons, sea level rise, blocked drainages and collapsing of dams were the most significant factors ($p < 0.05$ and 0.01) causing flooding and leading to water disasters occurrences in the country. In conclusion, this paper therefore recommended that only flood resistant buildings with raised pile foundations should be erected on floodplains. Building structures sitting on canals and drainages should be demolished and debris cleared to allow easy passage of water. Also there should be building of strong and high water defenses around dams and water bodies to prevent overflows.

Keywords: water disasters, real estate sector, disaster management, climate change, market value, pile foundation, flood proofing materials.

1 Introduction

The real estate sector is subjected to multitude of complicated influences which are generally classified into those which are external and those which are internal

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to the property (Mackmin [2], Bello and Bello [3]). Water disasters have both external and internal influences on the real estate sector and have caused the loss of many lives and properties worldwide. These disasters occur not only because of natural settings and events but also because of adverse socio economic situations and exacerbated human activities (Enrico and Maria [4]). Undoubtedly, the major contributing factor of water disasters in Nigeria is the incessant flooding which is occurring in most cities and towns of the northern, southern, eastern and western parts of the country in recent times. The National Emergency Management Agency (NEMA) [5] predicted that the country's coastal lines and flood plains which are below sea level would be in more danger of increased flooding as there will be heavy downpours and rising water levels in the years ahead. A lot of coastal land regions and uplands previously untouched by floods are being submerged nationwide and this gives a cause for concern. In the South West geopolitical coastal cities of Lagos, Port Harcourt, Calabar, Uyo and Warri, there were serious flooding episodes in 1996, 2000, 2002, 2004, 2006, 2009 and 2010. Also Lagos and Ogun states were ravaged by floods due to the release of water from Oyan dam in October 2010. This led to the displacement of people and loss of 400 homes inhabited by people living near the river bank. The most recent flooding episode which was the worst to hit Lagos state in recent times occurred on July 10th , 2011 where the rain fell for over 14 hours and 25 people were found dead, many injured and properties worth billions of naira destroyed (Abdulfatah [6]). According to Regina [7] "The exact amount of the rain that fell on July 10th 2011 was meant for a whole month". The northern part of the country is also not spared because in August 2009, thousands of families became homeless and many dead across twelve Local Government areas of Kano and Jigawa states following floods from Kano River. Sokoto and Kebbi States in September 2010 also witnessed heavy downpours where 50 lives were lost, 8,000 houses and 12,000 farmlands destroyed (Ibidun [8]). However these huge losses and high death rates can be lowered if the causes of these flooding are carefully analyzed and proper measures are taken to mitigate the effect of its challenges especially in the building and construction industries.

2 Water disasters

Water disaster is one of the greatest natural disasters known to mankind and it accounts for about 70 per cent of all global disasters. Water-related disasters are not only natural but are caused by a combination of both natural and human-induced factors. Natural and human-induced hazards are expected to rise further owing to global warming and the insensitivity of humans to climate change. Global climate change and projected increase in global temperature scientists generally agree will intensify the hydrological cycle and increase the number of heavy precipitation events in many land regions (ISDR [9]). There are other causes of water disasters which can result into flooding worldwide but according to Integrated Flood Management Concept (IFM) [10], flooding generally occurs when water overflows from a water body and submerges the land surrounding it,

destroying standing crops, dwellings, infrastructures machineries and buildings. This happens when the amount of water exceeds the capacity of the water body and overflows. It can also occur when there is continuous rainfall and the source of water body gains momentum and forces its way out of normal track engulfing whatever comes its way (UNSGAB [11]).

The location of Nigeria on the geography of the planet has been to its advantage such that there have been no cases of tsunamis, hurricanes with wind travelling at 240 mph; no volcanoes and no significant earthquake. Nigeria and the West African coastal regions are not really on the equator and as such not facing the direction of strong winds (Tuwrase [12]). The continental shapes facing strong winds encourage some of these disasters because the strong winds move from the epicentres where the effect of the wind strength is strongest to low pressure areas. However, Nigeria has been deluged with many episodes of water disasters and the rate of flooding has been particularly worrisome during the raining season. It rains heavily almost every day during the months of July to September in the coastal regions and there is virtually no August break thereby causing oceans and other water bodies to overflow their bounds. The World Bank assessment of flood disaster sites in Nigeria in December 2010 reported that 23 states were affected with serious consequences on socio-economic well-being thus making climate change "a reality". The effects of climate change on the built environment will also increase as sea level continues to rise and the number of extreme heat days (those over 35°C) increase in the coming years between 10% and 100% placing significant demands on building systems and the energy supply (Branz [13]).

Even though some elements of flooding are clearly beyond human control, it is clear from various submissions [14–16] that some key elements also emanate from human factors. Human activities contribute to the number of natural disasters being experienced in Nigeria and it is usually exacerbated as a result of poor drainage infrastructures, blockage of available drainages through improper disposal of refuse, collapsing of dams and dredging activities. Indiscriminate property development along water ways and unplanned urbanization is also another cause of flooding which subjects the marginalized segment of society to water disasters because their places of abode are majorly in the slums where they lack basic amenities. Drainage and sewage lines in many urban towns and cities have also been turned into refuse dump sites while people build on sewage lines and water channels. All these are due to human activities arising from ineffective land use regulations and building codes. There is also unnecessary exposure of people to canals and drainages which are still under construction as there are no barriers or warning signals. This has resulted in the death of many people who could not distinguish between the roads and the drainage channels already covered by the flood. The indiscriminate cutting down of trees is equally a great risk factor which not only leads to flood but prepares the soil on a perfect path to gully erosion. Also improper maintenance and release of water from dams without caution also leads to flooding with consequence on the host communities.

3 Buildings as barriers to environmental hazards

A building transcends ordinary shelter but rather it is a structure meant to provide comfort and at the same time serve as barriers to environmental factors (Aina and Somefun [17]). Regardless of a building location or type, the goal of a successful building design is to envelope, enclose and separate the indoor and outdoor environments. According to DuPont [18], buildings as enclosed structures should be able to keep water out and provide thermal control within the interior spaces. It should also control heat flow, airflow, water vapour flow, rain, groundwater, light and solar radiation, noise, vibrations, contaminants, environmental hazards, odours, insects, and fire. In the built environment there is the need for buildings to be designed in such a way that they are structurally resilient to withstand disasters and limit extent of damage and vulnerability from the environment (Warren and Matthews [19]). In Nigeria, buildings and many infrastructures situated along coastlines and hazard prone areas are not properly elevated and designed in such a way that they can withstand environmental hazards of wind, rain and ocean surges. The water bodies are not embarked and this has resulted in many flooding cases within and outside the buildings. This neglect in land use regulations and building codes has eroded progressively the coastlines of the country spanning a length of 850km with the Bar beach problem in Lagos being the most prominent. Storm surges experienced during the months of April to May and August to September have also made surge heights to exceed 4m above low water levels in Victoria Island and Ikoyi areas of Lagos Sate resulting in flooding and displacement of many residents. According to Fayemi [20] builders of houses and infrastructures in disaster-prone areas who traditionally put together projects that weigh lower up-front construction costs against the potential price of repairing or replacing these structures when a natural disaster strikes are the ones to suffer more loss when disaster occurs. Professionals and stakeholders in the built environment are therefore obliged to follow international best practices so that even when disasters or the accumulation of risk from regular and persistent smaller hazards occur, it cannot wipe out the hope of sustainability for properties in these disaster prone environments. The ineffectiveness of current standards and the use of poor and incorrect construction materials has being demonstrated by the rate of collapse and structurally defected buildings and this is a clear signal that massive challenges remain in achieving both buildings and environmental sustainability (Seth [21]).

3.1 Methodology

The study was carried in Nigeria using six geo-political zones and information was collected from the respondents with the aid of structured questionaires. The technique for the study is the stratified random sampling technique. Information sought for included the socio- demographic variables of the respondents, causes of water disasters in these regions and some disaster management plans to mitigate the effects of water disasters in Nigeria.

As regards the educational level of the respondents, it cound be observed from table 1 that the majority of the respondents (83%) had tertiary education, (14%) had SSCE, while just (3%) had pry school/JSCE. This is an indication that graduates were mostly involved in this survey. The essence of securing information on the respondents' qualifications was to be sure that they relatively understood what the survey was about and thereby, to some extent, were able to contribute solutions to the problems of flooding in Nigeria. As regard ethnic groups, (34%) of the respondents were Yorubas, (25%) of the respondents were Igbo while (41%) of the respondents are Hausa. Though the majority of the respondents are Hausa, all the three major ethnic group in Nigeria across six geo-political zone were fully involved in the study.

Table 1: Socio-demographic variables of respondents.

Variable	Frequency	Percentages
Gender		
Male	1317	55
Female	1083	45
Age		
20-30yrs	99	4
31-40yrs	306	13
41-50yrs	861	36
51-60yrs	486	20
Above 60yrs	648	27
Marital Status		
Married	1737	72
Single	651	27
Divorced	12	1
Highest Education		
Pry School/JSCE	63	3
SSCE	330	14
Poly/Univ	2007	83
Ethnic Group		
Yoruba	817	34
Igbo	597	25
Hausa	986	41
Geo-Political Zones		
South-West	400	16.6
South-South	400	16.6
North-East	400	16.6
North-West	400	16.6
North-Central	400	16.6
South-East	400	16.6
Total	2400	100

Source: Field Survey, 2011

Explicitly, the regression model for the study is expressed as:

$$Y = b_o + bx_1 + bx_2 + bx_3 + bx_4 + bx_5 + bx_6 + bx_7 + bx_8 + bx_9 + bx_{10} + bx_{11} + bx_{12} + bx_{13} + U$$

where

Y = Water disasters,

x_1 = Poor drainage infrastructures,

x_2 = Collapse of dams,
x_3 = Sea level rise,
x_4 = Excessive rainfall,
x_5 = Blocked drainages and canals,
x_6 = Topography,
x_7 = Types of soil,
x_8 = Unplanned Urbanization,
x_9 = Destruction of vegetation,
x_{10} = Dredging activities,
x_{11} = Location of country,
x_{12} = Environmental mismanagement,
x_{13} = Poor governance,
U = Random Error Term.

Table 2 shows the result of the regression analysis. Regression log result was chosen based on the number of dependent variables that are significant, the value of the coefficient of multiple determinations (R^2), the F-value as well as the value of the standard error. The table showed that R^2 is 0.683 meaning that the independent variables can explain about 68% of the variations in dependent variable. F-value of 20.060 means that the overall equation is significant ($p<0.01$) while Durbin Watson (DW) of 0.986 (less than 1.0) shows the

Table 2: Regression result of factors affecting flood in Nigeria.

Model	Estimates	Std. error	t	Sig
(Const.)	3.332	1.583	2.104	0.037
Topography	0.168	0.105	1.600	0.112
Poor governance	0.061	0.119	0.517	0.606
Dredging activities	0.144	0.120	1.206	0.230
Unplanned urbanization	0.230	0.120	1.912	0.058
Environmental mismanagement	0.075	0.106	0.712	0.478
Collapse of dams	0.378	0.156	2.424	0.017*
Poor drainage infrastructure	0.467	0.155	3.024	0.003**
Location of the country	0.014	0.035	0.410	0.683
Type of soil	0.046	0.134	0.347	0.730
Destruction of vegetation	0.020	0.160	0.123	0.903
Excessive rainfall	0.410	0.126	3.247	0.002**
Sea level rise	0.457	0.144	3.167	0.002**
Block drainages and canals	0.240	0.121	1.984	0.050*
R^2	0.683			
Adjusted R^2	0.649			
Std. Error	1.077			
DW	0.986			
F	20.060			

Source: SPSS Software computer printout.
**Significant at 1% level; *Significant at 5% level.

presence of auto-correlation. The result shows that out of thirteen explanatory (causes of flooding) variables used, five variables were significant, these are excessive rainfall, sea level rise, poor drainage infrastructure, collapse of dams and as well as blocked drainages and canals. Excessive rainfall, sea level rise and poor drainage infrastructure are significant ($p<0.01$). Collapse of dams and as well as blocked drainages and canals were also found to significantly affect the rate of flood in Nigeria ($p<0.05$). Excessive rainfall is the most significantly factor affecting flood in Nigeria.

3.2 Consequences of water disaster on the real estate sector

The real estate business is one of the basic economic sectors in the world. However, it is world-wide accepted that the real estate market is affected and formed not only by economic and productive factors, but also by various qualitative characteristics of the natural and human environment, in which each real estate activity is being performed (Karanikolas [22]). The challenges posed by global warming and climate change are getting worse, especially to those living in coastal areas and flood plains. This problem is compounded by the way the people live and build houses in total disregard of safety and good urban planning. Property owners and asset managers along the river banks and the coastal plains suffer the most from loss of property values, replacement costs and costs for modifying their structures. In realizing the implications or cost of climate change and reflecting on the aftermath of the flooding which destroyed lives and properties worth billions of Naira in Nigeria. Residents are vacating flooded properties and, as such, there is unwillingness to pay or renew the rent for these properties causing a decline in the market values which, according to the International Valuation Standards (IVS) is the "*estimated amount for which a property should exchange on the date of valuation between a willing buyer and a willing seller wherein the parties had each acted without compulsion*".

Every year floods in various parts of Nigeria have been reported to cause the death of many people, forced thousands of people from their homes, and destroyed scores of houses and many social infrastructures such as schools, roads and bridges. Floods have very devastating effects on its surrounding regions and causes damage and destruction to both buildings and infrastructures that comes its way. It obstructs the normal supply of water causing scarcity of clean drinking water, contamination and water borne diseases. More than that, it causes loss of lives and property on a huge scale and alienating affected areas from the normal flow of life, food supply, communication and easy access of vehicles. The most vulnerable regions and settlements being those located in coastal areas and within flood plains (Huntington [23]). According to the statistics released by NEMA, an estimated 1,555 persons died, while another 258,000 were displaced in various flood disasters in different parts of the country in 2010. **Hazards in and around flooded buildings include** risk of structural collapse, septic system collapse, trip and fall injuries, electric shocks, waterborne diseases and mold growth indoors. Flood waters often undermine foundations causing sinking, cracking of floors, buildings collapse thus making the damage caused by climate change to be enormous if not prepared for. The

cost of damage to buildings, cars, electrical installations, health, and property market cannot be fully estimated such that it takes a large chunk of funds from the nation's treasury for relief and rehabilitation.

The fact that the properties have already suffered floods proves that there is a high risk of such an environmental risk to appear again. In Figure 1, a percentage more than 80% declared that there is actually a discount on market value.

Figure 2 shows that the fact that properties have not flooded for at least five years but still have a decreased value. This is mainly due to fear that the

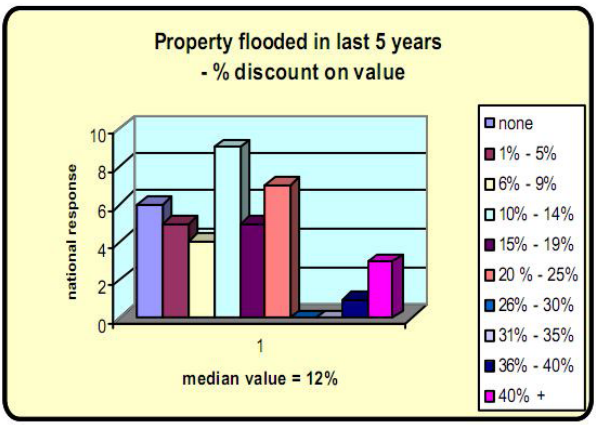

Figure 1: Decrease in value of flooded properties in 2004. (Source: RICS (Royal Institute of Chartered Surveyors) Foundation.)

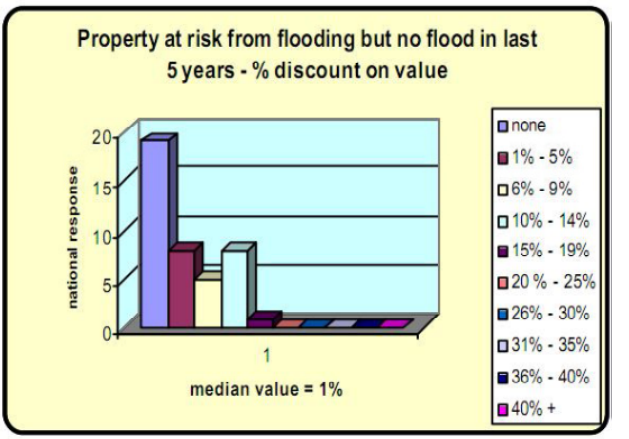

Figure 2: Decrease in value of properties at risk from floods in 2004. (Source: RICS (Royal Institute of Chartered Surveyors) Foundation.)

properties still stand a chance of being flooded in the nearest future. This brings about the unwillingness to pay for those properties and hence, there is still a decrease in their market value.

4 Conclusion and recommendation

In conclusion, after evaluating the descriptive statistics of this study which comprised mainly of graduates who are relatively informed about what the study is all about and using results from the regression analysis, this study is recommending the following measures to mitigate the effects of water disasters in the real estate sector.

4.1 Design features and flood resistant buildings

Engineering associations and professionals in the built environment should develop designs, guidelines and practices for enhancing water resistance in buildings. In promoting hazard resistant building designs in zones prone to flooding, there should be building specifications and regulations that guide construction works, networks that transport people and goods, distribute energy, and maintain communications in the building (Warren [24]). Engineers and architects should be practically exposed to liabilities in the event of structural damaged which occur as a result of negligence on their parts. This is necessary because of their crucial roles in developing building standards, designing what gets built and because of their professional responsibility in guaranteeing the performance of the structures they design. In frequently flood prone areas, flood-proofing materials and elevating of the infrastructure and communication links can reduce the debilitating impacts of floods on the economy (Carmon and Shamir [25]).

The use of water proof cement in concrete mix cannot be over emphasized in the construction industry where incidences of flooding are concerned. It does not allow water to seep through and the concrete continues to gain strength in the presence of moisture. When submerged in water, it absorbs very small amounts of water over long periods of time and as such when reinforced should be used for buildings erected in flood plains and coastal regions. For example in the rebuilding of New Orleans after Hurricane Katrina, architects and engineers were looking at structures that will keep water out and not shift or float away when submersed in floodwaters. One solution was to reinforced concrete walls to the roof height with a 12-in. thick concrete slab. The slab was kept in place with 8-in. helical anchors drilled (pile foundation) 10 to 13 feet into the ground (Hank [26]).

4.2 Risk assessments and management strategies

The Royal Institution of Chartered Surveyors, in a recent practice guide to property and facility managers drew on the recommendations of the Turnball Report as the basis for developing property risk assessment. This report strongly

recommended that all publicly listed companies should have a risk management strategy and proposed scope of risk assessment (Turnball [27]). The importance of this organizational risk assessment to external and internal crisis was specifically recognized into corporate governance considering the preparedness of societies to live and deal with risks taking into account risk perception issues and emerging threats such as global warming and climate change.

4.3 Planned urbanization

With the increasing population and migration of people from rural to urban areas, more people are forced to occupy hitherto inhabited areas with greater risk of exposure to hazards. The situation is aggravated due to a trend of migration of poor settlers who build indiscriminately in places which are natural courses of canals, streams and rivers. Land-use planning is another example of integrated policies that can help reduce water disasters risk in the built environment by taking account of the positive, social and economic aspects of flooding. Land use control should be adopted where intensified development on a particular flood plain is undesirable. Also providing incentives for development to be undertaken elsewhere can probably work better than simply trying to stop development on the flood plain. However, where land is under development pressure, especially from informal development, such planning constraints are unlikely to be effective and as such, there should be planned urbanization from the onset.

Urban drainage design is based on the principle of draining water from urban surfaces as quickly as possible through pipes and as such drainages should be cleared of debris to allow easy flow of water. Consequently the government, property managers and residents should take precautionary measures by regularly clearing drain systems and allowing for easy passage of water. Interference on natural and constructed drainage routes due to building of houses and infrastructures on them should not be encouraged as this also increases flood hazard both in downstream and upstream reaches. Buildings and infrastructures on these routes should be demolished without compensation to serve as deterrents to offenders. Development activities should also be coordinated in such a way that they do not contribute to the intensity of the hazard or spread them. There should be a limit to environmental degradation resulting from human development as this can also increase the vulnerability to risks posed by natural hazards.

4.4 Building of embankments

The building of embankments and the prohibition of buildings on vulnerable flood plains can minimize the loss of life and properties. Rivers and oceans prone to floods should be carefully managed and defences such as levees, bunds, weirs, reservoirs, and installation of rock beams, rock rip raps, used to prevent them from bursting their banks. When these defences fail, emergency measures such as sandbags or portable inflatable tubes should be used. Governments also have the prime responsibility of reducing risks before disaster strikes by

adequately utilizing dams and building of concrete reinforced defence walls to hold back rising waters.

4.5 Policy formulation

There is need for policy formulation and improved cooperation among decision-makers, property managers and water managers in federal, state and local government sectors. Indicators should be installed to detect and monitor changes in the natural and social environment so as to provide a quantitative basis for the design of disaster risk reduction policies and to monitor the effectiveness of these policies. People in flood prone areas should relocate and government should assist by encouraging resettlement schemes. Houses should be located far away from rivers so as to minimize the flood problems and residents relocated to safer areas and that those unwilling to do so because of culture and tradition be given an ultimatum to comply with the order. Research work and educational programmes should also be encouraged in institutions of learning as long-term solutions lie in being able to build a more resilient, and adaptive society. This should be founded on solid knowledge thorough understanding of hazard events, climate change manifestations and human vulnerabilities.

References

[1] Douglas, J., Building performance and its relevance to facilities management. *Proc of Facilities*, vol. 14, no. 3/4, pp. 23-32, 1996.
[2] Mackmin, D., Is there a residential valuer in the house? *Journal of valuation.* vol. 3, pp. 384-90, 1985.
[3] Bello, O., & Bello, V.A., Valuation of properties in close proximity to waste dumpsites. *Journal of Urban Economics,* 2009.
[4] Enrico, C.P., & Maria, C., The significance of geospatial information and the role of surveyors in meeting the challenges of disaster risk reduction and climate change adaptation. 2007.
[5] National Emergency Management Agency (NEMA). *World Bank assessment tour of flood disaster sites in the Nigeria*, December, 2010.
[6] Abdulfatah, B., Evolving efficient flood management strategy in Nigeria.
[7] Regina, F., Assistant-Director, Nigeria Institute for Oceanography and Marine Research (NIOMR).
[8] Ibidun, A., Vulnerability of poor urban coastal communities to flooding in Lagos, Nigeria, 2011.
[9] International Strategy for Disaster Management (ISDR). *Prepared as a supporting paper for the International Conference on Water Related Disaster Risks Dushanbe, Tajikistan,* 27-29 June, 2008.
[10] Associated Programme on Flood Management, (APFM) *Integrated flood management concept paper,* Technical Document No. 1, second edition 2004.
[11] United Nations Secretary-General's Advisory Board on Water and Sanitation (UNSGAB) *High-Level Expert Panel on Water and Disaster,* 2009.

[12] Terwase, Y., Natural disasters: Nigeria blessed but not really safe *newspaper,* 18 February 2010.
[13] Branz, D., An assessment of the need to adapt buildings for the unavoidable consequences of climate change, *Australian Government, Department of the Environment and Water Resource Canberra,* 2007.
[14] Intergovernmental Panel on Climate Change (IPCC) Impacts, Adaptation and Vulnerability. *Contribution of the Working Group II to the Third Assessment Report of the Inter governmental Panel on Climate Change*, eds. J. J. McCarthy, O. F. Canziani, N.A. Leary, D. J. Dokken, and K. S. White. Cambridge, UK: Cambridge University Press. 2001.
[15] Department for Environment, Food and Rural Affairs (DEFRA). Wetlands, land use change and flood management, *Joint statement*, 2003
[16] Parry, M., Millions at risk: defining critical climate change threats and targets. *Global Environmental Change,* eds N. Arnell, T. McMichael, R. Nicholls, P. Martens, S. Kovats, M. Livermore, C. Rosenzweig, A. Iglesias and G. Fischer, vol. 11, pp. 181-183, 2001.
[17] Aina, O., & Somefun., Effects of facilities provision on rental values of residential properties *Journal of land use development studies.* 2007
[18] Dupont, Tyvek, Moisture management in wall assemblies: air, water and vapor barriers, *AIA/Architectural Record Continuing Education Series* 2008.
[19] Warren, C., & Matthews, G., The Role of property and construction professionals in major disaster management. *paper presented to REC Building Resilience achieving effective post-disaster reconstruction Christchurch New Zealand*, 30 April 2 May, 2008.
[20] Fayemi, O., Nigeria prone to natural disaster. *lead story, news across Nigeria* 2011
[21] Seth, G., Durable designs and a greater sensitivity to the surrounding environment. *Journal Science* March 6th edition 2009
[22] Karanikolas, X., Real estate values and environment: a case study on the effect of the environment on residential real estate values, 2001.
[23] Huntington, T., Evidence for Intensification of the Global Water Cycle: Review and Synthesis. *Journal of Hydrology pp.* 319 (1-4): 83-95, 2006.
[24] Warren C., The Role of Corporate Real Estate Managers in Disaster and Business Continuity Planning. *Pacific Rim Real Estate Society Conference Wellington* 24-27 January 2010.
[25] Carmon, N., & Shamir, U., Water- Sensitive Urban Planning: Concept and Preliminary Analysis. 1997
[26] Hank, B., & DMK Group, Building Design and Construction, 2007.
[27] Turnball Report., Internal Control Guidance for Directors on the Combined Code. *The Institute of Chartered Accountants in England & Wales, London.* 1999