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Research article

THE COMPLACENCY OF FLOOD VICTIMS, SOCIO ECONOMIC FACTORS, AND EFFECTS AND VULNERABILITIES OF FLOODS IN LOWER KANO PLAINS, KISUMU COUNTY, KENYA

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Abstract: The behavior and thinking of disaster victims should be analyzed and understood even as experts continue to deescalate the destructive effects of such occurrences. Why people choose to live and reside in ecologically fragile environments like flood plains or steep slopes prone to mudslides or avalanches is a complex phenomenon that social scientists need to demystify. This study was conducted in the Nyando sub-catchment, Kano Plains in Kisumu County, Kenya. The study's objectives were to understand the reason for complacency of flood victims and to determine the effects and vulnerabilities of flood events in Kano Plains. Both qualitative and quantitative methodologies were used. Stratified sampling technique was used to select the three flood prone areas in Kano, namely, Nyando, Miwani and Lower Nyakach as study sites. Simple random sampling technique was used to select 100 households for the survey while Purposive sampling was used to select the key informants. Methods of data collection were; questionnaires, key informant interviews, focus group discussions (FGDs) and desk reviews. Descriptive statistics was used to analyze the questionnaires, and the qualitative data from key informants was analyzed using content analysis method. FGDs recordings were transcribed and analyzed thematically using NVIVO software. The main research findings were that socio economic factors such as household income, household size and culture play an important role in determining the choice of site to reside, thus the complacency, and that loss of farmland (17.98%), houses and property (69.66%) were considered the most serious effects of floods. The study therefore concludes that socio economic determinants such as household income, household size and type of housing have a significant role in determining household vulnerability to floods.

Keywords: Community Vulnerability; Complacency; Differential Vulnerability; Flood Risk; Flood Effects.

1. Introduction

Current disasters are becoming more complex and climate change presents a greater chance for even worse impacts (Aalst and Burton, 2002). Aalst and Burton, 2002, further realize that degradation of the natural environment has often been mentioned as a natural hazard risk factor, although little has been done in terms of policy formations to tackle the challenge. Urama and Ozor (2010) noted that sub-Saharan Africa has often reported cases of floods, and this has been mainly due to climate change, which has led to the loss of lives and property worth billions of dollars, the main reason for this being poor planning for such incidences. Kenya has had serious floods and drought disasters throughout the nation causing major destructions and even causing deaths in some instances. Natural occurrences including flash rainfall, river floods and coastal floods often lead to serious hazards (National Environment Management Authority, 2004). Certain incidences of floods sometimes are a result of human induced factors such as deforestation, interference with watersheds and areas prone to floods. For instance, floods have as well occurred along some basins having average rainfall as a result of excess runoff triggered through human activities such as land clearance for cultivation, settlement and general degradation.

1.1. Statement of the Problem

Since floods have been a frequent occurrence in Nyando river basin, this has substantially caused degradation in the area. Nyando River passes through Kano Plains and traverses a wide area of the lower Kano Plains, which is prone to frequent flooding. Such floods normally cause psychosocial problems, poses danger to health, disrupts settlements and infrastructure, causes food insecurity due to losses on farms, and a general malaise of the population, as a result hindering any type of development of this high potential Kano Plains (Opere, 2013). Vella (2012) states that in 2009, 1126 people (206 households) lost their houses and an additional 3,000 people were affected in various ways by the floods, schools were destroyed and subsequently closed, diseases associated with floods such as cholera breakout was recorded and about 2,000 farmers' crops got washed off in Kano Plains. A major cause of floods in River Nyando is due to bursting of the banks as a result of the river overflowing (Olang and Furst, 2011). This is a frequent occurrence in the long and short seasons of rain. The upstream of river Nyando are in Kericho and Nandi Counties which experience high precipitation annually; it is this rain which results in most serious floods in the basin (Olang and Furst, 2011). Also contributing to the floods are the flat topography, deforestation and black cotton soils within the watersheds that prevent rapid infiltration, which increase surface runoff (Onyango *et al*., 2005). The problem is aggravated through gulley erosion and poor land-use practices (Onyango *et al*., 2005).

1.2. Floods as a Hazard

One of the most overwhelming and frequently occurring natural hazards globally is flooding. Due to the damages it leaves behind, flooding remains a significant topic in the world today. Damages caused by this hydrological hazard ranges from socio-economic damages to loss of lives and properties (Komolafe *et al*, 2015). Between 1995 and 2015, The United Nations Office for Disaster Risk Reduction (UNISDR) and the Belgian-based Centre for Research on Epidemiology of Disasters (CRED) stated flooding had the highest percentage of natural disasters by disaster type with 3062 occurrences (43%). This report revealed further that in the past two decades, there have been 157,000 deaths from floods globally. The report

also says that 3062 flood disasters affected 2.3 billion people all over the world between 1995 and 2015, accounting for 56% of all those affected by weather-related disasters (Floodlist, 2016). Likewise, 290 flood-disasters were reported in Africa, with 23 million people affected and 8,183 dead; this also caused economic losses of $1.9 billion between 1996 to 2005 (Musungu and Motala 2012). There is a rise in global awareness for mitigation measures to flood damage due to the observed escalation in magnitude, frequency, and intensity of flood events worldwide (Hall *et al*., 2014). Most of these efforts have focused on quantitative methods of flood mitigation. However, this study employed a participatory approach to flood mitigation by engaging the local community in this research.

1.3. Complacency of Floods Victims

Aside from communities living in floodplains being pre disposed to the risk of floods due to geophysical factors, behaviour such as apathy in community based disaster preparedness activities during normal times when nothing happens exacerbates risk, Okayo 2015. In addition, other socioeconomic factors such as poverty, overpopulation, level of education, gender, poor land-use practices, culture and absence of flood mitigation mechanisms also heighten the vulnerability of populations to floods. For instance, women are forbidden from owning land in some cultures and this prevents them from making important decisions on issues regarding land (Nethengwe, 2007). A study by Speis *et al.,* 2019 found out that the 2017 floods in Attica region, Greece, has shown both short and long term psychosocial impact on the residents. Findings showed that residents had anxiety, depression, and post-traumatic stress from the floods, indicating that the exposure to these flood related impacts led to poor mental health, low level of income and lack of social support from their family members. Opportunities for effective integrated flood management should enable the government to realize that vulnerability is heightened by several physical factors such as; the degree of protection from flood hazards, the quality of available infrastructure, the level of access to relevant resources, and the capacity to avoid, withstand or recover from flood hazards. Many affected people are neither aware of some coping strategies used elsewhere, Flood Mitigation Strategy (2009).

2. Materials and Methods

This section covers the research design, study area, sampling procedure, sample size, research instruments and data analysis.

Research Design

This study adopted a descriptive research design, which involves describing the characteristics of a phenomenon and collection of information through interviewing or the administration of questionnaires to a selected sample size. Descriptive design is useful for extensive research, and is not only convenient for fast data collection but also ensures a high level of confidentiality. Descriptive design was chosen because it helped in the collection of data from the respondents spread across the study area. The study used the procedure of Rea and Parker, due to its ability to bring out issues important for development and management of human resources and their expectations.

Study Area

This research was carried out in the Kano Plains in Kisumu County, Kenya (Figure 1). The study focused on three sites in Kano plains, namely Nyando, Miwani and Lower Nyakach. Kisumu County is bordered by Nandi County and Nandi Hills to the North, Kericho County

to the East, and Homa Bay County to the South, and Nyabondo Escarpment to the South-East (NEMA, 2004; LBDA, 1992; Republic of Kenya, 2001). Kano Plains is located between longitudes 43^0 and 35^0 50' E and latitudes 1^0 30'N and latitude 0^0 and 05'S (NEMA, 2004). The Nyando basin has various land use characteristics, largely influenced by rainfall patterns and socio-cultural practices (Olang and Fürst, 2011). Main soil type in the area comprises vertisols, which is used to grow sugarcane, rice and cotton. However, there is a significant reduction in total cotton production and per hectare (WMO and UNEP, 2004). The floodplain has minimal rainfall, with mean annual rainfall ranging between 800 mm and 1200 mm. However, the northern and southern parts of the basin experience more than 1600 mm respectively. Most of the rainfall is experienced in the north in Nandi Hills, and this gradually reduces towards the south eastern side (WMO and UNEP, 2004). A peculiar characteristic of Nyando floodplains are the frequent floods aggravated by human activities due to the growing human population (Olang and Fürst, 2011). The rapidly expanding number of people in the basin is the main reason behind the majority of the land cover dynamics (Olang and Fürst, 2011). The upper catchment is mainly thick forests (e.g., Tinderet Forest), whereas the middle catchment has, scattered trees and grass, as a result of clearing, cultivation and burning due to human settlement (Opere, 2013).

The study area is captured in Fig. 1 below:

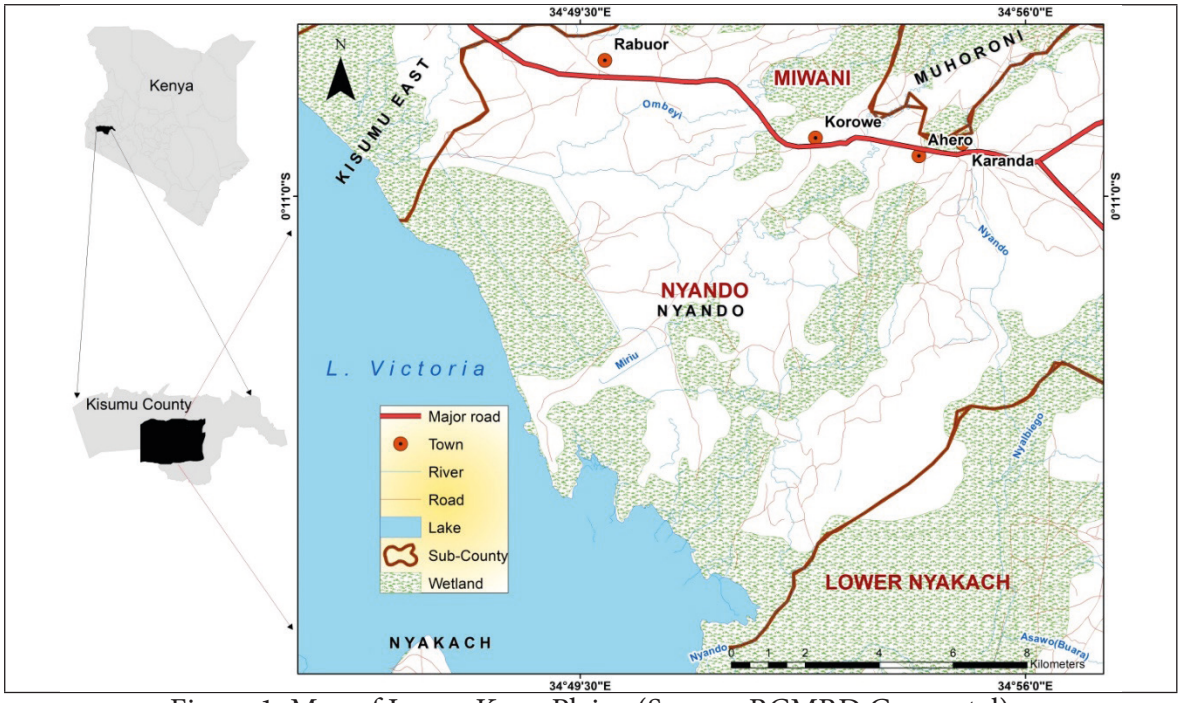

Figure 1. Map of Lower Kano Plains (Source; RCMRD Geoportal)

Sampling Procedures and Sample Size

The research was carried out in the three sub locations namely; Nyando, Miwani and Lower Nyakach. According to Kenya National Bureau of Statistics, KNBS 2019 census, the study area had 305,799 households (N). Stratified sampling technique was employed in this study to select the three study sites. Simple random sampling technique was used to select the 100 households from the strata that participated in the study; while purposive sampling technique was used to select the key informants. The sample size was calculated from a total of 305,799 households in the three study sites, using formula by Yamane, 1967.

Where;

$$n = \frac{N}{[1+N\,(e)^2]}$$

n= Sample size

N= population size

e= margin of error

The formula is useful in places with known populations; and the sample size obtained was:

Population size (N) = 305,799 Margin of error (e) = 10%

N = 305,799/1+305,799 (0.1)2

n = 99.95

n = approximately 100 respondents which were proportionately distributed in accordance to the individual populations in each of the three study divisions.

The distribution of the respondents is as per Table 1.

Table 1: Sample Size Distribution in the three Study Sites

Sub Location	Sample size	Population	Percentage (%)
Miwani Sub Location	**30**	**90,873**	29.71
Nyando Sub Location	**53**	**161,508**	52.82
Lower Nyakach Sub Location	**17**	**53,418**	17.47
Total	100	305,799	100.00

Source: Adapted from KNBS (KPHC 2019).

2.1 Research Instruments

The research instruments used for data collection in this study were; questionnaires, key informant interviews, focus groups discussions (FGDs) and desktop reviews.

2.2 Data Analysis

Quantitative data collected using questionnaires was cleaned, verified, and entered into the SPSS software for analysis. Data was analysed using descriptive statistics, and this was done as per the study objectives, to show relationship between socio-economic factors and their influence on floods management in Nyando. The results were summarized and presented in tables, pie charts, and graphs. In addition, SPSS was used for Chi-square ($\chi 2$) test which is one of the most useful non-parametric tests, also called a distribution free test for testing hypotheses when the variables are nominal (Pearson, 1900).

3. Results and Discussions

This section presents the analysed data of the research's finding including the demographic characteristics of the sampled respondents. In addition, the section presents and discusses

the results based on the main objective of the study, the socio economic determinants of community vulnerability to floods and the effects and vulnerabilities of floods.

Socio Economic Determinants of Community Vulnerability

Issues that were considered under this section included; Gender, Education, Marital status of the respondents, Size of household and Dependency ratio, Level of income, the Influence of households' proximity to River Nyando, and the Vulnerability of types of housing to flooding. These issues were considered to be some of the factors important for vulnerability assessment.

Gender of the Respondents

It has been widely acknowledged that men and women are affected differently by disasters due to the differences that exist in their social relations. From the study, it was established that 50.56% of the respondents agreed that women were most affected by floods than men while 46.06% saying men were the most affected gender. However, contrary to the findings of Odeyemi and Peter (2018), the study found the contribution of gender to be differential vulnerability small, this is because it was established that in most households, both gender was affected by floods in similar ways. Losses that occurred affected both gender almost in equal measure as gender roles in the modern days cross-cut and therefore both gender were likely to be affected equally.

Level of Education of the Respondents

The study established that the level of education attained by the respondents were as summarized in Table 2. The education level of the respondents was pertinent in the study since it showed various community members' knowledge on the potential flood hazards and the level of awareness on their vulnerability to flooding in Kano plain. It also helped in determining the push and pull factors for residing in the flood plain and their knowledge in the coping strategies to the flooding.

Table 1: Level of Education of the Respondents.

Education Level	Frequency (n=91)	Percentage (%)	Frequency affected (n=89)	% Affected
Secondary	47	51.65	46	51.69
Primary	37	40.66	37	41.57
Tertiary/College/University	6	6.59	5	5.62
No formal Education	1	1.10	1	1.12
Total	**91**	**100.00**	**89**	**100.00**

Source, Author, 2022

98.90% of the respondents had formal education (Table 2), indicating a high level of formal education among the residents in the study area. However, of these 98.90%, 89 respondents, were still affected by floods. The findings here contradicting those of Odeyemi and Peter (2018) that acknowledged education to be an indicator of cultural capital that gives a prediction of potential vulnerability to disasters, thereby increasing uptake of precaution.

Marital Status of the Respondents

Concerning marital status of the respondents, the results given in Table 3 were found.

Table 3: Marital Status of the Respondents

Marital status	Frequency (n=91)	Percentage (%)	Frequency (n=89)	% Affected by floods
Married	70	76.92	68	76.40
Widowed	15	16.48	15	16.85
Single	4	4.40	4	4.49
Divorced	2	2.20	2	2.25
Total	91	100.00	89	**99.99**

Source: Author, 2022

Table 3 indicates that (81.32%) of the respondents were married, 12.09% were widowed, while 4.40% were single, and 2.20% were divorced. Nethengwe (2007) acknowledges family and social resources as valuable indicators of flood vulnerability. Social networks can provide avenues of support and assistance during disasters. The tendency of households most affected by floods lying with the widowed, single and divorced (Table 3) the findings correlating with Yamano and Jayne (2002) research that found that households headed by 2 people are better placed to cope with floods than those headed by single heads.

Size of Household and Dependency Ratio

It was crucial to know the households' size; since this influenced their effort to generate income which dictated their economic power. Results are captured in Figure 2.

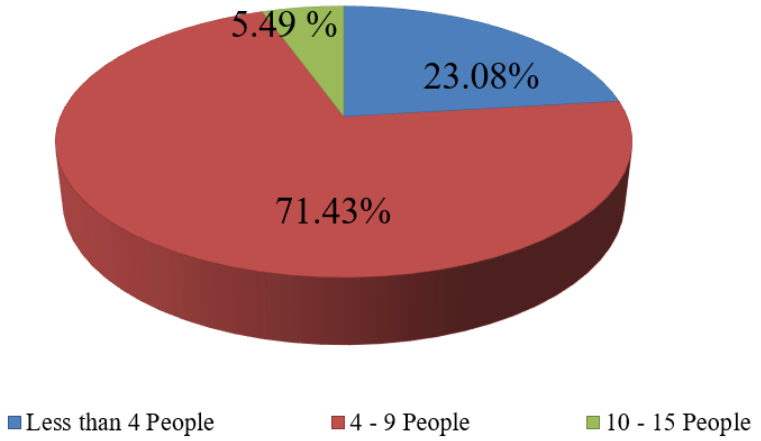

Figure 2. Size of Household (Source: Author, 2022)

Figure 2 revealed that 23.08%, 71.43% and 5.49% of the respondent were members of household size of less than 4 people, 4 - 9 people, and 10 - 15 people respectively. These findings gave insight on the possible vulnerability of the households that included the number of children to take care of, and senior citizens in case of any floods events. Similar to the work of Odeyemi and Peter 2018, the findings meant that households in the study area were more vulnerable to floods, due to their large number of dependents.

Level of income of the Respondents

The level of income of the respondents was as given in Figure 3. The level of income was found to be an important factor in preventing or reducing effects of disasters such as floods. People may continue living in disaster prone areas because they may lack the ability to move to safer places. Therefore, understanding the income levels of the respondents was important in understanding the resilience level of the population.

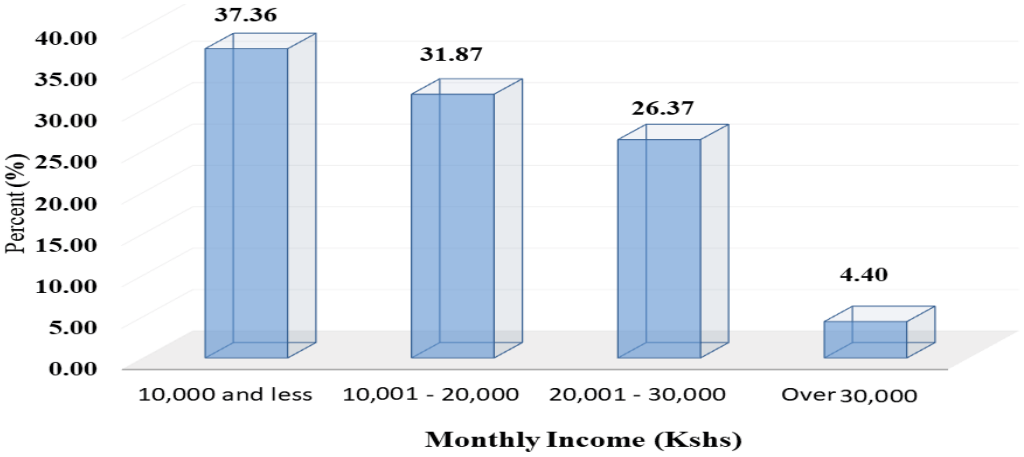

Figure 3. Respondents' Monthly Income (Source: Author, 2022)

Figure 3 shows that 37.36% of the respondents earned Kshs. 10,000 and less, followed by 31.87% who earned Kshs. 10,001 - 20,000, while 26.37% earned Kshs. 20,001 - 30,000, and only 4.40% of the households earned above Kshs. 30,000. The findings indicated that a majority (69.23%) living in the Kano flood plain earned a monthly income of less than Ksh. 20,000. This may mean that their level of financial capacity to cope with flood events is low, thus high vulnerability and risk. These findings concur with the study by Raburu and Okeyo-Owuor (2005), who found out that low economic status of the riparian communities had increased their demand for wetland resources, where they overexploited the resources therein including using it for livestock and crop farming, thus exacerbating their vulnerability. SERA Project (2002), similarly found a correlation between household resources and flood vulnerability to be that coping with and recovery from flood impacts demand resources that can cushion the household from negative flood impacts.

Households' proximity to River Nyando

The study sought to determine the households' proximity to River Nyando, as this could result in the severity of effects of floods in the Kano Plains. The distances were obtained from satellite images of scale 1:10,000 of the study area. A two-way contingency table (Table 4) was conducted to evaluate whether households' proximity was associated with livelihoods affected by floods in Kano plain. The proximity to river Nyando had six levels (Less than 100 Meters, 101 - 300 Meters, 301 - 500 Meters, 501 - 700 Meters, 701 - 900 Meters and more than 900 Meters) whereas livelihoods affected by floods had two levels (yes and no).

Table 4. Households' proximity to River Nyando vs Livelihoods affected by Floods

Yes No			Livelihood affected by floods		Total
Respondent distance from the River	Less than 100 Meters	Count	7	0	7
		Expected Count	6.8	.2	7.0
		% within Respondent distance to the River	100.0%	0.0%	100.0%
	101 - 300 Meters	Count	28	2	30
		Expected Count	29.3	.7	30.0
		% within Respondent distance to the River	93.3%	6.7%	100.0%
	301 - 500 Meters	Count	32	0	32
		Expected Count	31.3	.7	32.0
		% within Respondent distance to the River	100.0%	0.0%	100.0%
	501 - 700 Meters	Count	17	0	17
		Expected Count	16.6	.4	17.0
		% within Respondent distance to the River	100.0%	0.0%	100.0%
	701 - 900 Meters	Count	2	0	2
		Expected Count	2.0	.0	2.0
		% within Respondent distance to the River	100.0%	0.0%	100.0%
	More than 900 Meters	Count	1	0	1
		Expected Count	1.0	.0	1.0
		% within Respondent distance to the River	100.0%	0.0%	100.0%
Total		Count	87	2	89
		Expected Count	87.0	2.0	89.0
		% within Respondent distance to the River	97.8%	2.2%	100.0%

Table 4 shows that 75.82% of the respondents lived within 500 metres of River Nyando. Only 24.18% of the respondents lived beyond 500 metres of the river. 97.8% had experienced floods. These findings are vital because they reveal the level of vulnerability and risk of the households to the effects of flooding. This settlement pattern agrees with a study by Masese *et al.* (2016) who established that some residents risked by living close to the river simply because floods provided rich alluvial fertile soil for their crops, plenty of fish, water for domestic use and irrigation, and relief from NGOs, government and other stakeholders.

The Influence of Types of Housing to Floods Vulnerability

The nature and structure of housing determines, to some extent, their level of vulnerability and/or resilience to the effects of floods. The housing structure also gave an indication on the households' economic status. Table 5 and 6 shows the types of housing and the ownership status by the respondents respectively.

Table 5. Types of housing owned by the Respondents in Kano Plains

Type of housing	Frequency (n=91)	Percentage (%)
Permanent house	17	18.68
Temporary house	74	81.32
Total	**91**	**100.00**

(Source: Author, 2022)

Table 6. Housing status owned by the Respondents in Kano Plains. (Source: Author, 2022)

Housing status	Frequency (n=91)	Percentage (%)
Owned house	87	95.60
Rented house	4	4.40
Total	**91**	**100.00**

Table 5 shows that 81.32% of houses in the study area were temporary. The permanent houses were only 18.68%, and out of that, 95.60% of the houses were owned by the respondents, and only 4.40% were being rented (Table 6). The temporary houses were houses with walls of mud, while the permanent houses were constructed with stones and/or bricks. This finding implies that a majority of respondents' houses were temporary, and therefore bound to heighten vulnerability in the event of a flood occurrence. This is because the materials used would not be able to withstand the destructive force of floods; and this finding is similar to a study by Nyakundi *et al.* (2010), who found housing quality index an important indicator of flood vulnerability.

Housing Structures to Floods Vulnerability Descriptive Analysis

A three-way contingency table (Table 7) was conducted to evaluate whether households' structures was associated to livelihoods affected by floods in Kano plain.

Table 7. Housing Structures to Floods Vulnerability Contingency in Kano Plains

Average monthly income in Kenyan shillings Yes No				Livelihood affected by floods		Total
10,000 and Less Shillings	House structure	Permanent	Count	2	1	3
			Expected Count	2.9	.1	3.0
			% within House structure	66.7%	33.3%	100.0%
		Temporary	Count	27	0	27
			Expected Count	26.1	.9	27.0
			% within House structure	100.0%	0.0%	100.0%
	Total		Count	29	1	30
	Expected Count		29.0	1.0	30.0	
	% within House structure		96.7%	3.3%	100.0%	

10,001 - 20,000 Shillings	House structure	Permanent	Count	4	0	4
			Expected Count	3.9	.1	4.0
			% within House structure	100.0%	0.0%	100.0%
		Temporary	Count	24	1	25
			Expected Count	24.1	.9	25.0
			% within House structure	96.0%	4.0%	100.0%
	Total		Count	28	1	29
	Expected Count		28.0	1.0	29.0	
	% within House structure		96.6%	3.4%	100.0%	
20,001 - 30,000 Shillings	House structure	Permanent	Count	8		8
			Expected Count	8.0		8.0
			% within House structure	100.0%		100.0%
		Temporary	Count	16		16
			Expected Count	16.0		16.0
			% within House structure	100.0%		100.0%
	Total		Count	24		24
	Expected Count		24.0		24.0	
	% within House structure		100.0%		100.0%	
Over 30,000 Shillings	House structure	Temporary	Count	4		4
			Expected Count	4.0		4.0
			% within House structure	100.0%		100.0%
	Total		Count	4		4
	Expected Count		4.0		4.0	
	% within House structure		100.0%		100.0%	
Total	House structure	Permanent	Count	14	1	15
			Expected Count	14.7	.3	15.0
			% within House structure	93.3%	6.7%	100.0%
		Temporary	Count	71	1	72
			Expected Count	70.3	1.7	72.0
			% within House structure	98.6%	1.4%	100.0%
	Total		Count	85	2	87
	Expected Count		85.0	2.0	87.0	
	% within House structure		97.7%	2.3%	100.0%	

Table 7 indicates, 72 (82.76%) of Kano plains residents lived in temporary houses of which 27(37.50%) and 24(33.33%) had experienced floods and had Less than 10,000 Shillings and between 20,000 to 30,000 Shillings as their monthly income respectively.

Table 8. Housing Structures to Floods Vulnerability Inferential Statistics

Average monthly income in Kenyan shillings		Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Less than 10,000 Shillings	Pearson Chi-Square	9.310[c]	1	.002		
	Continuity Correction[b]	1.839	1	.175		
	Likelihood Ratio	4.950	1	.026		
	Fisher's Exact Test				.100	.100
	N of Valid Cases	30				

10,001 - 20,000 Shillings	Pearson Chi-Square	.166[d]	1	.684		
	Continuity Correction[b]	.000	1	1.000		
	Likelihood Ratio	.302	1	.582		
	Fisher's Exact Test				1.000	.862
	N of Valid Cases	29				
20,001 - 30,000 Shillings	Pearson Chi-Square	.[e]				
	N of Valid Cases	24				
Over 30,000 Shillings	Pearson Chi-Square	.[f]				
	N of Valid Cases	4				
Total	Pearson Chi-Square	1.540[a]	1	.215		
	Continuity Correction[b]	.086	1	.769		
	Likelihood Ratio	1.157	1	.282		
	Fisher's Exact Test				.317	.317
	N of Valid Cases	87				
a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .34.						
b. Computed only for a 2x2 table						
c. 3 cells (75.0%) have expected count less than 5. The minimum expected count is .10.						
d. 3 cells (75.0%) have expected count less than 5. The minimum expected count is .14.						
e. No statistics are computed because Livelihood affected by floods is a constant.						
f. No statistics are computed because House structure and Livelihood affected by floods are constants.						

The group who had a monthly income of less than 10,000 showed statistical association of the two variables (Housing structures and livelihoods affected) was confirmed by Likelihood ratio, p=0.026, due to the assumption that all the cells should have expected the counts to be equal to or greater than five, as depicted in Table 8, which shows that 3 cells (75.0%) have expected a count of less than 5. The minimum counts expected should be 0.10. There was a partially significant association between households' housing structures and livelihoods affected by floods in Kano plain; c2 (1, N=87) = 9.310c, P=.002.

The Chi-square is a significant statistic, and should be followed with a strength statistic. To measure the association between categorical variables that include more than two levels, Cramér (1946) recommended the following statistic, commonly referred to as Cramér's V or Cramér's phi: φC = square root of (χ 2 / N(L – 1)). The study found out that phi and Cramer's V registered a partial significance of P=0.002, which implies that the null hypothesis is rejected, and affirming that there was a partial significant association between house structures and livelihoods affected by floods in Kano plains, specifically among those earning less than 10,000 shillings per month. The findings here correlate with the study by Okayo *et al.* 2015 who found low income households chose precautionary measures reflecting limited financial reserves while medium to high income households preferred coping strategies that increase their financial reserves, consequently shielding them from flood related losses.

Effects and Vulnerability of Floods in Flood risk areas of Kano plains

The study found out that 97.80% of respondents had experienced flooding in Kano plains, with only 2.20% who had not been affected by floods. On the effects and vulnerability to floods, the study considered properties destroyed, such as houses, crops, livestock businesses, deaths from flooding, and effects on water sources and infrastructure such as roads.

Properties Destroyed during the Floods

Respondents were asked about what household properties were damaged or destroyed by floods during the flood incidences. Their responses were as summarized in Table 9.

Table 9. Property of the respondents destroyed by floods in Kano Plains. Source: Author, 2022.

Property Affected/Destroyed	Frequency (f=89)	Percentage (%)
House and household properties	62	69.66
Farm Land/crops	16	17.98
Loss/injury on livestock	6	6.74
Shop/Business properties	3	3.37
Loss/injury on human life	2	2.25
Total	**89**	**100.00**

(Note: n=89 because the 2 (2.20%) of respondents admit to have not experienced foods and had no property destroyed).

It is evident from the results in Table 9 that (69.66%) of the respondents lost or got their houses and household properties destroyed, while 17.98% lost farm land/crops. Those with loss/injury on livestock were 6.74%, those whose shops/business properties were destroyed were 3.37%, and loss/injury of human life was 2.25%. These findings correspond with that of Keller (2001), who noted that flood impacts include damages caused by flooding and those caused by the disruption and malfunctioning of services and systems associated with flooding. Primary effects of floods include injury and loss of life, damages caused by floods to homes, communication networks and buildings, while secondary impacts include short-term turbidity of the river, hunger, disease, and displacement of people from their homes. One respondent from Kanyagwal village in Nyando sub-County said during a key informant interview when asked about the effects of floods:

"In Nyando, floods wash away our farmlands, thus resulting to food losses and hunger as well as our socio economic livelihood, since this is an area where we practice horticulture highly. There is need to harvest this storm water for economic empowerment especially since this area has a high potential for horticulture. Floods also destroy our farmlands and cause loss of human and animals' lives as well as destruction to homes. They disrupt daily living, education and hinder livelihoods" (KII 13th May 2019).

In Miwani sub-location, where the people's main socio-economic activities were growing of sugarcane and rice plantations, the respondents said that floods washed off their crops and caused major setbacks financially and rendered them food insecure.

The respondents were also asked to quantify their losses in the most recent flood event, and their estimates were as given in Table 10

Table 10. Quantity of property of the respondents destroyed by floods in Kano Plains. Source: Author, 2022

Quantity of losses (Ksh)	Frequency (f=89)	Percentage (%)
10,000 and less	18	20.23
10,001 – 20,000	16	17.98
20,001 – 30,000	26	29.21
Over 30,000	29	32.58
Total	**89**	**100.00**

Results in Table 10 show that 32.58% of the respondents lost properties of over Kshs 30,000, followed by 29.21% that lost property between Kshs 20,001 - 30,000, then 20.23% lost Kshs 10,000 and less, and 17.98% lost between Kshs 10,001 - 20,000. This finding implied that the losses incurred rendered households more vulnerable to flooding, and this agrees with

the findings by Masese *et al.* (2016), who found that populations were more vulnerable to flood events as a result of significant losses incurred.

Effects of Floods on Homesteads and Infrastructure

The study found out that some of the effects of floods on homesteads and infrastructure in the study area were as shown in Plate 1 and Plate 2.

Plate 1: Destruction of a house due to effects of flood in Magina (Source: Author May, 2019)

Plate 2: Effects of flood on roads in Magina (Source: Author May, 2019)

From the transect walk, a number of roads and social amenities like schools and hospitals were found damaged by floods. Residents also talked of disruption of power lines and telephone communication networks, during heavy floods. The photos were taken in May 2019 after the short season rains for ease of identification of areas prone to floods. Masese *et al* (2016), similarly reported that damage to infrastructure not only exacerbates impact of flood disasters, but also creates problems in the evacuations of the affected population. Kabir and Hossen, 2019, records that in Bangladesh, a third of the country is vulnerable to flooding annually. They note that, flooding in the country impacts infrastructure like the roads leaving the country with impassable road network. They also note that flooding collapses the mud-houses in the rural areas leaving 32% of the residents homeless. Another damage caused by flooding, according to their study, is the effects to other infrastructures like electric power lines and other public amenities, leaving the residents exposed to avoidable calamities.

1.1.1. Effects of Floods on Water Sources and Energy for Cooking

The study found out that the effects of floods to water sources and cooking energy were as shown in Table 11.

Table 11. Respondents' sources of water and energy for cooking in Kano Plains. Source: Field survey, 2019

Water/Energy	**Frequency (n=91)**	**Percentage (%)**
River	81	89.01
Borehole	7	7.69
Piped	2	2.20
Other	1	1.10
Total	**91**	**100.00**
Firewood	76	83.52
Charcoal	9	9.89
Kerosene	4	4.40
Gas	2	2.20
Total	**91**	**100.00**

About 89.01% of the respondents depended on River Nyando as their source of water, while 7.69% cited boreholes as their source of water and 2.20% and 1.10% cited piped water and rain water as their sources of water respectively. The findings here correlate to the results from a study by Nyakundi *et al* (2010) which discovered that most of the residents experienced shortages of clean water for domestic use during floods.

Concerning energy for cooking, firewood was mentioned by 83.52% as their main source of energy. This was followed by charcoal (9.89%), kerosene (4.40%), and finally gas (2.20%). From these findings, it is clear that the majority of the respondents depended on firewood as their source of energy, and these were obtained from the nearby bushes and shrub. Therefore, during floods, the respondents had nowhere to collect the firewood. In addition, the clearance of the bushes and shrubs predisposes the area to severe flood vulnerability, due to lack of vegetation to reduce the speed of flood water run-off. These findings agree with those by Olang and Furst (2011) that indicated deforestation in the Kano plains as contributing factor to floods vulnerability.

Effects of Floods on Sanitation

About 97.80% of the respondents used pit latrines, with only 2.20% who could afford flush toilets . This implies that a majority of the population would be affected by water-borne diseases due to poor sanitation in the event of floods. This agrees with the findings of a study by Masese *et al.* (2016), who also found out that there is often an upsurge of water borne diseases attributed to unsafe water sources and flooded sanitation facilities.

One participant from the FGD held in Lower Nyakach sub location said:

"During floods, our pit latrines are swallowed up in the water and the contents swept off by the run off and this increases the cases of diarrhea and bilharzia and livestock diseases which are hard to treat especially during these long rain seasons" (FGD 13th May 2019).

The study agrees with Echendu, 2020, study that stated that flooding affects the potential of Nigeria achieving the SDG in time as the floods increase the rate of infectious diarrhea disease, typhoid fever, poor nutritional value to the citizens and impact on clean water as the

flood water disrupts the natural purification process of water aquifers. The study also found out that flood water affects the pit latrines in Nigeria carrying the human waste to drinking points leading to individuals getting ill from drinking contaminated water.

4. Summary and Conclusion of Findings

The study found that gender was not a significant factor as the ratio of males to females affected by floods was almost similar, just as for education level of the respondents, since only 1.10% were found to have no formal education, for the former (gender), reason being modern gender roles are similar while for the later (education), the apathy in heeding precaution against floods being overreliance on aid from government and other well-wishers. It was established that income plays an important role in response to floods with a likelihood ratio of p=0.026. There was high dependency ratio in the study area with 71.43% households having between 4 - 9 members. Both the young and old were equally affected by floods. It was also established that houses headed by single parents were hard hit during floods.

On effects and vulnerability of floods, the study found out that 97.80% of the respondents had been affected by flooding and from the affected group, 69.66% lost or got their houses and household properties destroyed, other losses were farm land/crops destroyed, loss/injury on livestock, destroyed shops/business properties and loss/injury of human life. 89.01% of the respondents depended on River Nyando for their source of water, with 7.69% depending on boreholes, 2.20% piped water and 1.10% rainwater. Firewood was the main source of cooking energy (83.52%), followed by charcoal (8.89%). 97.80% of the respondents used pit latrines with only 2.20% who could afford flush toilets. As far as the type of housing for the respondents was concerned, 81.32% were temporary, and only 18.68% were permanent and this presented a potential vulnerability to floods. The study also found that 75.82% of the respondents lived within 500 meters of River Nyando, which represented a high risk and vulnerability during floods.

From the study, it can be concluded that;

1) Flooding causes death, psychosocial problems, economic losses and infrastructural damages.

2) Flooding worsens the economic status of a community, as it destroys their livelihood like farming and businesses.

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