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Household's Adaptation Mechanisms to Flood Risk: A Case of Lower Nyando Basin, Kisumu County, Kenya

Alice Masese[1], Edward Neyole[2], Nicholas Ombachi[3]

[1, 2, 3] Department of Emergency Management Studies, Masinde Muliro University of Science and Technology, Kenya

Abstract: **Floods are becoming the most disparaging environmental catastrophe threatening lower Nyando basin, Kisumu County, Kenya. The floods cause socio-economic disruption which seriously undermines the quality of life of affected households. As a way of reducing the impact of flooding, residents have resorted to the use of diverse adaptation strategies. Knowledge about these strategies therefore1 formed the basis for this research. The study targeted heads of households, Govt. officials, and heads of NGOs, FBOs, as well as CBOs in a bid to answer the research question. The research adopted both correlational and survey research designs. Simple random technique was used to select 384 household heads. Both primary and secondary data were sourced using questionnaires, interviews, FGDs; direct observation and document analysis were used to enhance the documentation of the socio-economic adaptation mechanisms. Descriptive and inferential statistics used in data analysis include frequencies, percentages, chi-square, spearman's rank order correlation and Standard deviation. Findings reveal that (71.1%) of the respondents were affected by floods. Popular mechanisms employed by households to mitigate the impact of floods were moving the family and valuable goods away from home briefly to safer places (91.5%), constructing flood diversion trenches (83.3%) and seeking relief from the Government and other agencies (58.3%). In order to build resilience within the flood prone communities, the study recommends assistance in constructing flood proof buildings, availing subsidized loans and insurance policies to households and engaging the community in decision making in flood mitigation and preparedness processes to help reduce vulnerability.**

Keywords: **Adaptation mechanisms, Floods, Households, Nyando basin, Socio-economic.**

I. INTRODUCTION

Floods have been observed to disrupt personal economic and social activities and set back a nations development and security. They account for (52%) of all disasters in the world (Cred, 2008). Globally, water-related disasters have posed major impediments to sustainable socio-economic development, as witnessed with disasters such as the Indian Ocean tsunami in 2004, Hurricane Katrina in the USA in 2005, Cyclone Sidr in 2007 and Cyclone Nargis in 2008 (UN, 2009). In Africa, floods have largely affected countries in Western, Central and Eastern Africa regions. According to United Nations, at least 1.5 million people in 18 African countries have been affected by floods, with hundreds of thousands of people displaced and nearly 300 killed, (Smith, 2007). In September 2012, floods forced 15,000 people to leave their homes in northern Uganda where the deluge destroyed houses, crops, roads and bridges. These floods also affected the re-opening of schools (IRIN 2012).

Kenya's record of disasters indicates the worst floods were recorded in 1961-62 and 1997-98, the latter ones being the most intense, most widespread and the most severe. During this season the flooding was associated with the *El Nino* phenomenon. *El Nino* is a disruption of the ocean-atmosphere system in the tropical Pacific having important consequences for weather around the globe (UNDP, 2004). According to the Kenya Flood Mitigation Strategy (KFMS, 2009) floods are a recurrent problem in Nyando basin and an estimated 5000 people are affected by the flood in the area every year. The actual damage caused is estimated at 37 Million Sh. (Otiende, 2009). This phenomenon has serious

impacts on the social, economic, environmental, physical and psychological wellbeing of people and even on the political and institutional levels of the country. This paper therefore examines the adaptation mechanisms of the households to deal with flood risk in lower Nyando basin.

II. LITERATURE REVIEW

Coping is a temporary form of strategy used by a community until disaster circumstances become normal. When recurrent nature of disasters' impact cannot be withstood by existing coping mechanism and community or individual needs to change their regular life and livelihood strategy for a longer term, it is called adaptation (Morshed, 2007). According to Predo (2010) the ability of the households and community to recover and adapt to the changing physical environment after the occurrence of climate-related disasters depended on their access to credit, financial grants, and assistance in the locality.

Yodmani (2001) asserts that investment in diversifying the sources of livelihoods of poor people living in disaster-prone areas can be an effective longer-run DRR strategy. Action Aid found that women affected by increased flood risks in three South Asian countries had a clear understanding of adaptation actions and had developed multiple strategies but were constrained by lack of resources, knowledge/skills, and cultural barriers in access to services, such as agricultural extension (Action Aid, 2007b). Like coping mechanisms, adaptation strategies may become stretched in the face of new and increased forms of risk.

A study by Rashid, et al., (2006) on Livelihood Shocks and Coping Strategies of Bangladesh households examined strategies used by rural households for coping with the shocks and investigated whether there was any distinctive pattern in adopting these strategies. Results indicated that choice of coping strategies depended on the diversity and stability of household income sources found to be more likely to divest assets or obtain secured loans rather than rely on unsecured loans.

Similarly in a study conducted in Jakarta Indonesia on Micro-level vulnerability assessment and coping mechanism related to floods in urban areas Mone (2010) explored the vulnerability as well as the capacity for flood management based on people's perception. The study found out that the capability of people to deal with flooding was influenced by several indicators based on their socio-economic characteristics.

In a survey of 220 residents conducted in a flood prone region in Ghana, on coping strategies after a flood hazard Armah, et al., (2010) noted some of the strategies that respondents implemented included: roofing of thatch houses for money, fishing, weeding the farms of other individuals in return for food, trading and selling in nearby townships, obtaining loans from social contacts, selling of livestock, premature harvesting of crops, weaving and basketry, dependence on food from previous crop seasons, and resettlement in other towns (geographical diversification).

Sakijege (2012) in a study conducted in a flood prone settlement in Dar es Salaam found that the most common coping strategies at household level were use of sandbags and tree logs; raised pit latrines and doorsteps; provision of water outlet pipes above plinth level; construction of embankments, protection walls and elevation of house foundations; seasonal displacement; and boiling and chemical treatment of water.

Findings by Opondo (2013) on a study on loss and damage from flooding in Budalang'i, revealed that the most common coping strategies adopted by households included seeking support from organizations, temporary relocation, reduction of expenditure on household necessities, engagement in extra income-generating activities, sale of property, reliance on social networks, and modification of food consumption. Households mostly modified food consumption patterns by having fewer meals per day, eating cheaper foods, having smaller portions, and by reducing food intake of adults to be able to feed young children adequately.

Kenyans who live in risky environments employ a rich variety of strategies to reduce their exposure to climate hazards (Kandji, 2006) and cope in times of crisis. Common strategies used to minimize the adverse consequences of (climate) shocks in order of importance are: spend cash savings, sell assets (animals), work longer hours, reduce food consumption and receive help from family and friends (World Bank, 2009). Migration either temporary or permanent, and either within Kenya or to another country is also a widely used strategy. Remittances provide an additional, important social safety net (USDS, 2011).

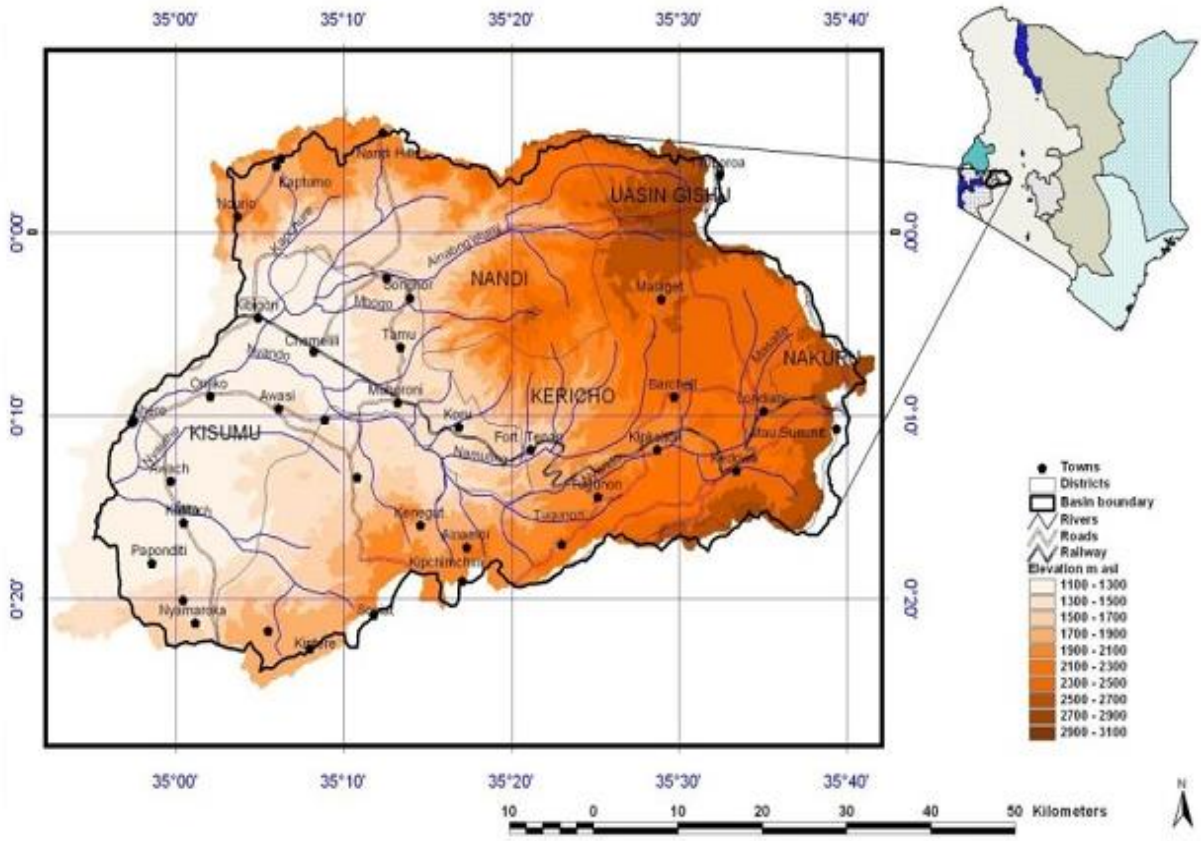
There has been relatively little social science research characterizing outcomes of flood hazards and the people's response to flood risk from a social perspective with calls in particular for more research into the social responses to flood

management in Kenya (Ongor, 2007; Mwaura, 2008; JICA, 2007). Since flood victims continue to suffer heavy losses, this study will unpack the mitigation strategies and capacity of households to withstand and live with floods in Nyando basin.

III. METHODOLOGY

Study site:

The study was done in Nyando basin. The Nyando River Basin covers an area of 3500 square kilometers in Kisumu County. The Nyando River catchment straddles the equator bound by longitudes 34°45' 0"E and 35° 21"E (Figure1:1). Over 5,000 people are affected every year by floods in the area during (April-June) long and (October-November) short rainy season's (Otiende, 2009). The average annual damage is about US$ 850,000 with annual relief and rehabilitation measures costing US$ 600,000 in the Kano Plains (Eitel and Ochola, 2006. The area therefore provided a fertile environment for this study.



(Source: WKIEMP, 2006)

Fig. 1.1: Map of Study Area –Lower Nyando Basin, Kenya

Research objective:

The main objective of this study was to examine the adaptation mechanisms of the households to flood risk in lower Nyando basin.

Study population and sampling:

The study targeted household heads that formed the basis of the study which was to investigate the adaptation mechanisms of households to flood risk in lower Nyando Basin, Kenya. Targeted stakeholders were the Kisumu County Commissioner, Deputy County Commissioners, Chiefs, Sub-chiefs, and Village elders, Faith Based Organizations (FBOs), NGOs like CARE, Red Cross, Action Aid, Ogra Foundation, Victoria Institute of Research and Development (VIRED), Japan International Co-operation Agency (JICA), Omega Foundation and insurance company managers who were all interviewed to establish their role in mitigating the effects of floods.

Purposive sampling technique was used to select the three locations under study. Two out of the seven locations in Nyando sub-county and one location in Muhuroni sub- County were selected because of the high risk of flooding associated with these locations. Considerations were applied on the basis of meteorological information by the Kenya Metrological Department (2012/2013) on the extent and frequency of flooding, discussions with the village elders on the area's history of flooding, close proximity to the river and subsequent visits to the area. The final selected areas of study were high-prone flood locations identified as Wawidhi and Kakola in Nyando Sub--County and Ombeyi in Muhoroni Sub-County respectively (GoK, 2009). The locations that had not experienced flooding were left out because they would not yield the required data for this study.

In order to take a random sample, a sample frame in the form of a list of all the household heads in each of the villages / clans was drawn with the help of local leaders who acted as gate-keepers to this study. The names and/or identification numbers of all household heads were written on pieces of papers; whereupon the desired sample was selected by picking the required number of papers. This was done by using the lottery method whereby numbers/names representing each element in the target population was placed in a container and thoroughly mixed. The researcher then blindly selected chips from the containers until the desired sample size was obtained. Gate-keepers who were conversant with the villages aided in identifying the selected homesteads.

Data collection:

The study collected both primary and secondary data. Different research instruments were used for complementary purposes. This ensured a triangulation approach to data collection. The study used a questionnaire, key informant interviews schedules, FGDs, and Observation check lists as tools of data collection. Questionnaires were administered to the sampled household heads. Focus Group Discussions were carried out among groups of 8-12 persons particularly heads of households and stakeholders. This work was supplemented with site visits to those areas that had been affected by flooding.

Data analysis:

Two analyses were made: descriptive analyses (by use of means, modes, percentages, and frequencies) and the inferential analyses (by use of chi-square, Spearman rank order correlation and Pearson's correlation coefficient). The former provided statistically significant associations between the variables and in the testing of the specific objectives. Chi square test were used to test differences that exist. The latter was used in describing and documenting the state of affairs as they were

IV. RESULTS

People living in the surveyed area have been experiencing frequent floods and have learnt how to minimize the impacts. Three types of adaptation strategies: technological/structural, economic and social organizational mechanisms strategies were explored. Formal coping and adaptation strategies were implemented by Governmental institutions while informal flood coping and adaptation strategies were mainly implemented by various socio-economic groups. The results are discussed under pre-flooding, during flooding and post-flooding.

Pre-Flooding Strategies:

Vulnerable people individually and collectively develop their own means, resources and strategies to cope with flooding. All of these mechanisms, however, have financial and social implications (ISDR, 2004). Social adaptive coping strategies are activities or social relationships and networks among community members and local government that can help local people minimize flood losses and damage. To prevent or minimize the potential impacts from natural disaster occurrence in the future, the respondents were asked what preparations and plans their households were considering to counter the impacts of floods. The adaptation strategies employed before floods were summarized in Figure 1.2.

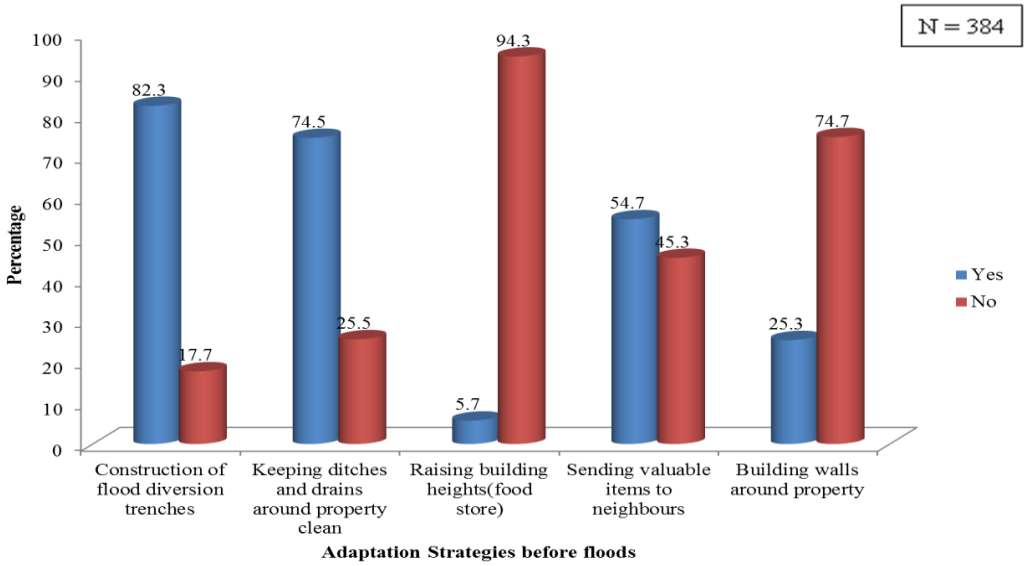


Fig. 1.2: Adaptation Strategies before Floods

The study revealed that 316 (82.3%) of the respondents constructed flood diversion trenches around their houses. This was based on their perception that the impacts were only short-lived and that life would return to normal after such disasters. This finding indicates that some households in the community lacked confidence to rely on cooperative solutions or to depend on local government units for defensive strategies and actions. This finding is consistent with a case study of community based flood coping mechanisms in Semarang, Indonesia, where households adapted to tidal flooding with structural measures such as making small dams in front of houses, increasing the floor level and creating dykes around residential areas (Anggraini, 2007).

It emerged from FGD that wherever households had extra space around their houses, they build protective walls or raised the foundation levels of houses to prevent water from entering their houses. This largely blocked water flow during flooding as erosion caused some of the protective walls and houses to fall down. It also became clear that most households gained their flood-related knowledge through a trial and error process and through the experiences of others over time. Past flood loss patterns show that flood damage becomes severe when local knowledge is inappropriate. A more effective pro-active planning approach involving the affected households and the community is necessary to improve their understanding of the situation and to enable them to make informed decisions.

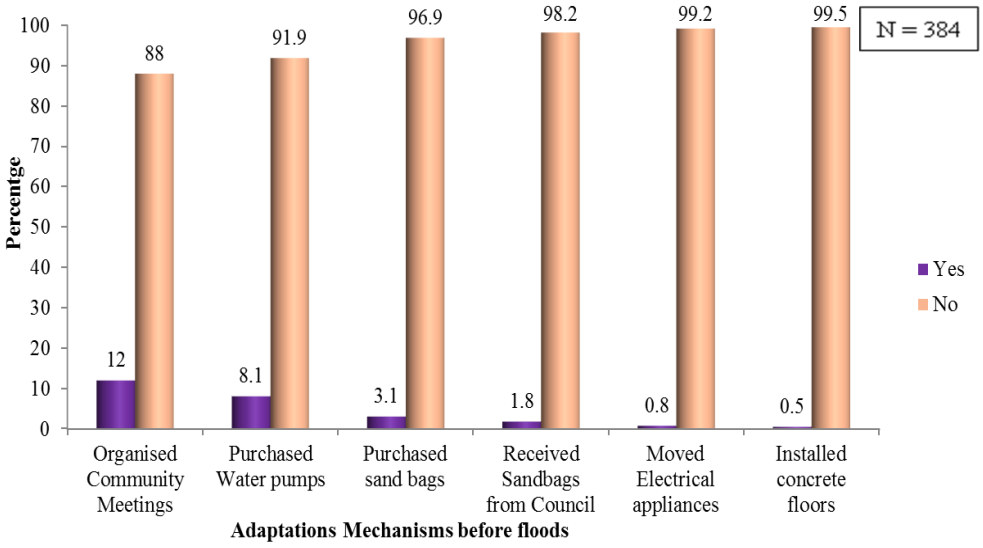


Fig. 1.3 Adaptation Mechanisms before Floods

Other adaptation mechanisms used by the household respondents are summarized in Figure 1.3. The findings reveal that 46 (12%) attended community meetings organized for DRR. Very few households 31 (8.1%) respondents purchased water pumps. Sandbags were purchased by 12 (3.1 %). The number of respondents who received sandbags from the local authority to prevent floods was 07 (1.8%) while 03 (0.8%) of the respondents moved electrical appliances. This result shows that not many houses had electricity installed in their houses. From the table (0.5%) installed concrete floors in anticipation of floods.

From the FGD it emerged that different households employed different adaptation mechanisms depending on available resources. It can be observed that the most common mechanisms used before floods were mainly a combination of both social (54.7%) and structural (82.3 %). These findings show that the indigenous knowledge of the households and the community was important to be considered always in identifying practical adaptation measures and strategies for flood disaster management.

Adaptation Strategies during Floods:

Household heads interviewed reported that they also employed social adaptation mechanisms during floods. The adaptation strategies employed were summarized in Figure 1.4.

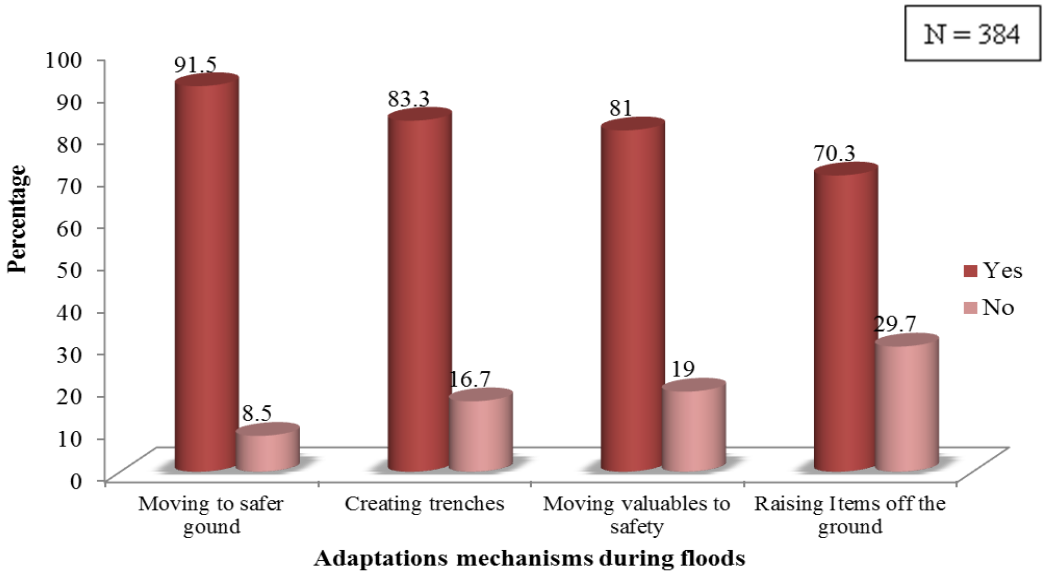


Fig. 1.4 Adaptation Strategies during Floods

The study established that the sampled households employed a wide range of adaptation mechanisms during floods which were mainly social in nature. The most popular flood proofing techniques were moving family and belongings to safer ground 351 (91.5%) and creating trenches to divert the course of water which were reported by 320 (83.3%) respondents. Moving valuables out of the way of flood water was a strategy used by 311 (81%) of the respondents. Finally 270 (70.3%) of the respondents reported raising valuable household goods off the ground as seen from Plate 1.1.

Plate 1.1: Household Items Elevated Above the Floor to Avoid Flood Waters in Wawidhi Location

Participants of the FGD in Wawidhi reported that some houses were constructed with a raised foundation of up to 4 feet high depending on the financial resources available.

However, in Ombeyi FGD participants reported that they blocked or sealed their windows and doors to stop water from entering their houses in addition to other flood proofing techniques such as digging trenches around the homesteads. Some household heads reported that they temporarily moved away household goods from their flooded homes, especially during heavy rainy days as shown in Plate 1.2.

Plate 1.2: Moving Household Items from Kakola Location to a Flood-Free Area

They normally sought refuge in their neighbors' homes that were not flooded, churches, schools and relatives homesteads until such a time when water levels went down.

There were also evacuation centers in all the three locations which served as a triage or rescue centers during times of floods. The centers were at Obiayo and Ombeyi. Interesting to note from FGD was that

Even the chiefs' home gets flooded and he stays with other people at the evacuation center. (Field data, 2014).

Churches and schools also served as rescue centers and victims kept their wares in these places.

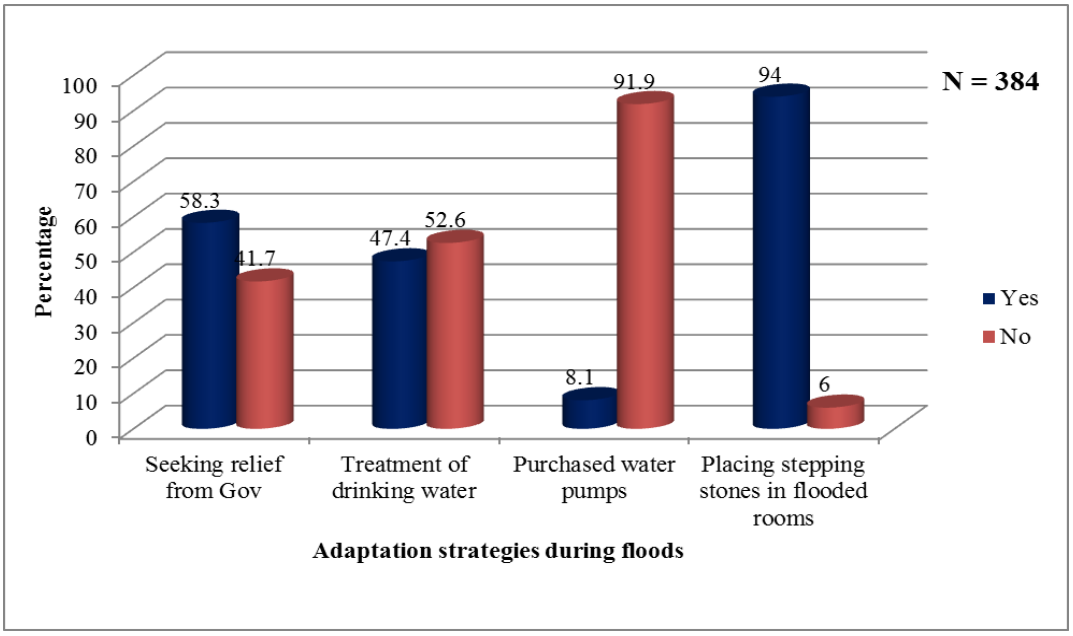


Fig. 1.5 Adaptation Strategies during Floods

Results from the household survey as shown Figure 1.5 revealed that the most popular adaptation strategies were seeking relief from the Government 224 (58.3%) other agencies. Due to lack of awareness most of the people did not take any precautionary measures to purify their drinking water during and after the floods. Only 182 (47.4%) treated drinking water during floods. Few respondents 31 (8.1%) purchased water pumps. Most of the respondents 361 (94.0%) placed

stepping stones on flooded rooms. This finding concurs with a study of people living in three communities that had recently been flooded in Ghana where most people were found to have had little knowledge of the cause of floods or what could be done to prevent damage. People who worked and who were better educated knew more and were more likely to have flood insurance. Government publications about flood risks were not understood by those at risk either. There was little effective communication about the nature and magnitude of the risks and what individuals could do to protect their lives and property and lower their financial risks. The risk management program emphasized communication and enforcement of the current law requiring people at risk who hold federally funded loans to be insured (Lave, et al., 1991).

Post-Flooding Strategies:

The study sought to establish from the respondents the adaptation strategies they employed immediately after floods. The results are given in Figure 1.6.

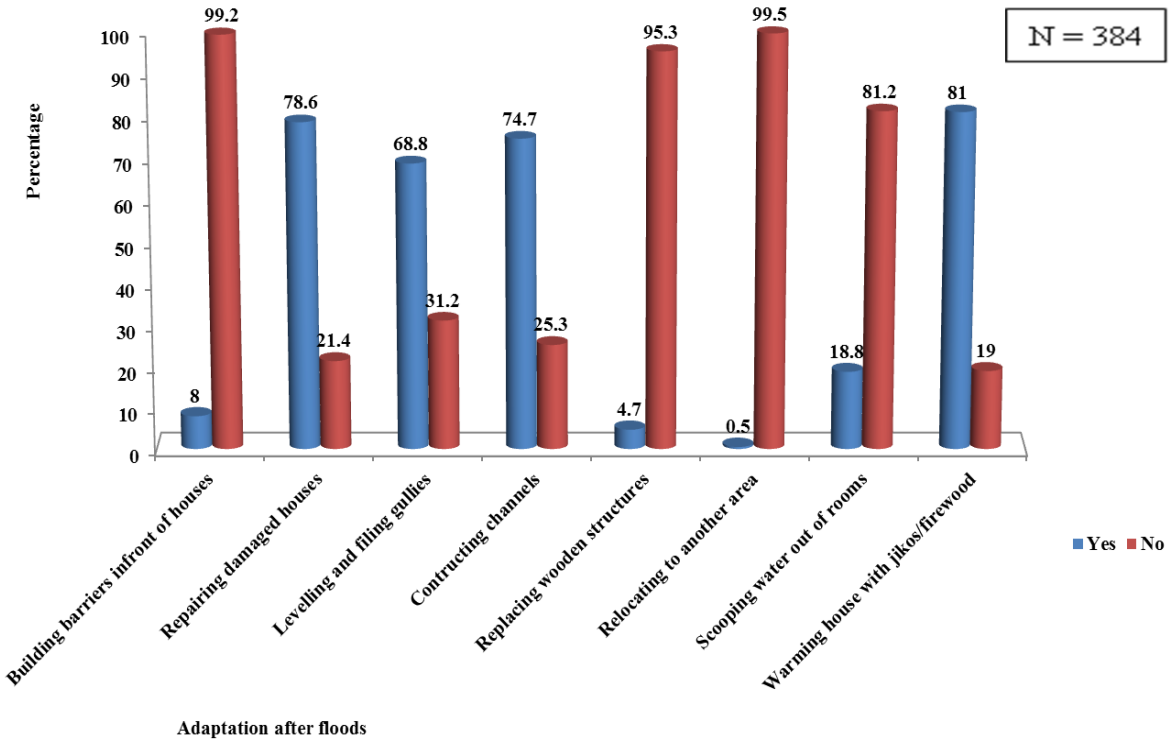


Fig. 1.6 Adaptation Strategies after Floods

Previous works suggest that in flood-affected localities, adaptation starts with efforts to save people's valuable lives, such as raising a homestead before a flood. Contrary to this, the results from this study indicate that, 381 (99.2%)) of the respondents did not build walls in front of the houses after floods. Building walls in front of the houses was not popular perhaps because of the high cost of building that was involved. Repairing of broken houses was reported by 302 (78.6%). Leveling and filling gullies was employed by 264 (68.8%). The other strategy implemented by the households was constructing channels for flood waters to evacuate easily which was applied by 286 (74.7%) of the respondents. Replacing wooden structures was not implemented by 366 (95.3%). Perhaps this was because the cost of wood replacement was prohibitive. Scooping water out of the rooms was not applied by 312 (81.2%). This is an interesting finding considering the high number of households affected by floods, its effectiveness and being cost- free. One would imagine this would be one of the most popular survival techniques. Using *jikos* and firewood to warm the houses was a popular strategy used by 311 (81%) of the respondents. From the findings it's worth noting that 382 (99.5%) of the respondents would not afford to undertake permanent mitigation measures like relocating to other areas because of lack of a steady income and livelihood. Only 2 (0.5%) were of the opinion that they would relocate. Seemingly, relocating to another area was not popular because most of the people in the study area were staying in their ancestral homes. This would therefore be the most expensive kind of strategy to undertake. This result implies that apart from adaptation mechanisms, the respondents also employed coping mechanisms.

Adaptation Mechanisms from FGDs:

Ranking of adaptation mechanisms from the three FGDs were tabulated using Spearman's rank order correlation. The results regarding rankings are discussed in Table 1.1.

TABLE 1.1 Adaptation Mechanisms from FGDs

Adaptation mechanism	RANKING		
	FGD 1 Ombeyi	FGD 2 Wawidhi	FGD 3 Kakola
Moving family/ belongings to safer grounds	1	1	1
Raising valuable household goods	3	2	2
Seeking relief from the government and other agencies	2	3	3
Treatment of drinking water	6	5	4
Ensuring safety of children by carrying them on their laps to prevent them from being affected by floods	4	4	5
Placing stepping stones on flooded rooms	5	6	7
Purchasing removable flood guards or sandbags	14	14	14
Building walls in front of the houses	7	8	6
Repairing broken houses	8	9	8
Leveling and filling gullies	11	11	12
Constructing channels for flood waters to evacuate	10	10	11
Replacing wooden structures with permanent ones	12	12	10
Relocating to another area	13	13	13
Scooping water out of the rooms, and using *jikos*/firewood to warm the rooms	9	7	9

From the results, the most highly ranked adaptation strategies in the three locations involved household responses rather than community cooperation and these were: Moving family/ belongings to safer grounds, raising valuable household goods off the ground, seeking relief from the government and other agencies, treatment of drinking being affected by floods and placing stepping stones in flooded rooms. This finding indicates that some households in the community lacked confidence to rely on organized strategies or to depend on the Government for defensive strategies. Another interesting finding was that the household's option of temporary relocation seemed to be based on the perception that perhaps the impacts were only for a short term and that life would return to normal sooner. This probably explains why relocating was not highly ranked. In view of this, a more pro-active planning approach is necessary to improve their understanding and help them make informed decisions. It is also important to note that some households with resources have permanently relocated to safe grounds. A spearman's rank correlation was done to determine the significance of the FGD rankings in the three locations. The results are reported in Table 1.2.

TABLE 1.2 Spearman's Rank Order Correlation of FGDs

	Ombeyi	Wawidhi	Kakola
Ombeyi		r = 0.958±0.02*	r = 0.960±0.02*
Wawidhi			r = 0.89±0.07*

**Correlation is significant ($p<0.05$)*

The results show that there is high correlation on the results given in Ombeyi and Kakola. The correlation is highly significant as indicated by ($p< 0.05$). However, there was a high correlation between the results of Wawidhi and Kakola but the relationship is not significant as indicated by ($p> 0.05$). The three main strategies that were used were moving family/ belongings to safer grounds, raising valuable household goods off the ground and seeking relief from the government and other agencies.

Timeliness of Support:

The essence of a social network is the provision of financial and moral support during emergencies. In rural societies like Nyando basin, residents depend on mutual assistance in times of need. Household heads who were the main respondents of this study were asked to state their opinion on whether the support they received from different stakeholders during floods was timely or not. The results were tabulated using means and standard deviation. They are summarized in Table 1.3.

TABLE 1.3 Timeliness of support N=384

Statement	Freq.	%	Mean	S.D
Timely support from relatives	316	82.3	1.1771	0.3822
Timely support from NGOs	278	72.4	1.2760	0.4476
Timely support from friends	256	66.7	1.3333	0.4720
Timely support from neighbors	238	62.0	1.3802	0.4861
Timely support from government	171	44.5	1.6328	1.6313
Timely support from FBOs	74	19.3	1.8073	0.3949
Timely support from well wishers	56	14.6	1.8542	0.3534

From the results, most timely support was usually obtained from relatives (82.3%) and NGOs (72.4%) followed by friends and neighbors.

From the FGD, participants highlighted that the community's strength in lending a helping hand to friends was seen as adequate. During the first few days, there was goodwill from neighbors and relatives who were not affected by the floods an indication that communities are willing to assist each other during calamities in their own way. This element of cohesion can be further strengthened with public awareness. In the event of floods people called out to each other to support them showing a greater solidarity than in usual circumstances. The support was mostly in sharing, caring and comradeship and not necessarily material or financial.

"My neighbor's son carried my sick child from my house to a safe ground, I was expectant and had two other small children, and I would not have managed to move all of them on my own." (Field data, 2014)

In Budalang'i, Opondo (2012) found out that help from neighbors was least common because neighbors had to deal with similar flood impacts at the time support was needed. Most of the help received from other people was in the form of food, cash, materials and time, for example in helping to repair houses. This shows that neighbors played a great role in helping others during floods and this brought about cohesion in the community as people came together to share their joys and sorrows.

V. SUMMARY

The results of this study revealed that different socio-economic groups implemented different adaptation measures because of their differential access to livelihood assets. Hence, households classified as poor undertook coping activities because of inadequate livelihood assets that would enable them to adapt while wealthier households mainly developed adaptation options, since they had resources to do so. Findings also reveal that households with lower income and less access to productive natural assets faced higher exposure to risk of flooding.

Those who faced the highest risk were those who were inadequately prepared both in terms of household and community preparedness. Although the Government had successfully reduced flood exposure with the construction of dykes, it had again introduced additional or intensified conflicts between landowners during the flooding seasons. There is need for the Government to complement the traditional adaptation mechanisms with non-structural measures such as preparedness, response, and legislature, flood forecasting and warning systems, flood proofing, post-flood rehabilitation financing, reconstruction and rehabilitation plan with the aim of reducing loss of life and damage to property. The findings show that many coping strategies employed by households were short-term. First, the sale of property reduces people's asset base and made them more vulnerable. This study posits that coping strategies can lead to unsustainable present and future

livelihoods for residents of flood-prone areas. The current situation and evidence from this study indicates that coping measures require policy intervention to enable households to develop the capacity to utilize resources available locally to cope with flood impacts more sustainably.

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