# Management of Flash Floods in Marigat Sub County, Baringo County, Kenya

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**Abstract**
Flash flood is a natural disaster that occurs due to the sudden onset of rainfall that causes runoff waters from high altitude areas to low altitude area. This runoff waters leads to loss of lives, destruction of property, and environment; a problem experienced by residents of Marigat Sub-County. The purpose of the study was to investigate the management strategies of flash floods in Marigat Sub-County. The study used descriptive research management practices of flash floods on qualitative and quantitative methods. The target population of the study area was 120,263 people with 24,893 households. Purposive sampling method for three locations which wereIlng'arua, Ng'ambo and Salabaniexperiencing flash floods with a population of 13,885 translating to 3168 households, from which a sample size of 355 respondents was obtained. Stratified proportionate random sampling method was used to select household heads for the survey. Purposive sampling method was used to identify key informants from the selected locations and one disaster management officer. Primary and secondary data were used. The questionnaire, key informants interview schedules, and observations were used to collect data. The validity of the study was achieved through the construction of relevant instruments to the objectives of the study. To ensure reliability, piloting of the questionnaire was done and results obtained were 0.76 Cronbach's alpha level. Collected data were coded and analyzed using the SPSS software, where descriptive and inferential statistics were generated to test the study hypothesis. The findings of this study will be beneficial to Baringo County and the Kenyan government in the management of flash floods and the achievement of sustainable development goals in which the residents of Marigat sub-county are direct beneficiaries.

**Keywords:** Marigat, Flash floods, Management.

## 1. Introduction

Flash flood occurs when water inundates in a dry land, but it occurs in many ways. This can include in a hurricane scenario, the affected land is covered with water. Flash floods occur when

the leeward side receives runoff from the side that had experienced convectional rainfall. Climate variability in warmer climates is reported by the Intergovernmental Panel on Climate Change (IPCC) to have an increased likelihood of flood occurrence. Weather-related disasters currently account for approximately 90% of natural disasters (Llasat et al., 2010). In flash flood-prone areas there is an evident increase of disaster-related losses aggravated by the increased population growth and economic assets (Kundzewicz et al., 2014). Approximately flood causes an annual $40 billion damage in the world (Webster, 2013). The United States records an annual loss of $ 8 billion per year in flood-related occurrences (Michel-Kerjan, Lemoyne de Forges, & Kunreuther, 2012). Millions of people have been killed in China due to flash floods (Ziegler, She, Tantasarin, Jachowski, & Wasson, 2012). In Europe early warning systems have been developed and improved through remote sensing and nowcasting that utilize mesoscales of up to 0-6 hours to predict the weather patterns and occurrences of flash floods, this is according to World Meteorological Organisation(Borga, Stoffel, Marchi, Marra, & Jakob, 2014)

In Africa, flash flooding has been experienced in different parts. News Africa, (2019), for instance, cites Mozambique with 5,756 homes and 141,325 people affected and Malawi, where 739,000 people were affected and from which 230,000 people were left without shelter in March 2019. According to a study done by Lukamba (2010), Eastern Africa is leading in hydro-meteorological disasters (41%), followed by West Africa (24%) and North Africa (14%). The effect is depended on the intensity of the flash flood and the vulnerability of the areas as measured by its topographic and demographic features, the quantity and quality of the materials exposed. The anthropogenic interventions and the effectiveness of the prevention measures taken by the local authorities, the social effects of the flood differ. Extreme flash floods are often experienced in the Mediterranean countries and tend to be greater in magnitude compared to the inner continental countries while they occasionally produce catastrophic damages (Llasat et al., 2013). In Nigeria flash floods hazard risk analysis involving computing of flash flood hazard, vulnerability and dangers posed to the people have been to mitigate the disaster (Komolafe, Adegboyega, & Akinluyi, 2015)

In East Africa, Kenya is one of the country's that have experienced significant losses from flash flood occurrences. The most common being Budalangi flash floods, where they have become an annual event, claiming several lives and properties in Western Kenya, dykes have been used to prevent flash flooding and due to poor maintenance have led to failure (Okaka & Odhiambo, 2018). Nyando experienced flash floods in 2018 which greatly affected human life and environment (Okaka & Odhiambo, 2019). Moreover, in Tana River, flash floods have regularly occurred due to bursting of the banks of River Tana. In 2018, most families living along the Tana Delta were affected. The majority were evacuated by Red Cross humanitarian aid as a result of submerges of the house in flash flood water (Shukla, Husak, Way-Henthorne, Macharia, & Takeaways, 2016).

Marigat sub- County, especially Lake Baringo has since been identified as the most flash flood-prone area in the Rift Valley since 2013 (Omondi et al., 2017). Approximately 2000 households were affected by the heavy rains that lead to an increase of the water level in Lake Baringo and homesteads and schools were equally affected (Deichsel, 2019). Almost five schools were submerged in Marigat making learning difficult for the better part of the first term of 2014. The

livelihoods were exposed to the dangers of water-related diseases and the challenges of wild aquatic animals such as hippopotamuses and crocodiles invading villages (Deichsel, 2019). Marigat Sub-County has been affected by flash floods and emergency response by government and NGO's, this happens during the occurrence of disasters which is a knee jerk reaction kind of response and not sustainable, therefore this study aims at finding and proposing long term solutions to this problem.

## 2. The problem

The effects of weather changes due to climate change have brought along adverse effects of flash floods in low-lying lands. Marigat in Baringo County is lowland that slopes towards Lake Baringo and during flash floods, people and animals die; property and food crops are destroyed. This affects economic generating units, premises, water sources, learning institutions and agricultural lands in Ilng'arua, Ng'ambo and Salabani locations. Despite frequent flash floods experienced annually in Marigat Sub-County since 2013 (Daily Nation, 2013), little has been done by both the county and the national government in addressing the flash flood disaster affecting and claiming lives in Marigat Sub-County. This study, therefore, was appraising the management of flash flood in Marigat Sub County, Kenya.

## 3. Objective

This study was aimed at determining management strategies of flash floods in Marigat Sub-County, Kenya. This will reduce the effect caused by this disaster that included loss of human life, destruction of infrastructures, soil erosion, loss of food crops and habitats.

The specific objective was to determine mitigation strategies of management of flash floods in Marigat Sub-County and to make recommendations on how best to address this problem.

## 4. Literature review

Various strategies are being employed to mitigate flash floods as discussed below.

### 4.1 Traditional knowledge

Traditional knowledge refers to knowledge, skills, and practices that were developed, sustained, and passed on from generation to generation within a community, often forming part of its cultural or spiritual identity (Nyakundi, Mogere, Mwanzo, &Yitambe, 2010). "Local knowledge", on the other hand, refers to knowledge that people in each community have developed over time and continue to develop. It is based on experience, often tested over centuries, adapted to the local culture and environment and embedded in community practices, institutions, relationships, and rituals (MacnightNgwese, Saito, Sato, AgyemanBoafo, &Jasaw, 2018). Traditional and local knowledge is a way to understand "culture" and in so doing, understand the world. Transmitting a body of knowledge believes and practices of the use of locally available resources to improve human health and wellbeing is an important function of culture in traditional societies. Research in recent decades has shown that traditional knowledge contributes substantially to topics like community resilience, sustainable use of resources, and biodiversity conservation (Nyakundi, Mogere, Mwanzo, &Yitambe, 2010). The relevance of

traditional and local knowledge in sustaining natural resources and improving disaster preparedness has been identified in different socio-ecological regions of the world.

MacnightNgwese, Saito, Sato, AgyemanBoafo, and Jasaw (2018), in their study in Northern Ghana, found that the local communities were utilizing the hippopotamus behavior to determine an impending flood. The locals believed that hippopotamus when the hippopotamus ventures inland, there is a flood coming, most of the time these animals spent most of their time in water except when there is heavy rainfall that could cause floods. In western Kenya, the local communities were found to have a number of traditional weather forecasting knowledge, for example when the bones of the old people began itching, frogs croaking, heavy lightning and thunder at the river, heavy and persistent rains together with rising water levels in the river (Nyakundi, Mogere, Mwanzo, &Yitambe, 2010).

## 4.2 Forecasts

Climate change events are currently addressed based on meteorological weather forecasts; various departments in questions are dependent on the department's projections for their early preparation on how to avoid disasters. 'Early Warning Early Action' has been a common phrase used by the humanitarian aid organizations in their bid to address an incoming disaster. The scientific community addresses the effective way of approaching a disaster is through early warning. this allows room for the affected communities to prepare and or to avoid the disaster altogether, for example, an early warning of an upcoming heavy rainfall in a flood-prone area, will allow the residents to evacuate the area early enough before the onset of the rains. On the other hand, people living in flood plains should also vacate the area early enough before the onset of the rains. Floods experienced in MarigatSub County have been due to lack of early warning system is used by the communities. Adoption of the early warning system should allow the communities living in Salabani, Ngambo and Ilng'arua to vacate the Lake Baringo region early enough before the onset of the rains.

## 4.3 Cash transfers program

Studies indicated that the victims of climate change disasters were often people of poor communities, especially marginalized communities in Kenya. Therefore implementing a cash program can help in reducing the effect of a flash flood event. This is explained as follows if poor families are financially empowered they will be in a capacity to evade a flash flood event, move to safer areas before the rains. comparing the cash transfer program to the Nyando plains residents, if the victims had received cash transfer before the rains most of them could have saved their commodities and families from the effects of flash floods. Lack of financial ability, allowed them to be caught up by floods, and the majority were moving away after the flash floods had swept their residential areas, this scenario is replicated in most parts of Kenya, where flash flood occurs then the aid comes in later after the effects have been felt. Kenya Government recognizes the benefits of social protection through cash transfers, it is described as Policies and actions (Suroso, Sagala, Alberdi, & Wulandari, 2018), including legislative measures, that enhance the capacity of and opportunities for the poor and vulnerable to improve and sustain their lives, livelihoods and welfare, enable income-earners and their dependents to maintain a

reasonable level of income through decent work, and ensure access to affordable healthcare, social security, and social assistance.

## 4.4 Humanitarian aid

Humanitarian aids known for addressing emergency situations in Kenya include Kenya Red Cross Society, St John Ambulance Kenya and the Kenya Police (Owuor, 2015) Among these are other Non-Governmental Organization such as AMREF, CARE international, and Concern worl4d, that have also been on the lead in addressing the emergencies that occur due to floods in the Arid and semi-arid lands. However, these responses are short-lived since they always come in after the flood event has occurred.

## 4.5Building of bridges

Innovations were essential in the management of flash floods in Kenya. Areas that are prone to this natural disaster were flat such that construction of bridges required skills to raise the facility to accommodate the large unpredicted quantities of water. Engineers have been advising and managing constructions of raised bridges to enable passage by vehicle, people and animal during the rainy season to the other side (Akivaga, 2010).

## 5. Methodology

A descriptive research design was used in this study was to determine the appropriate management practices in a flash flood and provide both qualitative and quantitative methods (Desai & Hoyer, 2000). This design was appropriate since it provided quantitative and qualitative data, also gave characteristics of the population which was studied.

The study population was 120,263 which were all population of Marigat Sub-County. The study was done in three locations that were purposively sampled namely; Ng'ambo, Salabani and Ilngarua locations that were affected by flash floods. The population of the three mentioned locations was 13,885 with total households being 3,168 (Kihu et al., 2015). The key informants were the 3 chiefs from the respective locations and 1 county disaster management officer working in Marigat Sub-County. Focus group discussion was held facilitated by village elders comprising of 6-12 people in every location.

## 6. Results

### Demographic characteristic

The majority of the respondents in terms of gender were male 232 (74 percent) and female was 82 (26 percent). The age of majority study respondents range between 34-41years ( 31.65 percent), 42-49 years (20.54 percent ), 26-33 years (17.17 years),18-25 years (12.46 percent), 58-65 years (11.45 percent), 50-57 years (4.04 percent) and the least were those over 65 years (2.69 percent). The researcher sort to understand the education level of the respondents which indicated in the results that illiterate were 112 (36.72 percent), certificate 119(39.02 percent), undergraduate 60 (19.67 percent) and Postgraduate (Ph.D.) 1 (0.33 percent). This showed that the majority have tertiary education with 119 (39.02 percent)

**Strategies of mitigating flash floods**

The results revealed that majority of the respondents were not aware of any mitigation measures 163 (53 percent) meaning people and environmental resource were in danger whereas 147 (47 percent) were aware of some form of mitigation strategies of flash floods in the study area.

The respondent who was aware gave their encounter to this phenomena and majority 169 (65 percent) often, 79 (30 percent), 9 (3 percent) have not experienced, 3 (1percent) did not know anything and 2(1 percent) about the experience of flash floods.

Regarding the signs of upcoming flash floods in the area the results, that the respondent was aware traditional signs which they used and majority said that clouds and rainfall 187 (76 percent ), use of stars 38 (15 percent),  Sheep intestines shape of the moon respectively had 7 ( 3percent), wind direction and temperature 5 ( 2 percent ) and animal behavior 3 ( percent ). According to Nyakundi, Mogere, Mwanzo, &Yitambe, 2010 traditional mitigation measures assisted in the management of flash floods in the world and it has been practiced by this community to gap problems associated with this problem. Adaptation of local culture and environment and embedded in community practices, institutions, relationships, and rituals (MacnightNgwese, Saito, Sato, AgyemanBoafo, &Jasaw, 2018).

On the time it takes from when the signs are observed to when the flash flood is experienced the results were the majority of the respondents said after a few hours 119 (67 percent) this proved that flash floods occurrence is immediately after rainfall. This does not give time for the preparation of calamities to occur. Other respondents were after some days 45 (25percent), after some weeks 7 (4 percent), after one year 5 ( 3 percent ) and after one month and above 3 ( 2 percent). All these were insignificant to the disaster that occurred.

Regarding where the appearance of the signs was seen, Rivers and lakes, 80 (44 percent) hinted that when the rivers and lakes begin swelling then flash floods were expected immediately. The results for the sky and ground 60 (33 percent) Highlands around Marigat was and an indication of rainfall occurs in the area.

Regarding how long it usually takes from time the signs are observed to when the flash floods are experienced were as follows; immediately 118 (38 percent ), a month 100 (32 percent), few days 76 (24 percent), more than one week 12 ( 4 percent) and do not know 3 (1 percent).

Regarding mitigation measures provided to flash floods affected households are detailed in the table below that the majority of the respondents agreed that often the supply of humanitarian aids was done 153 (49 percent). According to Owuor 2015 humanitarian aid was provided by Non-governmental organizations like Red Cross and AMREF by the provision of clothing and food. This strategy was unstainable due to increased population and regular occurrence of the disaster. The second significant management strategy was traditional warning 41 (13 percent),  cash transfer 4 (1 percent) and finally the building of bridges 3 (1 percent).

The table below shows a summary of the results.

| Mitigation | Very often | Often | Rarely | Not at all | I don't know |
|---|---|---|---|---|---|

| measure | Freq | Percent | Freq | Percent | Freq | percent | Freq | percent | Freq | percent |
|---|---|---|---|---|---|---|---|---|---|---|
| Cash transfers | 4 | 1.3 | 44 | 14.33 | 127 | 41.37 | 117 | 38.11 | 15 | 3.81 |
| Humanitarian aid | 153 | 49.35 | 76 | 24.52 | 59 | 19.43 | 22 | 7.1 | - | - |
| Traditional warning | 41 | 13.36 | 64 | 20.85 | 74 | 24.1 | 105 | 34.2 | 23 | 7.41 |
| Building of bridges | 3 | 0.94 | 60 | 19.67 | 145 | 47.54 | 84 | 27.71 | 13 | 4.26 |

**Recommendations and areas for further studies**

Based on the results, the following are the proposed recommendations

1) Findings proved that the respondent was aware of the problem affecting them and the government have no concrete plan to assist them since this area could be used for other productive projects rather than living and resettle the community
2) The results proved that the amount of water during the rainy season is high and this calls for a de-siltation process of rivers to accommodate a large volume of water.
3) There is need to have medical facilities in the area to facilitate emergency services in cases of this natural disaster.
4) Findings proved that the speed of water from highland around the area have caused damage to land through erosion. There is a need to grow more trees to facilitate absorption and percolation of more water into the ground and reduce runoffs.

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