The impact of flooding on Nigeria’s sustainable development goals (SDGs)

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ABSTRACT
Nigeria has Africa’s biggest economy and a population of over 200 million people. Nigeria faces numerous challenges as it struggles to achieve the Sustainable Development Goals (SDGs) with flooding being the most serious with wide-reaching impacts. This paper highlights the impact flooding has on Nigeria reaching SDGs and enumerates the specific SDGs most directly impacted. A systematic literature review provides an overview of the relationship between flooding in Nigeria and the SDGs. It highlights the main causes of Nigeria’s flooding problem are man-made and advocates spatial planning as a suitable Flood Risk Management (FRM) strategy for the Nigerian environment. The paper calls for collaborative action by all concerned stakeholders to address the flooding problem and to help move Nigeria closer to meeting the United Nations (UN) 2030 SDGs. Most importantly, the evidence presented in this paper seeks to promote action on a national scale to combat the flooding in Nigeria and help the nation work more effectively toward achieving the SDGs.

Introduction
Flooding is the most common disaster in Nigeria. The majority of Nigeria’s states are increasingly suffering from annual flooding during the rainy seasons caused by increased precipitation linked to climate change (Ajayi and Olaore 2014). Unlike some natural disasters, rainfall flooding can be controlled with proper planning and the provision of necessary infrastructure (Agbonkhese et al. 2014; Satterthwaite 2017). Nigeria’s flooding is mainly human induced with current poor urban planning practices and inadequate to non-existent environmental infrastructure contributing to and exacerbating the issue. The absence of a national Flood Risk Management (FRM) strategy or comprehensive flood risk maps, for example, are indicators of the lack of attention paid to Nigeria’s flooding problem (Oladokun and Proverbs 2016). This suggests designing and implementing adequate FRM strategies comprising proper spatial planning and infrastructure would help in controlling the floods which adversely impact Nigeria’s sustainable development (Ouikotan et al. 2017).

Urban infrastructure, underpinned by relevant legal and policy frameworks, forms the backbone of human settlements. Elements such as FRM measure aim at reducing the likelihood and/or impact of floods while spatial planning, also known as urban planning, town planning, land-use planning and physical planning, are methods employed by the public sector to shape the location, distribution and interlinkages of land use activities (Acheampong 2019; Ouikotan et al. 2017). Nigerian cities are characterized however by poor infrastructure which impacts livability and sustainability. The lack of relevant legal and policy frameworks is another indication of the low importance given to controlling and managing flooding in Nigeria at all three levels of federal, state and local governments and to date, little to no effort has been shown by the government to solve this problem (Cirella and Ilyomhe 2018; Okoye 2019).

The SDGs are global goals for achieving environmental and human development by the year 2030 (Bebbington and Unerman 2018). Nigeria’s path to achieving them is marred by the major issue of recurrent flooding. This paper sheds light on the specific ways flooding impacts Nigeria’s sustainable development by illuminating the connections between the phenomena and highlighting the specific development goals impacted namely 1: No poverty; 2: Zero hunger; 3: Good Health and Wellbeing; 4: Quality education; 6: Clean water and Sanitation; 8: Decent work and economic growth; 11: Sustainable cities and communities; 14: Life on water and 15: Life on the land. Highlighting these connections aims to encourage the Nigerian government and relevant stakeholders to act and provide the necessary infrastructure needed to control the flooding and thereby improve people’s lives. This paper first discusses flooding in Nigeria and its drivers, FRM and spatial planning, sustainable development, and the SDGs. It then highlights the specific SDGs impacted by the floods and the ways they are impacted. The paper concludes by summarizing the impacts of flooding in Nigeria and calling for...
collective and decisive action by all concerned stakeholders to control the flooding menace.

**Flooding in Nigeria - current and past**

In the states of south-western Nigeria, the Niger Delta, and communities downstream of dammed rivers in the North, flooding is an occurrence with wide-ranging impacts. The flooding is mainly from rainfall which is prevalent in the Niger Delta and southern parts of the country (Agbonkhese et al. 2014; U Nkwunonwo, Malcolm, and Brian 2015). In 2012, Nigeria experienced its worst flooding in recent history (Nkeki, Henah, and Ojeh 2013; OCHA 2012; Toure 2014). More than 2.3 million people were displaced, 363 lost their lives and another 16 million people were impacted in various ways and years of development gains were reversed (Nwigwe and Embarga 2014; Oladokun and Proverbs 2016). Total losses were put at US$16.9 billion (Security 2013). In reality, the extent and nature of Nigeria’s flooding are such that the actual figures for displacements, losses, and fatalities cannot be truly ascertained (Cirella and Iyalomhe 2018; Nkwunonwo, Malcolm, and Brian 2015).

Nigeria is a signatory to the UN SDGs and flooding impacts on many of the SDGs. Flooding threatens sustainability because it negatively affects the economy, social life, environment, and health (Ludwig et al. 2007). The negative impacts of flooding are not restricted to a particular geographic area as the disruptive effects delay progress toward the SDGs. However, the negative impacts are felt more in developing countries like Nigeria because of its lower level of development. At present there is no concrete legal framework or flood management policy to address this perennial problem (Adekola and Lamond 2018; Akinloye 2018). There has been little to no effort by the government to solve this problem and this could be attributed to lack of streamlined relationship and understanding of the impacts flooding have on the SDGs Nigeria is striving to achieve (Akinloye 2018), a gap which this paper fills.

**Causes of flooding in Nigeria**

While climate change has led to more rains than in the past which has increased the incidence of flooding, Nigeria’s flooding is mostly human induced and exacerbated by human-nature interactions (Aderogba 2012). The human-nature interactions that cause flooding in Nigeria form the focus of this paper and include, but are not limited to:

1. **Poor or non-existent drainage systems:** This is a major human-induced exacerbator of the flooding experienced in Nigeria (Ogundele and Jegede 2011). Most residential areas in Nigeria have no drainage system and rely on natural drainage channels, and it is common for buildings and other infrastructure to be constructed in a manner that actually obstructs these drainage channels which results in flooding during the rainy season (Nabegu 2014). Nigeria’s increasing urbanization has seen a growing proportion of ground surfaces concreted, which means there is no percolation of water, and adequate drains are not in place to take care of the surface runoff (Adeloye and Rustum 2011). The lack of provision for drainage is one of the main causes of urban flooding in Nigeria. There is a pressing need to construct drainage systems to tackle the flooding problem (Etuonovbe 2011).

2. **Poor waste management system:** Poor waste management is one of the anthropogenic factors contributing to, and worsening the already difficult flooding problem in Nigeria (Ojo and Adejugbagbe 2017). The poor attitude of Nigerians to waste disposal has been widely discussed in various studies (Eneji et al. 2016; Ojo and Adejugbagbe 2017; Olukanni, Adebayo, and Tenebe 2014; Sridhar and Ojediran 1983). Drainage blockages linked to poor sanitation practices are common in Nigeria’s highly populated urban areas. Roadside dumping, canal dumping, and dumping in rains is commonly practiced among a large proportion of the population. This causes blockage and results in flooding during the rainy season (Onwuemele 2012).

3. **Unregulated urbanization:** Flooding and urbanization are intricately related in both developing and developed countries. Over 50% of Nigerians live in urban areas today (Farrell 2018). Nigeria is witnessing high urbanization rates without commensurate provision of urban infrastructure and amenities (Aderogba 2012). Agricultural lands are also being increasingly converted to residential areas to accommodate housing needs and development is carried out without proper controls and infrastructure in place, thus worsening the flooding problem (Dan-Jumbo, Metzger, and Clark 2018). Urban planning in Nigeria is poor and this is compounded by numerous compliance problems; this poor planning is a primary cause of the flooding being experienced in Nigeria. Nigeria’s flooding is therefore inextricably linked to poor urban development practices (Omoboye and Festus 2014).

4. **Weak implementation of planning laws and corruption:** Nigeria’s current planning laws are standard but their development and implementation are poorly controlled (Nnaemeka-Okeke
Political interference in planning work, understaffing and a lack of working equipment are factors that negatively impact effective planning and the execution of duties by the planners (Nnaemeka-Okeke 2016; Oluwaseyi 2019). The lax implementation of planning laws mean construction projects on natural floodplains and stormwater paths are approved, which exacerbates the flooding problem and impacts on sustainability. Corruption is also a factor. It is not uncommon for town planning officials to accept bribes and overlook issues – these may include the unauthorized use of land, the alteration of approved construction plans in areas that obstruct drains and natural waterways, substandard construction of infrastructure like bridges which subsequently collapse during the rains (Oladokun and Proverbs 2016). Resulting debris reduces the carrying capacity of the channels which induces flooding and worsens the problem originally being addressed.

The people also capitalize on the loophole of ineffective development control and a lot of times extend their buildings over the approved areas and in some cases go as far as building over drainage. This non-implementation of the laws is inimical to achieving sustainable urban development. Lack planning and the lack of valid building approvals are the root cause of irresponsible developments with attendant consequences (Adeloye and Rustum 2011).

Flood risk management (FRM) and spatial planning in Nigeria

Flood Risk Management (FRM) comprises measures aimed at reducing the likelihood and impact of floods. It encompasses the prediction of flood hazards, socio-economic factors and consequences, and measures/tools for risk reduction (Schanze 2006). It is not a static approach but adapts to changing circumstances. The adoption of a particular flood risk management strategy is influenced by numerous factors from environmental (geographical features of an area and the type of flood risk an area is prone to) to socio-economic factors and can include both structural and non-structural measures (Adelekan 2016; Bubeck et al. 2017). Countries adopt approaches that suit their own local situation (Bubeck et al. 2017).

Historically, Nigeria has been more focused on post-disaster flood response than control (Cirella and Iyalomhe 2018). Reducing and addressing exposure to flood risk is now a national priority in the Nigerian government’s disaster risk management agenda. A national framework, now in place, aims at moving reactive flood response and recovery to pro-active risk management, however, nothing concrete has been done and a national FRM strategy to ensure harmonization of practice is still not in place (FGN. 2013; Okoye 2019). This is not encouraging despite the comprehensive post-disaster needs assessment conducted in 2012 by the federal government with international collaboration. This raises questions on the political will to achieve this goal. Funds are readily released post-floods but not pre-floods to avert it. In 2017 alone, the Nigerian government released as much as N1.6 billion as a post-flooding response (Adekola and Lamond 2018).

Inadequate attention has been paid to flood control and management on a nationwide level and efforts aimed at addressing the challenge have lacked proper coordination and therefore, failed (Okoye 2019). Despite evidence of flood interventions in the past, the lack of an integrated FRM practice means that sub-optimal solutions are adopted and in numerous cases, more problems are created in the process. For instance in 2017, parts of Port Harcourt city witnessed massive flooding as a result of improper channeling of drains to a burrow pit which got filled up during the rainy season causing water to flow into the surrounding suburbs and cause flooding of unprecedented magnitude (Ezeaku 2017).

The government is not lacking research institutions and agencies with the skills to design an FRM strategy, for instance, the National Emergency Management Agency (NEMA) has a department of planning utilizing Geographical Information System (GIS) to work on flood data but there is no still no effective national early warning system in place for floods at all levels of federal, state, and local governments, while the National Meteorological Agency (NIMET) provides seasonal rainfall predictions, but communication remains a problem (FGN. 2013). Integration and coordination are lacking among the existing government bodies who sometimes carry out flood control projects without liaison with each other and control projects become ineffective due to improper coordination (Oladokun and Proverbs 2016). FRM in Nigeria is mainly carried out by the state governments with inadequate federal input but there is also a lack of coordination among the states which ensures that different practices are obtainable even in cities with similar environmental problems and characteristics. Some of the state-level FRM have been critiqued for being deficient. For example, the FRM of Lagos state has been critiqued for lacking evaluation and early warning systems which makes it ineffective (Adelekan 2016; Ugonna Nkwunonwo, Whitworth, and Baily 2016). The lack of flood data has also been decried in the FRM plan of Oyo state (Egbinola, Olaniran, and Amanambu 2017).

To address the shortcomings of current practices, spatial planning is advocated as a suitable FRM strategy for Nigeria because it has the potential of
integrating existing practices. It is recognized as the most sustainable flood risk management method. The adoption of coordinated and sustainable spatial planning involving relevant agencies, planning practitioners, and stakeholders are an important tool for mitigating flooding. This is because spatial planning provides for managing flood risks, and influences factors like type, location, function, and design of development (Porter and Demeritt 2012; Ran and Nedovic-Budic 2016). Currently, the planning system in Nigeria is weak and there is an absence of integration of planning with existing FRM in Nigeria (U Nkwunonwo, Malcolm, and Brian 2015; Oladokun and Proverbs 2016). Focusing contemporary flood risk management in Nigeria on spatial planning is best suited to the local situation given that the country is located in a relatively stable geological zone which is not prone to extreme natural disaster events like landslides, cyclones, hurricanes which cannot be controlled. This removes uncertainties from not knowing when the next geological disaster will eventuate (Egbenta, Udo, and Otegbulu 2015; Oladokun and Proverbs 2016).

The adoption of modern concepts of spatial planning like collaborative and sustainable planning, which is flexible, and involves the public, and integrates environmental issues to take the lead in the urban growth process and effectively manage flooding (Dyachia et al. 2017; Lagopoulos 2018; Oyefara 2013). Spatial planning incorporating sustainable drainage systems as an FRM strategy could also be combined with ICT/technological tools like applications that residents can use to communicate with the relevant authorities in the event of an emergency or blockage of drains and onset of flooding. Integrating spatial planning and FRM is key to controlling flooding and moving Nigeria a step closer to achieving the SDGs.

### Sustainable development and the sustainable development goals (SDGs)

Sustainable Development is; “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” This is the most widespread and accepted definition of sustainable development, adopted from the UN Report of the World Commission on Environment and Development: Our Common Future, known as the Brundtland Report after the Chair, Gro Harlem Brundtland (Brundtland Report, 1987: 37). This landmark report provides baseline features and agreement that surround the concept of sustainable development for all nations, whatever the country’s status (developed or developing), and it views development as a continuous change to society with its objective being to provide the basic needs of humankind – primarily food, clothing and shelter – and fulfilling humankind’s present needs while maintaining earth’s integrity for both present and future generations. The United Nation Sustainable Development Goals replaced the Millennium Development Goals and came into existence in 2015. It is the guide to achieving Sustainable Development and a better future for all by seeking to collectively address the challenges faced on earth. It calls for action by all nations of the world, irrespective of development status, in a global partnership (UN, 2015b) to achieve the goals by transforming the world through addressing numerous issues facing humankind to ensure economic prosperity, well-being and environmental protection for both developed and developing countries by 2030. The SDGs are interdependent and indivisible, balancing the three basic dimensions of sustainable development: the social, economic, and environmental. As opposed to traditional development goals which focus on a prescribed set of measures, the SDGs proffer a multifaceted and holistic take on development (Pradhan et al., 2017). Disasters like flooding have disproportionate impact across populations all over the world. The differences in impact are attributed to the fact that countries of the world are at different levels of development and do not face the same challenges (Mata-Lima et al. 2013; Reckien et al. 2017). Indeed, flooding disrupts various aspects of life and the SDGs impacted as highlighted in this paper could be similar to other countries of the developing world and Africa. However, this paper focuses on Nigeria.

#### Flooding and goal 1 (No poverty)

SDG 1 seeks to eradicate poverty by 2030. Poverty is the biggest global threat to achieving sustainable development. Eradicating poverty is therefore primary to the success of the SDGs (Roy et al. 2018, 450). There is a two-way reinforcing relationship between flooding and poverty because they feed off on each other; flooding worsens existing poverty and poverty makes the impact of flooding much more severe by increasing vulnerability. They both decrease the living standards of people affected and have both impeded development progress, especially among the worse-off members of the society (Dube, Mtapuri, and Matunhu 2018). Nigeria is by no means a poor country, yet paradoxically, it has overtaken India (with its population of 1.4 billion) as the nation with the largest number of poor people – 87 million Nigerians out of a population of 200 million now live in extreme poverty (Homi Kharas and Hofer 2018). As floods have become an annual occurrence, poverty is further entrenched.

Environmental problems like floods exacerbate the living conditions of the already poor in Africa’s most populous country and pose a threat to Nigeria achieving the UN SDGs. Floods have the capacity to destroy the social capital of people and the physical environment/terrain as well as take away the little savings of the already poor households. When such floods become a frequent occurrence, the effects are compounded. Flooding is
hence, a major contributory factor to the existent poverty (Egbinola, Olaniran, and Amanambu 2017). The impact of floods on the poor is strongest in the immediate aftermath of occurrences, and it remains very significant in the long term. The disadvantages poor people have manifest heavily when disasters occur, which further disadvantages them. The poor are hardest hit whenever flooding occurs in urban centers. The low-income are usually the inhabitants of informal settlements which characterize Nigeria’s urban environment (Wahab 2017). Such settlements are poorly built, making them prone to collapse when struck by floods or storms and also have a lack of basic infrastructure. Poverty is worsening in Nigeria as seen in the incidence of disease and hunger, decreased life expectancy, and low per capita income (Richard Samans, Corrigan, and Hanouz 2017). Nigeria’s annual flooding only ensures that poverty is further entrenched. The relationship between flooding and poverty therefore deserves closer attention.

**Flooding and SDG 2 (Zero hunger)**

The SDG goal 2 aims to end hunger in all its forms by 2030 (Gil et al. 2019). The food and agricultural sector is key in eradicating hunger but this important sector is heavily impacted by flooding in Nigeria (Osabohien, Osabuohien, and Urhie 2018). Food security is the assured way of eradicating hunger and involves making food available and easy to access especially the staple foods but Nigeria is far from achieving food security. This is despite its vast arable land. Nigeria remains the biggest importer of food in Africa (Matemilola and Elegbede 2017; Osabohien, Osabuohien, and Urhie 2018). Food is a primal need of man and agriculture ensures food availability, but flooding undermines food security because of the negative impacts on agriculture (Akuwwe, Khoda, and Oluoko-Odingo 2018). Flooding impacts food security and food insecurity leads to hunger (Azubuikwe and Nnubia 2015). Floods therefore have a chain reaction effect on the agricultural system in Nigeria and represents a threat to food security because of the impact on production and supply of food (Armah et al. 2010). Floods destroy livestock, crops, and seedling stores. This reduces harvest and impacts the next planting season, culminating in a food shortage crisis. Flooding thereby impacts agriculture and food security beyond the short term (Chapagain and Raizada 2017; Conforti, Ahmed, and Markova 2018). Land for cultivation becomes scarce as arable lands are taken over by floods (Azubuikwe and Nnubia 2015). This leads to scarcity of food and the forces of demand and supply come into play, increasing food prices beyond what the mostly poor affected can afford (Matemilola and Elegbede 2017). The worst-affected communities in Nigeria usually rely on agriculture as their main source of livelihood. With no harvest from flooded farmlands for several months during the year, they face hunger (Ojeh and Victor-Orivoh 2014; Oyebola et al. 2018). In 2012 in Adamaa state alone, floods affected more than 35% of the vegetation cover and 56% farmland cover while in 2014, 42% of the total vegetation cover was overtaken by floods while 51% of the total farmland cover was inundated (Musa and Shabu 2019).

The poorer rural farming communities suffer more not only because they lose income, but they also lack the cash to purchase other food and non-food items they need. Inundated farmlands are unsuitable for cultivation and livestock are not spared during floods. Depending on the type of sediments deposited on farmlands during floods, they can be rendered uncultivable for a period creating a cycle of food scarcity and hunger (Armah et al. 2010). Nigeria does not have a social security net and there is usually no other source of income for the most vulnerable populations. Vulnerable flood victims become more exposed to starvation and hunger (Matemilola and Elegbede 2017; Osabohien, Osabuohien, and Urhie 2018). To reduce hunger, the close relationship flooding has with food security in Nigeria needs to be addressed by controlling and preventing the anthropogenic/human drivers of flooding in Nigeria.

**Flooding and SDG 3 (Ensuring healthy lives)**

The SDG 3 aims to ensure healthy lives and well-being for all. This goal is derailed by flooding which impacts health in a variety of ways with long-term effects (Aliyu 2015; Olanrewaju et al. 2019). Just as the SDGs are interconnected and linked to each other, the impacts of flooding on health also connect to other SDGs for instance; no poverty and zero hunger. Unhealthy people’s ability to work is impacted which causes poverty and hunger. Flooding directly impacts poverty and increases vulnerability to hunger while hunger is a precursor for disease outbreaks due to weakened immunity, among other factors. Flooding has both direct and indirect impacts on health. Increased deaths and injury are direct effects of flooding with 90% of these direct effects having occurred in developing countries like Nigeria (Zorn 2018). Nigeria’s fledgling health sector suffers setbacks from annual flooding disasters. Water-borne life-threatening disease epidemics like Typhoid, Cholera, and Dysentery are common during flooding (Okaka and Odhiambo 2018; Rieckmann et al. 2018). Floods provide a perfect breeding ground for parasites like mosquitoes which leads to a rise in the incidence of parasite borne diseases like Malaria. Women and children are especially vulnerable to these diseases which can lead to death. Flooded homes provide a good damp environment for mildews and molds to grow sporadically which triggers upper respiratory illnesses for people who have allergies and episodes for asthma patients. Such health problems
mostly affect the elderly and children. Power outages post-floods in developed countries force people to resort to fossil fuel-powered generators. When the generators are run without adequate ventilation, deaths due to Carbon Monoxide (CO) poisoning can occur (Prevention 2017). Even after floodwaters recede, health risks and threats remain. For example, when electrical wires become immersed in water, there is increased risk of electric shock. Debris like twigs, woods, broken tiles, falling walls, and weakened structures can cause physical injury.

Pollutants like insecticides and pesticides, animal, and human feces, sewage, fertilizers, and other contaminants are rife in floodwaters which also carry disease causing micro-organisms (Oriji 2015). Contact of contaminated waters with agricultural crops and food items elsewhere makes food unsafe for human and animal consumption. Power outages are common during flooding disasters and this affects food stored in the home and may cause serious health threats (DFTE 2017). During floods in Nigeria, water sources become polluted. The ground becomes waterlogged and wastewater and sewage treatment plants become overburdened with the contaminated floodwaters causing backflow into homes and lower lying surroundings. Private septic tanks and wells are common in Nigeria and become overfilled with polluted water during flooding and become a harbinger of diseases and infections.

Physical and emotional trauma are triggered by floods (Alderman, Turner, and Tong 2012). Tong (2017) highlighted the numerous ways mental health is affected by flooding events. Tong cites studies that show increased stress-related and mental health illnesses like post-traumatic stress disorders, anxiety, depression, and even behavioral shifts like aggression, sleeplessness, anger, hyperactivity, and suicide among flood victims. Long-term psychological distress, even years after flooding, is very common (Rufat et al. 2015).

**Flooding and SDG 4 (Quality education)**

The SDG 4 aims to assure equitable and inclusive quality education and bolster continuing learning chances for all (UN 2016). The role and importance of education in achieving sustainable development cannot be overstated (Oghenekohwo and Frank-Oputu 2017). In the developing world, there is even more need to promote education as the literacy levels fall well below that of the developed world (Winthrop and McGivney 2015). To that effect, there are numerous campaigns to promote universal basic education for all, especially for young children, but flooding disasters undermine this right to education of children (Mudavanhu 2014). Displacements due to flooding cause children in disaster areas to become educationally disadvantaged at the crucial school age, which sets them up for continued economic disadvantage and opportunities later in life. There is evidence of overall poorer educational performances and outcomes, reduced level of educational levels, and general disadvantages that continue into adulthood (Erica, Jessie, and Stephanie 2018).

Flooding disrupts the schooling of children and the delivery of education in many ways, no matter the severity of the flooding. Even in non-major floods, parents are not keen to send their children to school as they fear them treading dangerous flood waters en route to schools. They cannot ascertain if storms or rainfall will increase the severity of floods when the children are away at school and so prefer to have them at home where they have greater control over their safety, should the severity of flooding increase or there be need of evacuation. The teachers are also not in the best psychological state to teach because they also have to handle terrible conditions either in the school, home, or emergency shelter to get their lesson notes ready. They also have to deal with their own flooded homes and damaged properties. Parents on their part cannot do much for their children’s education at this period or help with teaching on the home front. Educational materials are destroyed and even after the floods recede or the waters dry up, longer term effects in the education system are experienced because it is not easy to replace damaged educational materials especially in developing countries. In places prone to annual flooding, there might also be reluctance on the part of the authorities to replace these learning materials, knowing that it may be damaged again during the next flooding cycle.

In Nigeria, schools serve as emergency shelters during disasters like flooding, so they cannot serve their primary educational purpose. The effects of flooding disasters in the education sector become more damaging in places where access to education is already inadequate. There are usually delayed reconstruction efforts for damaged schools in the worst hit developing nations. The effect of flooding on the education of young school children is much more profound in the areas that experience annual flooding of such a scale that is not classified as a major disaster, meaning that these children lose many months of school year every year. Also, disasters like flood bring severe hardship to poor families who might be forced to withdraw their children totally from school and push them into the labor market to work to help provide for their families basic needs which brings a halt to their formal education (Kousky 2016).

**Flooding and SDG 6 (Clean water and sanitation)**

Everyone should have access to adequate, clean, accessible, and cheap water for both domestic and personal use as well as good sanitation. The SDG 6 aims to ensure the availability and sustainable management of water and sanitation for everyone (UN
Disease wells (Raimi et al. 2019). Flooding further impacts clean water and sanitation in Nigeria despite the already poor numbers.

Flooding leads to contamination of water bodies and reduces access to potable water (Olanrewaju et al. 2019). Flooding also causes a rise in the groundwater level which reduces the efficacy of the natural water purification process and increases risk of infections and vulnerability to dangerous chemicals (Nations 2010). A lot of areas in developing countries lack adequate sanitary facilities and when it floods, the likelihood of outbreak of diseases like diarrhea and cholera drastically increases. Women and girls are also particularly vulnerable because in the developing world they do more of the water collection and washing. Contaminants that affect potable water during flooding include micro-organisms like bacteria, chemicals, sewage, industrial waste, etc., that can lead to illnesses and death (Sun et al. 2016).

The ground becomes waterlogged and wastewater and sewage treatment plants become overburdened with the contaminated floodwaters causing backflow into homes and lower lying surroundings. Private septic tanks and wells which are common in developing countries overflow with polluted water and become cesspools for disease and infection. In many flood-prone communities, up to 80% of ailments have been linked to inadequate access to water and sanitation during floods. Tube-wells (which are commonly used in communities) are submerged in floodwaters during floods, leading to scarcity of good water. Families depend on the polluted water for their water needs like washing, cleaning, bathing, cooking, and drinking (Chanda Shimi et al. 2010; Islam 2017). Water and sanitation are vital to life and a human right which flooding negatively impacts.

**Flooding and SDG 8 (Decent work and economic growth)**

The SDG goal 8 aims to enhance sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for everyone (UN 2016). This goal is undermined by flooding that destroys people’s means of livelihood. The impact of flooding on economic growth is well documented (Chapagain and Raizada 2017; Jongman 2018; Matemilola and Elegbede 2017; Mwape 2009; Olanrewaju et al. 2019). Disease incidence associated with flooding also means that manpower availability is limited as a sick person cannot contribute to the labor force.

In a flood impact study by Mwape (2009), 94% of the respondents who were primarily farmers had their farms devastated by floods, providing an insight into the high vulnerability of farming families. In another study by (Ikechukwu 2015) in Port Harcourt, Nigeria, the income of 30% of the research respondents has been negatively impacted while 29.4% had their buildings destroyed by flooding which is a regular occurrence in the rainy season.

A significant proportion of different forms of assets are lost to the floods including both productive assets like fishing and farming equipment, as well as nonproductive assets such as furniture, electronics, and clothing. Loss of income is experienced by flood victims as their sources of livelihood which yield household income are affected (Kwari, Paul, and Shekarau 2015; Mwape 2009). Property damage is the most pronounced economic aftermath of floods (Sardar, Javed, and Amir-ud-Din 2016). Also, the diversion of resources to reconstruction and rehabilitation tasks clogs the wheels of economic growth. The economic impact of flooding goes beyond the short term and usually extends beyond the affected region (Jongman 2018).

The 2012 floods in Nigeria cost Nigeria US$10Billion (Olalekan, 2018).

Illnesses caused by flooding also impact the economy, and a Cost-of-illness (COI) method is commonly applied to determine economic effects. The COI approach looks at the indirect and direct impact of disease on the economy, and indices include cost of medical care (diagnosis, medication, procedures, inpatient and outpatient care, etc.), non-direct medical costs like transportation for treatment and care, non-personal costs for instance information, research, and communication, education, etc., and income losses due to illness (Jo 2014). Flooding can also affect city infrastructure as services can be interconnected – water supply and electricity are usually connected, thus electricity outage can affect telecommunications and interrupt water supply. The geographical effect of such network interruptions often reaches far beyond immediately affected areas (Hammond et al. 2015). The impact of flooding on socio-economic activities in Nigeria impacts the nation’s economic growth and sustainable development (Kwari, Paul, and Shekarau 2015).

**Flooding and SDG 11 (Sustainable cities and communities)**

SDG 11 aims at making cities and human settlements inclusive, safe, resilient, and sustainable (UN 2016). The target by 2030 is to reduce significantly the death toll and number of humans impacted by disasters including water-related disasters and decrease direct economic losses as compared to global gross domestic
products caused by disasters. Goal 11 seeks to ensure human settlements are in the best possible state for inhabitants with the least negative impact on neighboring environment or communities (ibid). It is focused mainly on satisfying the needs of the poorest and the most vulnerable members of the community, which is predominantly women and children, and on preserving the integrity and security of human settlements amidst the current threats posed by climate change (UNDP, 2016). Climate change, rapid urbanization, poor solid waste management, inadequate maintenance of water, and wastewater infrastructures are factors that lead to flooding in urban areas (Koop and van Leeuwen, 2017). Nigeria is witnessing not only a spike in population but also rapid urbanization. Nigeria currently has over 50% of its population residing in urban areas and this number is set to increase to over 75% in the years to come (Aliyu and Amadu, 2017; Farrell, 2018; Reed and Mberu, 2014). The rapid population growth in Nigeria and unplanned urban development raise concerns on the sustainability of urban settlements which are the worst affected during flooding. In sub-Saharan Africa generally, 61.7% of the populace live in sub-standard housing which is more prone to flooding disasters (Reckien et al., 2017). Poor spatial planning fosters the decline and deterioration of the physical environment which manifests in forms like increased flooding disasters which further degrades and reduces the livability of the settlements (Nnaemeka-Okeke, 2016; Salami, von Meding, and Giggins, 2017). There are benefits to urbanization as urban centers are engines of innovation and productivity but the challenge in the Nigerian scenario lies in the haphazard manner in which urbanization is occurring and the rise of informal settlements which is not an ideal situation/scenario (A. A. Aliyu and Amadu, 2017). Human settlements at risk of flooding do not make for sustainable communities. Flooding is therefore a big threat to achieving SDG 11. The absence of social security and the inability of the urban poor in Nigeria to recover from the impact of flooding leave them more vulnerable (Salami, von Meding, and Giggins, 2017). The rate at which Nigeria’s population is growing and the urbanization rate demands that the vulnerability of its settlements to flooding which is the most recurrent and serious environmental problem it faces be paid a closer attention to build sustainable cities and settlements. Effective flood management and prevention will help in promoting sustainable places (Kiedrzyńska, Kiedrzyński, and Zalewski, 2015).

Flooding and SDG 14 (Life on water)

The SDG 14 aims to conserve and sustainably utilize the oceans, seas, and marine resources for sustainable development (UN, 2016). The place of water in discussions on sustainable development cannot be overemphasized given that water makes up 97% of the earth’s surface and 3 billion people depend on water for their livelihood (Chukwu, Weke, and Ikebude, 2018). Resources from water make up 5% of global Gross Domestic Product (GDP).

Flooding impacts on the successful utilization of water resources for sustainable development. It interferes and impacts water ecosystems and the services provided by the aquatic ecosystem. The impact of flooding on aquatic ecosystem often goes unrecognized because they are not as evident as the impact on land or on urban areas which are densely populated and also because of the difficulty in measuring impact on aquatic ecosystem (Talbot et al., 2018). The physical and chemical properties of water are important parameters that impact on the distribution and production of aquatic life (Khatri and Tyagi, 2015). Flooding induces changes in water quality from the waste, polluted sediments, and fertilizers from farmlands washing into the oceans during floods (Bariwari, Tawari, and Abowei, 2012). This pollutes aquatic ecosystem and causes deaths of aquatic life. Reproduction of the surviving ocean life is affected. This has an impact on sustainability of aquatic life because if they can’t reproduce, species become extinct. The dead aquatic life increases the presence of nitrates in water which is a by-product of decomposed marine life. Increased Nitrates in water on the other hand can hinder the capability of the red blood cells to transport oxygen and infants are more at risk of nitrate poisoning. Presence of Nitrates and Phosphates from fertilizers also promote eutrophication which enhances harmful algae blooms. Excessive algae growth blocks oxygen leading to further death of aquatic life continuing the devastating chain reaction. Carcinogenic heavy metals like chromium have also been found in higher concentrations in flood waters in Nigeria (Tawari-Fufeyin, Paul, and Godleads, 2015).

In the Niger Delta region of Nigeria, fishing is the traditional and primary means of livelihood but there has been a reduction in the quantity of catch in recent years due to environmental problems including flooding (Chukwu, Weke, and Ikebude, 2018). Local fish production is about 600,000 metric tons yearly of which the majority comes from the Niger Delta coastal region (Clement, 2013). The dependence on water for primary livelihood makes the region extremely vulnerable to flooding which impacts the primary economy. The adverse effect of flooding on water ecosystem results mainly from pollution, deposition of excess nutrients, and sediments which in turn lower water quality, degrade water ecosystem, contaminate aquatic food resources, and impact overall coastal production.

Flooding and SDG 15 (Life on land)

Goal 15 aims to protect, restore, and promote sustainable use of land ecosystems (UN, 2016). Nigeria’s ecosystem is suffering degradation because of a mix of
interacting factors including flooding (Izah 2018). Flooding destroys the life of humans, animals, and impacts the natural flora and fauna of an ecosystem. Flood waters destroy land by stripping soils and eroding shorelines, taking out the natural vegetative cover in its path (Smith 2017). The hazardous conditions it causes pose a threat to every form of life both plants and animals. Weed species dispersal is another effect of flooding. Propagation of invasive species and reduced competition of native plants due to regular flooding is common in areas that experience flooding. Floods thereby promote invasive species while impacting sustainability of native species by disturbing them (Cuda et al. 2017). Preventing invasive alien species is one of the targets of SDG 15, but flooding promotes invasion of alien species when seeds of plants are carried by floods to non-native areas. Wildlife is not spared either during flooding disasters as they are killed in numbers and are also displaced as a result of the loss of their natural habitats (Tawari-Fufeyin, Paul, and Godleads 2015). It is not uncommon to lose farmlands, livestock, and human life during flood events. There has been a surge of environmental refugees and internally displaced persons due to flooding-related disasters in recent years in Nigeria (Adeniji 2018). Soilborne diseases like Melioidosis which cause fatality has been linked to flooding. Rapid runoff from flooding causes erosion leading to land degradation which enhances deforestation. Deforestation on the other hand increases the seriousness of flooding. We see a reinforcing relationship whereby flooding degrades land and land degradation increases risk to flooding (De la Paix et al. 2013; Konrad 2003; Mahabaleshwara and Nagabhushan 2014; Mullan et al. 2019). Land degradation is a global issue but the effects and impacts are felt more in developing countries like Nigeria whereby its poor depend directly on land-based economic activities (Nkonya, Mirzabaev, and von Braun 2016). The inability to sustain living from the land makes life hard for them. Flooding is inimical to achieving SDG 15 as seen on the impact on land degradation and loss of habitat for humans and other species. Controlling floods is essential to sustainability of life on land and achieving the SDG 15.

Conclusion

This paper has outlined the specific ways flooding in Nigeria impacts the country achieving SDGs by enumerating the specific SDGs impacted and how they are affected. Rainfall patterns in the past three decades indicate that the intensity of rainfall will increase and flooding incidences will subsequently continue to rise with attendant consequences (Cirella and Ilyomhe 2018). The paper clearly illuminates the impact of flooding on Nigeria achieving the SDGs. It suggests spatial planning as a suitable FRM strategy to elicit more decisive actions by the government to combat the flooding menace. This work contributes to the flooding literature and is likely the first paper to establish a clear relationship between flooding and sustainable development in Nigeria. To make any progress and ensure sustainable development, the anthropogenic causes of the floods in Nigeria need to be addressed; this requires reviewing urban and environmental planning and management (Daramola and Ilem 2010), and integration with FRM. The Government and concerned stakeholders have a key role to play in controlling flooding by putting the necessary infrastructure in place as a control measure (Satterthwaite 2013). Addressing the flooding menace in Nigeria is essential for the country to achieve its SDGs.

Acknowledgments

My profound gratitude goes to Dr Susan Mowbray and Joshua Kalemba for reviewing this work. To my Supervisor, Dr Nichole Georgeou, I am profoundly grateful for your guidance. I also thank the anonymous peer reviewers for their invaluable feedback.

Disclosure

The author declares no conflict of interest in this work.

Funding

No funding was received for this work.

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