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Households' perception of flood risk and health impact of exposure to flooding in flood-prone informal settlements in the coastal city of Mombasa

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Abstract

Purpose – Mombasa City in Kenya is one of the most vulnerable towns to flood risk due to its low-lying coastal location. Those at the highest risk in the city are households living in the flood-prone informal settlements. However, little is known about the perception of these vulnerable households to the flood risks and its health impacts, which is important for developing effective long-term adaptation strategies. The purpose of this paper is to examine the general perception of the residents regarding flood risks, its impact on their health and their adaptation strategies.

Design/methodology/approach – This study surveyed 390 randomly selected households in three informal settlements in the city of Mombasa using a semi-structured questionnaire. This was supplemented with six focus group discussions (FDGs) and six key informant interviews (KIIs).

Findings – The majority of respondent households perceive future flooding as high risk or severe with high negative health impact. Despite this, many do not evacuate their homes because they do not have alternative places to move to. Flooding was indicated to have had a negative physical and mental health impact on members of households. Although majority of households had taken some adaptation measures, most of these were short term, mainly due to financial constraints, lack of knowledge and government support. Perception of flood risk and gender were found to have a strong influence on taking long-term adaptation measures at the household level.

Practical implications – Reducing flood risk and averting its health consequences in flood-prone informal settlements require empowering and supporting those living in these areas with ability to initiate long-term adaptation measures and creating awareness about future risks.

Originality/value – This study provides evidence about how residents of flood-prone informal settlements perceive flood risk and how the exposures to perennial flooding impact their health. The paper augments existing knowledge of flood risk in poor urban neighborhoods of developing countries.

Keywords Perception, Health, Flooding, Informal settlements

Paper type Research paper

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1. Introduction

Flooding has become one of the leading disasters worldwide and is predicted to increase in frequency over the coming years as a result of climate change and other human-induced activities (Bich *et al.*, 2011; Ding *et al.*, 2013; Mumuni, 2013; Tempest *et al.*, 2017). Today, many countries in the globe suffer some kind of flooding, and Kenya is no exception. Since the first worst recorded floods in 1961-1962, Kenya has experienced some of the most intense and severely devastating flooding as exemplified by the 1997-1998 *El Niño*-induced floods that were the most widespread (Owuor, 2015). The financial losses associated with the *El Niño* floods were estimated at US$800m (Karanja *et al.*, 2002). The problem of flooding has become perennial, every time taking back years of development and costing millions of dollars in reconstruction and recovery. In addition hundreds of lives are lost. According to the United Nation Environment Program (UNEP), (2009), flood-related fatalities constitute a whopping 60 per cent of disaster victims in Kenya. The flooding events in Kenya are influenced by a wide range of factors, including: the overflow of rivers, flash floods, coastal floods, floods as a result of unprecedented amounts and intensity of rainfall, inadequate or lack of drainage systems and in some cases, human interference with drainage basins, riparian zone and watersheds.

Flooding affects both rural and urban Kenya, but in the recent past, it has become more frequent and severe in the urban areas. Many towns in Kenya are now faced with the problem of recurrent flooding as a result of factors such as climate change, high concentrations of buildings and people, but mainly due to poor planning and poor disposal of waste that clog the drainage system. Some towns are at a greater risk of flooding due to a combination of factors, most of all due to their location. Mombasa City is one of the cities that have borne the biggest brunt of flooding over the recent past, and with the predicted rise in the sea levels due to climate change, the low-lying coastal city is at more scaled risk of experiencing greater and frequent devastating flood events. According to Awuor *et al.* (2008), Mombasa has a history of floods that have caused damage nearly every year. The effect of flooding in the city is, however, un-proportionately felt with the most-affected areas being the informal settlements. According to Moser *et al.* (2010), in Mombasa, poor households exist in spatially and physically vulnerable conditions. Their settlements are located on marginal lands, with poorly constructed houses and with limited or no access to roads, clean water, drainage, waste collection services and electricity. Some of the informal settlements are located at the edge of the sea and regularly get flooded due to high tides. The situation will be further exacerbated by the rise in the sea level due to the impact of climate change. This informs the need to find out how these people at heightened risk of flooding perceive their situation. The essence of understanding their perception of flooding is geared toward establishing their preparedness to deal with floods. It has also been recognized that there is need to integrate such knowledge in flood risk management to augment government action (Wood *et al.*, 2012). Moreover, knowledge on vulnerable people's perception of flood risk can help policy makers develop communication strategies to engage the communities most effectively to deal with the recurrent flooding and to develop an action plan for mitigation strategies based on these perceptions (Toan *et al.*, 2014).

In recent years, the perception of flood risk has become an important topic to policy makers concerned with risk management and safety issues (Kellens *et al.*, 2013). This is because it is envisaged that it will contribute to informed scientific and policy discussions that will be useful in effective tackling of the perennial problem of flooding in different parts of the globe (Bord *et al.*, 1998). The knowledge about risk perception may further provide important information about vulnerable people's willingness to take precautionary

measures and their support for government's risk reduction policies (Botzen *et al.*, 2009). At the same time, according to Babitski:

> [. . .] the role of the human perception is one of the most important questions. If we understood how a human perceives information and operates it we would more precisely make future forecasts and increase our efficiency (Babistki, 2011, p. 1).

However, Elrick-Barr *et al.* (2015) point out that there is limited knowledge of risk perception among communities at risk of flooding, like coastal communities, despite their vulnerability to flooding due to the sea level rise. In Mombasa City, whereas, there have been some studies on the risk that the coastal city faces and the impact of hazards like flooding (Awuor *et al.*, 2008; Kebede *et al.*, 2010), public perception and opinion of flood risk remain highly underexplored. Generally, in Kenya, much existing literature on flood risk management has mainly focused on the physical aspects of their nature and occurrence (Nyankudi *et al.*, 2010), ignoring how those at risk, particularly households, evaluate the risk. Yet, this is crucial for improving flood risk communication and in coming up with effective local mitigation policies. This study undertook to address this gap by providing a study on households' perception of flood risk.

The unit of focus for this study is the household. According to Collins (2015):

> [. . .] a household is a valuable unit of analysis for perceptions of flood risk because the household is the unit of action that resides between individuals and society, where personal values, societal norms and institutional demands (e.g., government policies) meet to influence investment and consumption choices (p. 23).

A household's decision affects the vulnerability to a disaster risk and choice of action. Elrick-Barr *et al.* (2015) reiterate that understanding a household's perception and the health impacts they encounter due to exposure to flooding will aid in developing effective policy responses to flooding and other hazards. This study was, therefore, designed to investigate the household perception of flood risk and health impact of exposure to flooding in flood-prone informal settlements in the coastal city of Mombasa, Kenya.

2. Methods

The study utilized a cross-sectional survey design. It was conducted in three informal settlements of Ziwa la Ng'ombe, Moroto and Bangladesh in Mombasa City. These informal settlements are located in low-lying areas that are prone to flooding. The study participants were the heads of households who had lived in informal settlements for the past three consecutive years and above. Also included in the study were key informants drawn from the public health department. The households were selected using systematic random sampling. The number of households sampled in each settlement were proportional to its contribution to the total number of households in the three settlements. Where no suitable participant was available (such as in a situation where nobody was found in the house or only children under age 18 years were found), the interviewers approached the next household. For qualitative data, between six and ten heads of households were picked to form groups for the focus group discussions (FGDs) taking care of age and gender. In total, there were six FGDs (two each for the three informal settlements, i.e. repeated for each area). Further, six key informants were purposively selected for the study. These were public health officers (two each serving in the area where the informal settlement is located).

The study utilized three research instruments; questionnaire, FGDs and key informant interviews (KIIs). The questionnaire was used to gather information on the socio-demographic characteristics of the respondents, perception and health impact of flooding on

the respondent households. The FGDs were used to gather information about participants' perception of flooding and how flooding has impacted on the health of the people in the community. Public health officers provided key information on health risks posed by flooding in the area, public health response and barriers.

The primary data collected were analyzed both qualitatively and quantitatively. Qualitative analysis considered the inferences that were made from the opinions of the respondents during the KIIs and FGDs (Mugenda and Mugenda, 1999). The qualitative data were transcribed and analyzed according to themes. Matrices were used to summarize the data. The matrices contained three columns: the first column contained the raw data (e.g. views) obtained in the field; the second column the description that placed the data into some categories; and the third column the memos that were made by the researcher, such as relation with some other categories and suggestions for further action. This analysis was then thematically presented in a narrative form. Direct quotes were used to demonstrate how the findings and interpretation have arisen. Quantitative analysis involved the analysis of data obtained through the questionnaires using both descriptive and inferential statistics. Descriptive statistics included the use of frequencies, totals, percentages and means. These were used to depict the respondent households' perception of flooding event in their area of residence and its impact on the health of the members of households. Inferential statistics involved the use of binary logistic regression to determine the dominant factors that influence taking long-term adaptation measures. Binary logistic regression is a suitable method used to predict the probability of a person/household taking a long-term adaptation measure (Stefanovic, 2015). The dependent variable (Y) is a dichotomous variable that takes the value 1 if a person/household has taken a long-term adaptation measure, and takes the value 0 if the reverse is the case. Binary logistic regression included the calculation of the Wald statistic (z-statistic), which indicates whether a variable is a significant predictor of the outcome. All explanatory variables were significantly estimated at the 0.05 significance level. These analyses were then presented in tables.

3. Results

3.1 Demographic characteristics of households

The analysis of the demographic and other household characteristics of the households shows that most respondents were males (57.7 per cent). In terms of age, the majority were falling in the age category of between 18 and 30 years (46.4 per cent), with the least being those aged 61 years (2.3 per cent). Most respondents were married (79.2 per cent). Over 33 per cent of the respondents reported not engaging in employment. The level of education of most respondents was secondary level (50.5 per cent), while 8.7 per cent had no formal education. Most households comprised between one and five members (83.1 per cent) with up to 12.3 per cent reporting having a member with chronic illness and 6.9 per cent reporting at least one member with disability.

3.2 Perception of flooding risk in the neighborhood

The survey solicited information on how the respondents perceive flooding risk in their areas of residence. Flooding was ranked first among other major problems in the three informal residential settlements (Table I). Others, in descending order are unemployment, prevalence of diseases and bad roads. Witchcraft was ranked lowest. But, these problems are multidimensional. One male participant in one of the FGDs claimed that he had learned to live with perennial flooding because he had no alternative of relocating to another place due to financial constraints. He lamented that the shack that he calls home which he has to rebuild after every flooding is not spacious enough to comfortably accommodate his large

family of six. He wished that the government could provide opportunities for people in informal settlements to acquire gainful employment so that they can rent or build bigger and better homes.

As shown in Table II, most of the respondents (81.3 per cent) observed that flooding incidences are increasing in frequency in their area of residence, while only 1 per cent indicated that it is decreasing. During the FGDs, the participants lamented that flooding has become so unpredictable that in some years they have occurred more than three times. An aged female participant observed:

> Nowadays we live in perpetual fear of flood menace, it happens so frequent even with short time rainfall. You can go to bed and suddenly wake up floating on water.

As, reported 71 per cent of the respondents believe that, in future, flooding will become a high risk in the area they reside in, with up to 67.2 per cent believing that it will have a high negative impact on their health.

Asked about the major causes of flooding, most household respondents believe that flooding in their area is caused majorly by a fault in the management system such as poor planning (67.2 per cent), followed by nature (35.9 per cent), high concentration of built areas (31.5 per cent) and poor environmental practices like improper waste disposal (25.9 per cent). Others were overpopulation (10.5 per cent), a curse from god or supernatural powers (6.9 per cent), changing climate (6.4 per cent), presence of an increase in the water level in the lagoons (4.9 per cent) and overflowing streams (1.8 per cent).

Arising out of the FGDs was that neglect of the settlements by the two levels of governments (the county and national) resulted in lack of proper planning and lack of drainage facilities which cause frequent flooding, even in the case of normal rainfall. One middle-aged male participant opined:

> In this area we are on our own, nothing comes our way from the government, everyone construct his shelter wherever there is space; we have small pathways instead of roads and absolutely no drainage. When it rains water has nowhere to flow and water from above there (points) flows down here into our houses.

Also noted from the FGDs was the place of supernatural powers and curses in causing the recurrent floods. An elderly female participant quipped that:

> Gods are not happy with our wicked ways and wayward behaviour that have become the norm rather than the exception among the current generation. Look, in Mombasa men are now sleeping with fellow men for money, and as a form of punishment, the angry gods are sending calamities such as flooding. We are cursed and need to change our ways to avoid further calamities.

Table I.
Mean ranking of major problem

Mean ranking	Mean	Position
Flooding	2.29	1
Unemployment	3.04	2
Prevalence of diseases	3.51	3
Bad roads	3.83	4
Pollution	5.14	5
Neighborhood security	5.65	6
Infestation by mosquitoes	6.39	7
Poor power supply	6.61	8
Witchcraft	8.58	9

Frequency and future flooding	*n*	(%)
Frequency		
Increasing	317	81.3
Do not know	31	7.9
Variable	21	5.4
No change	17	4.4
Reducing	4	1.0
Total	390	100.0
Major causes of flooding		
Fault of management system, e.g. poor planning	262	67.2
Natural event	140	35.9
High concentration of built-up areas	123	31.5
Poor environmental practices, e.g. improper waste disposal	101	25.9
Over population	41	10.5
A curse from god/supernatural causes	27	6.9
Changing climate	25	6.4
Presence of an increase in water level of lagoon/ocean	19	4.9
Overflowing rivers/streams	7	1.8
$n = 390$ for each response due to multiple response		
Future flooding		
Severe risk	57	14.6
High risk	277	71.0
Average risk	45	11.5
Low risk	8	2.1
No risk	3	0.8
Total	390	100.0
Impact on health		
Very high impact	87	22.3
High impact	262	67.2
Medium impact	22	5.6
Small impact	15	3.8
No impact	4	1.0
Total	390	100.0

Table II. Perception of frequency, major causes, future flooding and impact on health

The study further solicited information on whether the respondents will evacuate if flooding becomes more severe. As shown Table III, only 26.3 per cent reported they will evacuate, with over 73 per cent indicating that they will not. Asked why they would not evacuate, 84.9 per cent of those who reported that they would not evacuate stated that they have no alternative.

Evacuating	*n*	(%)
Chances of evacuating		
Yes	112	28.7
No	278	71.3
Reason for not evacuating		
My house is safe	25	9.0
I have no alternative	236	84.9
Risk losing the house	12	4.3
Family inheritance	5	1.8

Table III. Chances of evacuating the house in the event of severe floods

In one of the FGDs, a middle-aged single-parent female participant explained:

> Look at us here, most of us are very poor and are surviving by the grace of God. I have six children who need to be taken care of but I don't have a steady income. I get little money here and there through manual labour. So, do you think I can afford to pay the high rent that landlords ask for? (Shaking her head) No, that is why I live here; it is the only home I know.

The study also sought to find out the major source of information on impending flooding/disaster as this is bound to shape an individual's perception. The results (Table IV) show that radio was the leading (45.4 per cent) source of information on an impending flooding. This was followed by government officials (19.7 per cent), then neighbors (16.2 per cent). Only 1 per cent of the household respondents indicated that they get the information from the meteorological department.

3.3 Health impact of exposure to flooding

The survey found that 70 per cent of the households had a family member who fell sick during the last flooding experienced by the household. The major types of illnesses experienced by the members of household who fell sick according to results in Table V were malaria (58.7 per cent), diarrhea (56.2 per cent), skin infections (28.3 per cent), typhoid (16.7 per cent) and acute respiratory infections (9.1 per cent). Apart from these, up to 70.3 per cent experienced other illness like headache, fever and coughing.

Away from the physical illness, up to 80.8 per cent of the households had members who experienced mental health problems such as stress during the last flooding. From the FGDs, a number of these needed psychological counseling because the experience was traumatic as they lost most of their property and had nowhere to go after the house got flooded. One female participant lamented:

Table IV.
Main source of information on impending disaster

Main source of information	*n*	(%)
Radio	177	45.4
Government officials	77	19.7
Neighbors	63	16.2
Community leaders	26	6.7
Television	19	4.9
Family members	10	2.6
Newspaper	7	1.8
Internet source	7	1.8
Forecasting by meteorological department	4	1.0
Total	390	100

Table V.
Nature of illness

Nature of illness the family fell sick had	*n*	(%)
Malaria	162	58.7
Diarrhea	155	56.2
Skin infection	78	28.3
Typhoid	46	16.7
Acute respiratory infection	25	9.1
Others, e.g. headache, fever, coughing etc.	194	70.3

> It was agonising as the water swept across the room carrying everything with it; I lost everything including the two chicken I kept in my room to provide eggs for the family. I only managed to grab my children, but we had nowhere to go. For two days, with other families, we slept in pavements. I was so stressed and helpless I needed help from a counsellor but that was not forthcoming.

The negative health outcomes of flooding were corroborated by public health officers during KIIs. They noted that, during flooding, there are major outbreaks of diarrheal diseases, malaria, typhoid and even cholera in the informal settlements. They noted that some of the families needed psychological support, which they could not provide.

3.4 Adaptation measures to health risk of flooding

The study also sought to establish whether the respondent households had taken any adaptation measures to cope with health risks posed by flooding. The findings reveal that an overwhelming majority (99.5 per cent) had taken some adaptation steps to cope with health risks posed by climate change. However, most of them had only taken autonomous (reactive) adaptation measures rather than long-term measures. The autonomous adaption measures, according to the findings of the study, included clearing living area to avoid infestation by dangerous vectors during flooding (65.1 per cent), clearing trenches to unblock drainage channels (54.1 per cent), washing after exposure to flood waters (52.1 per cent), piling sand bags around the house (43.8 per cent), staying alert to warning from neighbors (40.5 per cent), storage of water for general use (31.5 per cent), raising the door steps of pit latrine during floods (24.9 per cent) and seeking alternative accommodation for children and elderly (24.6 per cent). The few long-term measures taken by some of the households include clearing and extending water drainage system (7.7 per cent), elevating the house (2.1 per cent), setting aside emergency funds for use during hazards (2.1 per cent), securing the house structure with water proof materials (1.8 per cent) and attending training in disaster/flood preparedness (1.5 per cent). Overall, only 15.1 per cent of the households have taken long-term adaptation measures.

Information gathered during the FGDs confirmed that most households resorted mainly to short-term adaptation measures to cope with health risks posed by flooding. They attributed this mainly to lack of financial resources, knowledge and limited help from the government who they claim treat their settlements as eyesore. One elderly male participant summed up this by stating that:

> Most of us can only carry out measures like trying to clean up the living area and surrounding to avoid mosquitoes and fighting flood water by piling sand bays around the house because we are very poor and cannot afford to improve the structure of our houses. Here we are at the mercy of nature. The government that should help us by improving infrastructure like laying down proper drainage system has abandoned us. They constantly threaten us with eviction as if we have somewhere else to go. We also lack knowledge on how to prepare ourselves for emergencies. Nobody bother with us.

Public health workers, on the other hand, pointed out that they normally react to health emergencies when flooding occurs but have not developed a long-term plan to effectively mitigate against health risk of flooding due to lack of adequate funds, personnel and facilities.

Further analysis involved cross-tabulating demographic characteristic and taking long-term adaptation measures (Table VI).

The results reveal that those who are slightly likely to take long-term adaptation are residents who have stayed longer in the settlements, males, older residents, those who are

Household characteristics of respondents	% long-term adaptation
Length of residence (years)	
Below 10	14.3
10 and above	17.5
Sex	
Male	19.6
Female	9.1
Age category (years)	
Below 30	14.4
31 and above	15.8
Marital status	
Married	14.5
Not married (single, separated/divorced or widowed)	17.0
Educational attainment	
Without high school education	17.5
High school education and beyond	14.0
Size of household	
1-5	13.9
6 and above	21.1
Household with children under 15 years	
Yes	14.6
No	17.0
Member of family with chronic illness	
Yes	14.6
No	15.2
Member of family with disability	
Yes	14.8
No	15.2
Occupation	
Not employed (unemployed)	13.7
Employed (formal and informal)	15.8
Perception of flood risk	
Low risk	7.1
High risk	16.5

Table VI.
Relationship between demographic characteristics and taking long-term adaptation measures

currently not married, the less educated, households with more than six members, households with no children under 15 years, those without a member with chronic illness or disability, those employed and those who perceive flooding as high risk in future in comparison to the rest of the population.

We further performed binary logistic regression (Table VII) to see the association between household demographics and perception of future flood risk and taking long-term adaptation measures. The predictor variables were categorized. For example, gender was categorized as males and females, marital status into married and not currently married,

Predictor variables	B	SE	Exp (B)OR	95% Cl for EXP(B) Lower	Upper
Length of residence	0.105	0.407	1.110	0.500	2.465
Gender	–0.838	0.333	0.433*	0.225	0.831
Age	–0.147	0.358	0.863	0.428	1.740
Marital status	0.329	0.425	1.390	0.604	3.196
Highest level of education	–0.179	0.329	0.836	0.439	1.595
Size of household	0.445	0.436	1.561	0.664	3.670
Household with children under 15 years	0.033	0.427	1.033	0.448	2.384
Member of family with chronic illness	0.278	0.466	1.321	0.530	3.293
Member of family with disability	0.186	0.599	1.204	0.375	3.896
Employment	0.127	0.354	1.136	0.567	2.274
Perception of flood risk	0.950	0.548	2.585*	0.324	7.570

Notes: *Significant at 0.05; Constant $\beta = 1.510$; Model χ^2 (11) = 15.075; $p < 0.05$; Pseudo-R^2 values Cox and Snell 0.038; Nagelkerke 0.066; long-term adaptation measures; $n = 59$

Table VII.
Significant predictors of taking long-term adaptation measures

among others. Nominal scale was used for all the variables. The reference/comparison group/category was identified for each variable as follows: below ten years for length of residence, male for gender, 30 years and below for age, married for marital status, without high school level of education for highest level of education, 1-5 members for size of household, family with children under 15 years for household with children under 15 years, member with chronic illness for member of family with chronic illness, member with disability for members of family with disability, unemployed for employment and finally, low risk for perception of flood risk. The dependent variable was dichotomized into those who have taken any one of the long-term adaptation measures and those who have not.

The results show that the regression model was statistically significant, χ^2 (11) = 15.075, $p < 0.05$. The model explained 15 per cent (Nagelkerke R^2) of the variance in taking long-term adaptation measures to flood risk. The results further show that gender (OR = 0.433, 95 per cent Cl; $p < 0.05$) and perception of flood risk (OR = 2.585, 95 per cent Cl; $p < 0.05$) are the only significant predictors of taking long-term adaptation measures against risks posed by flooding. This means that females are 0.433 times less likely to take long-term adaptation measures at the household level than males. At the same time, those who perceive flood risk to increase in future are 2.585 times likely to take long-term adaptation than the others.

4. Discussion

The findings of this study showed that households living in flood-prone areas in informal settlements in Mombasa City view flooding as one of the major problems they face. Communities that suffer frequent flooding are likely to rank it among the top problems due to repeated inconvenience it visits upon them. Like in the current study, Adelekan (2009) in a study on the vulnerability of poor urban neighborhood communities to flooding in the coastal city of Lagos, Nigeria, found that the communities listed flooding as the most important problem. Similarly, Musoke (2011) reports that residents of Bwaise Parish III, a low-lying flood-prone poor neighborhood in the city of Kampala, Uganda, mentioned flooding as their number one problem. However, unlike in the current study, Shisanya and Khayesi (2007) found that residents of Nairobi City mainly rated unemployment as the major problem, followed by corruption, while flooding had a much lower rating. The difference could be attributed to the location of the two cities in Kenya: Mombasa is found in

the low-lying coastal area prone to flooding, while Nairobi City is located in high-relief area. It could also be attributed to frequency of flooding. Flooding is more frequent in Mombasa City than Nairobi. However, contrary to expectations, Haque *et al.* (2012) in a study in Bangladesh found that most households living in flood-prone areas in rural Bangladesh did not perceive flooding as a major problem that is likely to become worse in future. Similarly, Adelekan (2011) in a study in Abeokuta, Nigeria, noted that, although 50 per cent of the households had experienced floods, the majority did not anticipate that it will become severe in the future, despite staying in a flood plain area. This means that other factors rather than vulnerability to risk may also influence perception. The results of this study further showed that most households mainly perceive flooding in their area of residence to be caused by a fault of management system such as poor planning, narrow drainage systems and the nature and high concentration of buildings. In cities in Africa, poor planning and high concentration of people and buildings have mainly been implicated in the increasing incidences of floods. According to Okaka (2014), poor urban planning in Kenya has not only encouraged the development of informal settlements in flood-prone areas but has also escalated flooding in these areas. Other studies in different cities have indicated that residents normally blame improper planning as one of the major causes of increased flooding in the cities. Musoke (2011) in a study in Bwaise Parish III, an informal settlement in Kampala City, Uganda, noted that households blamed unplanned construction of buildings, narrow drainage and poor garbage disposal as responsible for frequent flooding in the area. Salami *et al.* (2017) in a study in Ibadan, Nigeria, also reported that a majority of the residents perceive the major causes of flooding in the city to be blockage of natural and artificial waterways and improper planning. Further up field, Tas *et al.* (2013) in a study in Bursa, Turkey, also arrived at similar results where sampled residents mainly blamed unplanned informal settlements as leading to regular flooding in the town. Patel and Burke (2009) point out that there is a clear link between poor planning of urban areas in developing countries and the frequent occurrence of hazards like flooding that complicate the lives of people who are already in vulnerable situations.

The results of this study further show that majority of the households believe flooding hazard will become a high risk in future and will have high impact on their health. Such expressions have been reported in other cities in Africa among the poor neighborhoods and in rural areas that are prone to flooding. For example, Mendel (2006) noted that residents of the low-lying coastal settlement in Iwaya/Makoko in Lagos, Nigeria, reported that flooding is becoming more frequent and will worsen in future. The same case he found with the residents of Luis Cabral slum in the neighborhood of Maputo, Mozambique, who argued that flooding has worsened since 1980 and will increase in future. Nyankudi *et al.* (2010) in a study on community perception to risk in flood-prone rural Nyando sub-county in western Kenya found that the degree of perceived risk of flood threats to heath was significantly high. Scientific evidence has already indicated that, due to climate change, flooding will increase in frequency and severity in future, especially in coastal areas like Mombasa City and other low-lying areas within the lake basins. One of the major consequences of the increased incidences of floods is negative health impact which will be particularly worse among those living in poor neighborhoods. Thus, it is clear that the residents of flood-prone informal settlements in Mombasa City are well aware of their vulnerability, but at the same time, majority stated that they do not have alternative places to migrate to. The participants in the FGDs captured this more vividly by explaining their situation as lacking the capability of getting an alternative shelter. To alleviate the situation calls for the government, the community and other stakeholders to sit down and dialogue over the best solutions because the problem of informal settlements cannot be wished away.

The study revealed that the main source of information on impending flooding disaster for the households residing in informal settlements in the city of Mombasa is the radio. Radio is cheaply available to most poor urban households in Africa and is commonly used in passing information to the public by government authorities because of its wide outreach. Many common people, therefore, tune to their radio to get information, including those on impending disaster. Similar finding was obtained by Unaegu and Baker (2014) in Lower Benue River Basin, Nigeria, where they found that most respondent households heard about impending flood through the radio. The governments in Africa should, therefore, ensure that accurate scientific predictions of impending disaster are passed to the people through the radio because apathy to such warnings normally arise out of wrong predictions and, thus, people end up ignoring them to their detriment.

The findings of the study showed that most of the households had some members who fell sick during the last flood they experienced. The leading illnesses were malaria, diarrhea and other illness such as headache, fever and coughing. Floods are known to trigger outbreaks of mosquito-borne diseases such as malaria by creating new breeding grounds and increasing the mosquito breeding range, thus enabling them to multiply faster (Brown and Murray, 2013). After floods, the flood waters remain stagnant for a long period, especially in the informal settlements where there are insufficient or no drainage systems (Medimorec, 2013). Thus, in such areas, there is a long duration for mosquito breeding. In malaria-endemic zones, such as the coastal area of Kenya where the city of Mombasa lies, floods exacerbate malaria incidences to epidemic levels.

Moreover, floods transport bacteria, parasites and other pathogenic microorganisms that contaminate clean drinking water sources, leading to outbreak of diarrhea and other infectious diseases (Yomwan *et al.*, 2015). The situation is worsened by the poor and unhygienic environment that is the characteristic of the informal settlements such as those in the city of Mombasa. At the same time, households that are displaced end up in temporary settlements that lack basic sanitation facilities, thus heightening the outbreak of diarrhea and other infectious diseases. According to Brown and Murray (2013), during flooding, many factors work together to increase incidences of infectious disease outbreak, and the prevailing sanitation and environmental conditions play a critical role. The conditions of the house and surrounding resulting from flooding, such as presence of mold and moisture in the house, increase the risks of other diseases such as respiratory infections, coughing, skin infections, among others. The findings similar to the current study were arrived at in a related study among the Sikaunzwe community in Kazungula District of Zambia, in which Mwape (2009) found that the most significant diseases experienced by households following flooding were malaria/fever, diarrhea and coughs, with some reporting outbreak of other diseases such as scabies, sores and rushes, indicating similar pattern of disease outbreak among poor communities.

Floods do not only affect the physical health but also the mental health, as the current study has shown. Tempest *et al.* (2017) observe that flooding has been implicated in the increase in adverse mental health effects such as post-traumatic stress disorder (PTSD), anxiety and depression that can last for several months and even years afterward. In a systematic review examining the effects of flooding on people's mental health, Stanke *et al.* (2012) noted that many studies show that flooding is very stressful, and that the stress continues for a long time after the flood water has receded.

The study further found that, although majority of the respondents have devised some adaptation measures to cope with the health risks posed by flooding, most of these measures were reactive (autonomous) rather than long term. Therefore, these are mere stopgap measures and would do little to reduce vulnerability to health risks posed by flooding. It is

also clear that long-term adaptation measures were rare among the households. This was mainly due to lack of financial resources, lack of knowledge and inadequate government support. Long-term adaptation measures are geared toward preventing floods and/or being able to withstand floods by devising preventive steps. These efforts require money and knowledge of how to go about them. Above all, the government must get involved in initiating flood prevention measures. Other previous studies in poor urban neighborhoods (Sakijege *et al.*, 2012) and poor rural communities (Shimi *et al.* 2010) have implicated poverty, lack of awareness and government support as the major reasons for households not taking long-term adaptation measures against flooding.

5. Conclusion

The study has shown that flooding is ranked top among the major problems faced by households in the three informal settlements in the city of Mombasa. The majority see that flooding will become high risk in future with associated negative health consequences. However, most households would not vacate the flood prone-areas, despite the risks due to lack of alternative affordable places. Most households had members who fell ill during the previous flooding with malaria, diarrhea and other illnesses such as headache and fever being the leading forms of illness. In an attempt to reduce the health impact of flooding, the households had taken some adaptation initiative, but these were mainly short-term temporary measures like cleaning the living area after flooding and piling sand bags around the house, a fact mainly attributed to lack of finance, lack of knowledge and inadequate government support. It was also evident that perception of flood risk was a significant determinant of taking long-term adaptation measures like elevating the house. Based on these findings, the study underscores the need to consider the perception of households to flood risk in designing long-term effective adaptation strategies. The study also recommends that there is a need to empower and support those living in flood-prone areas with the ability to initiate long-term flood adaptation measures to avert negative health consequences of flooding.

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