
Environmental, Anthropogenic, and Health Dimensions of Flooding: Perspectives in Man-environment Interactions

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Abstract: Floods are events of great concern because of their adverse impact on the environment and human health. Natural causes of flood include environmental phenomena such as heavy rainfall, overflow of river banks and coastlines, and tidal surges. But beyond the natural, flooding also reflects the outcome of human interaction with the environment in many instances. Poor housing, high population density, poor drainage systems, and global warming are all anthropogenic factors in flooding. On the other hand, disease outbreaks, displacement of populations, economic losses, psychosocial disorders, injuries, and deaths are important problems associated with flooding. The concept of environmentalism provides some basis for understanding the man-environment interactions. Environmental determinism posits that human activities and behaviour is wholly determined by his environment. But the more lenient form of environmentalism is environmental possibilism, a concept that promotes the idea that man can substantially alter his environment to soothe his purposes and activities. However, some of man's influence on his environment directly or indirectly relates to known causes of flooding such as unplanned housing with poor drainage systems, damming, and climate change effects. The causes and effects of flood have important relationships that can be explored in devising appropriate and sustainable approaches to flooding control. This paper puts in perspective the significance of the man-environment interaction as it relates to flooding and associated problems. It describes some major consequences of flooding in the context of this interaction and sites some examples of major flooding events in the recent past in Nigeria.

Keywords: Flooding, Environment, Health, Nigeria

1. Introduction

Flooding is the accumulation and associated motion of water inundating land area that is usually dry, resulting in the covering of land, property, and associated infrastructure by

water [1, 2]. Heavy rainfall is the leading cause of inland flooding- a type of flooding known as fluvial flooding. Other causes of fluvial flooding are melting snow, glacial outbursts, and dam-break flows [3]. Flooding is the situation that results when land that is usually dry is covered with water as a result of a river overflowing or heavy rain. Floods are of great

environmental concern because of its adverse impact on the environment and its untoward effects on human health both on short and long term basis. Flooding is one of the most widespread form of environmental hazards and poses multiple risks to human health and the environment [4]. Floods are the most common disasters worldwide [5].

In many parts of the world, flooding poses serious challenges that governments and organizations at various levels have grappled with over decades. In fact, settlements and housing, industrialization, and allocation of resources have all been influenced by consideration related to floods and flooding in some ways in many countries of the world. Floods can be natural or man-made depending on the causative or aggravating factors. When floods occur as a result of rainfall factors such as high rainfall intensity and frequency or heavy rainfall of prolonged duration, and when it occurs as result of overflowing rivers or tidal surges, it is considered as a natural occurrence. On the other hand, when flooding results from diminished capacity for drainage as result of human activities or inaction as may be the case in poor drainage systems or blocked drains, it is considered as man-made. Whether natural or man-made, floods have significant environmental, anthropogenic and health dimensions expressed in the causative factors, and in the environmental and health effects [6].

2. Man-environment Interactions

Man is inseparable from his environment. Man is influenced by his environment and man equally exerts influence on his environment. The concept of environmentalism provides some

basis for understanding these interactions. Whereas environmental determinism posits that man is in the grip of his environment so much so that all that man does or engages in is determined by his environment, environmental possibilism implies that man can alter his environment to very great extents to serve his desires and needs [7, 8] The occupation of a people can be significantly influenced by the prevailing environmental conditions. For example, fishing is a major occupation in riverine communities in Nigeria while arable farming is common in the savanna grassland zone of the country. Many aspects of culture in traditional communities such as housing, clothing and trades were significantly determined by environmental factors. However, civilization, globalization and technological advancement have altered many of these observations and seem to promote the validity of environmental possibilism [9, 10].

The relationship between man and his environment may be “accommodating” in many instances. However, when that relationship is overstretched, adverse consequences may occur. Global warming, largely due to anthropogenic greenhouse gas emissions, has been implicated in flood disasters. Similarly, when dams used for agricultural or power-generating purposes collapse, floods can result. These two instances indicate how the interaction between man and his environment can directly or indirectly lead to the problems of flooding including disasters. Overall, an understanding of the interactions between man and his environment is useful in putting the causation, effect, and mitigation of flooding in perspective (Table 1).

Table 1. Environmental and human/health dimensions of flooding.

Domain	Dimensions	
	Environmental	Human/health
Causation	<ol style="list-style-type: none"> 1. Heavy rainfall 2. Tidal rise 3. Ocean surge 4. Earthquakes 5. Drainage collapse 6. Collapse or overflow of dams 7. Global warming 	<ol style="list-style-type: none"> 1. Poorly designed drainage system 2. Blocking drains 3. Poor solid waste management 4. Poor town planning
Effect	<ol style="list-style-type: none"> 1. Damage to roads, houses, and other properties 2. Destruction of farmlands and other vegetation 3. Pollution of water supplies 	<ol style="list-style-type: none"> 1. Accident, injuries, death 2. Psychosocial distress 3. Disruption of socio-economic activities 4. Famine and malnutrition 5. Disease outbreak 6. Interruption of services 7. Displacement of populations
Mitigation/Control	<ol style="list-style-type: none"> 1. Detention basins 2. Flood control dams 3. Flood-tolerant parks 4. River basin development 5. Sustainable development 	<ol style="list-style-type: none"> 1. Flood preparedness 2. Proper town planning 3. Maintenance drainage system 4. Sanitary waste management

Source: Synthesis from literature, 2019.

3. Environmental Dimensions of Flooding

The importance of environmental factors to flooding has

been brought to the front burner in recent times as a result of global focus on climate change [11]. Both in the causative dimension and the affective dimension, flooding has environmental components. Floods are a natural phenomenon, with both negative and positive impacts. Flood

disasters result from the interaction between extreme hydrological events and environmental, social, and economic processes. Flood disasters have the potential to put development back by five to ten years, particularly in developing countries [12].

Floods are destructive to components of the physical environment such as lands, roads, and houses [13]. For example, many houses were submerged in the flood disasters that occurred in Nigeria in 2012 (Figure 1a and b). Similarly, large areas of residential and farming lands can be completely covered for weeks to months by floods as was the case in Lokoja, North Central Nigeria in 2018, where about

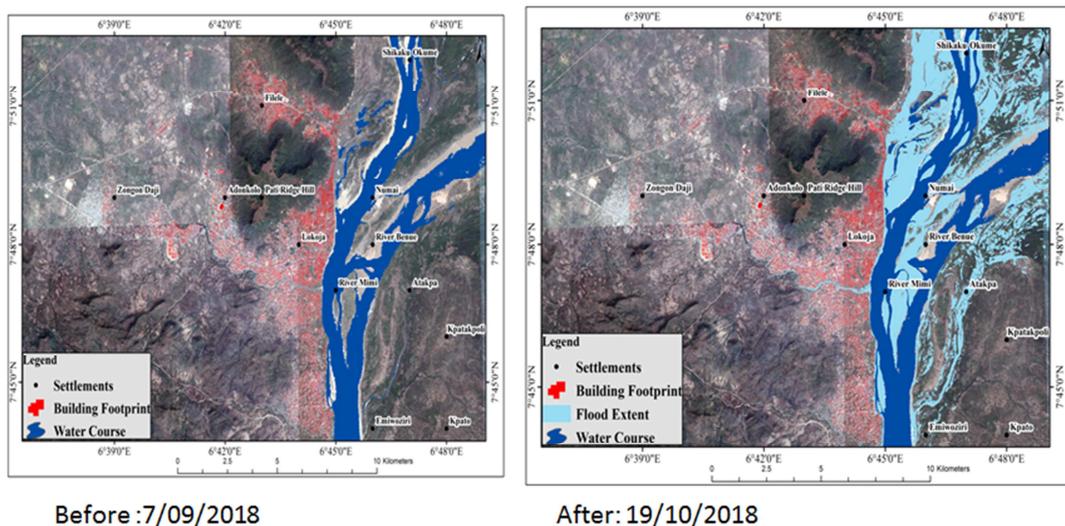
61km² of land area was inundated within six weeks (Figure 2). Recurrent or extreme flooding, pose grave risks to development and have negative impacts on lives, livelihoods and economic activity and can cause occasional disasters.

There are some positive aspects of floods. Floods play a major role in replenishing wetlands, recharging groundwater, and support agriculture and fisheries systems, making flood plains preferred areas for human settlements and economic activities. Extreme demands on natural resources due to population growth have forced people and their property to move closer to rivers in many parts of the world [12].



Source: [14].

Figure 1. Flooded communities in Southern Nigeria during the 2012 floods.



Source: NASRDA, 2018.

Figure 2. Flooded Communities in Lokoja, Nigeria.

4. Flooding and Human Activities

Social and economic activities of man can aggravate flooding problems. On the flipside of the coin, flooding can disrupt social and economic activities of man. Solid waste generated from socio-economic activities like market activities, weddings and funeral rites, harvesting of farm produce, school, and workplace activities can block drains if not properly managed. Poor or inadequate drainage systems are major factors in urban flooding [15].

When floods occur in communities, socio-economic activities are affected. Whole farming seasons have been lost during periods of heavy and prolonged flooding due to the devastating effect of floods as was the case in the floods in many parts of Nigeria in 2012 [16, 17]. Trading and social events like wedding and funeral ceremonies cannot take place as long as floods cover most parts of a community. Schools and worship places have to shut down due to floods. The adverse impact of the 2012 floods in Nigeria on the socio-economic activities of many communities was significant [13].

5. Flooding and Health

Flooding may be rightly considered as an environmental phenomenon. However, the effects of flooding both in the immediate and in the long run can be seen in the health of individuals, households, and communities at large. Immediate health effects of flooding occur in the form of injuries such as bruises, sprains, burns, and electrocution [3]. There is a clear risk of death and injury during and in the immediate aftermath of flooding [6]. In extreme cases, death can result from flood events in the form of drowning, electrocution, prolonged entrapment, and collapse of heavy structures on people [18]. Deaths from flood were have been reported to be associated with entrapment inside vehicles in Puerto Rico [5].

Flooding often causes damage to or completely destroy infrastructure that may include health facilities or access roads and rails to health facilities. In such situations, people who require healthcare services cannot access such services, thereby leading to worsening ill health and extreme cases avoidable loss of lives. There may also be instances where communication infrastructure and power supply facilities are destroyed by floods so that provision of health care services becomes difficult, if not completely impossible. For instance, there were reported cases of many flooded health facilities in the Niger Delta area of Nigeria in 2012 and other flooding disasters in subsequent years (Figures 3 and 4).



Source: WHO Office, Bayelsa State, Nigeria, 2019.

Figure 3. Flooded health facilities in Bayelsa State, Nigeria.

Flood can wash up waste such as sewage from pit latrines or damaged sewage pipes and septic tanks and transport them to living premises. Such waste can also be washed into water supply or water storage facilities. In both instances, significant contamination of water and food occur which may lead to disease outbreaks in addition to the resultant aesthetic nuisance. In the aftermath of a flood, left over flood water and the associated moist environment encourage vector breeding which in turn cause increased incidences of vector-borne and other communicable diseases [3].



Source: WHO Office, Edo State, Nigeria, 2019.

Figure 4. Healthcare workers navigating through floods to deliver health services.

Furthermore, it should be noted that flood is a humanitarian emergency that can lead to displacement of large numbers of people. Affected individuals resort to temporary locations with high population densities, inadequate food, and shelter, destroyed infrastructure, unsafe water and poor sanitation. These circumstances can increase the risk of transmission of communicable diseases and may lead to increased mortality. The effectiveness of communicable disease control during emergencies relies on a robust Early Warning Alert and Response Network (EWARN) to detect and respond rapidly to signals which may indicate outbreaks and clusters of epidemic-prone diseases [19]. During the flooding disaster in Nigeria in 2012, the World Health Organization (WHO) supported the activation of the EWARN component of the IDSR, with the recruitment of EWARN State facilitators and State coordinators. The EWARN data flow chart is shown in Figure 5 below.

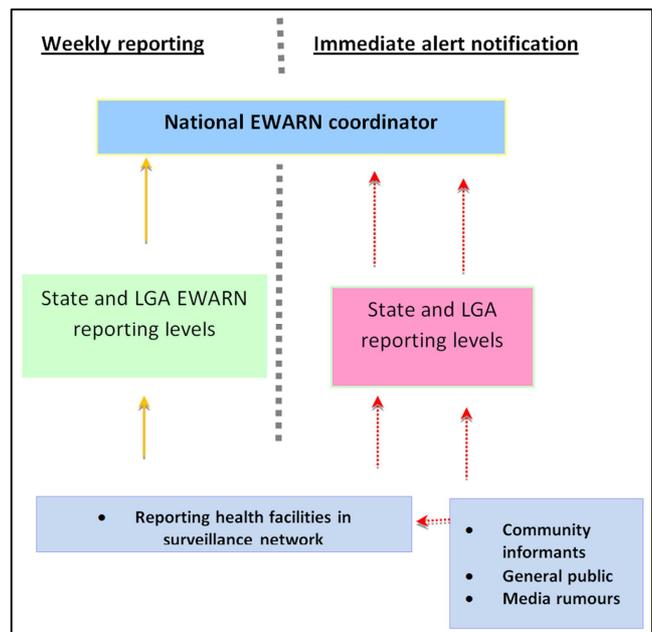


Figure 5. EWARN data flow chart.

In the wider picture, floods may destroy large expanse of farmlands and livestock grounds, leading to great economic losses [13]. The farmers lose means of feeding their families

and food prices soar in the aftermath. This can become a remote cause of malnutrition, especially among vulnerable populations of under-five children, pregnant and nursing mothers, and the elderly. In Nigeria, the very devastating flood of 2012 was deemed to be the worst in the last 40 years and according to the National Emergency Management Agency (NEMA), about 363-400 people were killed, 5,851 injured, 3,891,314 affected, and 3,871,53 displaced due to the resulting floods [20, 21].

Psychological and mental health could also be affected by the problems of flood. Depressive symptoms, post-traumatic stress disorder, and higher levels of anxiety have been reported in persons exposed to flooding [11, 22]. People living in flood-prone areas live in perpetual anxiety especially during periods of heavy rainfall. Sound sleep, which is important for rest, may often times elude someone living in a flood-prone part of a town when it rains at night. The need to relocate against one's wish due to flood incidence, together with the associated anxiety is mentally and psychologically distressing. Reports of the psychosocial impacts of flood events suggest that they can have significant effects on people's wellbeing, relationships, and mental health [23, 24]. Separation of persons from their loved ones and families as a result of floods is an excellent example of the adverse effect of flooding.

6. Conclusion

Flooding is a multi-dimensional disaster that is linked, to a very large extent, to man's interaction with his environment. Both natural and anthropogenic factors are implicated in flooding. Similarly, the resultant problems of flooding impact many aspects of human existence resulting in displacement of populations, destruction of properties, injuries, disease outbreaks and deaths. Any effective approach to the control of floods and its associated problems requires strong consideration of both natural and human factors in the context of the man-environment interaction.

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