ENVIRONMENTAL AND EDUCATIONAL SUSTAINABILITY: REDUCING EXPOSURE TO PLUVIAL FLOOD RISK.

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Abstract
Mitigation and adaptation capacities are the set of diverse knowledge, skills and resources people learn and acquire in dealing with hazards and disasters, either individually or collectively. This lack of awareness can in part be attributed to low levels of risk knowledge and availability of information. Improving peoples' awareness by educating them could be one part of a multi-pronged strategy for facilitating behavioural change to prevent, mitigate, foster preparedness to pluvial flood risk. This paper discusses environmental education sustainability measures for reducing exposure to pluvial (rain-related) flood risk (that is likelihood or chance of event happening and impact if it occurred) with the view of increasing resilience and reducing vulnerability of populations to climate change impacts. This paper shows high chance of flood hazard, exposure and sensitivity and low adaptive capacity in Ijebu-Ode. Therefore, sustainable environmental education is required to enhance flood risk knowledge (i.e., formal and informal) and raise proactive behaviours amongst the public. This paper is novel and significantly provides a mechanism to better understand challenges and potential solutions to pluvial flood risk in Ijebu-Ode communities. This will serve as advancement in knowledge of pluvial flood risk challenges in the urban cities in Nigeria and provide a platform for more research on flood risk globally. It was suggested that flood literacy can help to reposition those at risk (s) as an active agent of managing local flood risk, therefore, a clear need to entrench environmental education in school curricula (primary, secondary and tertiary levels), reinforced by Government, NGOs, and a strong community awareness to raise adaptive capacity to reduce flood risk and improve education.

Keywords: Pluvial flood risk, Vulnerability, Environmental education, Adaptation, Sustainability

Introduction

Floods are the most common of all-natural hazard, (Brilly and Polic, 2005Jha et al., 2012), causing more than half of all the fatalities, and accounting for a third of total economic loss from natural disasters globally (Kellens et al., 2011; Jonkman, 2005). Human systems are vulnerable to floods due to their exposure, susceptibility and resilience. Risk can be defined as the possibility of danger and its potential consequences, with the concept of risk a function of hazard probability, exposure and vulnerability (Samuels and Gouldby, 2009 and IPCC, 2012).According to the Nigerian Meteorological Society (NMetS, 2019), flooding is one of the major disasters that society should combat, and extensive education and sensitization of the population is required to highlight the current state of the effects of climate change that we must deal with. Sufficient education and informationwill assist individuals and communities in understanding risk mitigation, adaptation, and readiness (Madu, 2016). Information and knowledge sharing must be made available to a diverse variety of people, particularly the most vulnerable (Anabaraonye et al., 2019; BNRCC, 2011). An educational contribution to a sustainable future must address disaster risk reduction as well as climate change.

Flood risk is determined by summed probability of flood hazards, as well as the assets at risk of these hazards. Exposure of human settlements and critical assets to flood risk is increasing due to climatic change, sea level rise and extreme

precipitation as well as development intensification, population increases and economic growth (IPCC, 2014; Lawrence et al., 2013; Pelling and Blackburn, 2012).Exposure refers to assets, activities, livelihoods and people in an area in which hazards events may occur (UN-ISDR, 2004), while vulnerability refers to propensity of the exposed elements to suffer adverse effects when impacted by hazard events (IPCC, 2012). Obeta (2014) opined that flooding and the means of addressing its challenges are critical issues in Nigeria. Floods are a major hazard that are worth studying globally, and in Nigeria in particular. Flooding is widely acknowledged as the most frequent and widespread disaster in the world, causing devastating effects on the lives of millions of people and their properties, as well as infrastructure and the natural environment (EM-DAT, 2015; Vojinović, 2015). In all UN regions, floods were most frequently reported disaster type, with exception of Caribbean, North America, East Asia, Western Europe and Polynesia, where storms predominate (CRED, 2017).

It was revealed by (CRED, 2016) that, meteorological disasters affected 95.8 million people in 2016, the highest number reported since 2006 for this disaster type, which represents 2.4 times the annual average and the 78.1 million people affected in 2016 by hydrological disasters are near the annual average of 82.6 million. Also CRED 2016, added that the number affected by geophysical disasters (2.2 million) was the third lowest since 2006, 75.2% below the 2006-2015 annual average. As during previous decades, hydrological disasters were, in 2016, most frequent in all continents, except Oceania where more meteorological disasters were reported. UN regions with most people affected in 2016 were East Africa (31.8 million affected), in Nigeria, flooding cost 300 lives and impacted nearly two million people (CRED, 2018).

Disaster Risk Reduction

Disaster risk Reduction (DRR)is a systematic approach to identifying, assessing and reducing risks of disaster. It aims to reduce socio-economic vulnerabilities to disaster as well as dealing with environmental and other hazards that trigger them. The UN Office for Disaster Risk Reduction (UNISDR, 2004) defines DRR as the conceptual framework that was considered with the possibilities to minimize vulnerabilities and disaster risks throughout society, to avoid (i.e., prevention) or to limit (i.e., mitigation and preparedness) adverse impacts of hazards, within the broad context of sustainable development" (UNISDR, 2004). As pointed out in the introduction, flooding is widely acknowledged as the most frequent and widespread disaster in world, causing devastating effects on the lives of millions of people and their properties, as well as infrastructure and natural environment and seen as a part of nature, that have existed and will continue to exist due to the climate and meteorological events. It may therefore, not be feasible to remove flood risks. What is important therefore is to fully understand flood risk and associated effects within the framework of Disaster Risk Reduction (DRR). The Disaster Risk Management (DRM) is the application of Disaster Risk Reduction (DRR).

Adaptation to Climate Change

The concept of climate change adaptation has its roots in policy discourses emanating from the Intergovernmental Panel on Climate Change (IPCC, 2001), and their recognition of climate change as sustained and worsening problem threatening human development. Vulnerability is thepropensity or predisposition (of a system) to be adversely affectedand, until AR4, was viewed as comprising of three elements: exposure, sensitivity, and adaptive capacity (IPCC, 2007a). IPCC concurrently suggests that Adaptation can reduce vulnerability' (IPCC, 2007b). However, in IPCC (2012), vulnerability focuses only on sensitivity and capacity, with exposure more appropriately incorporated into the concept of risk (IPCC, 2012). The implication is that 'harm' or 'vulnerability' is caused by climate change itself, thus positing adaptation to climate change as a means of reducing such harm or vulnerability. Human and natural systems have a capacity to cope with adverse circumstances but, with continuing climate change, adaptation will be needed to maintain or increase this capacity (IPCC, 2012).

Behavioural Change and Education

Mosger (2007) observed the need for effective communication, public outreach and education to increase support for policy, collective action and behavioural change, a pressing context for anthropogenic climate change. Behavioural change and education will provide necessary insight and guides in formulating and developing effective teaching methods (i.e., pedagogy), suitable for achieving effective learning outcomes (i.e., improve learners way *think and talk about what they have learned). Education* is a method for developing and training learners mental and moral faculties (i.e., training their awareness) in achieving the ability of changing their actions (i.e., behavioural change). The communication of flood risk information is a key element of flood risk management (FRM)which aims to 'strengthen people's risk awareness and to motivate the population at risk to take preventive actions and to be prepared' (Hagemeier-Klose and Wagner 2009) as such understanding both behavioural and educational theory are important. According to Van Alphen et al., (2009), over the last decade flood risk management (FRM) has evolved to develop and enhance the community resilience to flooding, rather than simply focus on controlling flood waters using engineering solutions. For example, the UK Environment Agency's prime purpose for flood risk communications is to encourage participation in local FRM and develop community resilience (Environment Agency 2011). Flood risk communication encompasses two phases: first, identifying areas at risk of flooding; second, letting those at risk know when flooding is likely to occur (Rollason et al., 2018), both phases are crucial to helping those at risk prepare for, anticipate and act to lessen the consequences of flood events. Focus on flood risk communication is intended as a contribution to fostering the inhabitant's perception of risk that could contribute to raising of sufficient awareness, preparedness, response and resilience to flood risk and vulnerabilities.

Flood Risk

Since there is no instrumental river flow data, the only sources of current flood risk information that can be used to assess the risk in Ijebu-Ode as a sample,are qualitative ones, like the analysis of newspapers and other publications that have previously and recently documented flood events. News organisations interview people to learn about the scope of the flood and the issues that the population is facing. For the objective of determining how previous flooding affected the residents of Ijebu-Ode, publications that captured the vulnerabilities of the occupants (people) were examined. In recent years, especially during the rainy seasons in Ijebu-Ode, the flood risk problem has increased and now occurs frequently (nearly yearly).

According to Daily Trust Newspaper, (10th August, 2008), residents of Ijebu-Ode and it's environ cried out that the whole area has been flooded due to persistent rainfall. Each time it rained, situation was very critical, as water flooded the roads leaving no space on either part of the road. In addition, Tribune Newspaper on (Monday February, 2012), many areas in Ijebu-Ode, were recently flooded after a sudden downpour or first rain in the year which lasted for more than one hour devastating many areas like Talbot, Osinubi, Igbeba, Molipa, Ondo Road in Ijebu Ode etc. flooding the roads and making them impassable due to the level of water on them and damaging properties. According to Sunday Punch Newspaper (September 23rd, 2018) Ogun abandoned channelization turn to gully of deaths, swallow houses and farms. Gully sliced Owa Kurudu, Mayo-Mayo & Logun communities in Ijebu-Ode. Sadly, erosion ravaging the communities for some years has swallowed houses which left their owner distraught. One of the owners of house lamented that there was no gully or any life-threatening situation in 1989 when they moved in, the poor channelization caused destruction encountered

Drainage System Management, Maintenance and Misuse

Flooding occurs frequently in Ijebu-Ode, which is typically brought on by excessive rains and inadequate drainage systems, which frequently cause major floodsevery year. Most drainage canals overflow when there has been a lot of rain, which has a negative impact on people (Figures 1.1and 1.2). For many years, Ijebu-Ode's drainage systems have been in a terrible shape, which has posed major environmental problems

for the local population and surrounds. In many cases, deluges of rain so intense they literally submerged entire settlements, blocking traffic and rendering roads impassable for both pedestrians and drivers (Figure 1.1 and 1.2). This prevented people from leaving their homes and forced those who were inside to stay inside. While some bodies are located and others are not, some people are fatally washed away by the powerful floods. Floods result in evictions, threatened or actual building collapse, destruction of goods and property, and business closures.

During one of governor, Dapo Abioduninspection tours to areas of Ijebu-Ode in 2019, which included flooded areas in Igbeba, Paramount, Moborode, Italapo, Degun, and Imowo-Ibadan, the state's current governor, Dapo Abiodun, which was revealed in *Punch Newspaper 15th June, 2019; and The Sun Newspaper (16th June, 2019), that, the biggest problem Ijebu-Ode has is that the drains that crisscross the town are small concrete drains that are covered, and no maintenance of the drainage and they are very tiny. Ijebu-Ode requires a big open drain that can easily be serviced maintained, and it was suggested that a comprehensive plan will be aimed in resolving these problems once and for all. Residents were further advised to desist from habit of dumping refuse in drainages and other water channels causing flooding and attendant dangers.*

Pm News gathered that on the part of the people, any time that it is about to rain, they will go and dump their waste and refuse in the gutters which are not much spacious and deep, and will be blocked. Investigation reveals that most of the roads have big potholes all over because of lack of drainage channels in the town (PM News October 5th, 2011). And according to Aiyewunmi (2023), the residents have attributed incessant flooding to persistent rainfall; ineffective drainages; poor waste collection and disposal and poor town and urban planning.

Estimates have shown that 30 – 50 per cent of solid wastes generated in Nigeria cities are uncollected and disposed of indiscriminately (Falade, 2001; Olukanmi and Akinyinka, 2012; Olukanmi, 2013a). Presently, about 2.6 billion people are living without proper sanitation, of which Africa is not exempt (Olukanmi, 2013a; WHO/UNICEF. 2012). The need to provide proper drainage and sanitation facilities is essential to match up with the ever-increasing population growth (Bernajee and Morella, 2011).

Figure 1.1: a) wastes dumped on road dividers; b) uncollected waste in the neighbourhood in Ijebu-Ode. b) silted drain with growing plants and its impact on roads in Ijebu-Ode (Aiyewunmi, 2023).

Figure 1.2: a) excessive rubbish in the drain in Ijebu-Ode;b) flooded streets/roads and narrow and blocked drainage in Ijebu-Ode (Aiyewunmi, 2023).

Current Flood Risk Communication and Education

Current flood risk communication in Nigeria is in a poor state (Aiyewunmi, 2023), with much work required, reflecting a situation common across many African states. Levels of public awareness on issues related to climate change in Nigeria are low (BNRCC, 2011a and b). Current formal education on these issues provides insufficient knowledge or information resulting in a lack of awareness (Duru and Emetumah, 2016; Amanchukwu et al., 2015). Flooding in Nigeria with disastrous consequences in 2022 servedto

illustrate the country's ill-preparedness and lack of efficient disaster management plans by government and appropriate authorities. Four interconnected elements are key to effective flood risk management (mitigation, preparedness, response, recovery), with communication serving as a string that binds these elements together.Despite modest efforts to mainstream climate change adaptation into development agendas and policies, Nigeria is still grappling with challenges such as capacity building, poor technical skills and communication that reduce the effectiveness of adaptation efforts (FGN, 2021). These challenges are also an important reason given for the poor coverage of environment and safety matters in the Ijebu-Ode Local Government Area(ILGA); as such improved education of flood risk offers an opportunity to help address current knowledge gaps and a workforce skills gap.

Designing a Flood Risk Education Programme in Ijebu-Ode

There is an urgent need to engage in prevention, mitigation and adaptation to climate change effects, by adopting different policies and strategies in Ijebu-Ode. The design and implementation of an educational program on climate change and flooding are part of the strategies for strengthening the resilience of populations. The main purpose of flood-risk education programs is to raise awareness and increasing students' risk perception and their preparedness (Bosschaart et al., 2016). Environmental education should emphasize critical and integrative thinking, develop communication and problem-solving skills, as well as highlight the role of attitudes, values, and commitments in resolving environmental issues (Theis 1996; Simmons 2000).According to Oriola (1989), there is a clear need to entrench environmental education in school curricula, reinforced by a strong community awareness (on a national scale) and by strong mass-media support, which can influence behaviour. A fundamental idea of flood risk reduction is for knowledge and awareness raising and to select and implement measures to reduce vulnerability.

The objective of this paperis to raise adaptive capacity of individuals and communities to adjust to climate change and to develop awareness of flood risk. Through the design of a curriculum that will support children and adults, from age 6 to 25 years (covering primary, secondary and tertiary educational levels), it seeks to support actions to prevent, protect and adapt to climate change and flood events. This is supported by the Nigerian 6-3-3-4 system education policy, encompassing each level of education (pre-primary, primary, junior and senior secondary schools and tertiary institutions) part of the National Policy of Education (Premium Times & Opinion, January 10, 2017; Nigerian Tribune, January 20, 2022). Adaptation of a program to the cultural context of the country is critical, to ensure national ownership and sustainability of activities. The following steps and activities are proposed to be used to define and implement the program:

1) analyse the situation in Nigeria in terms of climate change and flood risk;
2) identify stakeholders that are involved in curricula development;
3) define the skills benchmark;
4) design the program;
5) share the program that has been developed with all stakeholders and teachers;
6) test and evaluate the program in schools;
7) generalize and perpetuate the program in Nigerian educational system.

The methodological approach that will be adopted shall be based on the involvement of all potential actors in the process (i.e., there are 8 fundamentals educational agencies in Nigeria), and these agencies are:

- National Universities Commission (NUC)
- National Commission for Colleges of Education (NCCE)
- Joint Admissions and Matriculation Board (JAMB)
- National Teachers Institute (NTI)
- West African Examinations Council (WAEC)
- National Examination Council (NECO)
- National Business and Technical Examinations Board (NABTEB)
- Teachers Registration Council of Nigeria (TRCN)

Conclusion

Less than 50% of survey participants and few of interviewees (i.e., community leaders) in Ijebu-Ode are aware of flood risk, illustrating the potential role education and schooling can play in raising flood awareness in Ijebu-Ode(Aiyewunmi, 2023). Therefore, greater environmental education is required to enhance flood risk knowledge of the practicing teachers' and raise proactive behaviours amongst the public. Flood literacy repositions those at risk as an active agent in managing local flood risk, as they can make informed judgements and decisions on risk and protective behaviour, rather relying on expert knowledge, which may not always be available (Willis et al. 2011). To encourage effective flood literacy through improved flood risk communications, there is a need to re-establish resilience as a process grounded in relationships, critically of social learning and dialogue (Twigger-Ross et al. 2011, 2014; Benson et al. 2016), rather than reliant on 'hard' infrastructure or property (McBain et al. 2010).

A senior environmental officer confirmed that Water Supply and Environmental Sanitation Department of the ILGA have challenges which include personnel, facility, and the unsustainable attitude of the inhabitants (Aiyewunmi, 2023). He noted that, some people (i.e., population) do take advantage of rain to dump their wastes indiscriminately, in this regards we are disabusing peoples mind and curtailing their unacceptable attitudes. The attitude of the residents is posing enormous challenges in achieving a sustainable environment. Many of inhabitants are so recalcitrant; many are still living in memory of years past and not bringing into cognisance developmental expansion that the town is witnessing". Indiscriminate domestic garbage disposal and collection are caused by a lack of environmental education, awareness, communication, and information. This increases the risk of flooding in many places. If the people are well educated, they will not put wastes in water ways so as to block drainages. People have carefree attitude of dumping refuse indiscriminately either into drainages or places they should not put them so that later when it rained it will be washed into drainages and block them. Wrong belief, such as when they throw wastes in drainages, water will wash them away, not knowing it will be deposited somewhere else and as more and more are been deposited, it will get to a point that it will eventually block the drains.

Recommendations

Successful flood risk management requires that government should develop clear, robust, and forward-looking strategic plans informed by rigorous research, administrative data gathering, dialogue with the public, evaluation, and learning. For example, flood risk education is an important advance in water education for Europe (Dogulu et al., 2015) and Netherland (Bosschaart et al., 2016).Environmental education is a part of the UN Sustainable Development Goals (SDGs), a strategy for more effective environmental management and has also long been part of global discourse on sustainability and has gained global agreement. *Government shouldcreate awareness and people should be aware of the hazard that can be caused if they behave otherwise.*

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