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Effects of Extreme Flooding of Lake Baringo on Livelihoods of Communities Lining around the Lake

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Abstract

Floods are among the natural disasters that often impact society. Floods tend to be more short lived but more disastrous. Between 2012 and 2014, Lake Baringo experienced unprecedented increases in their water levels, resulting in calamitous flooding that has inundated entire villages. A study was conducted to establish among others the impacts of this flooding on livestock, health and livelihoods. This paper discusses the effects of extreme flooding of Lake Baringo on livelihoods of communities living around the lake. The data was collected qualitatively from key informants. The data was analysed thematically and presented qualitatively. The paper argues that extreme flooding had adverse effects on livelihoods as farmlands and grazing pasture land were inundated. Families and households were displaced further breaking not just their pursuit of livelihoods but also social networks. Businesses, including tourist and fisheries as well as value chains were impaired thus leading to challenges in sustaining lives and livelihoods. While adaptation is an important way forward, early warning mechanisms would need to be put in place to ensure safeguards to livelihoods.

Keywords

Extreme Flooding, Livelihoods, Disasters, Agro-Pastoralism, Adaptation

1. Background

Livelihoods globally are subject to the vagaries of nature. According to Ritchie and Roser (2019) natural hazards cause severe economic losses worldwide. These include destruction of property, loss of financial resources, personal injury or

illness and in some cases loss of life. Floods are among the natural disasters that often impact society. Some of their impacts include loss of resources, displacement including destruction of shelter and often do lead to massive displacement of population. There are few places on Earth where people need not be concerned about flooding (http://sedac.ciesin.columbia.edu/data/set/ndh-flood-hazard-frequency-distribution). Among the many natural phenomena that have destructive effect on nature as well as human life and livelihoods are floods. Floods are to a large extent thought to be second after wildfires in terms of their being the common natural disasters on earth (National Research Council, 1999). Equally floods are a yearly occurrence in virtually every continent; brought about by monsoons in the Indian sub-continent; by hurricanes and rains in the Americas, as well as heavy rains in many African countries. Moreover, unlike droughts which have slow onset and may persists for long, floods are short lived but more disastrous (Huho & Kosonei, 2014). It is estimated that about 74% of these natural hazards were related to water; and that floods and storms account for close to 69% of the financial damages, and thereby exposing over three billion people and causing 166,000 deaths globally (Amarasinghe et al., 2020).

The African Rift Valley runs from the Red Sea in the north all the way to Mozambique in the southern part of Africa and hosts many lakes (Singh, 2006). The eastern Rift Valley has a series of eight lakes. While some of the lakes are saline, others are freshwater lakes. For instance, lakes Naivasha and Baringo are fresh water lakes; Lake Turkana is semi-saline, while lakes Magadi, Elmentaita, Nakuru, and Bogoria, and Lake Logipi are saline alkaline. It is important to underscore the fact that the lakes offer a diversity of habitats. The freshwater lakes support important fisheries and agriculture. The semi-saline Lake Turkana's hydrobiology sustains indigenous fisheries. The areas around the lakes have livelihoods such as agriculture, livestock keeping, trade and bee keeping.

Extreme flooding caused by the swelling of the lakes in the Rift valley is a major cause of concern. The lakes in the Rift valley are especially sensitive to changing catchment rainfall and have, in the past, ranged from near empty to much higher levels (Avery, 2020). This is because while excess rainfall could have been a cause of concern, this has not been the case; the lakes have been swelling over a period of time. Avery (2020) further reports that Lakes Nakuru, Bogoria, and Baringo have also risen to their highest levels in decades, inundating roads and building infrastructure. Lake Baringo area saw flooded area increase from 143.6 km^2 in January 2010 to a high of 219.8 km^2 in December 2014, an increase of 76.2 km^2 (53.1% increase by area) (Onywere et al., 2016). This is a major concern in light of the fact that Baringo is among the arid and semi-arid lands which constitute about 80% of Kenya and whose soils are largely poor as well as having high sand content, low water content and low natural fertility (Kigomo, 1998).

Increasingly, it is becoming evident that Kenya is becoming prone to significant variations in her climatic conditions and this is being manifested through

the alternating cycles of droughts and floods. According to the Kenya Red Cross Society, there have been cycles which have been experienced in, for example, 2004, 2006 and 2009 where droughts were interposed with floods (KRCS, 2012). There are many reports in all media about floods in many parts of the country just as there are reports about drought. Nevertheless, while it is generally known that climate change will have major impacts on livelihoods such as agriculture, be it farming or livestock keeping, when it induces flooding, this compounds these adverse effects. This is more so when it brings with it adverse effects on human health by way of water as well as vector borne diseases for animals and human beings. It also impacts aquaria-based livelihoods as fish and other related food sources are impaired. It is however important to point out that of course the rising of water levels has had also some positive outcomes by way of re-charging of ground water reservours. Flooding in some areas has meant irrigated agriculture can be undertaken.

Over the past two years to 2014, Kenya's Rift Valley lakes—including Lake Baringo (fresh water) and Lake Bogoria (saline water) experienced unprecedented increases in their water levels, resulting in calamitous flooding that inundated entire villages (Kemboi, 2014). Indeed, the rise of the water levels of Lake Baringo over the years to 2014 led to inundating of many homesteads, hotels, offices, sewers, pit latrines and other infrastructure. It affected availability of potable water, flooded farms and grazing fields, as well as tourism sites and hotels. Ultimately this caused significant impacts on lives and livelihoods of the community around the lake. This study documented the extent of these impacts on the riparian communities, and bearing a specific focus on livestock, health and livelihoods.

2. Conceptual Framework

This paper conceptually draws from pressure and release model which inbuilt vulnerability progression in its analysis and the entitlements model.

Disasters are a feature of society's existence in every society in whatever geographical location. In the case of Lake Baringo extreme flooding raised concern. It terms of conceptualisation given their impact there is always a question of who is responsible. Calandra et al. (2014) hold that understanding of disasters and their risks have gone through at least three important phases. The first phase was an era where disaster was considered as an "act of God", which risked an inherent fear of God's fury. The next phase saw disaster as "act of Nature" and its risk as an inseparable probability of occurrence, meant that only through knowing the "when and how" of natural events could people be safe. The third and final phase was where disaster was considered as an "act of Woman and Man"—where human activity was responsible. However this also needs to be seen within the context of vulnerability progression. This is within the context of the Pressure and Release model (PAR) initially developed by Blaikie et al. (1994) and later by Wisner et al. (2004) where disasters are seen as a function of hazards

and vulnerability. Normally, the pressure bit basically focuses on the processes that generate vulnerability as a result of a natural hazard event, while on the other hand, the release aspect is about reduction of the disaster so as to relieve the pressure and thereby reduce vulnerability. In the case of Lake Baringo, floods are likely to assume a disastrous effect on livelihoods if the living conditions are hazardous and the community is vulnerable. Looking at the living conditions in the low lying areas with weak livelihood systems, extreme flooding of the lake is likely to lead to adverse effects on livelihoods of communities. This is what this paper sought to examine.

It is however important to also point out that even in situations of adversity, communities still have resources they can leverage on. Sen's (1984: p. 497) entitlements approach holds that the set of alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces. Thus the fact that there are adversities it does not mean that communities cannot reorganise based on the resources available and uplift their standards of living. This approach will therefore help this paper highlight some of the positive outcomes and opportunities presented by extreme flooding in Lake Baringo.

3. Main Objective

This paper sought to establish the effects of extreme flooding of Lake Baringo on livelihoods of communities living around the lake. It aimed to characterise the state of livelihoods in Baringo; the extent of flooding of lake Baringo; explore how livelihoods have been impacted by extreme flooding and lastly indicate how communities have coped with the flooding.

4. Materials and Methods

Data used in this paper is part of data generated from two studies that used both quantitative as well as qualitative data collection approaches to generate data on the effects of extreme flooding of Lake Baringo. However, data on livelihoods was collected using key informant interviews, focus group discussions and direct observations. Key informants in this study included government officials in sectors relating to livelihoods, that is agriculture, tourism, and fisheries; community leaders, civil society leaders as well as business sector leaders. A cross-section of community leaders, including elders, women leaders, faith-based leaders, beach management leaders as well as business leaders were involved in a focus group discussion to further generate qualitative data on effects of flooding on livelihoods.

Data collected was qualitatively analysed using largely content analysis where emerging themes formed the basis of analysis. Photographs were taken to graphically characterise the effects of flooding. Results for this study were presented thematically and using descriptive approaches. Ethical considerations such as informed consent, confidentiality and participation were observed to ensure ethical conduct of the study.

5. Results

5.1. Livelihoods around Lake Baringo

Baringo County is one of the arid and semi-arid counties in Kenya. It is a county which has livelihoods challenges given that poverty is still a major challenge. It is estimated that poverty incidence stands at 52.2% (Government of Baringo, 2019). The area around Lake Baringo falls within the lowland of Baringo County and is characterized as largely a semi-arid area with complex soils. It is mainly a rangeland that has scattered and isolated pockets of dry subsistence agriculture and small-scale irrigation. Livestock and crop farming are the key pillars of livelihood and consequently the main economic activity.

According to Baringo County Integrated Development Plan (2019-2022) the main economic activities undertaken in Baringo include pastoralism, such as through group ranches in the Lake Baringo Basin, bee-keeping, mining, tourism, fish farming and horticulture. As at the time of the study in 2014, a key informant from Ministry of agriculture reported that, *agriculture employed up to* 80% *of the population*. Government statistics indicate that as at 2014, upwards of 46% of the heads of households were engaged in agriculture, that is, crop and livestock farming, as the primary occupation and source of income. Equally, crop activities contributed the 53% of incomes to youth-headed households, while it contributed 20% of incomes for female-headed households (Government of Kenya, 2014). With undulating of farms because of floods all these agricultural activities were adversely affected and thus undermined livelihoods and lives.

5.2. Extent of Flooding of Lake Baringo

While the causes of the extreme flooding of Lake Baringo around 2014 was a subject of conjecture, it is also a fact that Baringo as a county is prone to various climate related hazards including drought, floods (**Figure 1**), forest fires and landslides, all of which pose a risk to livelihoods and especially agricultural production which is the mainstay of the people (County Government of Baringo, 2019). Flooding of Lake Baringo in 2014 was at a proportion that it was causing concern not just to scholars, governmental authorities but also to local leaders.

Figure 1. Inundated land—loss of pasture and destruction of trees.

Studies show that the impact of flooding of the lake level rise saw Lake Baringo increase the area under flood water from 143.6 km^2 in January 2010 to a high of 231.6 km^2 in September 2013, an increase of 88 km^2 or 61.3% (Onywere et al., 2016). A male key informant, and elder of the Ilchamus community who lives on Kokwa Island stated that, *I have not seen this kind of flooding… the last time lake had reached this level of flooding was fifty years ago*. Equally, there is documentation that the alternating cycles of droughts and floods do not only destroy the livelihood sources but also severely undermined the resilience of the people living in the affected areas (KRCS, 2012).

It is important to point out that while the data for this paper was collected in 2014 as of the time of writing this article, the situation is still as challenging as the water levels have remained high. By the end of 2020, one of Kenya's wettest years on record, Baringo had risen by several meters, and had claimed 34 sq·mi. of land (Perrigo & Mutuku, 2021).

5.3. Effects of Flooding on Livelihoods around Lake Baringo

This paper, as shown in **Table 1**, adopts Sen's entitlements approach (Sen, 1981) to characterize how flooding has affected the livelihoods of people living around Lake Baringo. Sen defines the entitlement of a person as "the set of alternative commodity bundles that can be acquired through the use of the various legal channels of acquirement open to that person" (Drèze & Sen, 1989: p. 23; Drèze & Sen, 1990: p. 38). To that extent in Lake Baringo, flooding was depriving the residents opportunities that they are entitled to in pursuit of their livelihoods including access to food (**Table 1**). Again the entitlement approach is premised on the ability of people to command food through the use of the legal means available in society, and this underpins possibilities of the use of production possibilities, trade opportunities, entitlements vis à vis the state, and other methods of acquiring food. Flooding undermines all these options. Indeed it is important to note that while Sen's framework was initially developed to look at food security, it could also be applied to livelihoods that are equally impacted by extreme events such as flooding. This is because these impact the whole chain from production capacities, ability to secure employment and thus incomes to; through to negative impacts on trade as well as weakening capacities for social networks to thrive and offer safety nets in times of extreme events such as flooding. These waters have been rising and even in 2020 with the rains the water levels were so high such that it was reported that this rising waters of Lake Baringo have

Table 1. Link between entitlements and impacts of floods.

Entitlement category	Impacts of flooding
Labour-based	Decline in employment opportunities
Trade-based	Market failure—trade declines
Transfer-based	Informal safety nets fail

Adopted from Devereux (2007).

displaced more than 5000 people and destroyed schools, hospitals, hotels, and roads (Avery, 2020). The County Government of Baringo further reports that a total of 716 households have been affected, 9 human lives, 688 livestock lost, and 734 hectares of land submerged. Moreover, flooding in the past has resulted in damage to property, internal displacement and loss of lives (Government of Baringo, 2018).

5.3.1. Adverse Effect on Agro-Pastoralist Economy

Flooding inherently affected negatively the mix of options and the livelihoods equation as production systems collapsed—As can be perceived from **Table 1** and **Figure 2**, farms could not be cultivated, livestock herding grounds were flooded out; agri-business opportunities collapsed and so did employment opportunities in farm and non-farm related activities; irrigation infrastructure was also destroyed; markets and value chains were disrupted with consequent undermining and in some cases complete closure; and in the ultimate great human suffering as safe spaces were limited.

5.3.2. Displacement of Families

With the rising of levels of water, homesteads and dwelling grounds were submerged. The net effect was displacement of families who had to move to higher grounds. A local community leader reported that *many families have been displaced at Ruggus, Komolion and Noosukro after their homes were submerged by the swelling lake*. Talking to groups of residents, they reported that—*some of us… we brought down our buildings… and we moved up to higher grounds and even then the water still came—forcing us to still bring down our houses and move up the hill to Marigat and Leberer*. This movement affected family as well as household dynamics. Respondents also reported separation of families. They stated that, *the water has separated us from our relatives… we have no way of reaching out to other parts of the village where our relatives are*. To that extent the flooding created uncertainty and disorder in day to day lives of family. This is more so given that it was not clear when the water will ever recede and allow resumption of normal lives and livelihoods.

Figure 2. Flooding out of business premises.

A related effect was one of impaired social network with consequent loss of social capital. Generally, social capital is about shared values which allows individuals to work together to achieve a common purpose. This is made possible by members of a community coming together, bonding, working together and living harmoniously. With displacements, there are reduced opportunities to come together and equally the general rhythm of live is disrupted. It is through this social networks community members help each other as well as raise resources to support each other including through generation of investable incomes. All these became casualty of flooding around Lake Baringo.

5.3.3. Sub-Merging of Tourist Facilities

Key informants reported that rising water levels led to several tourist hotels and lodges adjacent to the lake being partially submerged (**Figure 3**) and thus had to be closed. A Kenya Wildlife Society (KWS) warden added that … *established tourist resorts such as Block Hotels*, *and Roberts Camp*, *were submerged and tourist operations closed down*. He added that, *we are contemplating moving giraffes from Ruko Conservancy to the mainland after the area turned to an island*. This led to loss of businesses not just by the hotels but also those who do business with the hotels. It also led to loss of market opportunities for especially local food producers who depended on the hotels for their livelihoods. At a national level the closure of hotels meant a loss of taxes and thus resources for county and national government.

5.3.4. Disruption of Trading Activities

The main source of livelihood in Baringo is agro-pastoralism. All these become meaningful when there are marketing outlets for crops and livestock. With flooding, livestock marketing systems were disrupted. This in effect meant households could not easily sell their produce and animals so as to meet their everyday requirements as well as raise capital for their businesses.

Figure 3. A submerged tourist facility in Lake Baringo.

6. Impaired Fisheries

It is a fact that lake fisheries are not only important sources of livelihoods as they provide food but they also offer employment opportunities. With rising levels of water in the lake, respondents reported that water chemistry changes. The decaying vegetation introduced poisonous gases which adversely affected fish stocks. Equally, fluctuations in water levels reportedly tends to affect productivity and the timing and area of breeding, food availability, catchability, expansion of shallow productive inshore areas, cage culture establishments (Kolding & van Zwieten, 2012). Flooding also destroyed fishing infrastructure, including submersion of fish landing sites.

7. Other Adverse Effects and Risks

The flooding did not just impact on livelihoods but also ushered risks and direct threats to lives. Respondents pointed out that flooding made it possible for crocodiles and hippopotamus to come close to places otherwise they did not reach before. The darkened water colour of the water, because of decayed vegetation, provided camouflage and thus human live was always at risk.

8. How Communities Have Coped with the Extreme Flooding

The affected communities living around Lake Baringo reported that they coped in a variety of ways as the lake waters rose. These included:

Migration—that is what they called it—though technically they became displaced. Respondents reported, *with extreme flooding and with the uncertainty of the water receding soon, the immediate reaction of the affected communities was to migrate*. The net effect of which was to crowd other areas and towns not prepared for the influx. To survive, new forms of livelihood had to be started. At the same time county and national government were compelled to mobilise resources to offer relief support. Government officials reported that the displaced people had to do with less public services. They stated, with the displacement there was less housing, water, health care facilities or police services available.

Adaptation—the norm after experiencing displacement is to pick the pieces and seek to start all over again somehow. With climate emergencies, now there is talk of climate adaptation. Similarly, the communities around Lake Baringo have been seeking ways of adapting to the new reality of the Lake waters being high and a threat to their lives and livelihoods.

9. Conclusion and Recommendations

From the foregoing, it is concluded that extreme flooding in Lake Baringo area has had adverse effects on livelihoods of households. This flooding resulted in displacement of thousands of people; disrupted livelihood activities and social infrastructure; flooded and eroded farmlands and thereby affecting food supply and marketing value chains. It also resulted in cross-contamination between Lakes Baringo and Bogoria and effectively adversely affected fisheries. As a way

forward, it is important that governmental authorities, at county as well as national level, come up with flood adaptation measures which should include setting up early warning systems so as to ensure preparedness and response if and when such flooding takes place. Equally, governmental authorities should set up social protection measures to alleviate any adverse effects on communities and their livelihoods. These measures also include. Equally, mitigation measures need to be put in place to cushion communities whenever extreme events occur so as to secure and safeguard livelihoods. In the short term, it is recommended that governmental authorities facilitate the community to adopt adaptation measures. To the extent that respondents were of the view that there is a pattern of a fifty-year cycle of extreme flooding of the lake region, this information will inform planning action and equally preventive development measures so that the next cycle, when it happens, around the 2060s, there will better response and less loss of livelihoods.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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