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## Editorial

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The ***Journal of Geography, Environment and Planning (JOGEP)*** is published twice in a year. The Journal presents to the specialised readers important new development in the areas of interest in Geography, Environmental Management and Planning.

The aim of the journal is to describe, assess and report research and new development efforts in the areas of disciplines.

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# DISASTER RISK AND URBAN VULNERABILITY: A STUDY ON THE RAIN/WINDSTORM DISASTERS AND ITS DAMAGE TO BUILDINGS AND INFRASTRUCTURES IN MINNA, NIGER STATE

OWOEYE OLUSEGUN IDOWU*

## ABSTRACT

*Understanding what risk is all about marked the starting point in combating the inflictions of hazard on human settlements. Hazard in its real sense is a natural event aggravates by human activity, however, it turns to be a disaster if strike an unprepared environment. Rain/windstorm hazard is a kind of hydro-meteorological hazards like flood, mudflows, debris and lots more which destroys the natural landscape of human settlements. In lieu of that, this study aimed at examining the impact of disaster caused by rain/windstorm hazard and its damage to buildings and infrastructure in the city of Minna. Questionnaires were administered to track the event of this disaster in different parts of the city, for the analysis on the incidence, nature and extent, the coping capacity and the factors responsible level of disaster in respect to damages on buildings and infrastructure, using a stratified sampling technique for primary source of data to compliment the secondary sources that establishes it as a phenomena. The analysis on this study revealed that, the incidence of rain/windstorm damage to property is true and do happens on a frequently basis between the month of April-May every year. The nature of the disaster has majorly been on residential structures, and infrastructure, with the roof, plot fencing and wall of the buildings, suffered more. The traceable factors have been humanly induced in nature, while the coping mechanism shows non familiarization with the conventional reduction initiatives. Against the background, the study proffers recommendations on the need for immediate and future approaches, to solving both the already existing problems and the potential risk threats that could occurs in time to come. The approaches focus on the physical planning procedures and disaster risk reduction initiatives through the development of framework that is structurally balance, contextual justified, policy stable and institutional oriented.*

**Keywords:** Disaster, Hazard, Risk, Urbanization, Vulnerability, Wind/Rainstorm.

## INTRODUCTION

Over the last three decades, natural and human-made disaster have claimed millions of lives and caused huge economic loss globally. Cities have become the focal point for everyone living in the world to reside, and it is fast becoming the locus for much of the destruction and loss from disaster. Rapid urbanization, coupled with global environmental change, is turning an increase number of human settlements into potential hotspots for disaster risk. (UN-Habitat, 2007). Because of the impending threat to human settlements and the environment, in recent years, there has been a major shift in peoples' attitudes and behaviours towards coping with natural disasters. In the past more emphasis was placed on humanitarian response and relief activities, with little attention being paid to disaster reduction strategies that have the potential to save thousands of lives by even the simplest of measures. Today, there is increasing recognition that while humanitarian efforts are important and need continued attention, risk and vulnerability are crucial elements in reducing the negative impacts of hazards and thus essential to the achievement of sustainable development (UN-ISDR, 2004).

Risk or disaster risk means the probability of harmful consequences or expected loss (of lives, people, injured, property, livelihood, economic activity disrupted or environment damage) resulting from interaction between natural or human-induced hazards and vulnerable or capable condition (UN-ISDR 2004a). According to UN-Habitat report 2007, it is observe that disaster in urban areas are experienced when life support system fail in the face of pressure from external stress resulting in loss of lives, damage

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to property and undermining of livelihood. However they are not natural events or act of God, but product of failed system and development. And that the majority at people in risk, with loss to disaster is determine more by processes and experiences of urban development and governance rather than the physical processes that could shape the natural or man-made hazards.

The numbers of hazard occurring in the world are immeasurable, the most devastating and frequent of them all is flood which always command huge losses and destruction whenever it strike. So also is rain/wind storm; a kind of disaster that is capable of inflicting greatly on human settlements and the on people. It is a devastating natural disaster plaguing the world as a whole and Nigeria in particular. The causes of risk in urban area has increase the concern of the city planners and the professionals urban in urban planning and development to identifies the factors that drives the disasters risk in the urban setting, these factors includes the rising urban population and increase density, weak urban governance, unplanned urban development, land tenure system, concentration of economic asset in a particular area of the cities, poor construction work and ecosystem decline through the climate change.

In Nigeria, the incidence of hazard cut through the six geo-political zones that made up of the country, this fact was established by the report of NEMA on the occurrence of disaster in the country in the year 2009, the report identified and analyzed nine prevailing hazards common to Nigeria, which include the following; Bomb explosion 0.30%, epidemic 0.30%, boat mishap 0.60%, oil spillage 0.60%, erosion 2.72%, communal or religion crises8.46%, flood 19.95%, rain/windstorm 29.91% and fire 37.16% (NEMA 2010). To develop a lasting measure to this, the country need to align its goals on disasters reduction after United Nations agenda on urban risk reduction, and have the depth understanding of the concerted efforts of the city planners in the 21$^{st}$ Century, there aimed, at creating a livable and safe city, through the development of framework and initiatives that will reduce the intensity and frequent happening of disaster. A resilient capacity is encourage, form against all sort of hazards.

This study aimed at examining the impact of disaster risk in the city of Minna, as a result of the occurrence of rain/wind storm damage to buildings and infrastructure, with the view to understand the resilient capability of the city against such kind of hazards. The objectives of this study include the following; to investigate and establish the incidence of rain/wind storm in different parts of Minna, to identify the areas mostly affected by rain/wind storm disaster in any part of the city, to examine the nature and extent of the damage caused by the hazard, to assess the mitigation strategy explored by the affected individual in the city and to assess the relative human factors or failures that are responsible for such level of damage recorded and those that could aggravates further occurrence in the future. Against these objectives given, the potential threat facing the city and the vulnerability of the city to rain/wind storm hazard are discussed.

## STUDY AREA

Minna in the total expanse of land coverage lies in between the latitude $9^0 92^1$ - $9^0 100^1$ North and longitude $6^0 30^1$ - $6^0 35^1$ East on geological base of undifferentiated basement complex of mainly gneiss and magmata. Based on its distance to other major towns and cities; it is about 135km away from the Federal Capital Territory, 86km to Bida, 110km away from Suleja and about 150 km to Kotangora. The city of Minna derived it name from the traditional festival performed by the "Gbagyi" who are the indigenous settlers. Presently the city serves the purpose of the administrative headquarters to Niger State. The climate of Minna is influenced by two dominant air masses; the dry and dusty tropical continental air masses. The variation in the climatic condition of the city determines the rainfall intensity, the temperature level, and the wind pattern mostly experiencing in the city. The rainy season is within the late April or early May – early October with annual rainfall of 1334mm, while the highest mean monthly rainfall is September with almost 300mm. The highest temperature in the city is in the month of March and April before the on-set of the rainy season. The temperature of the city at this period ranges between $38^0$c - $45^0$c. With regard to the topography of the city, Minna is hilly to the north and east, being steeply sloping rock outcrops from the principal physical constraint on the east side, a major drainage valley flow from the centre of the south-west ward with other tributaries (minor drainage) serving as the run-off for water from the hills. In some areas in the city, the major drainage form large area of flood land. The city

is characterizes with large but isolated rock outcrops and with few scattered rock and this topographical structure has affected the development of the city in a linear pattern.

The natural vegetation of Minna belongs to the guinea savanna vegetation, with tall grasses and elephant grasses. The effects of cultivation have reduces the presence of such trees and grasses in the city, so also is the impact of urbanization and the rate of fuel wood consumption have rendered the land empty of species of fauna that could have been of benefit to the city. In relation to the wind status, the city is predominated by two wind systems, resulting from surface wind pattern. The first prevailing wind is the south-west trade wind blowing from Atlantic Ocean, and the north-east trade wind from the Sahara desert. Constantly, there is occurrence of heavy destructive wind that accompanied the early rainstorm, usually in the month of April/May and it has cause damage to buildings, infrastructure, and loss of lives and property, absence of vegetation cover is adversely affecting the city during the rainy season and the dry season.

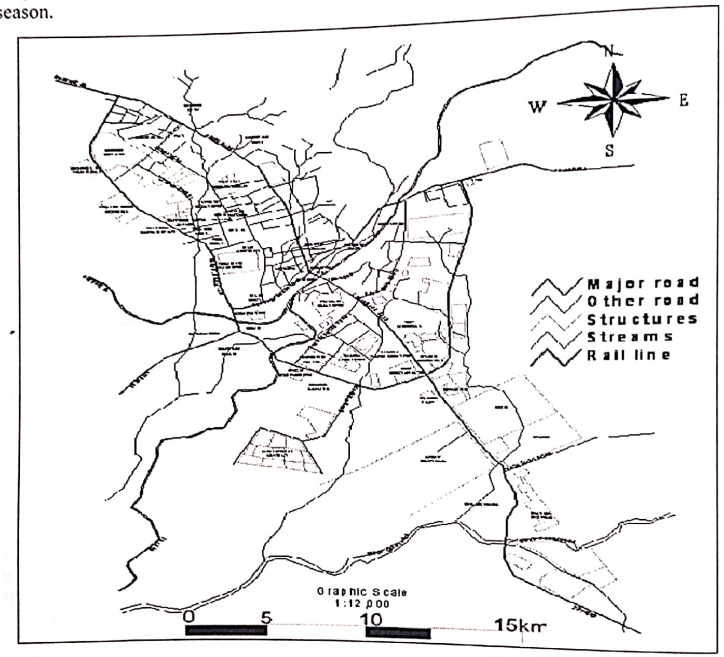


Fig. 1: Street Guide Map of Minna.

## LITERATURE REVIEW

Urban areas, a place where most of the people of the world like to live, work and play has become a place for the occurrence of different kind of hazards. The rate at which towns, semi towns and villages are growing had attracted more attention of experts and stakeholders, which has developed into serious discussions in conferences at various levels; communities, states, nations and world at large. Programmes were organized at local and international level on how to combat the already existing menace and to avoid the future threat or its re-occurrences. The steps and efforts made by international organizations in their capacity is noticed, through the organized events, international submits and

conferences. These organizations have within its main focus "disaster risk reduction initiative and sustainable development", such world gathering include the following; the UN conference on human environment at Stockholm Sweden in 1972, the world commission on environment and development, popularly known as Brundthland commission in 1983, the launch of the international decade for natural disaster reduction (IDNDR) in 1989, the UN conference on environment and development (the earth summit) in Rio de Jeneiro in 1992, the world conference on natural disaster reduction in Yokohoma Japan and UN conference on population and development both in 1994, the UN fourth world conference on women, Beijing China in 1995, first world water forum, Marrakech, Morocco in 1997, completion of the international decade for natural disaster reduction in 1999, by year 2000, the launch of the United Nation International Strategy for Natural Disaster Reduction took place, the same year with the millennium (MDGs) submit in New York, in 2005, the world submit on sustainable development in Johannesburg, South Africa took the centre stage and lately is the world gathering at Copenhagen on Climate Change in 2010. (UN/ISDR Report 2004a)

Going through the resolutions and communiqué of these meetings; analyzing their successes and failures, most of the public analysts do agreed that the major factor aggravating any disaster is rapid urbanization, and it has been seen by many as undesirable and the cause of most of the catastrophic incidence in the physical and social environment of the world. The negative effects of urbanization include problems like slums which increases geometrically on yearly basis, high numbers of squatter settlements, garbage heaps at the city highway, bad sanitation and disappearance of urban forest areas in replace of sophisticated buildings that are without planning precautions and development procedures being considered. In spite of this kind of growth the cities are experiencing, it is evidently cleared that the pace of the growth of the cities has not marched up with the quality and quantity of the desirable basic facilities and necessities needed for the development live enhancement of the residents. The implication of these situations is that most of the areas in the urban areas are under-developed with poor infrastructural provision. (Oke 1993, Adefolalu 2004 and Idowu 2006).

The effects of these adverse changes in urban landscape are more common within the developing countries, at the same time among the poor in the area. Considering the persistence increase in number of cities of the world, Adefolalu (2004), observes that, as cities are increasingly the focus of human habitation, the tendency of its agglomeration to give birth to large settlements is accelerating more in developing countries, which have been driven by lack of rural opportunities and perceptions of the rural residence for a better life in the cities. He further stressed the fact in respect to the deliberate attempts made by the government, in which has resulted into creation of more cities or "Super cities like Abuja". Analysis on the situation of Nigeria revealed that the Thirty-six States structure of the country has frightening the development and growth of the rural towns, in which, more of the semi towns are turning to "Capital" of the towns; with this, the process of urbanization keep increasing.

For the survival of the world inhabitants, the global economic of the environment which the cities rightly belongs to is considering as reservoir of resources, or life supporting system. All economic and development activities of man are dependent on these available environmental resources. The exploitation of these natural resources remains a basic necessity and an important activity which central to the existence and survival of human being in all the settlements (Jinadu, 2008). However, as these resources are serving the purpose of salvaging the quest of people in the environment, it also creates its impending problems for the future generations. The report of Idowu (2006), has buttress the fact that the growth experiencing in the urban cities today was as a result of the utilization of the abundant resources and has accompanied by high migration rate and rapid development which has exerted more pressure on high demand for space, infrastructure and other activities, with changes of the ecological setting of the environment as a return gains.

Supporting this view, Oke (1993), asserted in line with any kind of problems highlighted to be facing the urban environment, he agreed that the unplanned status of all the human activities remain a factor, which mostly aggravates the adverse changes and effects that are been experienced in most cities. And that several of these changes have imputed direct and significant impacts on the comfort, health, safety of the cities, their inhabitants, and the ecosystem, as the poor people in the cities, resides at the

receiving edge and abide with the devastating consequences known as disaster. Disaster is an extreme devastating event within human and non-human (not habitable) environment, it inflict loss to lives and properties with in a few seconds of it occurrence. Ordinarily, it may be referred to as hazard, but it has the tendency of becoming disasters, if it strikes an unprepared community. Virtually, all the cities of the world are prone to different form of hazard risk, with relatively difference in the intensity and the rate of destruction.

Risk is defined as the probability of harmful consequences or expected loss (of lives, people, injured, property, livelihoods, economic activity disrupted or environment damaged) resulting from interaction between natural or human-induced hazards and vulnerable/capable conditions. Conventionally, risk is expressed by the equation: Risk = Hazard * Vulnerability/Capacity. Risk-Vulnerability is a relative tool for disaster prevention or mitigation and is quite known as hazard analysis, threat assessment and risk assessment. It is a mean of identifying the hazard and determines the possible effects on the social, physical, and economic activities of urban area. Risk assessment/analysis is a process of determining the nature and extent of risk by analyzing potential hazard and evaluating existing condition of vulnerability/capacity that could pose a potential threat or harm to people, property, livelihood, and the environment on which they depend (UN/ISDR, 2004b).

For effective risk monitoring, data of different kind such as: socio-economic, infrastructure, settlements, and lots more are so important. In such that the data acquired on events of disaster will serves the purpose of background information on nature of hazard and the factors that could aggravate it to become disaster, to understand the kind of threat facing the human settlements and scourge of it on the people, if it is well utilized and made applicable to solving the existing problems as well tailored for any future re-surfacing. In contrary to this ideal situation, with the data acquired to be showing the numbers of events, the magnitudes in area covered and the level of the damages, if a sustainable framework is not adopted and implemented, the problems will remain unabated but pose more threat as it will spread out to other places. Natural disasters are undisputable and disastrous; measures must be on-ground to checkmate or mitigate its sudden occurrence. This is through the system known as Risk Vulnerability Assessment (RVA).

The broad concept of vulnerability assessment entails the susceptibility and resilience of the physical structures or development in any disaster area. Susceptibility is related to the factors that may cause an emergency response within the community, while resilience is the ability of those developments or activity to with stand the damages that the disaster may caused. The contents of vulnerability according to WHO (1999), focus this tool as procedure of identifying and examining the potential for hazard and determine their possible effect on any settlements, as to reduce the effects of the hazard on the people. It is considered as a dynamic on-going process of people and organization to develop a database that focus on the likely effect of potential hazard and anticipates relief needs of the victims in line with the available resources.

Of all kind of hazards experiencing in the world, hydro-meteorological related hazards is the most devastating, wide-spread and frequent. The major factor acclaimed by most scholars is the climate change, which is an attributes of numbers of adjoining factors for the changes in the ecological setting, with the end product becoming flood, mudflows, debris, drought, desertification, wild land fire, extreme temperature, sand and dust storms, wind, rain and other severe storms. Recently, both in the developed and developing countries of the world, all together were experiencing the deadly inflictions and the poisonous fangs caused by excessive surface water due to climate change. For instance in countries like; Portugal, United States, Spain, France, Britain, India, Nepal, China, Cameroun, Burundi, and Nigeria to mention a few. The losses incurred as a result of these disasters cannot be quantify in monetary term, but the account of the losses could be expressed in term to the loss of the biodiversity, loss of lives and livelihood, forced migration, social disorder, loss of investment and revenue, infrastructure damage and political instability (Jinadu 2008).

According to the EM-DAT 2008 report, cited by Jinadu (2008), reference to the magnitude of losses with respect to the direct impact on human population displacement, injuries, and death were pointed out as well the impact were mentioned as follows; in 1999, the flash flood in Venezuela killed

30,000 people, and rendered about 483,000 other homeless, also in Guatemala the occurrence of landslide which was triggered by hurricane buried the entire village, killing 30.000, the mudslide in Philippines in 2006 buried over 8,000 people. Jakarta Indonesia experienced the worst flood, reaching about 3metres in height killed 20 person and displaced more than 200,000 people.

In Nigeria between the year 2001 and 2007, the EM-DAT 2008 report on the events of disaster with in the period cut through all the geo-political zones, with no States of the Federation exempted. The three notable disasters in record are flood, fire and landslide, while the most frequent of these disasters is flood, which was documented in 21 events out of 27 of the events that were documented, other events are of fire and landslide disasters (see Table 1 below). According to the 2009 Annual Report of NEMA, on hazard identification and analysis in Nigeria, the recorded hazards include, bomb explosion, epidemic, boat mishap, oil spillage, erosion, crises, flood, rainstorm and fire. However in the frequency of occurrence of these hazards in Nigeria; fire and wind/rainstorm top the list of the hazard that frequently occurred with the total value of 67.07%. Though, flood event recorded the highest number of people affected which is about 41.52%, followed by the wind/rainstorm of 22.01%, communal/religion crises is 18.74%, fire 6.66%, epidemic 6.03%, erosion 4.14% and the collapse buildings with 0.90%.

**Table 1: Selected Disaster Cases and their Impacts on Affected Communities in Nigeria in 2000- 2007.**

| S/n | Date of Events | Disaster | Location/ State | Relative Impacts |
|---|---|---|---|---|
| 1 | Jun-00 | Flood | Sokoto | 250 homeless |
| 2 | 14th Aug. 2000 | Flood | Cross Rivers | 4 killed, 1000 homeless |
| 3 | 15th Aug. 200 | Flood | Zamfara | 750 homes damage |
| 4 | 23 Sept. 2000 | Landslide | Amakor, in Anambra State | 17 people were killed, 300 homeless |
| 5 | 20 -21 Sept. 2000 | Flood | Lagos | 500 people were affected |
| 6 | 23rd Sept. 2000 | Flood | Kebbi State | 1000 rendered homeless |
| 7 | 20th Dec. 2000 | Landslide | Atakumosa, in Osun State | 15 people were killed |
| 8 | 5th March 2001 | Fire | Gindiri in Plateau State | 30 killed, 10 injured |
| 9 | May-01 | Flood | Oke-Ogun, Idimissa, Iyere Ogbomosho, Ijebu-Owo, Oke – Ajana, Oke-Idigbon | 200 were rendered homeless |
| 10 | 22nd July, 2001 | Flood | Zamfara State | 50 injured, 3,802 homeless |
| 11 | Aug./Sept. 2001 | Flood | Jigawa and Kano States | 200 killed, 84,065 homeless |
| 12 | Apr-02 | Flood | Lagos State | 200 homeless |
| 13 | Sept./Oct. 2003 | Flood | Kaduna, Kano, Niger, Jigawa | 16 killed, 210 homeless |
| 14 | 9th-10th Mar.2004 | Fire | Oko- Baba in Lagos State | 16 injured, 5000 homeless |
| 15 | 17th-18th Jun 2004 | Flood | Lagos State | 100 affected |
| 16 | 22nd-25th Jun 2004 | Flood | Jigawa State | 4 Killed, 300 affected. |
| 17 | 8th-10th Aug.2004 | Flood | Ugelli Delta State | 15, 000 affected |
| 18 | 12th Aug. 2004 | Flood | Adamawa State | 65 killed, 600 injured, 10,000 affected |
| 19 | 21th-23rd Aug. 2004 | Flood | Gombe | 25 killed, 3000 affected |
| 20 | 6th Jan. 2005 | Fire | Port-Harcourt | 10,000 homeless |
| 21 | 6th Feb. 2005 | Flood | Lagos State | 1,000 affected |
| 22 | 7th/16th Aug. 2005 | Flood | Jigawa, Bauchi, Taraba, Yobe States | 60 killed, 4 injured 3000 homeless |
| 23 | 15th-17th Jul. 2006 | Flood | Edo State | 2000 affected |
| 24 | Aug./Oct. 2006 | Flood | Zamfara State | 10,000 homeless |

| | | | | |
|---|---|---|---|---|
| 25 | Aug /Oct 2007 | Flood | Plateau, Yobe, Ogun, Adamawa, Borno, Bauchi, Nasarawa, Kebbi and Sokoto | 68 killed, 50,000 affected |
| 26 | 1st Oct. 2007 | Flood | Gusau in Zamafara State | 10,000 homeless |
| 27 | 4th Oct. 2007 | Flood | Lagos and Ibadan | 17 killed |

Sources: Adapted from EM-DAT: the OFDA/CRED International Disaster Database 2008, as cited by Jinadu 2008.

The events of flood hazard in most of the time is in-conjunction with rain- storm or severe wind, both storms serve as catalyst to the disaster and the level of destruction recorded at period of incidence. Rain-storm or wind-storm is one the devastating natural disasters in the world and particularly in Nigeria. It has in recent years become an annual and wide spread phenomenon in all the States in Nigeria. Annually the country losses great amount of resources to rainstorm or other related storm disasters which usually resulted into colossus loss of properties and even lives, thereby worsening the housing and economic situation of the affected areas (Olabintan 2006). In another study conducted by Oluwole (2010), on the coping strategy for rain storm hazard observes that, the periodical occurrence of the disaster has been on seasonal basis. He considered it has natural event which has the tendency of raking havoc to both living and non-living things. Despite his view about the nature of the hazard, its occurrences cannot be fully established without a trace of any effects caused by human factors and while treating the hazard, it is expected not to be treated in isolation, its trends, causes and factors aggravating the disasters are very important and should be study all together, because, the essence of managing is inevitable and be timely.
Reacting to the causes of rain storm in the tropical area of Africa, Nigeria, Olabintan (2006), is of the opinion that two major factors are responsible for rainstorm disaster in Owo and Akure, these include the environmental and building engineering/technological factors. The environmental factors are characterized by the building exposure to weather condition, site relief and topography, wind velocity, wind drag and suction effects and building with its immediate environment. Considering the engineering or technological factors, this he highlighted as, the design load of the building, planning policies, implementation and control, building orientation, height and site topography, plan approval methods, government renewal programmes and policies, poor economy and lack of maintenance

## METHODOLOGY

The basic data sources for this study include the primary and secondary sources. Information from primary source involves the direct contact with the affected people in some affected areas in the city. The system for collection of the relevant data was through the aid of questionnaire, physical survey, observation and interview. The secondary data was mainly the printed and published and unpublished documents, reports, photographs and internet materials. Considering the urban structure of Minna, in line with the existing political wards delineation of the city and the road network pattern if the city, sampling methods were adopted in the administration of the questionnaire. The whole city however has twenty-four traditional wards or political wards. The study, the road network of the city serve a positive influence in diving the city into eight parts, four of them are within the metropolitan area metropolitan areas, while the other four were at the suburb areas. This study has its focus on the four inner parts of metropolitan area as the adopted sampled frame.

A total number of 210 questionnaires were administered among the four quadrants; characterized 0.1% of the population of Minna in line with the 2006 census figure of Minna as 209,951. Simple random sapling was employed in the distribution of questionnaire, as the fourth quadrant has 60 questionnaires, while the first three quadrants have only 50 questionnaires for each of them. The quadrants characterized the places like Bosso Estate, Low-cost Estate, Tundun-Fulani "A", Jikpan, Duksen-Kura, GRA, Limawa, Fadipe, Kpakungun and Mekera. The second quadrant comprises; Bosso, Angwai Daji, Tayi Village, Tundun-Fulani B and F-Layout. The third quadrant have the places like Railway quarters, Kwagila-Alagbado, Soje, Tunga A, Shiroro, Tundunwada, Barkin-Sale and Sauke-Kahuta. The fourth quadrant

covers such areas like Tunga B, Maitunbi, Sabon-gari, and Tundunwad North. The structure of these quadrants however covers both the densely and sparsely developed areas of the city. The analyzed data were done through the descriptive method was used, information about the finding were presented in tabular form, pictorial and in maps.

## DISCUSSION OF RESULTS

This aspect of the study covers the basis of what the study addresses in solving the number of threat and the incidence of hazards in the urban settlements in order to make the cities the best place for people to live, to work and to play. Topical discussion on the study centred on the incidence of rain/wind storms, nature and gravity of the damage to buildings and other things, the adopted system for mitigation or the coping strategy and the factors responsible for such level damage recorded in the city.

### Incidence of Rain/Wind Storms in Parts of Minna

The relevant information on the incidence of the hazard stipulated in the questionnaire is to ascertain the occurrence of any disaster in the areas covered by the study.

Table 2: Incidence of Disaster in Minna.

| Incidence of Disaster | Quadrant 1 | | Quadrant 2 | | Quadrant 3 | | Quadrant 4 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % |
| Yes | 44 | 88 | 42 | 84 | 37 | 74 | 47 | 78.3 | 170 | 81 |
| No | 6 | 12 | 8 | 6 | 13 | 26 | 13 | 21.7 | 40 | 19 |
| **Total** | **50** | **100** | **50** | **100** | **50** | **100** | **60** | **100** | **210** | **100** |

Source: Field Survey June, 2010

According to Table 2, in the first quadrant, 88% of the respondents agreed on the incidence of disaster, while 12% acclaimed not to be aware of it. In the second quadrant; 84% agreed, while 06% did not. Also, in the third quadrant; 74% agreed, 26% did not. And in the fourth quadrant; 78.3% accepted the incidence of disaster and 21.7% neither could not confirm the incidence. Taken the results from these quadrants into consideration; 81% of the respondents accepted the incidence, while 19% did not. This implies that occurrence of rain/wind storm hazard is well known to the people of Minna.

### The Nature and Extent of Damage Caused by Rain/Wind Storm in Minna

This entails the physical disruptions caused by the incidence of the hazard. The nature has to do with the affected items or facility, which comprises of the components of buildings or collapse and infrastructure, while the extent of the damage covers the magnitude.

Table 3. Nature of Damage Caused by Rain/Wind Storm in Minna.

| Nature of Damage Caused | | |
|---|---|---|
| **Structure** | **Infrastructure** | **Others** |
| Building collapse<br>Wall<br>Fences<br>Roof | Electricity poles<br>Street light | Tree<br>Monuments<br>Sign- post |

Source: Field Survey June, 2010

According to Table 3, the nature of damage caused by rain/wind storm hazard is classified into three, namely; structure: building collapse, wall being removed, or the fencing and the roof of buildings. Infrastructure are the electric poles, sand filling of drainages, and the street light, while other disaster include the falling of trees, monuments and sign posts.

Table 4. The Extent of Damage on Physical Structures (Buildings) In Minna.

| | Quadrant 1 | | Quadrant 2 | | Quadrant 3 | | Quadrant 4 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Extent on Structures** | **Freq** | **%** | **Freq** | **%** | **Freq** | **%** | **Freq** | **%** | **Freq** | **%** |
| Total Building Collapse | 5 | 10 | 3 | 6 | 2 | 4 | 2 | 3.33 | 12 | 5.71 |
| Collapse of building Wall | 12 | 24 | 9 | 18 | 6 | 12 | 8 | 13.33 | 35 | 16.67 |
| Collapse of Plot Fencing | 8 | 16 | 12 | 24 | 12 | 24 | 11 | 18.33 | 43 | 20.48 |
| Removed roof | 25 | 50 | 26 | 52 | 30 | 60 | 39 | 65 | 120 | 57.14 |

Source: Field Survey June, 2010

With regards to the extent of damage caused, in quadrant 1, 10% are collapse of buildings, 24% wall were affected by the storm, 16% on the fencing of the plots and 50% are the affected roof of buildings. In Quadrant 2; 6%are collapse buildings, affected wall 18%, plot fencing 24% and roof affected 52%. In quadrant 3; the collapse buildings 4%, affected wall 12%, plot fencing 24% and affected roof 60%. In the quadrant 4; 3.33% collapse buildings, affected wall 13.33%, plot fencing 18.33% and roof affected 65%. In the city in general, 5.71% of the buildings are affected and collapsed, 16.67% wall of the buildings are affected, 20.48% of the fencing of plots are affected by the storm and 57.14% of the damage affected the roof of buildings. This implies that at any incident of the storm in Minna, roof of buildings are much affected than any components or parts of building.

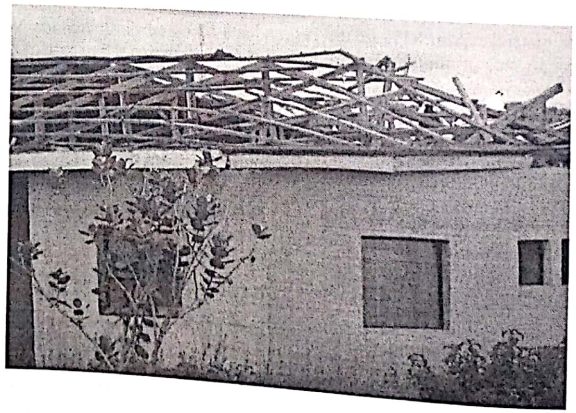

Plate 1: Roof of a building affected by the rain/wind storm

Table 5: The Extent of Damage on Infrastructure

| Infrastructure | Quadrant 1 | Quadrant 2 | Quadrant 3 | Quadrant 4 | Total |
|---|---|---|---|---|---|
| Electricity Poles | 19 | 15 | 21 | 12 | 67 |
| Street Light | 3 | 2 | 1 | 3 | 9 |
| **Total** | **22** | **17** | **22** | **15** | **75** |

Source: Field Survey, June 2010.

The infrastructure facilities were affected by the rain/wind storm. In quadrant 1, total number of 19 electricity poles and 3 street light poles were affected, in quadrant 2; 15 electricity poles and 2 street lights stands, quadrant 3; 21 street poles and 1 street light poles, in quadrant 4; 12 on electricity poles and 3 street light poles. Given that the total sum of 67 electricity poles were affected in different parts of Minna and 9 street light poles were affected in the city.

However, the evidence of hazard has been considered to be of negative impacts to buildings and infrastructure in the city of Minna. Quite numbers of buildings were affected, either the whole building get collapse or part of the wall, the fencing wall or the roof. The mostly affected part of the buildings as investigated in the study was the roof, which amount to 57.14% of the total percentage of the impacts on buildings and the components thereof. The mostly affected public infrastructure apart from this related structural effect (like schools, health care centres) is the electricity poles and street light poles. Apart from all these, other things that were affected but not counted in the numerical value are trees, sign-post, and city monuments.

**The Mitigation Strategy against Rain/Wind Storms**

The frequent occurrence of rain/wind storm hazard in Minna has called for the practice of different strategies against the impact the hazard may have on the city, these involve the placing of stones or blocks on the building roof, planting of trees as wind breaker, intention of changing location where it mostly affected by the storms and taken to the precaution while construction of buildings takes place or whenever repairs is being carried out.

Table 6: Mitigation Strategy

| | Quadrant 1 | | Quadrant 2 | | Quadrant 3 | | Quadrant 4 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Mitigation Strategy** | **Freq** | **%** | **Freq** | **%** | **Freq** | **%** | **Freq** | **%** | **Freq** | **%** |
| Placing stones on roof | 27 | 54 | 31 | 62 | 29 | 58 | 19 | 31.67 | 106 | 51 |
| Planting of trees | 3 | 6 | 3 | 6 | 6 | 12 | 7 | 11.67 | 19 | 9 |
| Intention of changing location | 4 | 8 | 7 | 14 | 4 | 8 | 11 | 18.33 | 26 | 12 |
| Taking caution while building | 16 | 32 | 9 | 18 | 11 | 22 | 23 | 38.33 | 59 | 28 |
| Total | 50 | 100 | 50 | 100 | 50 | 100 | 60 | 100 | 210 | 100 |

Source: Field Survey June 2010.

According to Table 6 on the strategy for mitigation as commonly practiced in Minna, in quadrant 1; 54% place stone on their roof to prevent storm from carrying the roof, 6% considered planting of trees

around their buildings, 8% were thinking of relocating to a better environment with less impact of storms, and 32% are taken caution at construction stage. In quadrant 2; 62% placed stones on roof, 6% on planting of tree, 14% intends changing their environment, while 18% had considered taken cautions at the development of their structure. In quadrant 3, 58% place stones on their roof, 12% decided to plant trees, 8% intending to relocate out of the area and 22% are taken the building precaution into considerations. In quadrant 4; 31.67% place stone on their buildings, 11.67% subscribed to planting of trees, 18.33% have intention of relocating to another areas. Considering the mitigation strategy in against rain/windstorm hazard in Minna, 51% of the building assessed placed stones on their roof, 9% plant trees around their street of buildings, 12% have the intention of changing and 28% considered taken into consideration the necessary precautions while building their houses. The implication of this is that, the structure in place as capacities is seen crude, weak and cannot face the velocity of any stronger wind.

**The Human Factors/Failure that Responsible for the level of Damage and those aggravating it.**

Quite numbers of human factors and system failure are responsible for the level of damage recorded in Minna, as well; reference is made toward some notable circumstances that give room to the disaster to be recorded in Minna. These factors includes the poor or weak planning procedures by the government agencies, the inadequate drainage pattern, poor construction work on most of the buildings in the city and non planting of trees around the buildings as a wind breaker. Table 7 revealed respondent comments on the factors alighted.

The Aggravating factors includes the following: attitudes of the people, inefficiency of the governmental agencies in charge of land and urban development, lack of awareness on the impacts of their actions on the urban environment, economic based and the level of poverty, the relationship of the urban structure and spatial planning and governance.

Table 7: The Human Factors Responsible for the Level of Damage Recorded

| Human Factors Responsible for Hazard | Quadrant 1 | | Quadrant 2 | | Quadrant 3 | | Quadrant 4 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % |
| Lack/Weak Planning Procedure | 18 | 36 | 22 | 44 | 20 | 40 | 27 | 45.00 | 87 | 41.43 |
| Non/Poor Drainage Pattern/misuse of use | 7 | 14 | 5 | 10 | 11 | 22 | 8 | 13.33 | 31 | 14.76 |
| Poor Construction Work & Design error | 15 | 30 | 18 | 36 | 15 | 30 | 17 | 28.33 | 65 | 30.95 |
| Non Planting of Trees | 10 | 20 | 5 | 10 | 4 | 8 | 8 | 13.33 | 27 | 12.86 |
| Total | 50 | 100 | 50 | 100 | 50 | 100 | 60 | 100 | 210 | 100 |

Source: Field Survey June 2010.

According to Table 7, on the human factors responsible for the level of damage; in quadrant 1: 36% agreed on weak planning procedure, 14% for non/poor drainage, 30% poor construction work and 20% for non planting of trees. In quadrant 2: 44% for weak planning procedure, 10% for non/poor drainage, 36% poor construction work, and 10% for non planting of trees. In Quadrant 3: 40% were due to poor planning procedure, 22% for non/poor drainage work, 30% for were due to the poor construction work and 8% for non planting of trees. In Quadrant 4: 45% were mainly due to poor planning procedure, 13.33% for poor drainage pattern, 28.33% for inadequate construction work and 13.33% for non planting of trees. In regard to these findings on factors responsible for the level of damage recorded in Minna as a whole; 41.43% of the respondents submit to the fact that it was due to lack or weak planning procedures

for managing the urban space, 14.76% were for non/poor drainage pattern, 30.95% for poor construction work and 12.86% were mainly because of non planting of trees.

Plate 2: Collapse building due to weak materials and poor construction

## RECOMMENDATIONS AND CONCLUSION

### Summary of findings

The occurrence of rain/wind storms has become a common event in the Minna; this do happened mostly every period it rains. But the most devastating and destructive one is being experienced at the commencement of the rainy season in Minna, by the month of April/May. As a result of this, incidence of disaster was confirmed by the respondents of about 81%. The nature of the disaster cut through the residential, commercial, public buildings; also the public infrastructure (street light poles and electricity poles), city monuments and sign-post were all affected. The implication of this is that the city will be in the "black-out" as the PHCL poles and wires are down. The mostly affected components of the building include; the roof of the building, the plot fencing and the wall (see Plate 1 and 2). Regarding the factors responsible for the hazard; poor planning procedure have been responsible for the pattern of development in the city with 41.43%, and this now have effect on the building development. The buildings are characterized with poor/sub-standard materials, non professional individuals handled the construction work, which posses' danger because of the poor work-done on the building. With respect to the coping strategies; placing of stones on buildings is so common to prevent the wind from lifting or remove the roof, this action never last in solving the impending problems as it cannot prevent the roof from leakage and stronger wind with high velocity. The aggravating factors includes; the attitude of the people, inefficiency of the agencies who are in- charge of land and urban development, lack of awareness on the potential hazards and the effects on the people and their property, the high level of poverty, the relationship of the urban structure and spatial planning and governance.

### Recommendations

With the devastating effects of rain/wind storms experiences in Minna over the period of time past, the residential land use in large scale have experienced it more than other land uses, contributing to the insecurity in the urban environment. Against this background, following recommendations are given:

i. Arrangement of all spatial related activities, which must be done in line with the urban planning principles and the need for developing a mechanism for the approval of the existing buildings plans in the city by the government agency.
ii. Enforcement of laws that are related to building development, such as the Urban and Regional Planning Law, Building Code and the enactment of building maintenance law and mandatory use of professional for building project

iii. The need for the review of Master Plan of Minna will enhance reduction of rain/wind storm hazard with other hazards shall be discussed with in-depth solutions to the city insecurity. Also the need for renewal scheme in some areas of the city where incidence of the disaster was recorded high.
iv. Strategy on public enlightenment and awareness on the causes, effects, and precautions be developed and supported by the government.
v. Replacement of the weak electricity poles with concrete poles to resist the pressure against the wind and re-install the street light poles with formidable steel that has more strength.
vi. Disaster reduction initiatives be should centre people oriented ideas, coupled with the context, policy and institutional framework for disaster reduction and vulnerability capacity building.

**Conclusion**

Risk is the probability of harmful consequences, or expected losses (death, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human induced hazard and vulnerable conditions. Recently, the urban environment is not only a place of interest for everyone living on earth, but also a place full of risk, as a result of human activities. Risk is rooted in condition of physical, social, economic and environmental vulnerability that need to be assessed and managed on a regular basis.

The occurrence of hazard (rain/wind storm) in Minna has been noticed to be a yearly phenomenon, with serious damage to buildings and infrastructure; however, mitigating the mitigating strategy is nothing to commend about, vulnerability assessment or analysis of the losses or the potential threat has not attracted any commendable attention from the necessary stakeholders. Resolving on what needs to be done against the rain/windstorm hazard in Minna, the need for policy and institutional framework of disaster risk reduction should be seen as a necessity that will address the immediate and future event as well the potential threat from other unnamed hazards. Understanding the nature of disaster should not be only documented but with information on the vulnerability capacity. The primary objective is to minimize exposure to hazard through development of individual, institutional and societal capacity that can with stand any damage.

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