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Impacts of Floods on Human's Health and Medical Infrastructure

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Abstract: *Man and disaster such as flood are inseparable. As long as man lives flood continues to happen. One of the indelible events that remain fresh in the memories of Kelantanese is the massive flood of 2014 that occurred towards the close of that year. Heavy rains fell initiating vast flooding in most areas of Kelantan leading to great destruction of livelihood of local communities. The flood recorded severe fatalities, injuries and exposed many vulnerable to diseases and destroyed information technology (IT) infrastructures. This paper via critical review of literature considered the long-term impact of floods on human's health and IT's infrastructures as the effects could meaningfully contribute to the worldwide burden of disease. Also, its outcomes are relentless hence need to be adequately comprehended and addressed through sustainability. The study indicated vulnerability to flooding and the associated impacts hence seeking for sustainable approaches on safety and relief interventions during the expected event. Kudos to the Malaysian government who has taken bold steps in recent time, to uncover the long term impacts of 2014 flood as well as to appropriately address the issues. Government should ensure strict implementation of reports in obedience with the Sendai Framework for Disaster Risk Reduction 2015-2030 targets.*

Keywords— Floods impact, health, diseases, Information technology infrastructures, Mitigation

1. INTRODUCTION

Among the first natural disaster that was noticed in sequences in known parts of the global community have been floods. According to Elias, Hamin and Othman (2013), the physical infrastructure of the earth have been altered by climatic changes, economic and technological growths which have resulted to floods strike or occurrence everyplace with little or no warning. A menace which was identified regularly with the third world and underdeveloped nations has emerged to be the concern of the many developed and developing nations. The prevalent concern with floods is the tragedy that proceeds from the loss of lives, devastation to property and farm lands, disturbance of communities' services and economic losses suffered not only by the business class or community, but in general affecting the community's quality of life. A number of tropical nations like Malaysia suffer from the impacts of floods annually. This is acknowledged by Elias, Hamin and Othman (2013), that monsoons were at a time seen as the cause of annual happenings of flood waters, currently the nation of Malaysia bears the displeasure of development and their unmapped penalties each time overwhelming waters paralyses communities and manifest through wide spread destruction. A recent example of this unwanted and never wish to remember experience was the 2014 flooding in Malaysia that caused a national instability across the length and breadth of the country. The flooding experience of 2014 cannot be forgotten by Malaysians especially the Kelantanese.

Precisely, on the 26th of December 2014 to January 2, 2015, there was a massive flood in the state of Kelantan, Malaysia. Heavy rains fell initiating great flooding in most regions of Kelantan resulting into great disruption of livelihood of residents (Ahmad and Abdurahman, 2015). Report confirmed it that across the country, quite large populations of residents were affected by the flood (unwanted visitor) and Kelantan state was identified as the most affected among the affected states (Shamshuddin, Panhwar, Othman and Ismail, 2016). In an attempt to describe the scenario, Mohamed et al. (2017) said it is not out of place for one to say that the speed of the flood water in the affected regions flowed so fast with vitality equivalent to that of Tsunami, displacing anything that obstruct its channel of flow including buildings and other infrastructures predominantly information technology facilities as displayed in **Fig. 1** and **Fig. 2** respectively.

Fig. 1 *Property damaged: House uprooted on another house*

Fig. 2 *Tsunami-like disaster damaged the cars*

Record has the flood as the worst that hit the country of Malaysia in two centuries (20 decades). With the assumption that surge of such magnitude happens seldom perhaps once in 1000 years. Specifically, for the state of Kelantan, the catastrophe was exceptional in the trace of its existence. Estimating the worth of property lost, Berita Harian (2014) valued property that was ravaged by the floods comprehensively in parts of peninsular Malaysia, is anticipated to cost Putrajaya and the Kelantan state governments more than RM 1billion. Considering the assessment of destruction caused by the natural hazard, it is appropriate to call it a national disaster because of the huge economic loss of approximately USD 0.7 billion that Malaysia as a nation suffered. It is knowledge widening and truthful that natural hazard such as floods are not caused by natural processes only but also by human activities.

A number of investigators have revealed that human activities contribute largely to natural menace like the one under context. For example, Azuhan (2015) and Sathiamurthy and Kong (2015) unwaveringly blamed the happening of the flood on the unusual rainfall within short interval and illegal exploitation of natural vegetation such as logging activities. The flood caused acute fatalities, injuries and left many residents to diseases. In the expressions of Jonkman and Kelman (2005) and Yeo and Blong (2010), great and astonishing floods such as the one under discussion, subject the elderly, who are in need of assistance regarding evacuation and admission to medical amenities, and who perhaps hesitate to abandon their houses, at bigger risk of injury and death.

Giving more evidences that residents of the affected locations actually suffered these discomforts can be traced to the work of Baharuddin et al. (2015) titled "The Record-Setting Flood of 2014 in Kelantan". Baharuddin et al. (2015) acknowledged the inflow of flood victims (patients) of Kelantan to Hospital University Sains Malaysia (HUSM) to add to the numbers transferred to HUSM by Hospital Raja Perempuan Zainab 2 (HRPZ2) after the vacation of their health centre on the 25th day of December 2014. The transferred patients' situations were largely critical issues from protracted medical situations namely; acute exacerbation of chronic obstructive airway disease, acute coronary syndrome, sepsis, heart failure, among others.

Sam and Pesigan (2011) considered medical home (hospital) as one of the most important facilities needed during flooding to give a medical facility and treatment of the highest quality to in and out patients. This is to say that, hospital is a major centre of reference that supplies information on diagnostic and treatment services. Labarda, Labarda and Lamberte (2017) and Lai et al. (2003) viewed hospital as a building furnished with up-to-date facilities and structures of sophisticated medical implements as well as involving human resources (professional employees) to offer medical services and attention to patients. This edifice needs to be protected or keep intact before, during and after disaster taking into cognisance the mediating and numerous functions of the medical facilities.

Yusoff, Shafii and Omar (2017) recommended a course to be pursued to review the issue of the impact of floods in the hospital and measures to reduce its impact accordingly. So as to ensure continuing medical services' provisions for patients exclusively during emergency cases such as floods. It is in the light of this and other pressing issues that this paper will ponder on the long-term impact of floods on human's health as the effects could meaningfully contribute to the worldwide burden of disease with central focus on information technology infrastructures such as transportation and communication system, water and power lines and public institutions. These were selected based on the important roles they play and also seen as the basic facilities, services and connections required for the effective running or operational of a society or community.

2. CONCEPT OF FLOODS AND ITS IMPACTS

Flooding is the most common kind of natural disaster globally, and has so become an important focus of concern within the developed and developing countries (Mohamed et al., 2017). In Europe, floods have been testified to affect over

3.4 million people over the last decade, with number of death extending into the thousands (Jakubicka et al., 2010). The World Health Organisation Regional Office for Europe (2011) predicted that by the year 2085 flooding could directly affect about 5.5 million people in Europe yearly, if adaptation along with further exacerbation of climate change is not taken serious. With tenacious rainfall causing various types of flooding, this affected over 7000 households in the United Kingdom while incurring major disruption to personal livelihoods, property and public transport systems (Muchan et al., 2015).

According to Yusoff, Shafii and Omar (2017), floods are an annual manifestation of unpredictable event in states on the east coast of Peninsular Malaysia such as Pahang, Terengganu and Kelantan. In late December 2014, the most significant and largest recorded flood was specifically in the Kelantan. It was considered to be a "tsunami like disaster" in which 202,000 victims were displaced and causing widespread collapse of public infrastructure (Ghani et al., 2016; Baharuddin et al., 2015). Kelantan whose location faces Northeast monsoon from November to March each year and compounded by unplanned urbanization, geographical feature and land use planning, triggered the severe flood (Khan et al., 2014). Flooding affects numerous aspects of man's environment and these include his economic activities; settlements and health.

Flooding is a momentous rise of water level in a stream, lake, reservoir or coastal system that overflows the banks. There is increasing susceptibility or vulnerability of populations and infrastructure to flooding and flood related hazards (Otomofa et al., 2015). ProVention Consortium (2008) expressed that normal floods are anticipated and welcomed as they offer rich soil, water and means of transport, but flooding at a big scale may causes damage to life, built and natural environment. Majority of people probably think that floods are a meteorological phenomenon and climate inconsistency that are influenced by geomorphology, geology, land use and other conditions (WHO, 2002). But floods are complex events by nature, caused by a collection of human exposures, incorrect development planning and climate change (APDC, 2005; ProVention Consortium, 2008). Hence, attempting to describe any form of floods gives prominence to central factors such as weather, climate and climate change. These three words (weather, climate and climate change) are interconnected notions.

Sakar et al. (2013) confirm that for the past few decades, Malaysia like other nations of the world has experienced climate change through changing rainfall patterns, increasing temperature, and life-threatening weather conditions that lead to growing incidence of climate related disasters which are primarily floods that promotes regular global warming development. Worthy of mentioning is the 2014 flood in Malaysia where three states namely; Kelantan, Terengganu, and Pahang experienced unusual and heavy rains that caused great flooding. Among the affected states, Kelantan was the most severe and left with the greatest ravage. The Kelantan flood of 2014 can be regarded as unpredictable and unprecedented. Going by the level of devastation, it is marked the biggest and worst flood in the state in the past 10 decades (century).

Flood events in former times advised the relevancy to safeguard infrastructure from unhelpful threats and stimulated the need to work on preparedness, response and recovery plans associated to infrastructure safety. Ayog et al. (2017) supported that besides daily needs, it is imperative on the occasions of floods as the infrastructure will be used for safe road access for evacuations, to offer temporary refuge for the affected people, to provide medical treatments for injuries and many more. As vulnerability to floods are inescapable, relentless attention has to be dedicated to lessening hazard connected with its happening through the introduction or adoption of adequate planning to enhance operational capabilities and preventive steps that are focused at reducing the impacts there of.

This paper examines the impact of floods on the built environment with emphasis on human's health and information technology infrastructures in Kelantan State, Malaysia. This becomes unique duty to do because one of the fundamental goals of post-disaster reconstruction is rebuilding facilities and infrastructures for the affected community or society, which includes critical infrastructures as indicated under the introduction section of this study (Farahdilla, Mansur and Abdullah 2013). It is primacy to understand and analyse the defenselessness or exposure of critical infrastructure and accompanying buildings in order to recover the aptitude to be prepared to avoid and manage unsafe flood circumstances. Ayog et al. (2017) believed that via the assessment of vulnerability, effective measurements for flooding can be enhanced and therefore, reduces the devastating effects caused to critical infrastructure which in return lessens the disorder done to the society as critical infrastructure is vital to public health and safety, economic strength as well as nation's security.

3. Flood Risk, Hazard and Vulnerability

It is basically important to comprehend the nature of flood risk so as to be appropriately positioned to future-proof human lives as well as economic damages and losses against the speedily changing conditions of the 21st century. Kates and Kasperson (1983) fashioned out three distinct steps for the assessment of risk which are the identification of hazards; the estimation of risks and the evaluation of the associated consequences of the derived risk. Nevertheless, Ologunorisa and Abuwua (2005) expressed that post-audits of all risk exercises should be reflected as another complementary step in the quest for sound risk management to arise. Risk can be communicated mathematically as *Risk = Hazard x Vulnerability x Exposure*.

Based on the formulae, the potentially harmful event magnitude called hazard refers to both physical and statistical dimension of inundation such as the return period, flow

velocity, extent and depth of a flood (Apel et al., 2009). Previous records and experience are vital in the determination of hazard. Exposure is the intensity, frequency and degree of human or assets exposed to an agent. The exploitations of areas prone to flood as a result of the tremendously increased world's population have prompted more exposure of people, infrastructure and property to the susceptibility of flood. Risk is only obvious and operational if buildings in the flooded places are exposed otherwise not. Balica, Douben and Wright (2009) defines vulnerability in the perspective of flood, as the extent to which a system is susceptible to floods due to exposure, a perturbation, in conjunction with its ability or inability to be resilient, which is to cope, to recover or to adapt.

Ayog et al. (2017) summarized description of flood risk in line with the previously mentioned critical infrastructure using category presented in **Table 1, 2** and **3**. It shows the relevancy of risk assessment as a move to conquer the common enemy known as floods.

Table 1: Flood risk and effects on transportation network (Ayog et al., 2017)

Availability of Transportation	Description	Risk involved
Cannot travel outdoor	Transportation access abandoned	Severe
Very hard to travel outdoor	Very limited transportation access	Critical
Hard to travel outdoor	Limited transportation access	Moderate
Minor difficulty to travel outdoor	Slightly transportation access	Light
Free to travel outdoor	Full transportation access	None

Table 2: Flood risk and effects on communication system (Ayog et al., 2017)

Availability of Transportation	Description	Risk involved
Cannot be reached (both phone and face-to- face)	No communication access	Severe
Very limited contact (via phone)	Very limited communication access	Critical
Limited contact (face-to-face with minor challenges)	Limited communication access	Moderate
Good contact (face-to-face with minor challenges)	Slightly limited communication access	Light
Not affected	Full communication access	None

Table 3: Flood risk and effects on buildings (Ayog et al., 2017)

Description	Risk involved
More than 50% of the structure destroyed	Severe
30% to 50% of the structure destroyed	Critical
5% to 30% of the structure destroyed	Moderate
Less than 5% of the structure destroyed	Light
Structure not affected by flood	None

From the above, it can be discussed that the impacts of flood on information technology infrastructures is very high and difficult to be quantified. And even hard to recover from the shocks each time memory is reflected on the magnitude of impacts. As such reflection is capable of awakening psychological trauma in the brains of the affected communities which serve as threat to their existence and livelihood. Observations and experiences showed that in the event of flooding, transportation system suffered most. As access to safe places such as hospital, markets, rescue by volunteers, etc will be largely denied and as a result inflict more pains on the affected people sometimes ended up in rapid increase in the number of death. Flood has the capacity to affect the internal hospital facilities, such as communications, medical equipment and supplies, electricity, and even transportation to evacuated patients (Yusoff, Shafii and Omar, 2017). Hence, it is needful to have proper preparation before the occurrence of an event specifically floods.

4. FLOOD MITIGATION PRACTICES CONSIDERED IN THIS PAPER

The paper is developed based on synopsis or rundown of literature from journal, newspaper, articles, books and report. The review comprises of both local and other country experiences regarding flood influence in public infrastructure issue and come up with the best of measures for reducing the risk of flood on the infrastructures. Given increasing international concern about the resilience of health facilities in the face of climate change, many countries have strengthened and developed legal frameworks, research and funding schemes for disaster reduction and climate change

adaptation (Loosemore, Chow and Mc George, 2014). As discussed in the previous sections, floods also caused a vast damage of property and life threatening population. Therefore, these publications contacted basically concentrated on floods.

According to Menne, Murray and World Health Organization (2013), flooding can either damage health care facilities directly or disrupt accessibility to them. Hence the need to design guide for improving hospital safety is paramount among others. The World Health Organization (WHO) Regional Office for Europe and the United Kingdom Health Protection Agency (HPA) work in partnership to assess the health effects of floods as well as to identify measures to avert or lessen their health effects (Yusoff, Shafii and Omar, 2017). This Hyogo Framework for Action (2005-2015) adopted by the World Conference on Disaster Reduction enumerates the need to incorporate planning for disaster risk reduction into the health region.

This framework to the best of human's knowledge addresses primary, secondary and tertiary prevention for managing flood risk with a collection of interventions and measures to moderate the impact of human health (Loosemore, Chow and Mc George, 2014). The recommendation to reducing flood impacts in critical infrastructures must be relocating the infrastructures outside of the floodplain as advised by (FEMA, 2013). After exhausting reasonable study targeted at recommendation for prevention or lessening of the consequences of flood, it is imperative to add that the best and sustainable practice for flood mitigation to be considered is multi-methods.

5. CONCLUSION

Reports show vulnerability to flood related diseases as psychological distress in the survivors is responsible for a quota of all physical ailments and malnutrition if not bring under timely control. Inadequate supports and emergency services in connection with a shortage of resources largely influence the ugly health effects of flooding in the study area. The fact remains that climate change may be increasing the regularity and brutality of floods experienced across the globe. Quite number of relief interventions have be initiated by the Malaysian government to prepare communities for floods, lessen and assess risk, and perform emergency services and aid. Nevertheless, some numbers of these appropriate interventions suffer deficiency in sustainability and resources to guarantee a long term recovery assistance to those that may require the services or expected beneficiaries. Kudos to the Malaysian government who has taken bold steps in recent time, to uncover the long term impacts of 2014 flood as well as to fashion out safety measures for the future. Government should ensure strict implementation of reports in compliance with the Sendai Framework for Disaster Risk Reduction 2015-2030 targets.

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