International Journal of Thesis Projects and Dissertations (IJTPD)
Vol. 3, Issue 3, pp: (81-99), Month: July - September 2015, Available at: www.researchpublish.com

Homeowners' Environmental Attitude and Onset of Flooding In Mavoko Peri-Urban Settlement of Nairobi Metropolis, Kenya

[1]Omukaga O. Panyako, [2]Jacob W. Wakhungu, [3]Felix Ngunzo Kioli

[1, 2, 3] Department of emergency management and humanitarian assistance Masinde Muliro University of Science and Technology, Kenya

Abstract: **Governments have enacted legislations and prescribed structural measures to govern urban development in order to mitigate urban flooding and other disasters. However, as settlement activities in peri-urban areas increase, flooding incidents have been observed to escalate. The objective of this paper was to analyse the relationship between homeowners' environmental attitude and the onset of flooding in Mavoko. The study targeted heads of household; the general public; officials of government and quasi-government institutions as well as professional associations responsible for environment, settlement and disaster mitigation; leaders of religious and community organisations and societies responsible for emergency management and humanitarian support in Machakos and Nairobi Counties. The study took a survey design and used multistage random, snowballing, purposive and quota sampling techniques to identify participants. The study used mixed methods to collect quantitative and qualitative data using questionnaire, interview guide, document analysis, focus group discussions and observation. Data were analysed through descriptive analysis, Nomothetic evaluation, Chi-square test at a level of significance of 95% ($\alpha = 0.05$), and Crammer's V analysis. The study revealed that there was a significant relationship between the homeowners' environmental attitude and the onset of flooding. The study recommends that policy makers and settlement planers, together with other players, to develop packages that will generate positive environmental attitude change among households.>**

Keywords: **environmental attitude, urbanisation, peri-urban human settlement, urban flooding.**

I. INTRODUCTION

Cities and towns in the entire world are experiencing rapidly growing population in unsustainable proportions with half of the world's population living in urban areas in 2008; and the proportion estimated to rise to 60% in 2030, and 70% in 2050 (Jha et al., 2012; UN-Habitat, 2010). It is projected that half of all of Africa's population would live in cities and towns by the year 2030 (UN-Habitat, 2010). To accommodate the increasing urban population, Nairobi expanded its city boundaries in 2006 to become a larger metropolis to include the three counties of Kajiado, Kiambu and Machakos, where Mavoko is one such upcoming peri-urban settlement (GoK, 2008).

As the cities and towns grow in sizes, flooding in the urban and peri-urban environments have been observed to be getting more serious (Douglas et al., 2008; DEFRA, 2006). Urban flood incidents are also reported to get more frequent, complex and multifaceted as illustrated by the recent events in America, Australia, Brazil, Pakistan, Scotland, Sri Lanka and the United Kingdom (Jha et al.,2012; Coates, 2010). African cities like Accra in Ghana, Kano in Nigeria, Kampala in Uganda; Maputo in Mozambique and Bujumbura in Burundi have also witnesses serious flooding (Tucci, 2007; ILGS & IWMI, 2012). Nairobi, in Kenya, has also been observed to suffer flooding each rainy season.

Urban flood mitigation efforts have been through state driven engineering and regulatory measures to govern human settlement and housing, but the efforts by local governments to enforce these measures towards flood disaster risk reduction in peri-urban settlements have been overwhelmed (Amoako, 2012; Douglas et al., 2008). The failure by the

engineering and legislative efforts to tame unsustainable human settlement and land use to reduce flood disaster risks in urban and peri-urban environments suggests it is an attitudinal problem that requires a psycho-social intervention (Oluyinka & Balogun, 2011).

II. LITERATURE REVIEW

Globally, cities and towns experience rapidly growing population in unsustainable proportions with half of the world's population living in urban areas in 2008; and the proportion estimated to rise to 60% in 2030, then to 70% in 2050 (UN-HABITAT, 2010). Although this was initially associated with developed countries, it is fast engulfing developing countries like Latin America where more than 75% of the population is urban compared to the global rate of 47.2% (WRI, 1996). Further, 40% of Africa's population, and 23.5% of the East African's, lived in urban areas in 2009; and it is projected that half of all of Africa's population would live in cities and towns by the year 2030 (UN-HABITAT, 2010).

Accommodating the rapidly increasing population poses a major challenge for the city and town administrations leading to poor quality of life reflected in the spontaneous, uncontrolled expansion of urban slums and informal settlements with residential overcrowding (ILGS & IWMI, 2012). Cities like New York and Washington in the US; London and Birmingham in the UK; as well as Accra, Cairo, Johannesburg, Maputo and Nairobi in Africa have expanded their municipal boundaries to larger metropolitan regions (*Amnesty International*, 2009). Part of the populations acquire land and settle in the peripheral areas, many a time on floodplains and hillsides as illustrated by Soweto-on-Sea near Port Elizabeth and Alexandra in Johannesburg, South Africa; Bujumbura in Burundi, but still feel they are within the city (Douglas et al., 2008; Jha et al., 2012). In Kenya, people settle in peripheral areas of Kiambu, Limuru and Kikuyu to the North; Ngong, Ongata Rongai and Kiserian to the West; Kitengela, Athi River and Machakos to the South; and Thika, Ruiru, Kangundo and Tala to the East but still feel they are within Nairobi (GoK, 2008).

As the cities and towns grow in sizes, the attendant urban problems have been observed to increase with urban areas recording serious environmental challenges such as flooding and pollution (Chukwuocha & Chukwuocha, 2013). In particular, the occurrence of flood events in urban environments is a serious and growing problem affecting both the developed and developing countries where these events are noted to be on the ascendancy globally since the last half century as demonstrated by the recent widespread and severe flood events in America, Pakistan and the United Kingdom between 2010 and 2012 (Jha *et al*., 2012; 2011).

African cities like Accra in Ghana, Kano in Nigeria, Kampala in Uganda and Maputo in Mozambique have also witnessed perennial flooding incidences (Tucci, 2007; ILGS & IWMI, 2012). Nairobi, in Kenya, has also suffered flooding, with informal settlement and slum dwellers reported the worst affected during 1997-98 el-Niño induced rains which occasioned excessive damage to property and loss of lives (GoK, 2009). Since then, the problem has been observed to be perennial in that each rainy season (March - June and October - December), Mavoko and the larger Nairobi Metropolis experiences rain-fed flooding, when, like in other urban areas worldwide, even moderate storms cause increased runoff and higher flooding incidents (*Amnesty International*, 2009; Werritty et al., 2007).

Globally, national and local governments have implemented a range of state driven structural and regulatory measures in line with HFA to tackle the challenge of flooding in urban and peri-urban settlements (Oluyinka & Balogun, 2011; Douglas et al., 2008). Most African governments, including Kenya, have established full ministries and departments that are in-charge of the environment and water resources. Moreover, they have formulated legislation for proper physical planning and building control through the enactment of Building Codes, as well as Environmental Management Regulations which are enforced by the concerned Local Authorities (UNISDR, 2005). In addition, social actors like NGOs and private agencies are also increasingly noticeable through community participation (Omondi, 2010).

However, the fore-mentioned approaches have not been effective because statistics show that environmental abuse and flood events in the urban and peri-urban environments are on the increase (ILGS & IWMI, 2012). Efforts by local governments to enforce the measures towards preparedness for flooding in peri-urban settlements have been overwhelmed by the rapid urbanization, limited investment in storm water management infrastructure and unsustainable urban land use (Amoako, 2012). Homeowners are also increasingly reported to loath and circumvent the services of professionals; and to disregard local authority regulations as they acquire, develop and utilise their homes in the peri-urban settlements (Frazier, 2012; Jha et al., 2012). Residents are also reported to acquire and build in dry river beds and riparian areas; dump refuse and waste in valleys and open fields; and put up unauthorised structures, all of which lead to runoff obstruction noted as the main contributor to flooding in urban environments (*Amnesty International*, 2009; UNISDR, 2006).

The inadequacy of the structural measures and legislative mitigation efforts to tame environmental abuse and reduce flood disaster risks in urban and peri-urban environments suggests it is an attitudinal problem, which requires a psychological intervention (Oluyinka & Balogun, 2011). Used interchangeably with environmental concerns, environmental attitude, represent human predispositions that influence behaviour in a certain manner (Milfont & Duckitt, 2004). It refers to an individual's psychological tendency to evaluate or react with a certain degree of favour or disfavour towards different issues within their environment such as dumping of wastes and/ or associating with neighbours.

Past studies reported a correlation between environmental abuse tendencies and socio-cultural factors, which have been observed to alter with the increasing pressures on individuals at the inter-phase of urban and rural lifestyles (Al-Khatib et al., 2009; Arafat et al., 2007). Positive environmental attitude is also reported necessary for voluntary participation in pro-environmental actions (Oluyinka & Balogun, 2011). Thus, by translating the anthropogenic factors human settlement activities into environmental behaviour embedded in the mind-set of individual actors, positive environmental attitude might be correlated with reduction in environmental hazards like flooding (Houston et al., 2011; Ogunjinmi et al., 2012).

Despite the benefits associated with positive environmental attitude, and existence of legislative controls, there is high level of environmental abuse in urban and peri-urban settlements world over, leading to increased food risks (Oluyinka & Balogun, 2011). However, there is little documented evidence of research on the relationship between the citizens' environmental attitude and flood disaster interventions in Kenya. It is with this background, therefore, that the current study sought to determine the association between homeowners' environmental attitude and the onset of flooding in peri-urban settlements of Nairobi metropolis in Kenya.

This study was anchored on Smith's (2004) concept of environmental hazards and Mustafa's (2005) concept of a hazardscape where urban flooding is conceived as arising from the interaction of the physical, social and technological factors. From Smith's concept of environmental hazards, urban flood hazards are seen as being hybrid product of an interaction between the physical, social and technological factors (Alam et al., 2007). This relationship is considered as interplay between three types of environments, namely: the anthropogenic environment, the social environment and the flood risk environment, interplay between which is as illustrated in Figure 1.

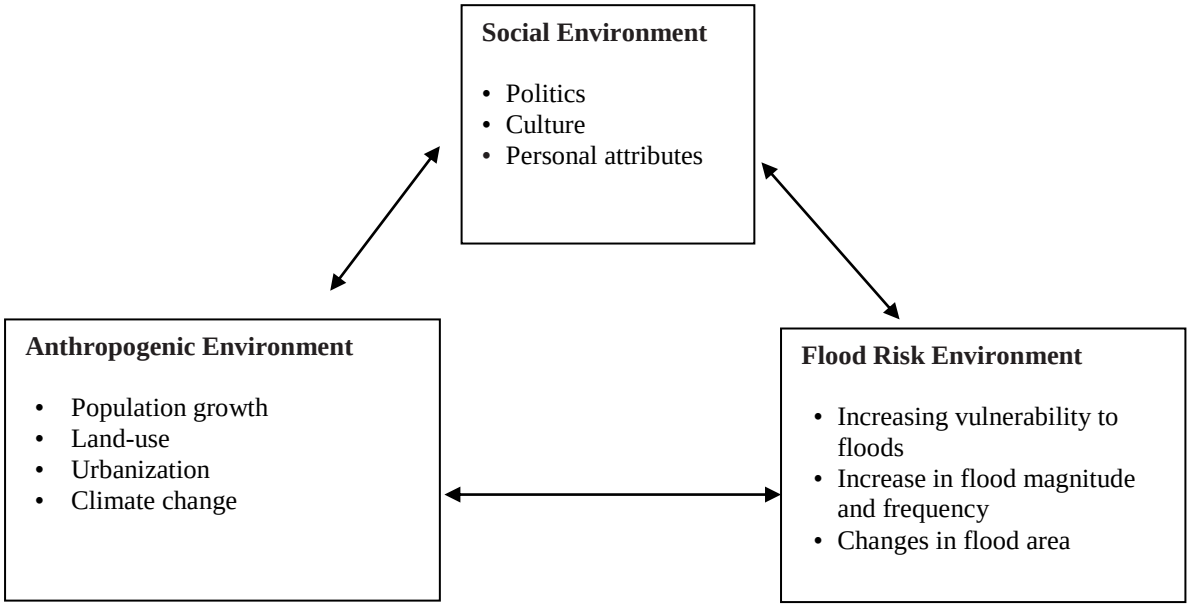


Fig. 1: Interplay between human activities in the natural environment and the dynamics in the flood risk environment (Source: Bosher et al., 2009)

From Fig. 1, the anthropogenic factors (in the anthropogenic environment) like population growth, land-use, urbanization and climate change influence the dynamics in the flood risk environment. In the social environment, social factors like personal attribute determine the distribution of vulnerability and risk (Bosher et al., 2009).

From Mustafa's concept of a hazardscape as illustration by Satterthwaite et al. (2007) in Figure 2, unsustainable urbanisation processes like artificial hard surfaces, inappropriate land use, and inappropriate storm water management

play a significant role in exacerbating urban and peri-urban flooding. Human settlements located on riparian grounds with no storm water drainage schemes, coupled with poor housing construction are susceptible to flood risk (*Action Aid*, 2006). These issues are consequences of unplanned or poorly regulated peri-urban settlement development which alters the hydrology and the geomorphology of the natural landscape, thus exacerbating flood risk in these environments (Lee et al., 2003).

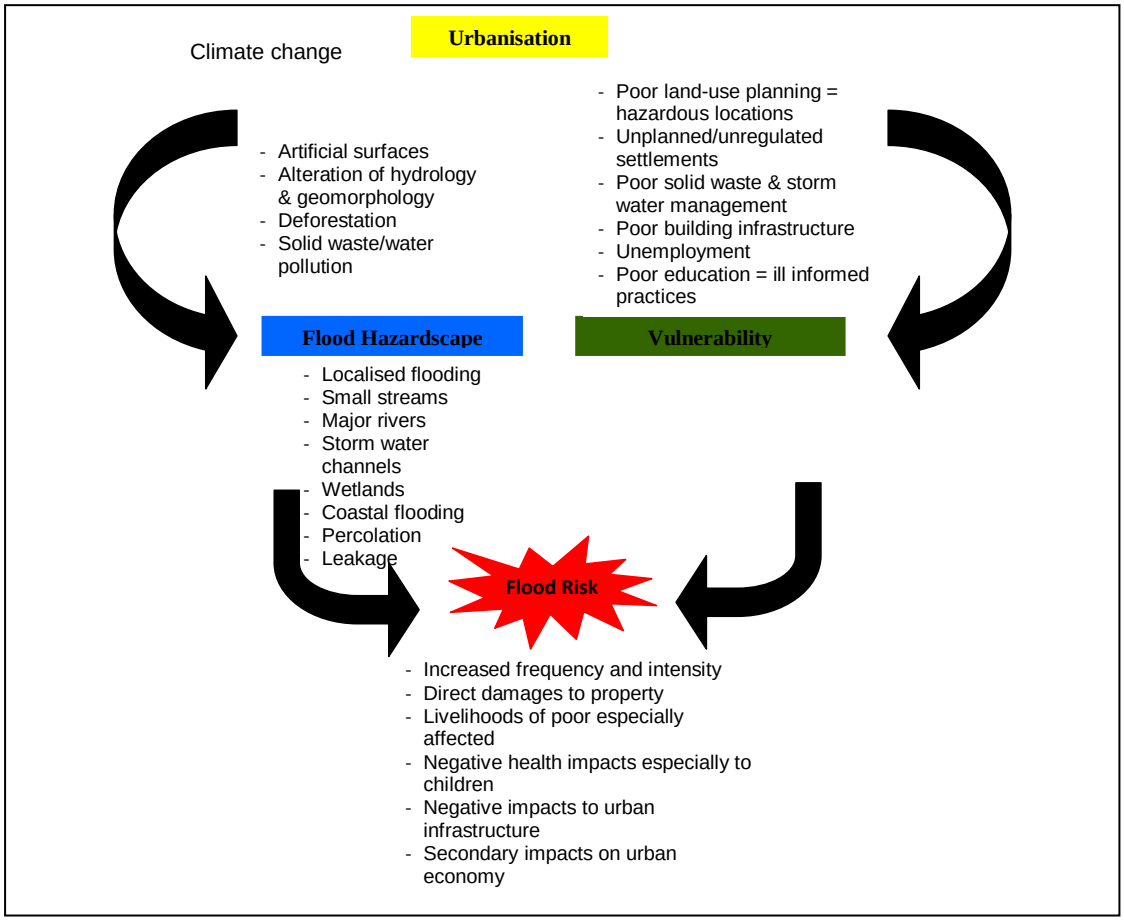


Fig. 2: Influence of Urbanization on Flood Risk (Source: Satterthwaite et al., 2007)

From the fore-illustrations, therefore, this study considered that personal attributes such as like attitude (in the social environment) had an influence on some activities in the anthropogenic environment that would determine the dynamics in the flood environment (change in flood characteristics and response there to). This relationship is conceptualized as illustrated in Fig. 3.

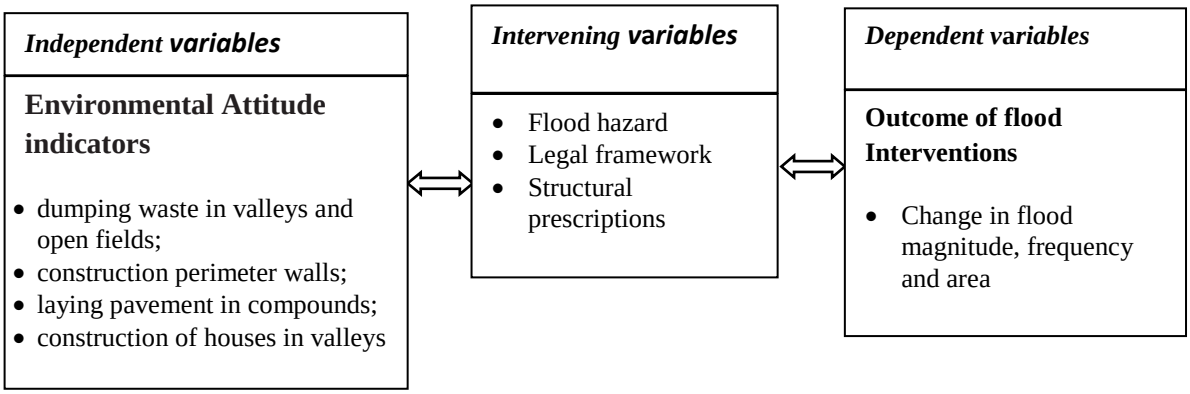


Fig. 3: Conceptual framework model for the correlation between independent and dependent variables (Source: Researcher, 2015)

The effect of the personal attributes on the activities in the anthropogenic environment would enhance the flood risk; and increase the vulnerability of the populations to flooding. It is therefore anticipated that positive personal attributes (in the social environment) would lead to sustainable activities (in the anthropogenic environment) resulting into reduced flood risks and reduced vulnerability to flooding.

III. METHODOLOGY

Study Site:

The research was carried out in the geographical region defined as Mavoko settlement, which covers Mavoko constituency of Machakos County within Nairobi Metropolis. Mavoko settlement was identified for this study because it was considered as forming a special geographical space for academic and practical scrutiny for five reasons. First, the area is a transitional zone between the truly urban Nairobi city and a clearly rural area of Machakos County, hence experiencing rapid socio-economic transformation and environmental challenges related to the emergence of urban activities in rural areas (UN-HABITAT, 2006). Secondly, the study site poses new institutional challenges for socio-ecological planning and vulnerability assessment arising from the intertwined nature of the rural/urban characteristics; the residents' heavy dependence on and exploitation of the natural resources; and the residents' relationships to environmental changes (Eakin et al, 2010).

The third reason was that Mavoko settlement is an integral element of urban systems in spatial, temporal social, economic, functional and planning dimensions, because it and its environment are integral to the growth and operation of the growing Nairobi city (Simon, 2008). Fourth, being at the formative stages of development, the area is a place with the potential for positive change due to the livelihood diversification plus access to services and information that could shape the residents' environmental adaptation (Ricci, 2011). Lastly, the study site is reported to suffer disasters perennially. The area recently suffered mass demolitions of homesteads constructed on illegally acquired land with massive displacement of families; and there occurs flooding every rainy season. The increase in impervious surfaces in the larger Nairobi metropolis will affect local hydrological systems because the area is low lying with a relatively flat surface of poorly draining black cotton soils, exacerbating the residents' vulnerability, thus necessitating better mitigation measures.

Study Population and Sampling:

The study targeted heads of household; the general public; community and religious leaders; local government officials; leaders of quasi-government institutions, NGOs, CBOs , NEMA; and officials of the Association of architects and physical planners considered to be stakeholders in disaster management in Nairobi. It used the survey design to generate data for the purposes describing the demographic characteristics of the household heads in Mavoko; and to analyse the relationship between homeowners' environmental attitude and the onset of flooding.

It was not easy to determine the exact population size of Mavoko at the time of this study because of the fast growing population. Hence, to determine the number of participant household heads, the study employed John Eng (2003)'s formula for calculating representative multistage random sample size of unknown population size as follows.

$$n = \frac{4z^2_{\alpha/2}p(1-p)}{d^2}$$ ---------- Equation 1

Where:

n = the sample size

z = the standard normal deviate relating to the 95% degree of confidence set at 1.96

p = an estimate of the proportion of people falling into the group in which we are interested in the population

d = the proportion of error we are prepared to accept

In this study p = 0.5. (Choosing 50% provided the most conservative estimate of the random sample size). The confidence interval of 95% was estimated to be within 10% of the true value. The multistage random sample size was then given by:

$$n = \frac{4 * 1.96^2 * 0.5(1-0.5)}{0.1^2}$$

$$n = 384.16$$

$$n \cong 385$$

This formula gives a number that is an estimate of the absolute minimum, making it necessary to have more respondents to compensate for loss during follow-up or other causes of attrition. John Eng (2003) and Botsch (2011) recommends an addition of 10% of sample size to compensate for persons that the researcher is unable to contact; and further 30% to compensate for non-response. Thus, the sample size for this study was 600 distributed across all county wards in proportion to their population density as illustrated in Table 1.

Table 1: Sample size distribution in Mavoko, Nairobi, Kenya.

County Ward	Pop. Density (No. of people/Km^2)	No. of respondents per sub-location		Totals
Athi River	659	Athi River North	101	202
		Athi River Township	101	
Kinanie	43	Kinanie	7	14
		Muthatani	7	
Muthwani	90	Muthwani	10	30
		Katani	10	
		Ngelani	10	
Syokimau/ Mulolongo	1130	Syokimau	177	354
		Mulolongo	177	
TOTAL				**600**

The sampling of the households who participated in this study was done using the multistage random sampling methods in three stages. First, the study used the lottery technique where the settlements were divided into nine (9) administrative sub-locations in the four county wards as shown in Table 1. In the second phase of sampling, the lottery technique was used to sub-divide the sub-location into small clusters. The urbane sub-locations of Athi River North and Athi River Township in Athi River ward; and Syokimau and Mulolongo in Syokimau/ Mulolongo ward with high population density were clustered into courts. The rural-like sub-locations of Kinanie and Mathatani of Kinanie ward; and Muthwani, Katani and Ngalani of Muthwani ward were clustered based on villages. A list of all the clusters (courts and villages) was drawn with the help of the local leaders. The names and/or identification numbers of all the clusters were written on pieces of paper; and the desired clusters were randomly selected by picking the required number of papers.

From the area, the study identified 34 courts each from Athi River North and Athi River Township Sub-locations; 54 courts each from Syokimau and Mulolongo sub-locations; and three villages each from the five sub-locations in Kinanie and Muthwani county wards. The lottery technique was then used to select three (3) households chosen from each of the identified courts and villages. In order to take a random sample, a sample frame in the form of lists of all the household heads in each of the courts and/or villages were drawn with the help of local leaders who acted like gate-keepers. The names and/or identification numbers of all household heads were written on pieces of papers; whereupon the desired sample was selected by picking the required number of papers.

This approach was guided by Broer and Titherdge (2010), who used the sampling strategy to reach the dispersed eco-self-built community projects in the UK to evaluate whether Eco-Self-Built Communities lead to feasible, sustainable and low carbon lifestyles. Similarly, in her study, 'public understanding of and response to climate change in the South of England', Whitmarsh (2005) used this strategy to cover different socio-economic groups within flood-prone and non-flood-prone areas; and different groups within areas with differing levels of exposure to air pollution. The sample sizes and sampling techniques of other units of measurement and observation in the study population were as shown in Table 2.

This study used non-probability sampling methods to identify interviewees and participants in the FGDs. Purposive sampling was used to select officers of government who head disaster response units as well as managers of quasi-government institutions, non-governmental organizations and community leaders that were to participate in the study. This was guided by the work of Dauglas et al. (2008) who used this method and reported that while the urban poor in Africa adapt to floods, recognition of local, national and international governments' and organisations' responsibility to mitigate flooding was urgently needed. I addition, the study used the saturated sampling method to identify and classify literature to be reviewed based on the themes in the study. This was guided by the work of Pharaoh (2013) who used this sampling method and reported the existence of an analytical gap in the literature on flood-risk in poor South African communities where virtually all of the data was qualitative, having been gathered from interviews, focus group discussions or using participatory risk assessment techniques.

Table 2: Study population units, sampling method and sample size in Mavoko, Nairobi, Kenya.

Study population unit	Sampling method	Size (N)
Household in Mavoko	Multistage random, Cluster, Lottery	600
Flood victims in Mavoko	Snowball	20
General Public in Mavoko	Lottery	8
Ministry of lands officials	Purposive	1
Mavoko Sub-County officials	Purposive	1
Red Cross Officials in Mavoko	Purposive	1
NEMA officials	Purposive	1
Residents Association officials	Purposive	2
Religious leaders	Purposive	2
Professional body of physical planners	Purposive	2
Meteorological department	Saturated	2
Focus Group Discussion	Quota	10 per FGD
Document analysis	Saturated	10
Observation checklist	Saturated	10

Data Collection:

The study used a methodology that embraces both quantitative and qualitative approaches to collect primary and secondary data. The secondary data collection and review preceded the collection of primary data. A review of existing documents provided background information about, and more insights into, the phenomenon of flooding in urban and peri-urban areas (Mogalakwe, 2006). The search for and collection of secondary information was conducted through exploring official and non-official resources. Official sources included publications and policy documents of the KNBS, UN-HABITAT, ICFRC, the National Centre for Disaster Prevention and the meteorological department among others. Secondary data from the *KNBS* were necessary for the purpose of socio-demographic profiling of the study population, to ensure that the sampling was representative of the socio-demographic characteristics because certain types of individuals and households were likely to be more vulnerable to the effect of flooding than others. Secondary data also provided information on the impact of previous flood events and the community's coping mechanisms.

In order to do an exhaustive document analysis, the study first identified the types of documents available and relevant to the study area, before securing authority for their access. Guided by the *Evaluation Review* (2009), the researcher compiled the relevant documents with respect to the objectives of the study and talked to the custodians before checking the accuracy of the documents by comparing those that contain similar information. The information from documents reviewed was then summarised, indicating the type of document reviewed, the way to reference each document and information relating to specific objectives of the study.

Primary data were collected through questionnaire, key informant interviews, focus group discussions and direct observations. The questionnaires were designed to be completed by respondents with minimal or no assistance from the researcher. The respondents were left with the questionnaires to fill for collection after three to seven days. The survey was conducted during the November – December 2012 short rainy season and during the April – May 2013 long rain season. During the November – December 2012 short rainy season, questionnaires as indicated in Appendix 5 were hand delivered to 120 households in the four County Wards of Athi River, Syokimau/ Mlolongo, Muthwani and Kinania that make up the Mavoko; of which 106 were returned. During the April – May 2013 long rainy season questionnaires were hand delivered to 480 households in the same study area and 417 were returned. A total of 463 (77.16%) of the questionnaires were returned, which upon scrutinising, 55 questionnaires were discarded because the respondents had not filled in properly for accurate analyses.

Key informant interview guides were used to elicit information from officers of government and quasi-government institutions; as well as community and religious leaders to answer the 'how' and 'why' questions for the study to explore differences, inconsistencies and meanings through conversations (Durand, 2009). The interviews provided expert and community opinions about vulnerability of peri-urban settlement communities to flood disasters and the causality factors; effects of flooding on the population; and the mitigation measures. It also gave an in-depth understanding of the

intervention measures to enhance the community's response to flooding as informed by professional discourses. Appointment letters and interview guides for face-to-face interviews were hand-delivered to twenty (20) key informants in Mavoko. The proceedings were audio-recorded and written responses from the interviewees in form of handouts obtained.

FGDs were used to obtaining in-depth descriptive data on beliefs, perceptions and practices pertaining to the occurrence of, and response to, flooding in Mavoko. The researcher convened two (2) FGD sessions of ten (10) participants composed of two (2) homeowners who participated in the household survey, (two) 2 representative from the church, two (2) elders, two (2) business people, one (1) youth and one (1) woman from within Mavoko in order to explore some of the issues related flooding in the community. One FGD focused on the urbane area of Athi River Syokimau/Mulolongo County ward, while the other focused on the rural-like areas of Kinanie and Muthwani County wards. The FGD guide enabled participants to give information on how homeowners' environmental attitude contributes to the onset of flooding.

The direct observation checklist enabled the researcher to make observations to enrich his understanding of the homeowners' environmental tendencies with respect to the objectives of the study. The observation included noting and recording of events, behaviours and activities related to how community members relate to and care for the environment. It also focused on the extent of flooding and household participation in flood disaster interventions so as to get an in-depth understanding of the local practices.

Data Analysis:

The data collected were in both qualitative and quantitative form and were analysed using descriptive statistics, Chi-square, Correlation analysis and Nomothetic evaluation. Qualitative data involved tape recorded and written responses to interviews, proceedings at the FGDs, field notes and summary of document content analysis. After reviewing the works of different qualitative research specialists, the researcher used the nomothetic evaluation method to analyse the data from the FGDs; and transcribed and analysed qualitative data from the other sources using the hierarchical coding procedure as illustrated by Whitmarsh (2005). The responses were ordered and grouped through cross-case analysis before it was transcribed and analysed using the constant comparative method to develop relationships and interrelationships from which themes and patterns about flood disaster interventions (Occhio, 2003). The issue of validity was addressed by asking a number of interviewees to comment on the analysis.

Quantitative data were mainly from closed ended questions in the questionnaires. To determine the association between the homeowners' environmental attitude and the onset of flooding, data were collected on the causes and incidences of flooding in the study area through questionnaires. The study used descriptive statistics to measure demographic characteristics before analysing the association through the application of the SPSS. Because the sample size was large (408), the statistically significant Chi-square was not conclusive about the relationship between the variables, hence the need to measure the association between the two variables (Horber, 2013).

Guided by the works of Garson (2012), the current study considered adopting Cramer's V to measure the correlation between the two variables, which were nominal and/or ordinal. This is because: i) It is based on the Chi - square and was easy to generalise across contingency tables of varying sizes; ii) It is not affected by sample size and was therefore very useful in eliminating errors where statistically significant X^2 could have been due to the large sample size instead of any substantive relationship between the variables; and iii) It is interpreted as a measure of the strength of an association between two variables. The coefficient ranges from 0 to 1 Characterised that: (> 0.5) High association; (0.3 to 0.5) Moderate association; (0.1 to 0.3) Low association; and (0 to 0.1) Little (if any) association.

IV. RESULTS

Households' Attitude Towards the Physical Environment in Mavoko:

On a scale of 'Very Commonly' to 'Not Very Commonly', the respondents were asked to indicate how commonly they observed residents of Mavoko settlement tended to engage in a set of practices considered as indicators of their attitude towards the phsical environment. These practices were: use of masonry perimeter wall; use of concrete paved compound; dumping of wastes from construction in valleys; levelising ground at people's gates; dumping of garbage in open fields; settling in valleys/wetlands/ reparian areas; and releasing waste water from households into the open. The results were as shown in Table 3.

Table 3: Obsrvation rate of practices in Mavoko, Nairobi, Kenya

Practice	1	2	3	4	5	T/C
Use of masonry perimeter wall	218 (53.4%)	124 (30.4%)	19 (6.3%)	30 (7.4%)	17 (4.2%)	**69.1**
Use of concrete paved compound	166 (40.6%)	132 (32.3%)	29 (7.1%)	50 (12.3%)	31 (7.6%)	**72.9**
Dumping of wastes from construction in valleys	284 (69.6%)	107 (26.2%)	5 (1.2%)	9 (2.2%)	3 (0.7%)	**95.4**
Levelising ground at people's gates	140 (34.3%)	236 (57.8%)	11 (2.7%)	12 (2.9%)	9 (2.2%)	**92.1**
Dumping of garbage in open fields	145 (35.5%)	171 (41.9%)	27 (6.6%)	44 (10.8%)	21 (5.1%)	**77.4**
Settling in valleys/ wetlands/ reparian areas	189 (46.3%)	192 (47.1%)	9 (2.2%)	5 (1.2%)	13 (3.2%)	**93.4**
Releasing waste water from households into the open	142 (34.8%)	165 (40.4%)	18 (4.4%)	46 (11.3%)	37 (9.1%)	**75.2**

KEY: 1 = Very Commonly; 2 = Commonly; 3= Not Sure; 4 = Not Commonly; 5 = Not Very Commonly; T/C = Total Commonly (%)

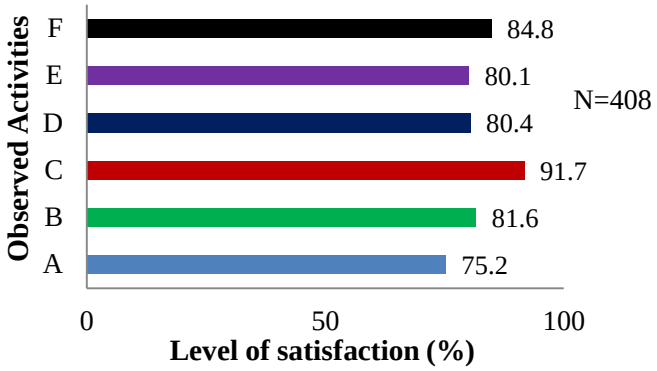
It was observed that 391 (95.4%) of the respondent "commonly" observed residents damp wastes from construction sites in valleys and open fields; 381 (94.3%) "commonly" observed people acquire plots and settle in valleys/wetlands/ reparian areas; while 376 (92.1%) of them "commonly" observed their neighbours level off the ground at their gates for easy access into the compounds. It was also observed that 342 (83.8%) of the respondents "commonly" observed compounds enclosed with masonry perimeter walls; 316 (77.4%) "commonly" observed people damp garbage in open fields; while 307 (75.2%) of them "commonly" observed their neighbours release waste water from households into the open. Similarly, it was noted that 298 (72.9%) of the respondents "commonly" observed compounds with concrete pavements.

From direct obsrvation, the study noted two issues about the environmental tendancies amonst the households in Mavoko. First, some households packed waste from their houses into polythene bags and damped them into the open fields. This behaviour was commonly observed in areas with low population density like Kinanie and Muthwani. Two, in some areas, there were established garbage colletion points, but these seemed un attended and overflowing. The other direct observation was that developers simply deposited solid waste such as cotton soil from construction sites into dry valleys and open fields.

Proceedings at the FGDs revealed that garbage and solid waste disposal was a big environmental challenge which created an eye and potetial disease outbreak when it rained. Participants also revealed that the rampant dumping of cotton soil in valleys and open fields blocked free flow of storm water making the area get flooded. It was revealed that some households damped the waste at night to avoid being seen by other neighbours.

To understand how comfortable the respondents were with the investigated tendencies, the researcher asked them to indicate, on a scale of 'strongly satisfied' to 'strongly dissatisfied', how satisfied they were with the way people: use masonry perimeter walls; use concrete paved compound; acquire and develop plots; dispose off solid waste and garbage from their households and construction sites; handle waste water from households; and manage surface water drains near their compounds.

The responses were presented as shown in Fig. 4 from which it was observed that 341 (83.6%) of the respondents were "satisfied" with a compound with masonry perimeter wall; 334 (81.9%) were "satisfied" with the way people dispose of solid waste and garbage from households and construction sites; while 261 (64.0%) of them were "satisfied" with having a concrete paved compound. It was also observed that 251 (61.4%) of the respondents were "satisfied" with the way people manage drains near their compounds; 239 (58.6%) were "satisfied" with the way people acquire and develop plots; while 235 (57.6%) of them were "satisfied" with the way people handle waste water from their households.



KEY:

A: Use of masonry perimeter walls

B: Use of concrete paved compounds

C: Acquisition and development of plots

D: Disposal of solid waste/garbage

E: Handling of waste water from households

F: Management of drains near their compounds

Fig. 4: A satisfaction rate of activities in the physical environment in Mavoko, Nairobi, Kenya

The investigated set of practices were indicators of negative attitude towards the physical environment. This study revealed that there was a high tendency by the residents to engage in practices that were negative to the physical environment; and they were highly satisfied with their level of engegement in the said activities. This finding was in agreement with Erdogan and Ozsoy (2007), who reported that the economic considerations and developments have made people use the natural resources wastefully.

The researcher did Chi-square tests to determine the relationship between the respondent's gender, age, level of education, level of income and type of residence ownership on the one side; and the use of masonry perimeter walls, use of concrete paved compounds, acquisition and development of plots, disposal of solid waste and garbage from households and construction sites, handling of waste water from households and management of drains near their compounds on the other. The results of the analysis were as shown in Table 4 from which it was obsrved that the the respondents demographics had a statistically signinificant effect on their tendency to in the investigated activities.

Table 4: Cross tabs of Chi-square tests between the demographics and activities in in the physical environment in Mavoko, Nairobi, Kenya

VARIABLES	Gender	Age	Level of Education	Level of income	Residence ownership
A	12.378**	15.354**	16.083**	52.144*	73.637*
B	10.232**	19.680*	17.223**	90.187*	50.213*
C	14.472*	42.045*	43.247**	162.205*	2.472**
D	9.168**	41.721*	23.468*	42.125**	34.638*
E	13.668*	30.638**	54.964*	36.138*	4.247**
F	12.080**	25.203**	32.402*	45.263**	36.426**

KEY:

A: Use of masonry perimeter walls;

B: Use of concrete paved compounds

C: Acquisition and development of plots

D: Disposal of solid waste and garbage from households and construction sites

E: Handling of waste water from households

F: Management of drains near their compounds

G: Interaction with neighbours

* = Highly significant at $p < 0.01$

** = Highly significant at $p < 0.05$

Cause of Flooding in Mavoko, Nairobi, Kenya

The study then sought to analyse the causes of flooding in Mavoko peri-urban settlement. Data from the reviewed documents revealed that flooding in urban and peri-urban settlements was as a result of two factors: blockage of waterways; and creation of impervious surfaces. On a scale of "Strongly Agree" to "Strongly Disagree", the respondents were asked to indicate how much they agreed with statements that occurrence of flooding in Mavoko settlement was due to blockage of waterways; and creation of impervious surfaces.

The responses were tabulated as shown in Table 5 from which it was observed that 390 (95.6%) of the respondents 'agreed' that flooding in Mavoko was due to blockage of waterways; while 307 (75.2%) of them 'agreed' that it was due to creation of impervious surfaces.

Table 5: Causes of flooding in Mavoko, Nairobi, Kenya

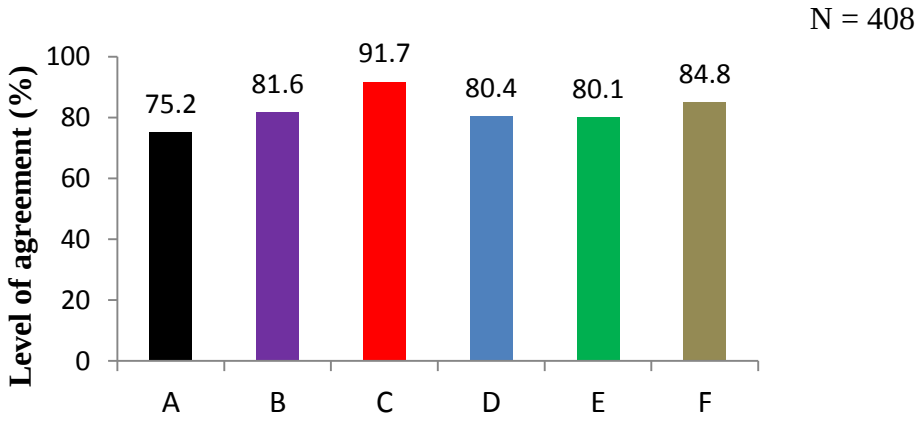
Cause of flooding	1	2	3	4	5	T/A (%)
Blockage of waterways	191 (46.8%)	199 (48.8%)	5 (1.2%)	9 (2.2%)	4 (1.0%)	**95.6**
Creating impervious surfaces	142 (34.8%)	165 (40.4)	28 (6.9%)	45 (11.0%)	28 (6.9%)	**75.2**

KEY: 1 = Strongly Agree; 2 = Agree; 3 = Not sure; 4 = Disagree; 5= Strongly Disagree; T/A = Total Agree

The researcher did a Pearson Chi-square test of the effect of blockage of waterways and creation of impervious surfaces on the occurrence of flooding. The Chi square value ($X^2_{16,0.05} = 149.94 > 32.00$) revealed that blockage of waterways had a highly significant effect on the occurrence of flooding; while the Chi square value ($X^2_{16,0.05} = 63.34 > 32.00$) revealed that creating impervious surfaces had a significant effect on the occurrence of flooding in Mavoko peri-urban settlement.

Data from the reviewed documents revealed that some tendencies towards the physical environment contributed to blockage of natural waterways and creation of impervious surfaces. These tendencies included: having concrete paved compound; Carefree dumping of waste materials from households; Carefree damping of cotton soil from construction sites; levelling off the ground at entrances; building and settling in valleys/wetlands/riparian areas. On a scale of "Strongly Agree" to "Strongly Disagree", respondents were asked to indicate how much they agreed with statements that the fore-stated tendencies led to the blockage of waterways and creation of impervious surfaces in Mavoko settlement.

The results obtained were as shown in Fig. 5, from which it was observed that 374 (91.7%) of the respondents 'agreed' that dumping of cotton soil from construction sites blocked natural waterways and created impevious surfaces; 346 (84.8%) 'agreed' that building/ settling in valleys/wetlands/reparian did; while 333 (81.6%) of them indicated that it was due to carefree dumping of waste materials from households. It was further observed that 328 (80.4%) of the respondents 'agreed' that levelising off the ground at entrances to compounds blocked natural waterways and created impevious surfaces in the settlement; 327 (80.1%) 'agree' that it was due to construction of masonry perimeter walls; while 307 (75.2%) of them indicated that it was due to having concrete paved compounds.



Cause of blockage of waterways and impervious surfaces

KEY:

A: Having a concrete paved compound

B: Dumping of waste materials from households

C: Dumping of cotton soil from construction sites

D: Levelising ground at entrances

E: Construction of masonry perimeter walls

F: Building/settling in valleys/ wetlands/reparian areas

Fig. 5: Envrironmental tendencies associated with onset of flooding in urban settlements

The study used Cramer's V to analyse the relationship between the homeowners': tendency to have a concrete paved compounds; affinity for carefree dumping of wastes from households; affinity for carefree dumping of cotton soil from construction sites; tendency to level off the ground at entrances; tendency to construct masonry perimeter walls; and tendency to build/settle in valleys/ wetlands/riparian areas on the one side and the blockage of water ways and creation of impervious surfaces on the other.

The results were as shown in Table 6 from which it was observed that both blockage of waterways and creation of impervious surfaces had a significant effect on the occurence of flooding in Mavoko.

Table 6: Cross tabs of the correlation (Cramer's V) between the causes of flooding and the various attitude factors in Mavoko, Nairobi, Kenya

Variables	Blockage of waterways	Clearing of vegetation
Having a concrete paved compound	0.287	0.306
Carefree dumping of waste materials from households	0.303	0.244
Carefree dumping of cotton soil from construction sites	0.987	0.377
Levelising ground at entrance to compounds	0.255	-
Construction of masonry perimeter walls	0.280	0.210
Building/settling in valleys/wetlands/reparian areas	1.000	0.238

KEY: > 0.5 = High correlation

0.3 to 0.5 = Moderate correlation

0.1 to 0.3 = Low correlation
0 to 0.1 = Little (if any) correlation (Garson, 2012)

V. DISCUSSIONS

a) Environmental Attitude and Blockage of Waterways in Mavoko:

The value (Cramer's V = 1.000) revealed that there was a perfect correlation between the tendency to build/settle in valleys/ wetlands/riparian areas and the blockage of natural waterways; and the value (Cramer's V = 0.987) revealed that there was a near perfect correlation between the homeowners' affinity for carefree dumping of cotton soil from construction sites and blockage of natural waterways. The value (Cramer's V = 0.303) revealed that there was a moderate correlation between the homeowners' affinity for carefree dumping of wastes from households and blockage of natural waterways; while the value (Cramer's V = 0.287) revealed that there was a low correlation between the homeowners' tendency to have concrete pavements in their compounds and blockage of natural waterways.

Further, the value (Cramer's V = 0.280) revealed that there was a low correlation between the homeowners' tendency to construct perimeter walls and blockage of natural waterways; and the value (Cramer's V = 0.255) also revealed that there was a low correlation between the homeowners' tendency to level off the ground at entrances to their compounds and blockage of natural waterways. However, the positive Spearman's correlation values observed revealed that there was a direct relationship between the respondents' negative tendencies towards their physical environment and blockage of natural water ways. Thus, as the respondents' negative tendencies towards the physical environment increased, the blockage of natural water ways also increased.

Regarding the observed perfect relationship between the tendency by the respondents to build and/or settle in valleys/ wetlands/riparian areas and the blockage of natural waterways, this practice is often seen as necessary due to the lower cost of such plots. This practice is usually done in an unplanned manner or where residents tend to circumvent professional advice and do not give due consideration environmental conserns as they acquire, develop and utilise their homes leading to increased exposure to flood hazard (Frazier, 2012). Despite increases in knowledge of where and how frequently floods may occur in some cases, the residents were observed to acquire and build in dry river beds and reparian areas, though sometimes the choices of development are often made without proper awareness of the risk in the prevailing area (WMO, 2007).

The observed direct relationship between the homeowners' affinity for carefree dumping of cotton soil from construction sites; and their affinity for carefree dumping of wastes from households and the blockage of natural waterways could be attributed to the commonly observed practices of indiscriminately damping refuse and solid waste in valleys and open fields as earlier discussed. Data from direct observation revealed three issues with regard to disposal of solid waste and garbage in the sampled units. First, some households packed waste from their houses into polythene bags and damped into the open fields and/or swampy areas which they have turned into dumping sites. This behaviour was commonly observed in areas with low population density like Kinanie and Muthwani. Secondly, in some areas, there were established garbage collection points, but these seemed un-attended and overflowing.

The other observation was that developers simply deposited solid waste like cotton soil from construction sites in dry valleys and open fields as shown in Plates 1 and 2.

Plate 1: Researcher views cotton soil from construction sites damped in open field in Mavoko, Nairobi, Kenya (Researcher, 2015)

Plates 2: Deposit of Cotton soil along the road in Mavoko, Nairobi, Kenya (Researcher, 2015)

It was also observed tha most homeowners had constructed perimeter walls; they had concrete paved compounds as opposed to natural grass lawns; and had levelled off the ground at entrances to their compounds instead of laying culverts that would facilitate faster drainage.

Proceedings at the FGDs and key informant interviews revealed that there are no proper solid waste disposal mechanisms and systems in Mavoko settlement; and even Mavoko county government itself had limited capacity to collect refuse in their jurisdiction. This left the residents with no option but to dispose of waste in a variety of ways, some of which are not environmentally friendly.

Data from the secondary document analysis also revealed that in the developing world, the proportion of structures subject to planning or building controls is low; and is reported to be denser in upcoming peri-urban and in informal settlements (WMO, 2007). Similarly, while research in Dar es Salaam, Tanzania, identifies flooding caused by the dumping of solid waste and rubble into watercourses (Sakijege et al., 2012), Jha et al (2011) reported that landfill sites in Gugulethu compounded the challenge of poor drainage in affected communities. This phenomenon was also reported in Sweet Home; where flooding was linked to the clogging of concrete drainage ditches running alongside roads by household refuse.

b) Environmental Attitude and Creation of Impervious Surfaces in Mavoko:

The value (Cramer's V = 0.377) revealed that there was a moderate correlation between the homeowners' affinity for carefree dumping of cotton soil from construction sites and the creation of impervious surfaces; while the value (Cramer's V = 0.306) also revealed that there was a moderate correlation between homeowners' tendency to have concrete paved compounds and the creation of impervious surfaces. However, the value (Cramer's V = 0.244) revealed that there was a low correlation between damping of waste materials from households in open fields and the creation of impervious surfaces. The value (Cramer's V = 0.238) also revealed a low correlation between construction of houses in valleys and the creation of impervious surfaces; while the value (Cramer's V = 0.210) revealed that there was another low correlation between the construction of perimeter walls and creation of impervious surfaces in Mavoko settlement.

The use of concrete pavements in the compounds, damping of waste materials from households in open fields, construction of houses in valleys and the construction of perimeter walls are practices that were reported by the respondents as "commonly observed" in the Mavoko settlement as earlier discussed. None-the-less, the positive Spearman's correlation values observed revealed a direct relationship between the respondents' negative tendencies towards their physical environment and the creation of impervious surfaces. Thus, as the respondents' negative tendencies towards the physical environment increased, the creation of impervious surfaces also increased.

Data from secondary document analysis revealed that the proliferation of made up surfaces in urban and peri-urban settlements increases run-off and rainwater ponding in the resultant impervious surfaces which the capacity of natural surfaces and open spaces to provide temporary storage of rain water (Jha et al., 2011; Satterthwaite, 2008). Majority of the plots in the Mavoko peri-urban settlement are sub-divided into one-eighth (1/8) acre pieces. The increasing peri-urban settlement activities lead to increased rate of densification as residents tend to utilise their small plots to the maximum leading to an increase in hard surfaces and a decreasing permeability of open space left after the construction of buildings.

The impervious surfaces arise from the need for improved of road network, paving of front gardens to allow for parking spaces and preparation of playing grounds for leisure and recreational uses. As illustrated by Jha et al (2011), these impervious surfaces cause a change in the water cycle as illustrated in Fig. 6 from which it is observed that as the proportion of the land surface under impervious cover increases, there is a decrease in the level of permeability leading to excessive runoff and overload of the existing drainage systems as the settlement activities increase. Therefore, increased peri-urban settlement activities aggravate flooding by restricting where floods waters can go because large parts of the ground are covered with roofs, roads and pavements (*Action Aid*, 2006).

Analysis of data from multiple sources also revealed that flooding in Mavoko was a case of anthropogenic issues that had not been adequately engineered and governed leading to both the blockage of natural water ways and creation of impervious surfaces. Key informant interviews revealed that Mavoko was previously ranch land used for grazing and subsistence agriculture, thus the change of user to a peri-urban settlement has contributed to the increased flood hazard by reducing the flexibility of the system to absorb excess water. This is worsened by the noted influx of new inhabitants who have increased the settlement activities in the area.

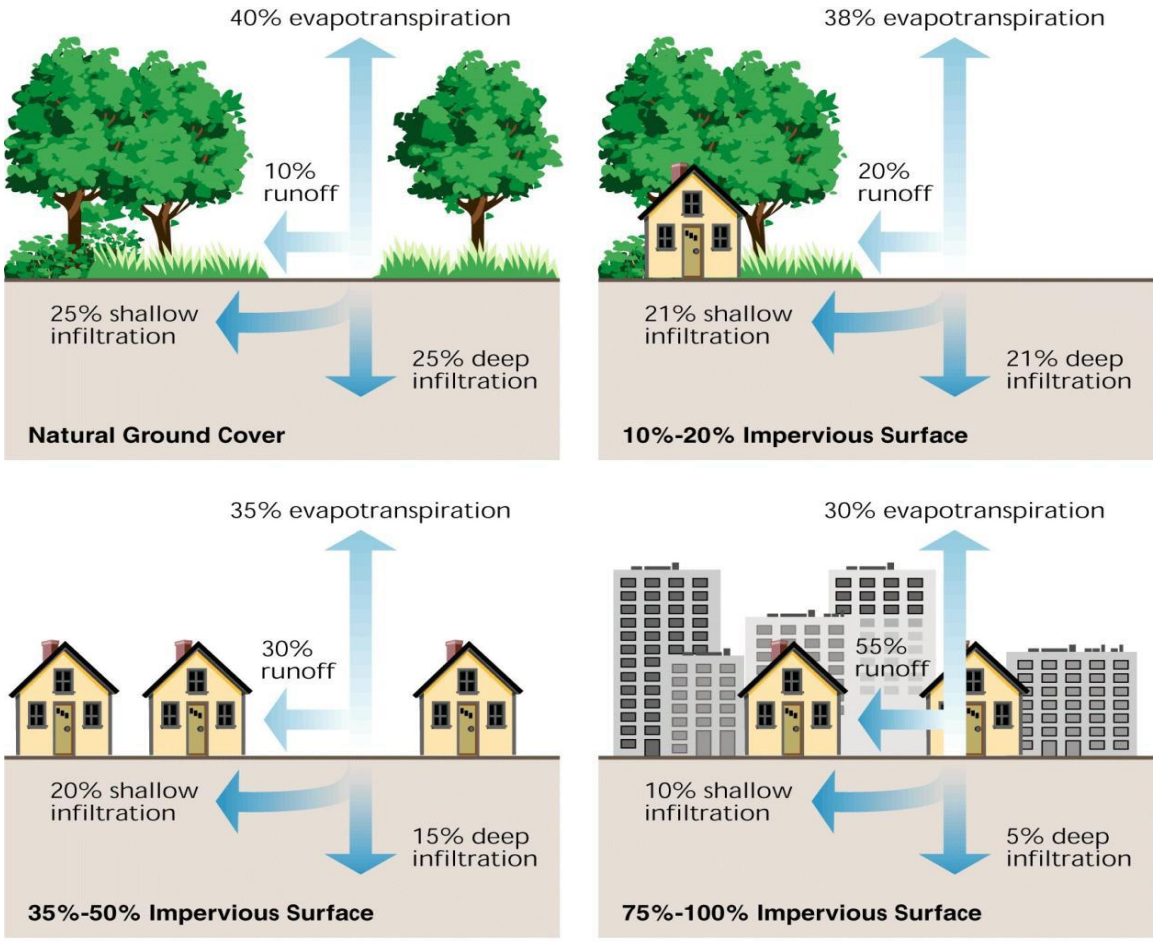


Fig. 6: Change in watershed characteristics after urbanization (*Source: Jha et al., 2011*)

Secondary data from document analysis also revealed that change of land use contributes to increase in urban flooding downstream due clearing of the natural vegetation creating impervious made up surfaces as new infrastructure development like road networks introduce elevated structures which obstruct natural flow paths (Jha et al., 2011). Change of land use also destroys the delicate water and land balance leading to reduced rain water absorption and storage as well as increased run-off (Satterthwaite, 2008). In the development of the Mavoko peri-urban settlement, natural land use changes was noted in the damping of solid waste and garbage, including none-biodegradable materials, in the open and swampy areas as shown in Plate 3.

Plate 3: Development on riparian areas in Syokimau in Mavoko, Nairobi, Kenya (Researcher, 2015)

From direct observation, the study noted that there were many developments in the study area standing on wetlands and riparian areas. This could partly be attributed to secondary data from document analysis which revealed a variance of information in some official records and the real situation on the ground. For example, in the land sub-division map of the Katani/ Mlolongo wards where the existence of some streams is not indicated yet they exist on the ground.

It was observed that in some developments, watercourses were altered restricting their course and capacity, with deliberate narrowing and obstruction through bridges and culverts as the immediate surrounding rendered impermeable using concrete paving. The man-made channels lead to faster flow rate causing alteration of volumes at the receiving points in a short time with possible flood hazard. The study also observed that the construction of masonry perimeter walls made excess surface run-off which could be conveyed through this land to either divert causing increased hazard elsewhere or stagnate within the homestead causing increased flood hazard for the household.

Direct observation also revealed that while people were constructing houses in the settlement, there was no commensurate development of the drainage infrastructure for the increasing surface run-off. This was particularly notable in Athi River and Mlolongo townships where the drainage infrastructure was observed to be inadequate with poor operational maintenance while the drains were blocked, thus increasing the flood risk in these areas. As data from proceedings at the FGDs revealed, the inundations can be said to be arising from the failure to balance the relation between physical planning, actual development of the human settlement and supervisory capacity of local authorities to oversee constructions in their areas of jurisdiction. One participant explained thus:

"...drainage infrastructure is yet to be developed…the occurrence of flooding in this area is caused by people interfering with natural water ways…some people even damp cotton soil and garbage in valleys...construct perimeter walls blocking water flow …"

As pointed out by Karley (2009), poor physical planning of settlements is recipe for flooding, but the problem could be greatly reduced where adequate and effective drainage is provided. Data from proceedings at the FGDs revealed that the residents of Mavoko understood the environmental challenges in their neighbourhoods and knew what ought to be done to mitigate the problem. One participant expressed thus:

"...the problem with us...is not 'not knowing', but the lack of goodwill to do and the capacity to oversee the doing of what is for the common good..."

These observations contextualise the evident lack of care for the physical environment at both the individual household level; and at the institutional level where those charged with the responsibility to oversee implementation of policies evidenced by the increased interference with the natural waterways and creation of impervious made-up surfaces. This translates into issues of attitudes, where homeowners and potential homeowners continue to ignore or violate laid down rules and regulations by the authorities who were not adequately on the ground to enforce the same.

VI. CONCLUSION

The objective of this study was to determine the association between homeowners' environmental attitude and the onset of flooding in Mavoko settlement. Analyses of the data revealed there was a significant, positive correlation between the participants' negative tendencies towards the physical environment and the blockage of water ways and/or creation of impervious surfaces, which resulted in the onset of flooding in Mavoko settlement. The study concluded that there is a significant relationship between the homeowners' environmental attitude and the onset of flooding in the Mavoko peri-urban settlements of Nairobi metropolis, Kenya.

ACKNOWLEDGEMENT

Numerous individuals have given us generous amount of support and encouragement during this study, thus contributed in a substantive way to its successful completion. We were blessed with incredible opportunities to consult with the best experts that the field has to offer both in and outside of academic world. Special thanks to all friends and colleagues who read this work and provided insightful comments for improvement – it has now become a significantly stronger piece of work, thanks to their constructive inputs.

We are also very grateful to our technical and support teams; and all the people we met and interviewed during the fieldwork for sharing their time, ideas and concerns. Without their participation this research would not have been accomplished.

REFERENCES

[1] Action Aid (2006). *Climate change, urban flooding and the rights of the urban poor in Africa*. Key findings from six African cities

[2] Alam, K., Dankelman, I., Bashar, A. W., Diagne, G. Y., Fatema, N., and Mensah-Kutin, R. (2008). *Gender, climate change and human security lessons from Bangladesh, Ghana and Senegal*: WEDO, ABANTU for Development in Ghana, Action Aid Bangladesh and ENDA in Senegal.

[3] Al-Khatib, I. A., Arafat, H. A., Daoud, R. and Shwahneh, H. (2009). Enhanced solid waste management by understanding the effects of gender, income, marital status, and religious convictions on attitudes and practices related to street littering in Nablus – Palestinian Territory. *Waste Management, 29,* 449-455.

[4] Amoako, C. (2012). *Emerging issues in urban flooding in African cities - The Case of Accra, Ghana.* 35th AFSAAP Annual Conference Proceedings 2012. Retrieved from: http://afsaap.org.au/assets/AMOAKO.pdf

[5] Arafat, H., Al-Khatib, I., Daoud, R. and Shwahneh, H. (2007). Influence of socio-economic factors on street litter generation in the Middle East: Effects of education level, age, and type of residence. *Waste Management & Research 25 (4),* 363–370.

[6] Ashiembi, P. A. (2013). *Factors influencing wastewater management and re-use in peri-urban areas in Kenya: a case of Ongata Rongai.* MA thesis, University of Nairobi

[7] Banga, M. (2013). Household Knowledge, Attitudes and Practices in Solid Waste Segregation and Recycling: The Case of Urban Kampala. *Zambia Social Science Journal, 2(1), Article 4*. Retrieved from: http://scholarship. law.cornell.edu/zssj/vol2/iss1/4

[8] Bosher, L., Dainty, A., Carrillo, P., Glass, J. and Price, A. (2009). Attaining improved resilience to floods: a pro-active multi-stakeholder approach. *Disaster Prevention and Management 18(1), 2009*, 9-22. Retrieved from: www.emeraldinsight.com/0965-3562.htm

[9] Botsch, R. E., (2011). *Significance and Measures of Association*. Retrieved from: http://www.usca.edu/polisci/ apls301/Text/ Chapter% 2012.%20Significance % 20and %20Measures%20 of%20Association.htm

[10] Broer, S. and Titheridge, H. (2010). Eco-self-build housing communities: Are they feasible and can they lead to sustainable and low carbon lifestyles? *Sustainability 2010, 2,* 2084-2116. Retrieved from: www.mdpi.com/ journal/sustainability

[11] CBS (2003). Population and Housing Census. *Counting Our People for Development Vol.1*. Central Bureau of Statistics, Nairobi.

[12] Dawson, R. J., Speight, L., Hall, J. W., Djordjevic, S., Savic D. and Leandro, J. (2008). Attribution of flood risk in urban areas. *Journal of Hydro-informatics, 10 (*4), 275–288. Retrieved from: http://www.iwaponline.com/jh/010/jh0100275.htm

[13] Douglas, I., Alam, K., Maghenda, M., Mcdonnell, Y., Mclean, L. and Campbell, J. (2008). Unjust waters: climate change, flooding and the urban poor in Africa. *Environment and Urbanization, 2008 (*20) 187. Retrieved from: http://eau.sagepub.com/ content/20/1/187.

[14] Durand, F. J. A. (2009). *Unpacking the social construction of ´natural´ disaster through policy discourses and institutional responses in Mexico: The case of Chalco Valley's Floods, State of Mexico.* Ph.D thesis, The Bartlett University College London. Retrieved from: http://discovery.ucl.ac.uk/18983/1/18983.pdf

[15] Eakin, H., Lerner, A. and Murtinho, F. (2010). *Adaptive capacity in evolving peri-urban spaces: Responses to flood risk in the Upper Lerma River Valley, Mexico*. Global Environmental Change

[16] Ekere, W., Mugisha, J. and Drake, L. (2009). Factors Influencing Waste Separation and Utilization among Households in the Lake Victoria Crescent, Uganda. *Waste Management 29*, 3047-3051

[17] Erdogan, M. and Ozsoy, A. M. (2007). Graduate students' perspectives on the human-environment relationship. *Journal of Turkish Science Education, 4(2)*. Retrieved from: http://www.tused.org/internet/tufed/arsiv/v4/i2/ metin/ tusedv4i2s2.pdf

[18] Evaluation Review. (2009). Data collection methods for evaluation: Document review. *Evaluation Briefs, 18*

[19] Franzen, A. (2003). Environmental Attitudes in International Comparison: An Analysis of the ISSP Surveys 1993 and 2000. *Social Science Quarterly*, 84, 297-308.

[20] Frazier, A. (2012). *Self-build homes*. Retrieved from: http://infotechmfp.wordprocess.com/auther/aaronfrazier/.

[21] Frederiks, E. R., Stenner, K. and Hobman, E. V. (2015). The socio-demographic and psychological predictors of residential energy consumption: A comprehensive review. *Energies 2015, 8,* 573-609. doi:10.3390/en8010573. Review from: www.mdpi.com/journal/energies

[22] Garson, G. D. (2012). *Measures of Association*. Asheboro, NC: Statistical Associates Publishers.

[23] Gatersleben, B., Lindasteg,L. & Svlek,C. (2002). Measurement and determinants of environmentally significant consumer behavior. *Environment and Behavior, 34(3), May 2002,* 335-362

[24] GoK (2009). *Draft National Policy for Disaster Management in Kenya*. Ministry of State for Special Programmes Office of the President. Nairobi, Kenya

[25] GoK (2008). *Nairobi Metro 2030 Strategy.* Retrieved from http://www.nairobimetro.go.ke/index.php?option=com_docmanandtask= doc_detailsandgid=7andItemid=53

[26] Horber, E. (2013). *Nominal association coefficients.* Retrieved from: http://www.unige.ch/ses/sococ/cl/////stat/stat/association.nomcoeff.html

[27] Houston, D., Werritty, A., Bassett, D., Geddes, A., Hoolachan, A and McMillan, M. (2011). *Pluvial (rain-related) flooding in urban areas: the invisible hazard*. JBA Consulting, University of Dundee and University of St. Andrews. Retrieved from: http://www.jrf.org.uk/publications/pluvial-flooding-invisible-hazard

[28] IFRC. (2010). *World Disasters Report 2010: Focus on urban risk*. Retrieved from: http://www.ifrc.org/publicat/ wdr2010/images/WDR2010-cover.jpg. .

[29] ILGS and IWMI (2012). *Community adaptation to flooding risk and vulnerability*. Final Report, February, 2012

[30] Jha, A., Lamond, J., Bloch, R., Bhattacharya, N., Lopez, A., Papachristodoulou, N., Bird, A., Proverbs, D., Davies, J. and Barker, R. (2011). *Five Feet High and Rising: Cities and Flooding in the 21st Century*. Policy Research Working Paper 5648. The World Bank, Transport, Energy & Urban Sustainable Development Unit, East Asia and Pacific Region. Retrieved from http://econ.worldbank.org

[31] Jha, A. K., Bloch, R. and Lamond, J. (2012). *Cities and Flooding A Guide to Integrated Urban Flood Risk Management for the 21st Century*. Washington, DC: World Bank, GFDRR. Retrieved from: http://www.gfdrr.org/gfdrr/sites/gfdrr.org/files/ publication/World_Bank_ Cities_and_Flooding_Guidebook.pdf

[32] John Eng. (2003). Sample size estimation: How many individuals should be studied? *In Radiology* 227, 309– 313. Retrieved from: http://radiology.rsna.org/content/227/2/ 309.full.pdf.

[33] Kan, K. (2007). Residential mobility and social capital. *Journal of Urban Economics*, 61, 436– 457.

[34] Karley N. K. (2009). Flooding and physical planning in urban areas in West Africa: Situational analysis of Accra, Ghana. *In Theoretical and Empirical Researches in Urban Management Number* 4(13)

[35] Lee, G. C., Bruneau, M., S., Chang, E., Eguchi, R. T., O'Rourke, T. D., Reinhorn, A. M., Shinozuka, M., Tierney, K., Wallace, W. A. and von Winterfeldt, D. (2003). A framework to quantitatively assess and enhance the seismic resilience of communities. *Earthquake Spectra*, 19(4),733–752.

[36] Milfont, T. L. and Duckitt, J. (2004). Preservation and Utilization: Understanding the Structure of Environmental Attitudes. *Medio Ambientey Comportamiento Humano 2006,* 7(1), 29-50. Retrieved from: http://mach.webs.ull.es/PDFS/ Vol7_1/Vol7_1_c.pdf

[37] Mogalakwe, M. (2006). The use of documentary research methods in social research. *African Sociological Review*, 10(1), 221-230.

[38] Mustafa, D. (2005). The production of an urban hazardscape in Pakistan: modernity, vulnerability and the range of choice. *Annals of the Association of Geographers,* 95 (3), 566-586.

[39] Occhio, C. (2003). Local governance, Collective actions and civic development: A Study case in the last European dictatorship, the Republic of Belarus. *In faces of poverty – capabilities, mobilization and institutional trans formation. Proceedings of the international CERES summer school (pp* 334 *– 342)*. Amsterdam: Tropical Royal Institute.

[40] Ogunjinmi, A. A., Onadeko, S. A. and Adewumi, A. A. (2012). An Empirical Study of the Effects of Personal Factors on Environmental Attitudes of Local Communities around Nigeria's Protected Areas. *Journal of Trans-disciplinary Environmental Studies*, ISSN 1602-2297. Retrieved from: http://www.journal-tes.dk/vol_11_no_1_ page_18/no%206%20 Ogunjinmi.pdf.

[41] Oluyinka, O. and Balogun, S. K. (2011): Psycho-sociocultural Analysis of Attitude towards Littering in a Nigerian Urban City. *Ethiopian Journal of Environmental Studies and Management*, 4(1)

[42] Omondi, L. A. (2010). Social Capital, Access to Water and People Living with HIV/AIDS: Experiences from Nyando Irrigation Scheme, Nyando District, Western Kenya. MA. Thesis, Maseno University

[43] Pharoah, R. (2013). *Sometimes I think the shack was better: Examining Flood-Risk in Subsidised Housing Areas in Cape Town*. Ph.D thesis, University of Cape Town.

[44] Sakijege, T., Lupala, J. and Sheuya, S. (2012). Flooding, Flood Risks and Coping Strategies in Urban Informal Residential Areas: The case of Keko Machungwa, Dar es Salaam, Tanzania. *Jamba: Journal of Disaster Risk Studies*, 4(1).

[45] Satterthwaite, D., Huq, S., Pelling, M., Reid, A. and Romero-Lankao, P. (2007). *Building Climate Change Resilience in Urban Areas and among Urban Populations in Low- and Middle-income Countries.* The Rockefeller Foundation, International Institute for Environment and Development (IIED) Research Report, 112 pp

[46] Satterthwaite, D. 2008. *Climate Change and Urbanization: Effects and Implications for Urban Governance.* Paper prepared for the United Nations Expert Group Meeting on Population Distribution, Urbanization, Internal Migration and Development, 21-23 January 2008. New York: UNDESA.

[47] Shibia, M. G. (2010). Determinants of attitudes and perceptions on resource use and management of Marsabit national reserve, Kenya. *Jan Hum Ecol*, 30(1): 55-62

[48] Simon, D. (2008). Urban Environments: Issues on the Peri-Urban Fringe. *The Annual Review of Environment and Resources.* Retrieved from: www.annualreviews.org

[49] Teo, M M M, Loosemore, M, Marosszeky, M, Karim, K and Gardner, D. (2000). Operatives' attitudes towards waste on construction project. In: Akintoye, A (Ed.), *16th Annual ARCOM Conference, 6-8 September 2000, Glasgow Caledonian University. Association of Researchers in Construction Management*, 2, 509-17

[50] Tucci, C. E. M. (2007). *Urban Flood Management*. Cap-Net International Network for Capacity Building in Integrated Water Resources Management. Retrieved from: http://www.cap-net.org/sites/capn-et.org/files/Urban%20 flooding _E_ Low Res.pdf

[51] UN-HABITAT. (2006). *Mavoko urban sector profile*. Nairobi: UN-HABITAT. Retrieved from: www.unHABITAT.org/pmss/getElectronicVersion.aspx?nr=2789andalt=1

[52] UN-HABITAT. (2010). *The State of African Cities 2010: Governance, Inequality and Urban Land Markets*. Nairobi: UN-HABITAT. Retrieved from: http://www.africafiles.org/article.asp?ID=24844

[53] UNISDR (2005). *Hyogo Framework for Action 2005–2015: building the resilience of nations and communities to disasters*. Retrieved from: www.unisdr.org/ wcdr/intergover/official-doc/L-docs/Hyogo-framework-for-action-english.pdf.

[54] UNISDR (2006). *Disaster statistics 1991–2005*. Retrieved from: www.unisdr.org/ disasterstatistics/pdf/2005-disaster-in-numbers.pdf

[55] Werritty, A., Houston, D., Ball, T., Tavendale, A. and Black, A. (2007). *Exploring the social impacts of flood risk and flooding in Scotland*. Scottish Executive Social Research

[56] Whitmarsh, L. E. (2005). *A study of public understanding of and response to climate change in the South of England*. Ph.D thesis, University of Bath.

[57] WMO (2007). *Tools and Role of Land-use Planning*. Flood Management tools. WMO.

[58] WRI (1996). *Population and human well-being: Urban growth*. World Resources Report 1996- 97 (Oxford University Press, New York, 1996). Retrieved from: http://www.wri.org/publication/content/8479