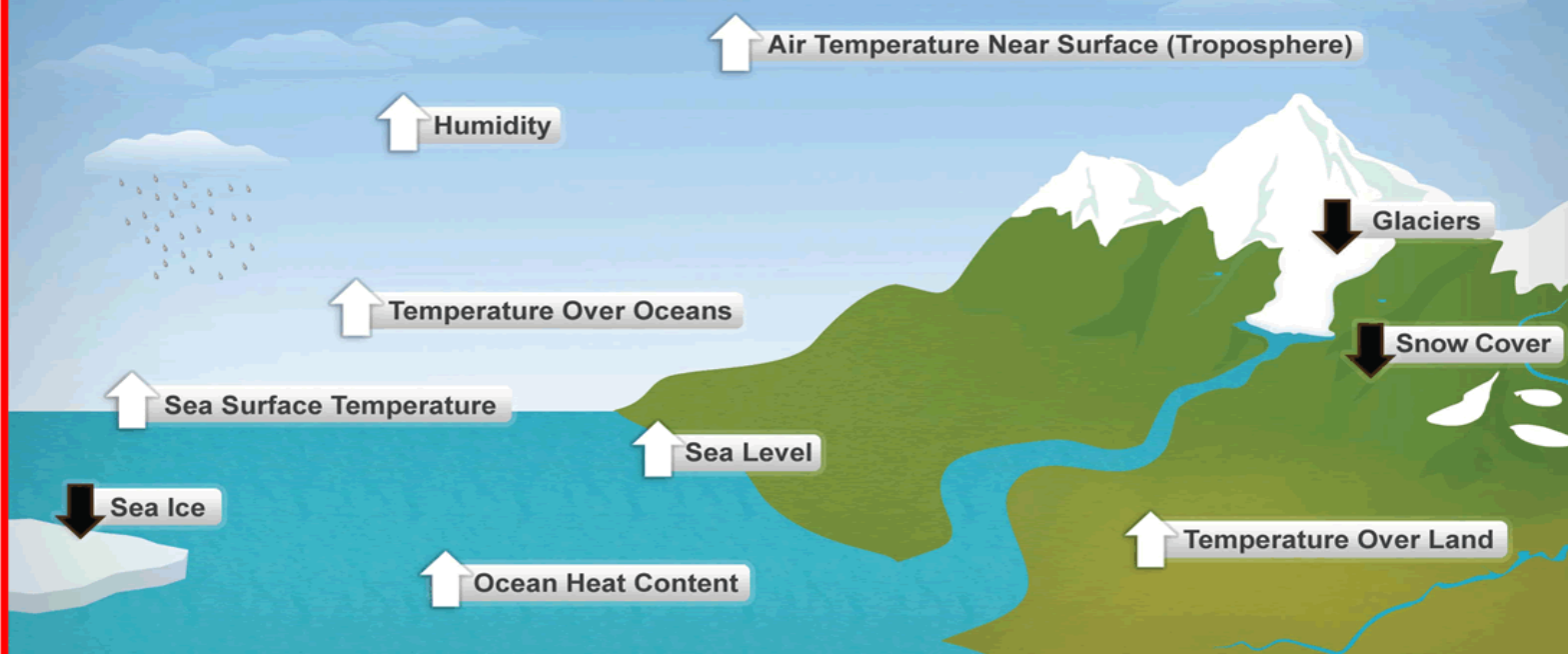


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Ten Indicators of a Warming World



Assessment of Flood Vulnerability and Coping Strategies of Communities Living along River Tana in Madogo Ward, Kenya

*Erick Odoyo, Julius M. Huho, Ahmed M. Mohamed & Joseph M.
Mbugua*



Assessment of Flood Vulnerability and Coping Strategies of Communities Living along River Tana in Madogo Ward, Kenya

 Erick Odoyo^{1*}, Julius M. Huho², Ahmed M. Mohamed³ & Joseph M. Mbugua⁴

¹Masters Student, Department of Natural Sciences, Garissa University, Kenya

²Senior Lecturer, Department of Art and Social Sciences, Garissa University, Kenya

³Senior Lecturer, Department of Natural Sciences, Garissa University, Kenya

⁴Lecturer, Department of Information Sciences, Garissa University, Kenya



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Abstract

Purpose: Flood is a natural disaster that occurs due to the sudden onset of rainfall that causes runoff waters from high to low altitude area. Community living along the River Tana in Madogo ward, Tana River County are affected by the floods when it occurs. It was therefore important to assess factors contributing to their flood vulnerability and assess their flood coping and adaptation strategy for current and future planning. This study assessed the factors contributing to flood vulnerability, adaptation and coping strategies along River Tana in Madogo Ward, Tana River County, Kenya. The research objectives were to assess the trends of flood occurrence in Madogo Ward between 2000 and 2020 as well as the coping and adaptation strategies of communities to floods in Madogo Ward.

Materials and Methods: A descriptive research design approach was used. Data collection approaches involved the use of questionnaires to identify coping strategies by communities. Key informant interviews were also conducted with government officers within the study area to provide information on factors contributing to flood vulnerability, flood trends, occurrence adaptation and coping strategies. Secondary data was acquired through journals, books, and maps. The Statistical Package for Social Science was used to analyze the quantitative data. The

analyzed data was presented through maps, tables, figures and graphs.

Findings: The results indicated that the floods occur after every two years in the study area with different magnitudes and durations. The main coping strategies employed by the community living along River Tana in Madogo Ward was relocation to the higher grounds. It was also established that the community in the area had developed adaptive strategies to flood by putting barriers round their houses. Further findings indicated that the major flood vulnerability factor was topography of the area.

Implications to Theory, Practice and Policy: Based on the findings, it is being recommended that community leaders and county government of Tana River should not allocate plots in the flood zone area. Hence, there is a need for flood zone mapping for resident to know whether they are living within flood zone or not. Additionally, the people's economic power should be enhanced through entrepreneurial training and giving them first priority in job opportunities. There is also a need to improve the quality of the infrastructures in the area to enhance their resilience to the negative impact of floods.

Keywords: *Flood Vulnerability Factors, Floods Occurrence, Community Coping Strategies, Kenya*

1.0 INTRODUCTION

Flood is the overflow of rivers into adjacent low-lying plains usually produced by prolonged heavy rainfall, snow melt, dam-breaks, tidal and cyclonic surges, and development projects (Lyon and Yetman, 2005). Nonetheless, in recent times climate variation has become one of the significant causes of floods globally due to the increase in world temperatures resulting in worst floods in many parts of the world. The changes have been linked to climate and weather variability, like the El-Nino Southern Oscillation (ENSO). Globally, 15% of deaths associated to hydrological disasters are caused by flooding and the worst affected is Asia its 44% (Alfieri *et al.*, 2013).

In East and Central Africa countries, extreme flooding events have been a common phenomenon affecting all the making them the most flood-prone countries in Africa. In Kenya, many parts of the country experiences high rain in the month of April to May and from month of October to December. Part of Kenya which are commonly susceptible to flood disasters are the lower part of Lake Victoria Basin and Lower Tana sub-basin. The water that floods these sub-basins originates from the Nandi hills, Mau Forest, Mt. Kenya catchments and Aberdares (Ministry of Environment and Natural resources, Kenya 2002). These makes hundreds of communities living in the low-lying areas move to higher grounds, build makeshift shelters, and depend on donation from well-wishers as flood coping strategy. The projections of Intergovernmental Panel on Climate Change (IPCC 2007a) were that floods disasters have been one of the serious threats to the human being globally. Therefore, more focus was needed for the affected communities to adapt, stop, alleviate, respond, and decrease flood effects on their socio-economic and physical environment.

Though poor African communities are rich with indigenous ways of improving their lives and protect themselves from disasters (UN / ISDR, 2004), community coping strategies is of concern with the capacity to minimize the impacts of floods through some form of adaptation and strategies. These strategies lay the foundation for flood risk management strategy. Nearly all effective community flood coping strategies consist of actions being taken before floods occurs, during and post floods (Wisner *et al.*, 2004). The main coping strategies in disasters management include minimization of impact, prevention and after event coping strategies. Prevention strategies try to evade the calamity from occurring in the first place. These include community involvement and robust political mobilization to guarantee execution at large scale actions. Smith (2006) stated that prevention strategies include construction of dykes, water drainage systems and construction of dams to hold the flood waters at the upper catchment and the enhancement of channels to drain surface waters more quickly.

Since the year 2000, Tana River County, Kenya has been experiencing severe and recurrent flooding in the year 2002, 2004, 2006, 2007, 2008, 2009, 2012, 2013, 2015, 2017, 2018, 2019 and 2020 with different magnitudes and duration. The worst flood occurred in 2018 within the study area where it lasted for 95 days with a magnitude of $654.858M^3/S$. These floods have raised the concerns of stakeholders on the flood vulnerability factors, coping and adaptation strategies of communities living adjacent to the river especially the low-lying areas of the Tana Delta, Balambala and Madogo which floods when it rains (Water Resources Authority, WRA, 2020). One of the most affected are communities that live in Madogo Ward yet factors contributing to flood vulnerability and coping strategies are yet to be understood. Therefore, a comprehensive assessment was necessary to understand flood occurrences in Madogo, factors which contribute to flood vulnerability and better understand the flood coping strategies employed communities. The vulnerability factors and flood coping strategies will support policy and law makers in identifying

in advance the flood vulnerable factors, flood hot-spots, design and implement effective flood preparedness and coping strategies as recommended by Malczewski (1999).

Statement of the Problem

Dilley (2005) stated that floods are among the most catastrophic hydrological disasters globally which has resulted in the loss of many of human lives and properties destruction every year. In recent times there is a remarkable increase in the occurrences of floods in Kenya which has been attributed to climate change and has also resulted in loss of human lives, ecological refugees also called Internally Displaced Persons (IDPs) on temporary basis, loss and damages to properties and environmental degradation. People who have been seriously affected are those who live in low-lying places, adjacent to rivers and high rainfall prone areas. Floods occurrence in Kenya has raised concerns with regard to floods vulnerability and flood coping strategies by the affected communities. Hence, an exhaustive assessment was necessary to understand flood characteristics, factors flood vulnerability and better understand the community flood coping and adaptation strategies in Madogo Wards, Tana River, County Kenya.

Objectives of the Study

The study had the following objectives:

- a) To assess the trend of flood occurrence along the River Tana in Madogo Ward between 2000 and 2020
- b) To assess the community flood coping strategies in Madogo, Mororo and Konoramadha sub locations within Madogo Ward.
- c) To determine the factors which contribute to flood vulnerability within Madogo ward.

Conceptual Framework

A conceptual framework in Figure 1 indicates the link between the study variables.

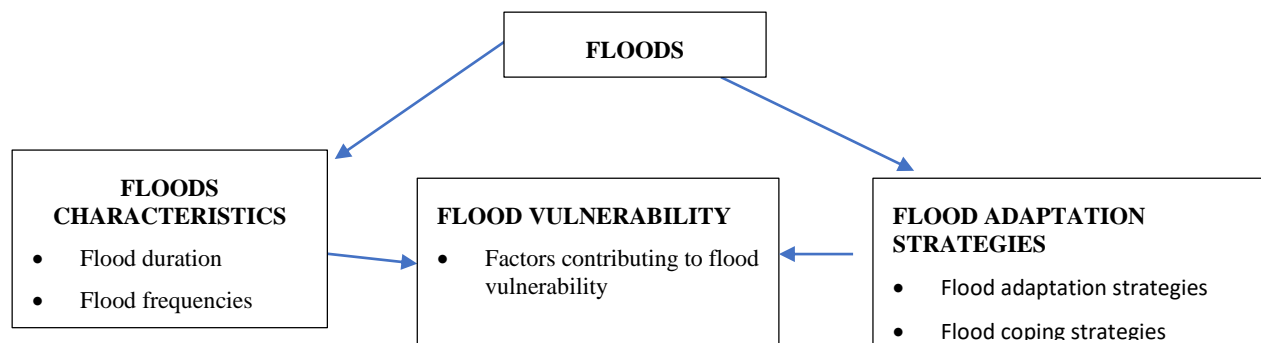


Figure 1: Conceptual Framework

Source: Author (2022) Based on Literature Review

Flood is the overflow of rivers into adjacent low-lying plains usually produced by prolonged heavy rainfall, snow melt, dam-breaks, tidal and cyclonic surges, and development projects (Lyon & Yetman, 2005). Flood has different characteristics like magnitudes, durations, and magnitudes which make community living in the flood prone areas to developed flood adaptations strategies and flood coping strategies. Social and economic characteristic of people coupled with flood characteristics of flood contribute to flood vulnerability of the residents of flood prone areas.

The study was also inspired by the research gaps in the earlier studies which have not narrowed down to flood vulnerability factors and coping strategies along River Tana in the lower sub basin. Therefore, to fill these research gaps, this study was conducted. Munyai (2017) looked at an assessment of community flood vulnerability and adaptation: A case study of Greater Tzaneen Local Municipality, South Africa. The studies in South Africa present a contextual research gap and given the contextual difference between the countries. Locally Mulwa (2013) focused on community awareness and preparedness for floods along the lower Tana River, Tana River County. Meshack (2019) also did a study on the assessment of perennial floods in the Madogo-Mororo area of Tana River County, using machine learning algorithms and didn't focus on level of flood vulnerability. Julius Kepkemoi (2019) study focused on investigating effects and management of flash floods in Marigat sub-county, Baringo county, Kenya. All these studies didn't focus on post flood recovery by the flood victims.

The study found that the households within flood prone areas get humanitarian assistance from both Government and Development Partners as a coping strategy and to recover from floods effects, get flood early warning systems and still vulnerable to floods. The study therefore recommends further research on Assessment of post flood recovery in Madogo Ward. The study is also anchored on the Normative Theories of Disaster Management. There are numerous normative theories that are very useful to emergency managers. These frameworks have been designed to specify actions that emergency managers ought to take. It is assumed that their effectiveness will be enhanced if they abide by these prescriptive lessons.

2.0 MATERIALS AND METHODS

The study was conducted in Madogo Ward which is situated in Madogo Division of Tana North Sub County, Tana River County. It is located on the Northern part of Kenya, 365km East of Nairobi and 5km from Garissa town and it covers an area of 3,704.8 km². It is approximately located between longitudes 39⁰10'0"E and 39⁰50'0" E and latitudes 0⁰10'0"S and 0⁰50'0" S Figure 2 shows the study location. The area is an arid with scattered trees and the rainfall within the area varies between 200 and 300 mm per year with mean annual temperature of about 30°C with human population of 33,62.

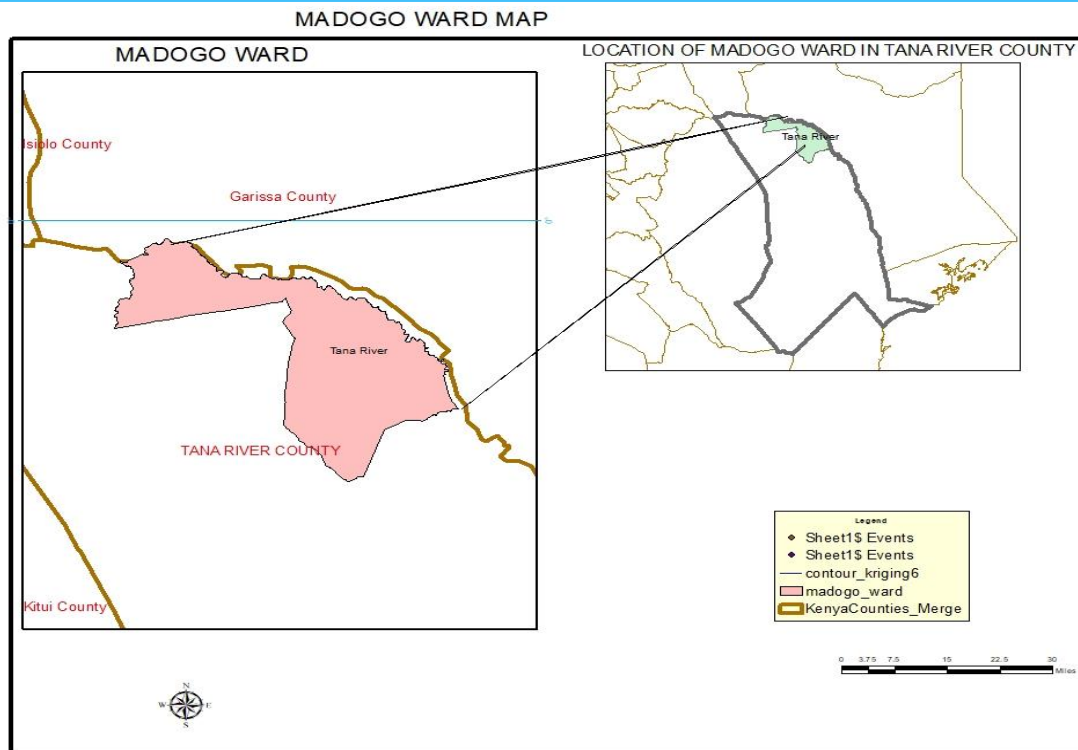


Figure 1 : Map of Madogo Ward (WRA 2019)

The study targeted the population of the communities living along the lower River Tana within the Tana River County and more specifically populations living in the Madogo Ward. The study was conducted in Madogo, Mororo and Konoramadha sub locations within Madogo ward with a household size of 9,390 (Kenya National Bureau of Statistics, KNBS, 2019). The study adopted Yamane (1971) formula to determine a sample size of 384 households which was then sampled through systematic random sampling method.

To collect data, the study made use of semi-structured questionnaires, interview guide as well as Focused Group Discussion (FGDs) which aided collection of both quantitative and qualitative data from the household heads. Secondary data was obtained from review of published books and documents sourced from the university libraries, online sources from government reports and agencies as well as reports. Thematic analysis was used to analyze the qualitative data while descriptive statistics (frequency, mean and percentages) were used to analyze the quantitative data.

3.0 FINDINGS

The Flood Recurrence Interval (T)

The research found out the floods occurred in 2002, 2004, 2006, 2007, 2010, 2012, 2013, 2016, 2018, 2019 and 2020 with different duration and magnitude as indicated in Table 1. The flood recurrence interval was used to determine how often floods occur. Flood recurrence interval is how often, on average a flood of a certain magnitude can be expected to occur. The recurrence interval of floods in the study area were calculated as shown below. Where the number of years on records were 20 and number of flood events were 11.

$$\text{Recurrence Interval} = \frac{\text{Number of Years on Record}}{\text{Number of Events}}$$

$$= 20 / 11$$

$$= 1.8$$

The recurrence interval of the floods in the study area was found to be 1.8. This showed that after every two years floods occur with different magnitude and discharges which is dependent on the rains on the upper part of the catchment. Large, catastrophic floods have a very low frequency or probability of occurrence, whereas smaller floods occur more often. The larger the number of years in a recurrence interval, the smaller the chances of experiencing that flood in a particular year as expressed by Huho (2005). This implies that with low flood frequency interval in Madogo, the magnitude of the floods is not that much.

Flood Duration

The study sought to know from the respondents how long floods last when it occurs. Table 1 below shows their responses.

Table 1: Flood Duration Madogo Sub-Location between the Year 2000 and 2020

Year	Durati on (Days)	Recorded Data (Days)	Months	Flood Magnitude (m ³ /s)
2002	25	365	May, April	598.842
2004	16	335	Nov	504.191
2006	16	357	Nov	775.315
2007	16	362	Jan, May, Nov	618.188
2008	6	361	April	501.080
2009	3	337	November	503.152
2012	22	346	May, Nov	525.993
2013	41	219	April, May	678.808
2015	23	153	Nov, Dec	615.124
2017	17	210	April, Nov	541.235
2018	93	364	March, April, May, June, Dec	654.858
2019	53	360	Oct, Nov, Dec	669.570
2020	85	363	Jan, Feb, March, April, May, June, Nov, Dec	669.095

Source: Water Resources Authority, 2022

It was established that in the year 2018, flood lasted for 93 days which was the highest number of days in a year. This was the worst floods in the study area from the year 2000 to 2020 in terms of duration. The second worst year of floods in terms of duration was in 2020 with duration of 85 days in a year. The third worst year of floods was in the year 2019 where floods lasted for 53 days. In the year 2009, the floods lasted for 3 days in the month of November and that was the least. Key informants indicated that the floods take an average of 15 days but it varies with the magnitude. About 95.57% of the residents from the study area confirmed that on average, the floods last for more than 15 days.

Flood duration is the time floodwater takes on land before it drains all to the river course and this depends on a number of factors which are Soil, topography, vegetation, and rainfall intensity. Among the factors which affected the flood duration in Madogo Ward, the topography of the area is a major factor that made flood waters take longer as the area is generally flat. This is further exacerbated by clay soils of the area.

Flood Vulnerability Factors

The study established various factors that led to vulnerability to floods within Madogo Ward as shown in Table 2.

Table 2: Factors That Contribute to Flood Vulnerability

	Quality of Infrastructure	Level of Education	Status of Employment	Topography of the Place	Houses Quality
N	384	384	384	384	384
Mean	2.64	1.41	2.53	4.48	4.24

Source: Field data (2022)

The study findings indicated that topography of the study area ranked as the main contributor to the flood's duration and vulnerability (Mean = 4.48). The area is generally flat and when the river waters spill over to the area it takes longer to drain back to the river as shown in Figure 3. As Hudson (1991) pointed out, the steeper the topography, the steeper the hydraulic gradient. This means that water circulates quickly inside the soil, thus allowing the soil to reabsorb a certain amount of water before saturation. The slope of a region regulates the flood occurrence as low flat plain area has a strongly association with flooding condition in the rainy season. A high number of floods occur in lower slope area as the water cannot discharge swiftly. Slope between 0° and 10.59° supports the fact of flooding as the Frequency Ratio (FR) value is considerably more than one (Gray *et al.*, 1982). High slopes indirectly enhance the flood probability as it fosters speedy water and the area with high slope has the less time to regulate and percolate water under the ground. The study area is generally flat and making flood waters to last for long as shown in Figure 3.

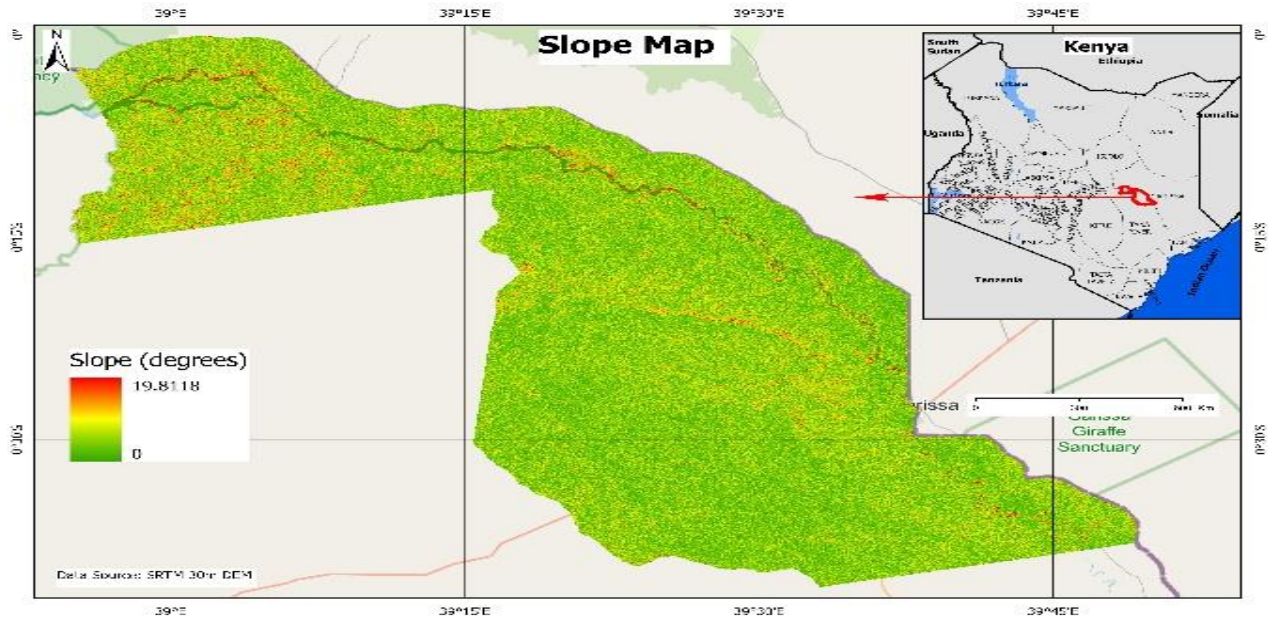


Figure 2: Topography (Slope) of Madogo Ward, Kenya

Source: WRA 2022

The house quality was ranked as the second main determinant of flood duration and vulnerability (Mean = 4.24). Most of the houses in the study area are mud built hence easily demolished by flood waters as shown in Plate 1. From Figure 4 the study established that that majority (54.74%) of the residents in the study area have mud houses which make them vulnerable to floods since they can easily be demolished by floods. About 5.53% have Manyatta type of houses made of twigs and grass, 2.37% have their houses made of tents and plastic bags, 8.42% houses are made of metallic/iron sheet and only 18.95% of the houses are made of stones.

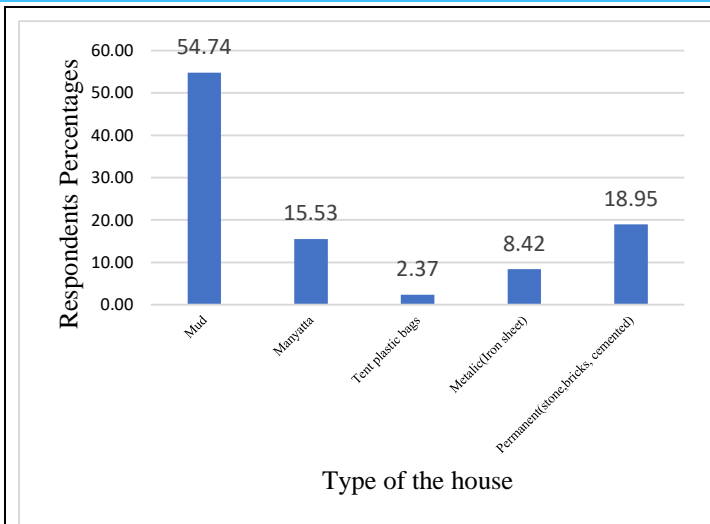


Figure 3: House Quality in Madogo Ward, Kenya
 Source: Field Data (2022)



Plate 1: Low Quality House Made of Mud in Mororo Sub-Location.
 Source Field Data, (2022)

This implied that when floods occur, majority of the houses made of mud are demolished by floods which exacerbates vulnerability to floods. Plate 1 above shows houses made of mud in Mororo sub-location within the study area. Respondents indicated that the buildings which were constructed with earth-based materials, using stone and brick in mud mortar were highly vulnerable to damage by heavy rains and floods.

The quality of infrastructure was ranked the third after house quality (Mean = 2.64). The study established that the road from Madogo to Konoramadha is of low quality and in case of any flood events, the road is washed away by the flood waters since it has no culverts to allow water passage thereby blocking water from moving. The quality of infrastructures, including roads and culvert are prone to flood damage. Their geographical extent is a determinant of, and is determined by patterns of human development, which is often concentrated in floodplains. It is important to understand how low-quality infrastructure systems react to large-scale flooding. In Madogo Ward where our study area lies, infrastructure qualities are critical because their failures could lead to ‘serious consequences, including severe economic damage, grave social disruption, or even large-scale loss of life (Water Resources Authority, 2020).

The status of employment was ranked the fourth determinant of flood duration and vulnerability (Mean = 2.53). The study revealed that 41.9% of the respondents were unemployed. This implied that they are poor since they don’t have any informal and formal job. The rich and poor people alike tended to be affected by high-intensity flood events; poor people are more likely to be impacted by frequent flood occurrences. While poverty delays recovery from a disaster, access to a stable source of income such as formal and informal financing, and community-saving groups. The poor are less likely to have recovered quickly from flooding. Poverty is closely linked to higher flood risk in Madogo Ward (Personal communication with Area chief, 2022). Poverty drives vulnerability to flooding in different ways, from increased risk of exposure to flooding to lower access to coping mechanisms that can support recovery. But not all poor people are equally

affected or affected in the same way. Factors such as the source of income the family relies on, access to finance, both formal and informal, as well as tenure arrangements matter as well (Goyal, R.*et al.*, 2020).

The status of level of education which had a mean scale of 1.41 out of 5 was ranked fifth. The study established that 86.7% of the household heads had a little schooling, therefore would not be conversant with flood vulnerability and coping strategies. Education is key in flood prone areas because educated people were well informed of the likely disaster that arises when rainfall is experienced. Educated people also have high chances of getting employed in both formal and informal sectors increasing their financial capability and able to employ flood coping and mitigation strategy where finances are needed.

Flood Adaptation

The study sought to find out if the residents of the study area had household flood adaptation strategies before the floods occurs and Figure 5 show response from the residents.

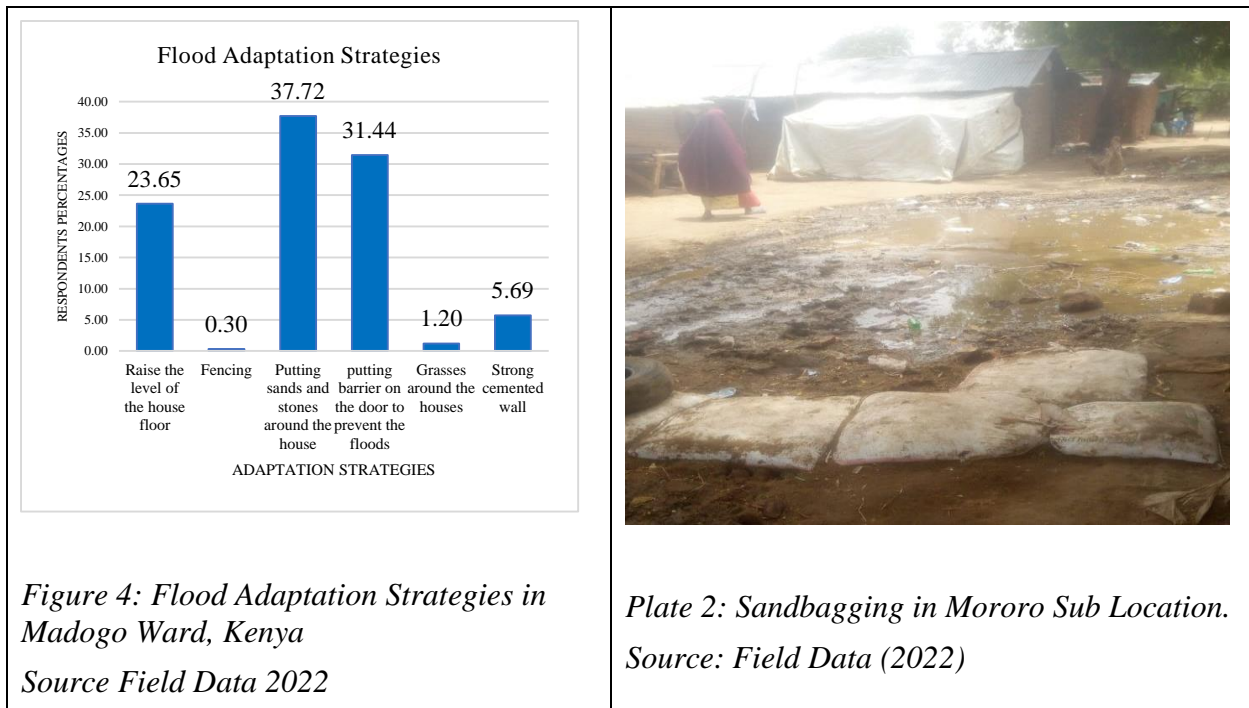


Figure 4: Flood Adaptation Strategies in Madogo Ward, Kenya

Source Field Data 2022



Plate 2: Sandbagging in Mororo Sub Location.

Source: Field Data (2022)

The study established that the residents of Madogo Ward have developed different flood adaptation strategies in the anticipation of flood events. From the field observation, it showed that about 37.72% of the residents put sand and stones around the houses to prevent the floods when it occurred. Sandbagging is a flood prevention technique that is being used by the Madogo Ward residents and it has been around for a long time. They are used to build a barrier with sandbags to help divert and stop flood water from getting inside vulnerable doors and around foundations (KRCS, 2020). Plate 2 shows sandbagging put on the roads to prevent water from flowing in Mororo sub-location, Madogo Ward. The residents prefer using sandbags because they are easily available and inexpensive. The economic status of the residents could not allow them to go for expensive flood adaption measure.



Plate 3: Stone Barrier Around the House in Madogo Ward, Kenya.

Source: Field Data (2022)



Plate 4: Raised House Under Construction As Flood Adaptation Strategy in Madogo Ward, Kenya.

Source: Field Data (2022)

Putting concrete barriers on the door and round the house is another flood adaptation strategy employed by the residents of Madogo Ward and study established that about 31.44% of the residents put concrete barriers around their houses. Putting concrete barriers around the floor and house as flood adaptation strategy are preferred by some residents because the material being used were made locally, they were also cheap and appropriate for their houses. The concrete barriers are made of sand, ballast, and cement in form of blocks and then put round the houses and Plate 3 shows concrete barrier round one of the houses in Madogo sub-location Madogo Ward. These materials are readily available within the study area. About 23.65% of some residents said that they prefer raising the floor of the house as their household adaptation strategies. Plate 4 shows houses under construction with raised floor as flood adaptation strategy. This is not common in the area as it requires more finance.

Other household flood adaptation strategies employed by the residents were building houses with strong walls and planting grass around their houses. Those who chose these adaptations said that its cheap for them and its only option which is appropriate for them. Insurance policies is another adaptation to flood strategy which compensate the victims whenever there is a loss due to risk occurrence and flood is one of the risks which is insured. The study revealed that majority (99.7%) of the respondents had no insurance cover on the destruction of floods. Further interrogation of the reasons behind lack of flood insurance established that 55.20% of the respondents had no insurance policy because of lack of awareness in regard to flood insurance, 43.20% did not have finance and 1.60% thought that insurance was not necessary. Among the flood adaptation strategies, sand bagging was the most preferred method in the area since it is cheaper because the materials are readily available.

Flood Coping Strategies

The study sought to know if the respondents have any type flood coping strategies. Figure 7 shows the findings.

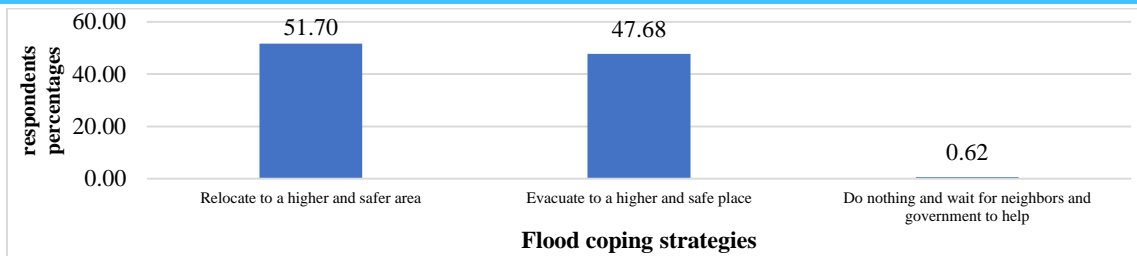


Figure 5: Flood Coping Strategies in Madogo Ward, Kenya

Source: Field Data (2022)

The study showed that the majority (99.38%) of the respondents moved to a higher and safer area when floods occurred. One of the places the flood victims moved to was Madogo Secondary School play field (Plate 5) and some made makeshift tent along the Garissa Nairobi Road (Plate 6). Table 3 shows the number of peoples who were displaced by 2018 floods within Madogo Ward

Table 3: Internally Displaced Persons in 2018 in Madogo Wards

Sub-location	Mororo	Madogo	Konoramadha	Total
Number of HHs in the Camp 2018	419	614	103	1136
Number of Males	824	1102	123	2049
Number of Females	847	1192	183	2222
Total Number	1,671	2,294	306	4281

Source: KRCS (2022)

In the year 2018, a total of 4,281 people were displaced by floods within the study area in Madogo Ward where the highest number was witnessed in Madogo Sub-Location followed by Mororo and Konoramadha Sub Locations.



Plate 5 : Internally Displaced People Camp Along Garissa Nairobi Road in 2020



Plate 6 : Internally Displace Persons (IDP) Camp in Madogo Secondary School in 2020

Source: Water Resources Authority (2022)

Challenges to Adoption of Various Flood Coping and Adaptation Strategies

The study sought to find out the challenges faced by the residents in the study area in coping with and adapting to floods effects at household level. The findings are shown in Figure 7.

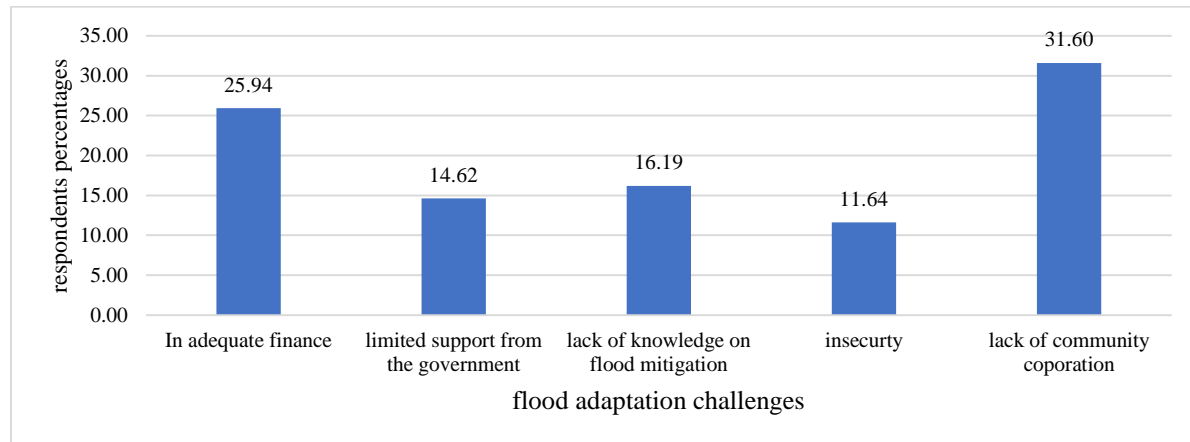


Figure 6: Challenges Faced in Adoption of Various Flood Adaptation Strategies

Source: Field Data (2022)

The study established that the majority of the respondents (31.60%) cited lack of community cooperation in flood adaptation strategies as a major hindrance to flood adaptation strategies because each household had their own coping mechanisms. Community cooperation can be broadly understood as the active involvement of people in making decisions about the implementation of processes, programmes and projects which affect them (Adnan, 1991). Community cooperation is being encouraged in many areas of development, including disaster management, but practical guidance remains relatively limited. In disaster reduction, the aim is to enable communities to protect themselves more effectively against floods in communities living along the River Tana, especially in Madogo Ward. Lack of community cooperation during pre-flood response and relief operations during major flood events regularly lead to public discontent or loss of trust in the authorities or the state and national governments.

Additionally, about 25.94% of the respondents cited inadequate finance as a major challenge in coping with floods. Majority of the households in the study area are poor. From an economic point of view, disasters have a proportionally greater effect on poor people around the world (World Bank; Global Facility for Disaster Reduction and Recovery, GFDRR, 2012). Poor people around the world are more likely to have their savings concentrated in their homes and livestock, both of which may be damaged, injured, or lost in disasters (Moser & Felton, 2007; Nkedianye *et al.*, 2020; as cited in Hallegatte *et al.*, 2017). In contrast, people who are not poor are more likely to have their savings in various places, including financial institutions, which means their wealth is better protected from natural disasters. This in part may be why natural disasters alone push 26 million more people around the world into poverty each year (World Bank, 2012).

4.0 CONCLUSION AND RECOMMENDATIONS

Conclusion

Floods occurrence in Kenya has raised concerns with regard to floods vulnerability and flood

coping strategies by the affected communities. The study hence assessed flood vulnerability and coping strategies of communities living along River Tana, Madogo Ward, Kenya. From the study findings, it was established that floods occur after every 2 years and flood duration of the area depend on a number of factors which are the type of soil, topography, vegetation, and rainfall intensity.

Among the factors which affected the flood duration in Madogo Ward, the topography of the area is a major factor that made flood waters take longer as the area is generally flat which was further exacerbated by clay soils of the area. Within the study area, the residents were aware of the floods and hence developed flood adaptation and coping strategies by putting barriers around their houses and moving to the higher grounds. However, inadequate finance and lack of community cooperation were the challenges experienced by the area residents in implementing these strategies. The topography of the area was the major factor which contributes to flood vulnerability of the area residents. The area is very flat and doesn't allow floods water to flow quickly into the river course. The house quality of the residents was also another contributing factor to flood vulnerability since most of the houses along River Tana are made of muds.

The flood adaptive measures employed by the residents were putting sand filled in gunny bags around the houses and putting barriers on the door to prevent floods from entering the house, some also raise the floor of the houses. All the houses control measures are preferred by the residents because the materials they are using are cheap and readily available within the area. When floods occur, the victims move to higher ground as coping strategies and wait until the floodwaters reced then go back to their homes leading to the closure of the camps for the displaced persons. The major factor that led to vulnerability within the study area was found to be the topography of the area and this was followed by the quality of the house's residents have.

Recommendations

A number of actions that can be taken by both government agencies, non-governmental organizations and the community in the study area to mitigate against the impact of floods are highlighted;

- Community leaders and county government of Tana River should not allocate plots in the flood zone area. Hence, there is a need for flood zone mapping for resident know whether they are living within flood zone or not.
- In order to reduce the level of vulnerability among the victims of the flood, the people's economic power must be increased thorough training and giving them first priority in job opportunities and improving the quality of the infrastructures in the area.
- Creation of awareness among people living in flood-prone areas of the risk they face and how best to respond when it occurs can be done to enhance local people's confidence and empower them to act when faced with danger and the construction of dyke should be considered to trap the excess water back to the river course.
- Community involvement and their active participation should be encouraged in order to gain greater insight into the individual and collective perception of development and risk, and to have a clear understanding of the cultural and organizational characteristics of each society as well as its behavior and interactions with the physical and natural environment,

this will cultivate increased participation among the local community to deal with the effects of the disaster.

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