BIOPHILIC DESIGN PROVISION FOR DISASTER AND RISK MANAGEMENT

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Abstract

The aim of this paper is to study the roles of biophilic elements in disaster and risk management with a view to assess the roles and make useful recommendation. The objectives are to identify biophilic elements present in the study area, to examine the resilience benefits of the biophilic elements and to assess the response of the people towards their biophilic institution and governance. The estimated population of the students is about 800. A total of 70 structured questionnaires were administered to all the students of the 400 level (HND) students. The data was analyzed in a descriptive manner of statistical computation using direct observation and mean score and on this basis a ranking was done on it. The study deduced that only 35.7% of the biophilic elements are established in the polytechnic community where this study takes place. The study identified the five most importance roles of biophilic elements in disaster and risk management. The study also identified efforts of the biophilic institution and governance in the polytechnic community in the area of existence of educational programs that promote teaching on green design, existence of Green design and planning regulations on biophilic elements, priority to Nature conservation, existence of any group or club that participate in caring for local nature and Institutional promotion of education and awareness on green preservation. The study is recommended to all environmentalists; Estate surveyor, landscape planner, Architect, Builder, Land surveyors and those in government, policy makers and other stakeholders in the field disaster and risk management.

Keyword: *Biophilic, design, cities, disaster, risk.*

Introduction

Biophilic design holds that good design, at the building, site, city and regional scale, must include nature and natural elements (Beatley and Newman, 2013). It is based

especially on the concept of *biophilia*, popularized by Harvard myrmecologist and sociobiologist E.O. Wilson. Wilson argues that humans have co-evolved with nature and that we carry with us our ancient brains and our need to connect with and affiliate with nature, to be happy and healthy. Wilson defines biophilia as ―the innately emotional affiliation of human beings to other living organisms. Innate means hereditary and hence part of ultimate human nature. To Wilson, biophilia is really a ―complex of learning rules developed over thousands of years of evolution and human-environment interaction (Wilson, 1993; Wilson, 2007).

According to Beatley and Newman (2013), achieving the conditions of a biophilic city will go far in helping to foster social and landscape resilience, in the face of climate change, natural disasters and economic uncertainty and various other shocks that cities will face in the future. Green neighborhoods and more natural living environments have been associated with reductions in stress and increased levels physical and mental health. An important study in *The Lancet* concludes that populations with greater exposure to green space experience lower mortality and that green space exposure can help reduce health inequalities (Mitchell and Popham, 2008). Godschalk (2003) on a natural hazards perspective describes a resilient city as one that ―would be capable of withstanding severe shock without either immediate chaos or permanent harm. While they might bend from hazards forces, they would not break.

On this basis UNDP (2004) defines disaster as a serious disruption of the functioning of a society with widespread human, material or environmental losses which exceed the ability of the affected society to cope using only its own resource. According to Ammann (2012), cities face increasing risks of impacts from large scale disasters. Risk in urban areas is a combination of two factors: first, location and exposure to hazards; and second, increased vulnerability due to poor local governance, environmental degradation, and the overstretching of resources (UNDP, 2010). Risk is identified as a phenomenon which occurs and likely to make various damage and losses in human lives and which can be avoided or reduced if human activities like the arbitrary urbanization and environmental pollution are avoided (Zelloum, 2009). Disasters often occur because risk reduction measures have not been considered or undertaken, despite their previous knowledge of existing hazards and threats (Bosher, 2014).

Statement of problems

The conflicting scenario of the rapid depletion in global natural resources simultaneous to the acceleration in global population, it is imperative that the attendant demands on global natural resources are balanced with the 'carrying capacity' of the physical environment (Kadiri, 2006).

Climate change will occur regardless of whether greenhouse gas emission are significant reduced. The effect of climate change on the built environment will depend on the sensitivity and adaptability of the systems (US EPA, 2011 in University of Michigan and US Green Building Council, 2011). This poise a challenge to the global community especially third world nations who are faced with climatic factors such as intense solar radiation, high humidity and condensation, dust and sandstorms and flood which affects the comfort of man and safety of built environment (Elimisiemon, Raymond &Hyeladzira, 2016).

The aim and objectives of the study

The aim of this paper is to study the roles of biophilic elements in disaster and risk management with a view to assess the roles and make useful recommendation.

The objectives are to:

1. identify biophilic elements present in the study area
2. examine the resilience benefits of the biophilic elements
3. assess the response of the people towards their biophilic institution and governance

The concept of Biophilic design

Biophilic cities are cities that provide close and daily contact with nature, nearby nature, but also seek to foster an awareness of and caring for this nature. A biophilic city, moreover, is also a city in which residents are actively involved in experiencing nature—e.g., hiking, bird watching, sky-gazing, gardening, among many other activities.

The presence of abundant nature is a necessary, but not sufficient condition, and the ―philic is as important as the bio. In biophilic cities, residents are directly and actively engaged in learning about, enjoying and caring for the nature around them and have developed important emotional connections with this nature (Beatley and Newman, 2013).

The Concept of Disaster and Risk Management

According to UNDP (2004), Disaster is a serious disruption of the functioning of a society with widespread human, material or environmental losses which exceed the ability of the affected society to cope using only its own resource. Wahab, Atebije and Yunusa (2013) observed that disaster occurs when natural events, situations and normal human activities are impacted by significant and sudden adverse events that cause damaging impacts on human lives, property and the environment.

Disaster impacts may include loss of life, injury, disease and other effects on human, physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation (UNISDR, 2007b). Disasters often occur because risk reduction measures have not been considered or undertaken, despite their previous knowledge of existing hazards and threats (Bosher, 2014).

UNISDR (2012) described disaster as a serious disruption to the functioning of a society with widespread human, materials, or environmental losses which exceed the ability of affected society to cope using only its own resources. Similarly, risk is described as the combination of the probability of an event and its negative consequences.

Zelloum (2009) asserts "Risk is identified as a phenomenon which occurs and likely to make various damage and losses in human lives and which can be avoided or reduced if human activities like the arbitrary urbanization and environmental pollution are avoided. According to Zelloum (2009), risk is characterized by the magnitude, intensity, frequency and return period. The risk is a neutral and natural phenomenon, neither good.

Disaster management is a process which involves the coordination and integration of all activities necessary to build, sustain and improve the capability (of people) for disaster prevention, mitigation, preparedness, response and recovery (Khan et al, 2008). Disaster risk management is therefore the systematic process of using administrative, organization and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impact of hazards and the possibilities of disasters (UNISDR, 2012). In general, risk is measured as a combination of the probability of an event and its consequences.

Biophilic Design and Disaster and risk management

Biophilic cities are cities that accommodate and celebrate other life forms and in the process help to advance resilience. Often the animals and wildlife of a city are an important contributor to a unique or distinctive sense of place (Beatley, 2010).

Resilience has many meanings, of course, but at its core is the essential ability to successfully adapt to and respond to these shocks; the word derives from the Latin *resiliere*, meaning to jump back or rebound. Godschalk (2003) on a natural hazards perspective, describes a resilient city as one that ―would be capable of withstanding severe shock without either immediate chaos or permanent harm. While they might bend from hazards forces, they would not break. Composed of networked social communities and lifeline systems, resilient cities would become stronger by adapting to and learning from disasters(Godscalk, 2003).

Resilience does not imply a return to dysfunctional or unsustainable community conditions, but adaptation to dynamic social and ecological conditions in ways that protect and enhance quality of life, long term ecological productivity and public and personal health (Beatley and Newman, 2013).

According to Beatley and Newman (2013), the movement in the direction of making cities greener, more natural, more *biophilic*, will also help to make them more resilient. There are many pathways from biophilic design and urban biophilia to urban resilience, many ways in which the conditions of green and biophilic cities will also serve to make a city more resilient in the long run, ecologically, economically and socially. Some of these biophilic pathways are direct: as when investments in green infrastructure (say restoring wetlands or planting drought tolerant vegetation in cities) serves to yield resilience benefits and outcomes (e.g., reduced summer temperatures, reduced flooding from coastal storms). Other pathways are more indirect: as when green elements serve to stimulate or enhance beneficial and health-inducing behaviors, such as walking, that in turn serves to enhance the resilience of individuals and families to cope with future stresses (Beatley and Newman, 2013).

Cities with extensive tree canopy coverage provide many ecological benefits that will make cities more resilient—including moderation of air pollutants, cooling through evapo-transpiration and shading and reduction in urban flooding and runoff. Protection and restoration of urban streams and rivers will reduce vulnerability again to floods, provide important cooling benefits and help to moderate the weather and temperature changes predicted as a result of climate change (Beatley and Newman, 2013).

Biophilic urbanism

Beatley and Newman (2013) expressed the usefulness of Biophilic urbanism in protecting or strengthening favorable climatic and micro-climate conditions in cities. They went further to say Biophilic cities help cities become more resilient in the face of a host of emerging resource scarcities likely in the decades ahead, including long term decline in global oil supply (peak oil), diminished supplies of potable water and food, among others. Greening cities can, as already mentioned, significantly reduce energy consumption and reduce consumption of energy for heating and cooling. In promoting modes of urban mobility other than automobiles (walking, bicycling) there is the possibility of greater resilience in the diminished oil supplies. Equally true, biophilic urbanism can achieve significant water conservation and, through the protection of peri-urban farms and agriculture and by promoting urban agriculture, might help to ensure the food security of a city (Beatley and Newman, 2013).

Urban environments that are greener, more *nature-full*, will attract greater interest by residents and help to strengthen emotional bonds to place and community, in turn increasing urban resilience (Manzo, 2003).

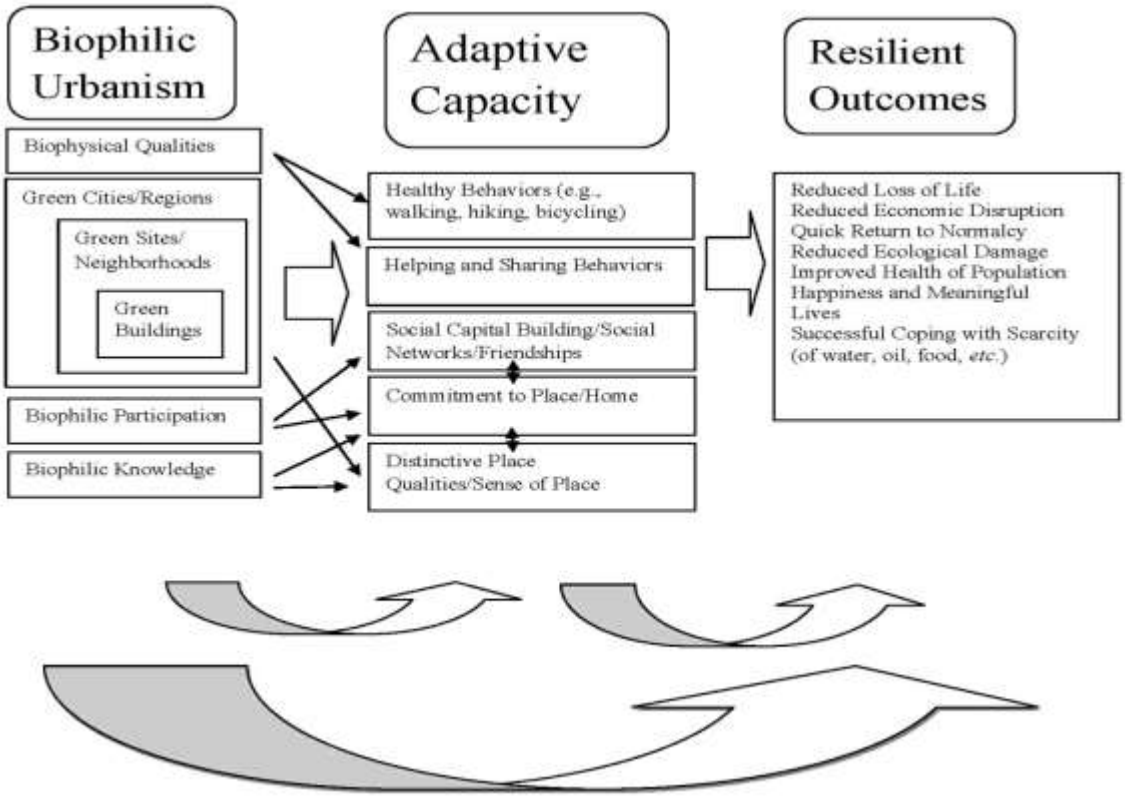

Figure 1: Biophilic pathways to urban resilience
Source: Beatley and Newman, 2013.

Biophilic cities deliver a host of positive benefits at an individual and family level that will help to enhance ability to successfully cope with and adapt to future stressors and shocks (Beatley and Newman, 2013).

Nature in cities delivers considerable and often underappreciated health benefits, furthering bolstering city's capacity and ability to adapt to stresses and shocks in the future. Residents of greener neighborhoods have been found to walk more and spend more time outside, in turn with considerable positive health effects (Schantz and Stigell, 2008).

Biophilic urbanism can help to provide the basis for healthier lives and lifestyles in many ways. An extensive network of walking and hiking trails, the close physical proximity of large blocks of greenspaces to urban neighborhoods and an urban land use pattern of nearby parks, all contribute to at the least the possibility of a more

physically active, healthier lifestyle. Gardening and food production opportunities in the city provide similar benefits—the opportunity to engage in an emotionally rewarding activity, but also one with substantial calorie-burning potential and the possibility of improving diets, as well (Cobb, 2011).

There are many ways in which access to nature will make individuals, families and communities healthier and happier and will help to forge new social connections and friendships in biophilic cities, which should make such cities more resilient. Healthier, more socially-connected individuals, families and communities will increase the likelihood of successful adaptation to this dynamic future (Beatley and Newman, 2013).

Biophilic cities and city initiatives can also, in many important ways, help to bring people together in pursuit ad enjoyment of common interests and concerns and can expand and strengthen social networks and capital. The green spaces of a city offer important sites for residents to come together and to build a degree of cohesion and trust. Friendships and social interaction provided by direct participation in nature activities can in turn help to strengthen adaptive capacity. Participation and engagement with nature in cities is a key aspect of a biophilic urbanism and can take many forms (Beatley and Newman, 2013). According to them, a biophilic city also places priority on educating children and young people about the nature around them and fostering these natural connections at an early stage

Obstacles to biophilic design

And there are obstacles presented by the prevailing short-term centered political and economic decision making mechanisms. Beatley and Newman (2013) observed Short term economic cost may be an impediment, for instance, in installation of green neighborhood or project features, such as green walls and green roofs, though the long term savings almost always dwarfs these short term costs (and thus a need to find creative ways to encourage long term and full-cost accounting).

These will include heat waves, drought and other likely effects associated with climate change, as well as natural disasters and a host of potential resource shocks and scarcities, such as decline in global oil supplies and availability of water and food.

Environmental Benefits of Green Building Design

The benefits of green building design are diverse. They may be categorized broadly into three: environmental, economic, and social. However, other environmental benefits of green design are discussed below.

Acccording to Elimisiemon and Kagai (2016), Good sustainable design offers economic, environmental and societal benefits. A planted or “green” roof, for

example, can have significant economic benefits, by lowering the roof temperature and thereby reducing the amount of cooling tonnage needed, and even lowering costs for neighboring buildings. A planted roof can reduce the environmental impact of a building, by reducing pollution from the building's power usage, as well as reducing the city's heat island effect. Another environmental benefit of planted roofs is reduced storm water runoff.

In addition, societal benefits of green building include physically and aesthetically pleasing effects for building occupants and neighbors, and jobs for workers to install and maintain planted roofs. The careful use of materials can reduce energy consumption during the manufacturing process and protect the health of occupants. Careful construction techniques can reduce the amount of construction waste that reaches landfills by 95% or more. Re-use of existing structures can reduce resource consumption while preserving our country's heritage. Careful siting can make buildings perform better from both environmental and human perspectives: proximity to transportation reduces pollution and improves occupants' quality of life. The key is holistic, integrated consideration of all the factors that influence building, including consideration of the decision of whether to build at all.

Other benefits of green building design as identified by the U.S. Green Building Council (2016) include the following:

Green building is cost-effective: Upfront investment in green building makes properties more valuable, with an average expected increase in value of four percent. By virtue of lowered maintenance and energy costs the return on investment from green building is rapid: green retrofit projects are generally expected to pay for themselves in just seven years.

Green buildings reduce day-to-day costs year-over-year. LEED buildings report almost 20 percent lower maintenance costs than typical commercial buildings, and green building retrofit projects typically decrease operation costs by almost 10 percent in just one year.

*The benefits of green building are expanding the market and breaking records:*Interest in green building is growing rapidly. The sector made up only two percent of nonresidential building starts in 2005, but by 2012, that number jumped to 41 percent. Now it's estimated that 40-48 percent of new nonresidential construction will be green, representing up to $145 billion.

As of August 2015, more than 13.8 billion square feet of building space is LEED-certified. More than 675 million square feet of real estate space became LEED-certified in 2014, representing a 13.2 percent jump from 2013. The green building market is poised to break this record again in 2015 with LEED-certification being reported as a top sustainable goal for both public and private organizations.

Extending beyond new construction, green building is accessible through retrofit projects. The green share of these projects is expected to more than triple by 2030, representing an investment of $960 billion.

Green buildings use natural resources efficiently, lowering both utility bills and impact on the environment: Buildings are positioned to have an enormous impact on the environment and climate change. At 41 percent of total U.S. energy consumption, buildings out-consume the industrial (30 percent) and transportation (29 percent) sectors.

Buildings use about 14 percent of all potable water (15 trillion gallons per year), but water-efficiency efforts in green buildings are expected to reduce water use by 15 percent and save more than 10 percent in operating costs. Retrofitting one out of every 100 American homes with water-efficient fixtures could avoid about 80,000 tons of greenhouse gas emissions, which is the equivalent of removing 15,000 cars from the road for one year.

Standard building practices use and waste millions of tons of materials each year; green building uses fewer resources and minimizes waste. LEED projects are responsible for diverting more than 80 million tons of waste from landfills, and by 2030 that number is expected to grow to 540 million tons.

Methodology

The methodology employed involved both primary and secondary data. The primary data involves the use of structured questionnaire and direct observation. The secondary data uses both internet sources and the digests of world summits and declarations on sustainable development, journals, text books, seminars and conference proceedings formed ready sources of reviews. Data was sampled at the Waziri umaru federal polytechnic, Birnin kebbi, Nigeria. This study was done using the college of environmental. The estimated population of the students in the college is about 800. The college is made up of Urban and regional planning, Architecture, Quantity surveying, Land surveying and Geo-formatics, Estate management and Building department. A total of 70 structured questionnaires were administered to all the students of the 400 level (HND) students. The data was analyzed using physical survey and mean scores of the descriptive statistics. On the basis of the mean scores, a ranking was done on the resilience benefits and efforts of the biophilic institution and governance.

TABLE 1: AVAILABILITY OF BIOPHILIC ELEMENTS

BIOPHILIC ELEMENTS	Available	Not A
Green Rooftops	-	Not Available
Rooftops Garden	-	Not Available
Green walls	-	Not Available
Green courtyard	Available	-
Green streets	-	Not Available
Stream daylighting	-	Not Available
Urban trees	Available	-
Edible landscaping	-	Not Available
Ecology parks	-	Not Available

Community gardens	Available	-
Greening greyfields	Available	-
Green schools	-	Not Available
School tree canopy	Available	-
River systems/flood plains	-	Not Available

Source: Field survey, 2016.

Table 1 shows the availability of Biophilic elements within the polytechnic community. It is evident that 14 biophilic elements were under physical survey. It is clear that of all the identified biophilic elements, only 5 biophilic elements; Green courtyard, Urban trees, Community gardens, Greening greyfields and School tree canopy are available in the polytechnic community. This is equivalent to 35.7%. It implies that 35.7% of the biophilic elements are available while 64.3% of the biophilic elements are not available in the study area.

TABLE 2: RESILIENCE BENEFITS OF BIOPHILIC ELEMENTS

Resilience benefits of Biophilic elements	Mean score	Rank
Biophilic design helps in reductions in stress	2.49	1st
Biophilic design helps to increase the levels of physical and mental health	1.77	6th
Nature has immense power to restore, heal and fascinate Biophilic design enables the regeneration and resilience of the environmental features	1 .84	5th
Biophilic design creates a disaster-resilient communities (adapt to and respond to shocks)	1.96	4th
Green infrastructure helps cities and urban regions respond to and spring back from climatic and natural events	2.10	3rd
Trees and natural vegetation will help protect property and reduce damage from wind, rain and flooding	2.4	2nd
Biophilic designs can help to protect or strengthen favourable climatic and micro-climate conditions in cities	1.74	7th
Cities with large natural wetland systems will be better able to absorb flood waters from hurricanes and storms	1.66 1.74	9th 7th

Source: Field survey, 2016.

Table 2 reflects resilience benefits of biophilic elements. The first-five most ranked of the resilience benefits are Biophilic design helps in reductions in stress, Green

infrastructure helps cities and urban regions respond to and spring back from climatic and natural events, Biophilic design creates a disaster-resilient communities (adapt to and respond to shocks), Biophilic design enables the regeneration and resilience of the environmental features, and Nature has immense power to restore, heal and fascinate.

TABLE 3: EFFORTS OF THE BIOPHILIC INSTITUTION AND GOVERNANCE BY THE RESPONDENTS

Efforts of the Biophilic Institution And Governance	**Mean score**	**Rank**
Existence of Green design and planning regulations on biophilic elements	2.61	2nd
Institutional promotion of Education and awareness on green preservation	2.36	4th
Existence of educational programs that promote teaching on green design	2.63	1st
Existence of any group or club that participate in caring for local nature	2.36	4th
Priority to Nature conservation	2.46	3rd

Source: Field survey, 2016.

Table 3 shows efforts of the biophilic institution and governance by the respondents. The order of delivery and involvement in the promotion of biophilic designs are after this order, Existence of educational programs that promote teaching on green design, Existence of Green design and planning regulations on biophilic elements, Priority to Nature conservation, Existence of any group or club that participate in caring for local nature and Institutional promotion of Education and awareness on green preservation.

Conclusion and Recommendations

This study was carried out on Biophilic design provision for disaster and risk management. The study deduced that only 35.7% of the biophilic elements are established in the polytechnic community where this study takes place. The study identified the five most importance roles of biophilic elements in disaster and risk management after this order; Biophilic design helps in reductions in stress, Green infrastructure helps cities and urban regions respond to and spring back from climatic and natural events, Biophilic design creates a disaster-resilient communities (adapt to and respond to shocks), Biophilic design enables the regeneration and resilience of the environmental features, and Nature has immense power to restore, heal and fascinate. The study identified efforts of the biophilic institution and governance in the

polytechnic community, and this is revealed according to their order of significance as follow; Existence of educational programs that promote teaching on green design, Existence of Green design and planning regulations on biophilic elements, Priority to Nature conservation, Existence of any group or club that participate in caring for local nature and Institutional promotion of Education and awareness on green preservation. The study is recommended to all environmentalists; Estate surveyor, landscape planner, Architect, Builder, Land surveyors and those in government, policy makers and other stakeholders in the field disaster and risk management.

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