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Circumscribing the Nexus between Natural Disaster, Water Resources and Poverty in Sub-Saharan Africa

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Abstract
Sub-Saharan Africa (SSA) is prone to a wide variety of natural disasters. The occurrence of phenomena such as earthquakes, floods, tsunamis, hurricanes, droughts, wildfires leave behind huge losses of life and property. With an estimated population of 880 million in 2005, SSA fast growing population rate of 2–4% per annum, the number of people exposed to disasters will continue to rise. Given the fact that there is a nexus between water resources, poverty and natural disaster occurrence, it is but paramount that studies should be carried in this domain. Unfortunately, many studies tally on the pressures exerted by anthropogenic activities on water resources, but pay less attention to the link between disaster occurrence water resources and poverty, especially in SSA. Again, SSA lags behind in terms of scientific knowhow to predict and provide solutions as regards disaster management in many ways. Moreover, there is a general laxity on the part of policy-makers to invest in science and innovations coupled with relatively weak infrastructure that characterize the few scientific institutions. Knowing that water resources are essential to both humanity and the environment and that the occurrence of natural disasters might reduce the economic importance of water resource, it is imperative to shed light in this area. This article, therefore, raises awareness and examines the links between natural disasters, water resources and poverty in SSA.
Keywords: Natural disaster, Water resources, Poverty, Sub-Saharan Africa

1. Introduction

Natural disasters as observed by Mulegeta et al (2011) are rapidly mounting serious tension globally and give cause to worry on how present and future generations will survive. For instance, the frequency of recorded natural disasters markedly surged from about 100 per decade up to 1940, to nearly 2800 per decade during 1990s. The African continent is prone to a wide variety of natural disasters. The occurrence of phenomena such as earthquakes, floods, tsunamis, hurricanes, droughts, wildfires leave behind huge losses of life and property. With an estimated population of 880 million in 2005, Africa's fast growing population rate of 2–4% per annum, the number of people exposed to disasters will continue to rise. Africa remains the only part of the world whose actual share of reported disasters has augmented over the past decade (Mulegeta et al., 2011). SSA's disaster profile is characterized mainly by extreme hydro-meteorological events, which might increase in frequency and magnitude due to climate change (Ngoran et al., 2015). Therefore, natural disaster in SSA would constrain water resources available and increase the chances of disease prevalence and subsequently surging poverty. The goal of this study is therefore to shed light on the water-disaster-poverty nexus.

2. Brief literature review

The number of registered natural disasters in SSA has augmented significantly since the 1970s (Bhavnani et al., 2010). Over the last four decades, SSA has experienced more than 1000 natural disasters, with 300 disasters in the last ten years alone. Subsequently, more than 330 million people were affected by droughts, floods, cyclones, earthquakes and volcanoes in Africa (SK & Julius, 2008). Disasters in SSA are predominately hydro-

meteorological and climatological, and comprise cyclones and storms, floods, landslides, extreme temperatures, wildfires and droughts. Geological disasters, such as earthquakes and volcanoes, occur to a lesser extent. Droughts affect the highest number of people on the continent, followed by floods and storms. Drought and floods account about 80 percent of loss of life and 70 percent of economic losses linked to natural hazards in SSA (Bergholt & Lujala, 2012).

Almost all countries in SSA are exposed to one or multiple natural hazards. Floods usually affect large river basins such as the Congo, Niger, Nile, and Zambezi basins, but flash floods can impact any area after extreme rainfall. Droughts occur predominately in semi-arid and sub-humid regions of the Sahelian countries, the Horn of Africa, and Southern Africa (Guha-Sapir et al., 2011). The risk of landslide is high in countries with hilly topography, high levels of rainfall, soil erosion and deforestation due to unsustainable land management. Cyclones and tropical storms affect countries on the southeastern coast of the Indian Ocean, primarily Madagascar, Mozambique, and the Indian Ocean islands. Storm events regularly cause severe damages and losses, particularly during the southwest Indian Ocean cyclone season (November to May). Many extreme hydro-meteorological events on the continent may be linked to the El Nino Southern Oscillation (ENSO) phenomena. Climate change will likely exacerbate existing climate variability and increase the frequency and magnitude of extreme events (Kabat, 2003; Lenton, 2013)

Countries along the Rift Valley, stretching from Eritrea to Mozambique, are particularly vulnerable to earthquakes. Along the Rift Valley and on Indian Ocean islands, many volcanoes are known to be active, including Mount Nyiragongo in the Democratic Republic of Congo (former Zaire, and Mount Karthala on the Comoros. Sea level rise is gradually a concern for many countries in the coastal areas, particularly those with low-lying urban cores, such as the densely populated Niger delta and low-lying areas along the coasts of West and East Africa and Madagascar. Recent studies show that low-lying countries along the coast of the Indian Ocean are susceptible to tsunamis (Richmond et al., 2011) vulnerability – low coping capacity due to poverty, high reliance on rain-fed agriculture, and limited institutional capacities. The disproportionate impact of natural disasters on the poor has been well documented (Masozera et al., 2007; Arora-Jonsson, 2011). Natural disasters tend to have a greater impact on poor countries, thus countries with small and vulnerable economies, such as many small island states, land locked nations and many countries in SSA. Their ability to recover and reconstruct after a major disaster is often limited, further diminishing their ability to increase resilience to disasters. This cycle is often referred to as the “disaster risk–poverty nexus”. The vulnerability of the SSA to natural disasters is mostly linked to its poverty and structural.

2.1 Poverty in SSA

According to the UN Food and Agriculture Organization estimates, 239 million people in SSA were hungry or undernourished in 2010. About 925 million people were hungry globally. The Africa continent ranked second in terms of the largest number of hungry people. Asia and the Pacific ranked first with 578 million, predominantly due to the much larger population of Asia when compared to SSA (Reig, 2012). SSA actually had the largest proportion of its population undernourished, estimated at 30 percent in 2010, compared to 16 percent of their Asia and the Pacific counterparts (Tiwari & Zaman, 2010). Therefore, almost one in three people who reside in SSA were hungry, far greater than any other region of the globe, with the exemption of South Asia. In 2008, about 47 percent of SSA population lived on $1.25 a day or less (Rafiu, 2014). With poverty rates in SSA already high, the recurrent impacts of natural disaster, especially climatic disaster on water resources will further aggravate the already poor state (Figure 1).

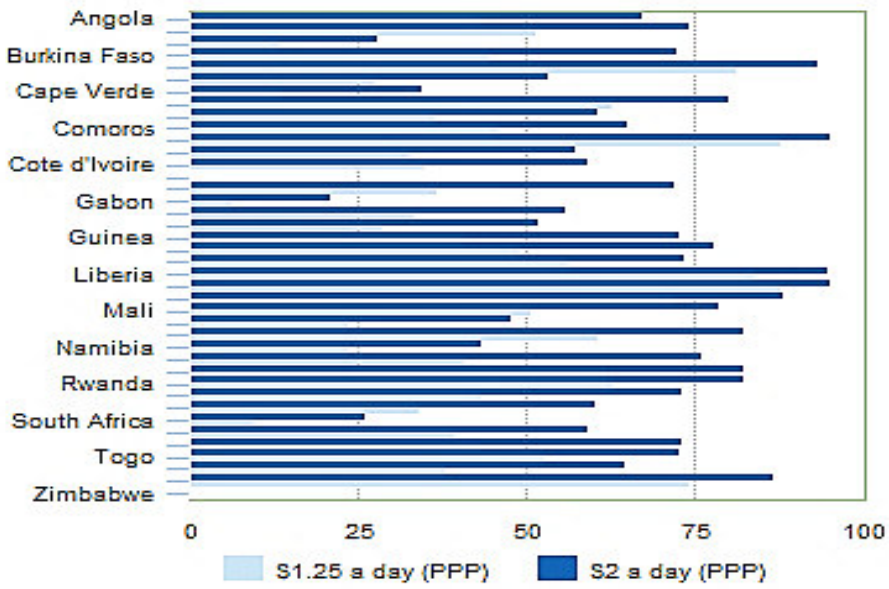

Figure 1: Percentage below the poverty line
http://povertydata.worldbank.org/poverty/region/SSA (Retrieved 12/01/2015)

2.2 Disaster Risk-Poverty Nexus

The link between poverty and risk is becoming clearer as disaster data collection and analysis improves (Figure 2). Empirical data from all regions of the globe shows that disasters produce measurable declines in consumption, income, and human development indicators, and that these consequences are disproportionately centered on poor households and communities (Jha & Duyne, 2010). The effects of disasters are especially pronounced in some of the indicators of human development most significant to poverty reduction: productivity, health, and education. The poor in SSA countries have a limited capacity to shield themselves against disaster losses, whether the risks are intensive or extensive. Gaps in public measures during disaster recovery in most SSA nations also limit social protection to the poor. This discussion points out the importance of investment in measures to prevent and reduce disaster risk. By the time a natural disaster strikes, it might be too late to interject the negative feedback loop between poverty and disaster risk. Therefore, ensuring that financial assistance for housing and community reconstruction for the poor and insisting that investments are made in disaster risk reduction in the reconstruction of housing, infrastructure, and other community assets might reduce the rampage of natural disasters.

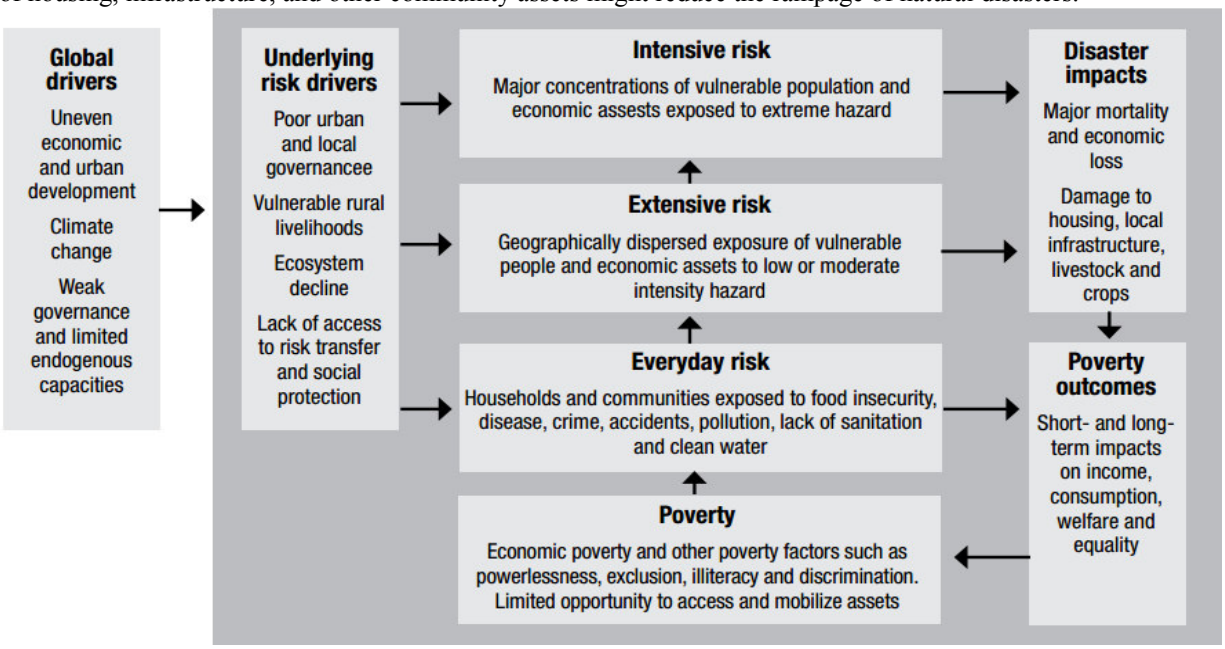

Figure 2: Disaster Risk-Poverty Nexus
Source: Jha & Duyne (2010)

2.3 Selected natural disasters-water resources nexus

2.3.1 Lake Victoria

Lake Victoria is located in East Africa and shares boundaries with 3 countries; Tanzania, Kenya and Uganda. Additionally, Rwanda and Burundi are part of this catchment area. Lake Victoria is the largest tropical lake and second freshwater lakes in the world. It also counts as the deepest lake in Africa and second in the world. However, there are uncertainties expressed by the scientific community that this precious water body might disappear within the next two decades. In recent years, water levels have plummeted dramatically due hydro-thermic variation linked to hydro-climatic disaster (Ngoran et al., 2015). Moreover, over 41 million people harbor this catchment area with agriculture being their mainstay of livelihood. Also, the increasing construction of hydroelectric dams further threatens the lake's resources. The crisis endangers the livelihood of the more than 30 million people who rely on the lake for food and work.

2.3.2 Lake Chad

Contrary to Lake Victoria, Lake Chad is located in central Africa and shares hydrological boundaries between Cameroon, Chad and Nigeria (Figure 3). Though it is a closed lake with no surface discharge, influxes are primarily compensated for by evaporation and by infiltration to a certain extent (Lemoalle et al., 2012). The surface area of the lake directly depends on river inflow, which fluctuates as a result of the variability of annual precipitation over the basin. Most of the inflows to Lake Chad are provided by the Chari and the Logone rivers. A recent striking appearance of this unevenness has been the decline of the lake in 1973 to 1975. As a result of the drought over the Sahel belt, the northern pool of Lake Chad, which covered an area of 9000 km^2 throughout the 1960s, totally dried up in 1975. According to Leblanc et al. (2006) the level of the Lake Chad dropped approximately from 25,000 km^2 to less than 6000 km^2 from 1960 to 1990 respectively, due to climate fluctuations. Furthermore, augmenting aridity in the Sahel area and more demand for freshwater for agriculture (irrigation) entails that Lake Chad will continue to shrink if remedial measures are not taken into consideration. Since this period, this northern pool of the lake has been sporadic and moderately flooded. The drought events over the region and the lake recession have deeply altered the natural resources in the basin and around the lake (Akaegbob, 2012).

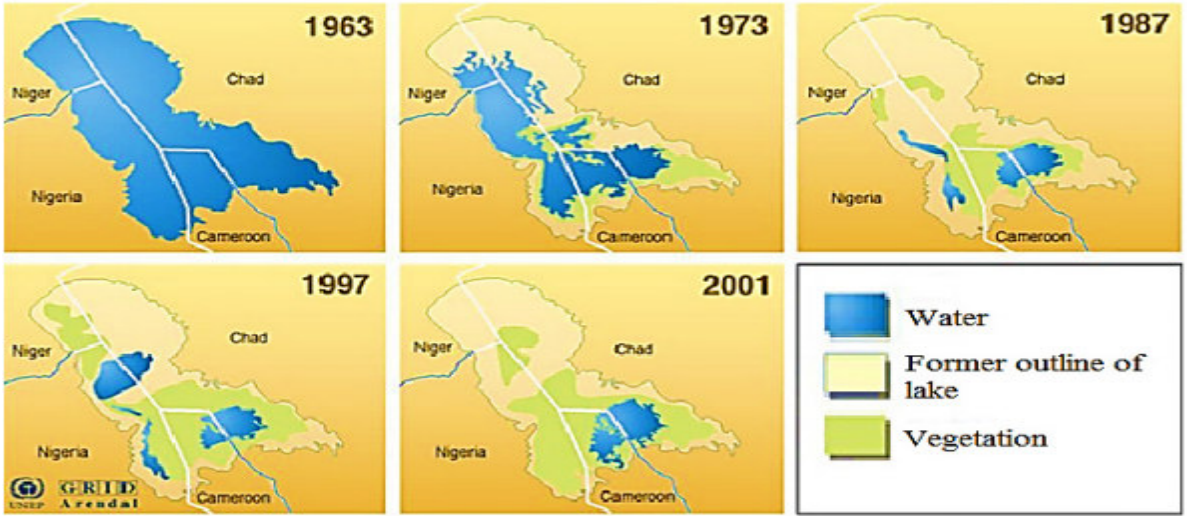

Figure 3: Adverse meteorological the anthropogenic impact with anthropogenic impact on Lake Chad
Source: Ngoran et al. (2015)

2.3.3 Lake Faguibine

In the past, Lake Faguibine in Mali was counted as one of the largest lakes in West Africa, at about 230 square miles (Lamizana et al., 201). With most of the water supplied by the Niger River, the ecosystem sustained a healthy economy of agriculture, livestock rearing, and fishing. But by 1990, droughts had completely dehydrated the lake, driving the local population to seek subsistence from other resources (Figure 4). A return of precipitation in the last 15 years has added about six percent of former surface area to the lake. Moreover, long-term restoration of Lake Faguibine had been unsuccessful (Djoudi & Brockhaus, 2011). This clearly demonstrates that the signature left behind by climatic disaster (droughts) and heavy socioeconomic impacts on humans.

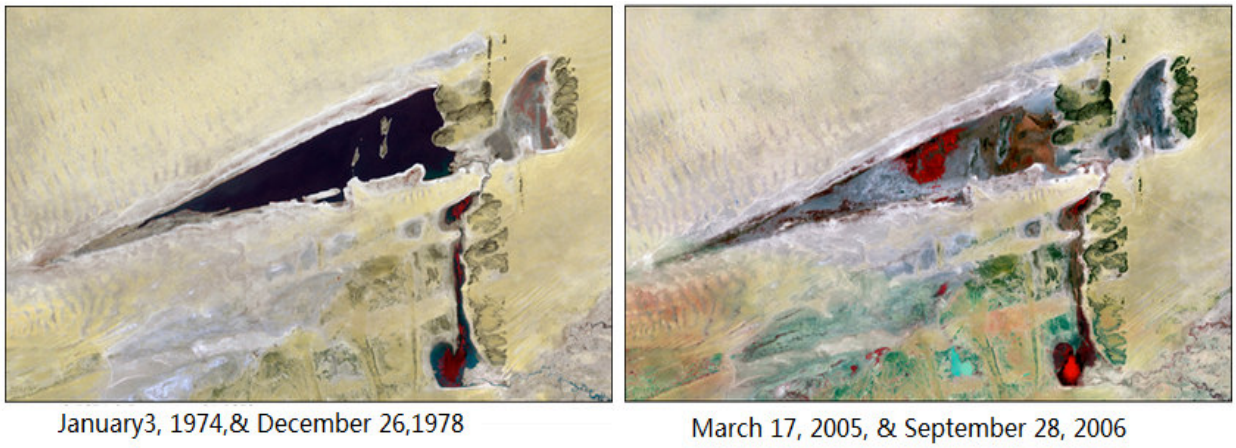

Figure 4: Changes of Lake Faguibine over time due natural disaster
Source: http://earthobservatory.nasa.gov/IOTD/view.php?id=8991 (Retrieved 02/01/2015)

2.3.4 Lake Assal

With increasing temperatures peaking51.66 degree Celsius during the summer periods, the evaporation of Lake Assal is an inevitable reality (Welland, (2009). Basined in a volcanic crater, the body of water is believed to have been divided from the great Indian Ocean and the Gulf of Aden, by lava flows. In such harsh conditions, Lake Assal receives little rainfall runoff to gauge its basin. Rather, its volume is replenished through subsurface water flow from the adjacent gulf. It is one of a few lakes that have not shrunk because of water diversion. The lake still plays an important natural resource for the local economy. Lake Assal is 10 times more saline than marine water, and its salt is gathered for distribution across Africa and Europe (Montaron & Tapponnier, 2010) (Figure 5).

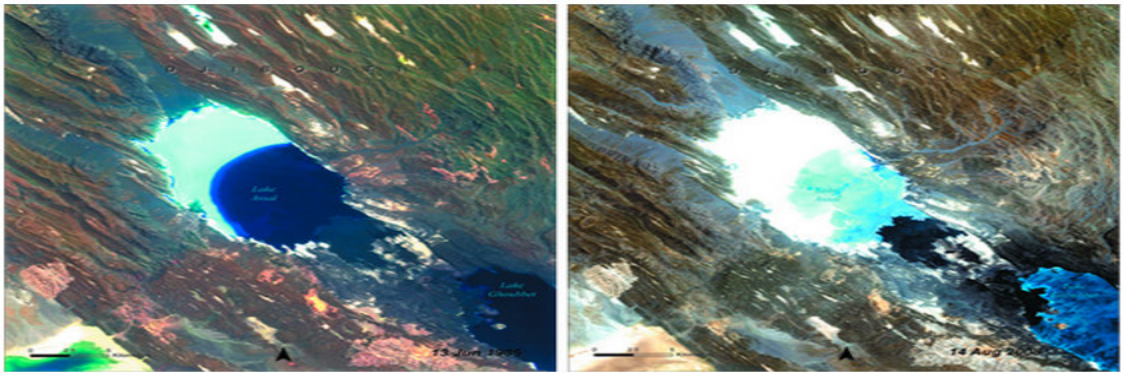

Figure 5: Lake Assal with increasing salt importance
http://mentalfloss.com/article/56732/10-lakes-are-disappearing-or-already-gone (Retrieved 02/01/2015)

3. The nexus between natural disaster, water resources and poverty

Except in the equatorial region and coastal areas of eastern and southern Africa, the rest of the African continent spans from dry sub-humid to arid. With continuous global warming, soil moisture and runoff in the sub-humid zones will further decrease due to high temperatures and evaporation. Africa has the lowest conversion factor of rainfall to runoff in the world (15 percent), and the situation is rapidly getting worse. There has been a reduction in runoff of 17 percent in the past decade. Indeed, Omoruyi & Ngoran (2014) found out that the southern Africa region will experience the greatest reduction in runoff by the year 2050, increasing the number of states included in the water stress category (using a per capita water-scarcity limit of 1,000 cubic meters per year). Similarly, Chhibber et al. (2008) estimated that between 2000 and 2025, the number of SSA countries enduring water stress will increase from 8 to 18 and the population affected will further swell in size, reaching approximately 600 million. This relative scarcity of water is also as a result of rapid population growth. Poor people are likely to be the most affected, since they have limited access to water resources. Also, rarity of water resources can potentially impact the entire economy of a country. Water resources oriented industries (agriculture, aquaculture, tourism etc.) are among those heavily threatened by the scarcity of water, especially in drought scenarios (Rijsberman, 2006). In Ghana, the exceptional drought of 1982–83 obliged electricity rationing until 1986, which stresses the necessity to develop alternative sources of energy.

Droughts (periods of prolonged dryness or prolonged water scarcity) and floods (periods of sporadic water abundance) alone account for 80% of the loss of life and 70% of the economic losses in SSA (Sivakumar,

2005; Shiferaw et al., 2014). Frequent drought conditions have reduced the GDP growth of several SSA countries (Nyong et al., 2007; Shiferaw et al., 2014) and threatened their development gains (Hellmuth et al., 2007). The consequences of drought can either be direct and indirect. Directly, drought affects production, lives, livelihoods, health, infrastructure and assets which lead to food insecurity and increasing poverty (see Table 1). Indirectly, drought results in environmental degradation and therefore, reduce household welfare via its impact on crop and livestock prices could be greater than its direct effects (Enfors & Gordon, 2008) (Figure 6). In the past five decades, drought has become a major challenge of many SSA nations and it has resulted in the depletion of assets, ecological degradation, impoverishment and unemployment (Hanjra et al., 2009).

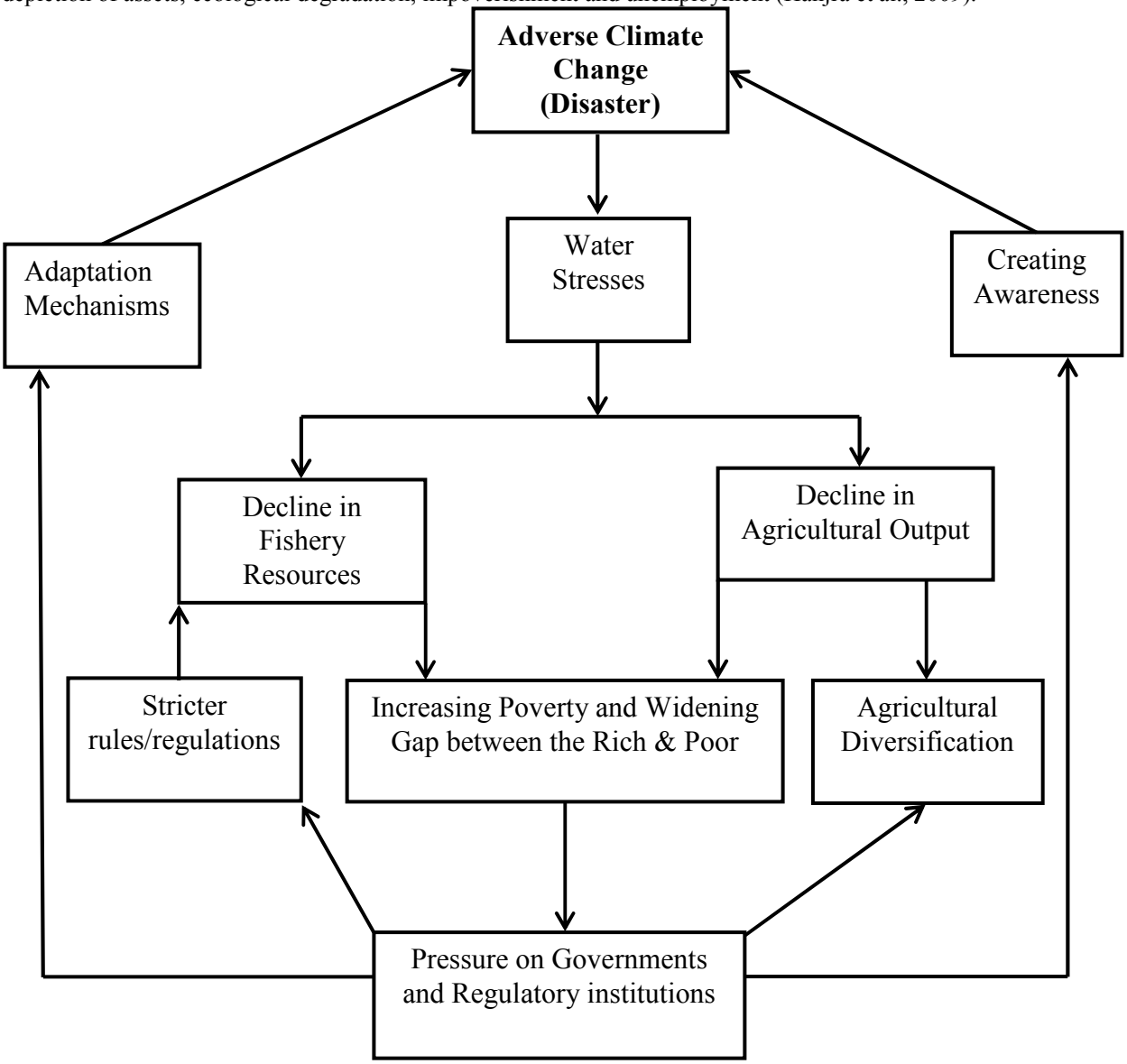

Figure 6: Disaster scenario and ramifications

Table 1: Hydro-climatic disaster (droughts) and socio-environmental impacts

Primary impacts	Secondary impacts
Social	
Disrupted distribution of water resources	Migration, resettlement, conflicts between water users
Increased quest for water	Increased conflicts between water users
Marginal lands become unsustainable	Poverty, unemployment
Reduced grazing quality and crop yields	Overstocking; reduced quality of living
Employment layoffs	Reduced or no income
Increased food insecurity	Malnutrition and famine; civil strife and conflict
Increased pollutant concentrations	Public health risks
Inequitable drought relief	Social unrest, distrust
Increased forest and range fires	Increased threat to human and animal life
Increased urbanization	Social pressure, reduced safety
Environmental	
Increased damage to natural habitats	Loss of biodiversity
Reduced forest, crop, and range land productivity	Reduced income and food shortages
Reduced water levels	Lower accessibility to water
Reduced cloud cover	Plant scorching
Increased daytime temperature	Increased fire hazard
Increased evapotranspiration	Crop withering and dying
More dust and sandstorms	Increased soil erosion; increased air pollution
Decreased soil productivity	Desertification and soil degradation (topsoil erosion)
Decreased water resources	Lack of water for feeding and drinking
Reduced water quality	More waterborne diseases
Economic	
Reduced business with retailers	Increased prices for farming commodities
Food and energy shortages	Drastic price increases; expensive imports/substitutes
Loss of crops for food and income	Increased expense of buying food, loss of income
Reduction of livestock quality	Sale of livestock at reduced market price
Water scarcity	Increased transport costs
Loss of jobs, income and property	Deepening poverty; increased unemployment
Less income from tourism and recreation	Increased capital shortfall
Forced financial loans	Increased debt; increased credit risk for financial institutions

Source: Gbetibouo, (2009).

In an advent of natural disaster, access to safe water might jeopardize and therefore pave the way for waterborne diseases. The most documented and commonly occurring diseases after disaster scenarios are water-borne diseases (diarrhoeal diseases and Leptospirosis). Diarrheal disease outbreaks occur when drinking water is contaminated and drank by people causes of floods. The risk linked to diarrheal disease outbreaks following natural disasters is higher in developing countries as compared to developed countries. Diarrhoeal diseases cause over 40 percent of the deaths in disaster and refugee camp settings (Cronin et al., 2008). Diarrhoeal outbreaks have also been attributed to shared water containers and cooking utensils, scarcity of sanitizers (detergent, soap etc.) and soiled food, as well as pre-existing contaminated sanitary infrastructures, sewerage systems and water supply.

Hepatitis A and E are other prevalent waterborne diseases the sometimes precedes a natural disaster.

Hepatitis A and E are also transmitted by the fecal-oral route, in association with inadequate access to safe/portal water and sanitation. Hepatitis A is endemic in especially in developing nations, and most children are exposed and develop immunity at an early age. As a result, the risk for large outbursts is most often minimal in these settings. In hepatitis E–endemic zones, outbreaks are frequently followed by torrential rains and floods; the illness is generally mild and controllable, but in the case of pregnant women, mortality rates can attain 25 percent (Anyamba et al., 2010). With flood events, outbreaks of hepatitis E have been reported in Chad and Cote D'Ivoire. Hepatitis E was also responsible for 66 percent of acute sporadic hepatitis cases in Chad, at least 22 percent of such cases in Cote d'Ivoire, and 44 percent of acute hepatitis cases in one study in Senegal. A case-series and a case report of hepatitis E from Nigeria have been published (Nelson et al., 2011).

Leptospirosis is an epidemic-prone zoonotic bacterial disease that is transmitted by direct contact with contaminated water especially during floods (Lau et al., 2010). Rodents extrude large amounts of leptospires in their urine, and transmission occurs via contact with the skin and mucous membranes with water, vegetation or damp soil or mud contaminated with rodent urine (de Vries et al., 2014). Flooding especially during disaster, enables spread of the organism because of the multiplication of rodents and their nearness to the population shared high ground. Outbreaks of leptospirosis occurred in Ghana (7.8% in febrile hospital admissions (ELISA) 2010), Ethiopia 47.5% using rapid serological diagnosis in febrile patients, Mayotte 45 cases per 100,000 persons and in Seychelles 60 - 101 cases per 100,000 persons (Halliday et al., 2013).

Some water resources are potential natural disasters. For instance, the Lake Nyos, Cameroon, a volcanic lake, erupted in 1986 and killed almost 1,800 people, more than 3,000 cattle and numerous wild animals, birds and insects[1].The main eruption of gas was accompanied by a tsunami with a wave height of about 20m. The release of CO_2 from the lake was caused by a phreatic explosion, which mobilized accumulated gas at the bottom of the lake (Othman - Chandev, 1987). This disaster reaped-off the survivors of the Nyos community from their daily subsistence and aggravated poverty (See Figure).

Figure 7: The eruption of Ladeathyos gassed castle to death
http://www.neatorama.com/2007/05/21/the-strangest-disaster-of-the-20th-century/ (Retrieved: 10/12/2014)

4. Conclusion

In this study, we have covered the triangular relationship between water resources, poverty and natural disaster. It is ascertained that few works address the impact of natural disaster on water and eventually how this influences livelihood strategies. Bearing in mind that the poor are those who mostly inhabit disaster prone-zone, depend on doubtable sources of drinking water, there are likely to be exposed to disaster eventual disease. Against this backdrop, poor people are not expected to escape or break the poverty circle any time soon. Since, SSA lags behind in terms of scientific knowhow to predict and provide solutions as regards disaster management; the challenge will further be compounded. Therefore, awareness on water-disaster-poverty nexus needs to be raised. SSA policy-makers are called upon to invest in disaster forecast technologies and science and innovations that seek to understand the impact of natural disaster on water resources.

[1]http://www.neatorama.com/2007/05/21/the-strangest-disaster-of-the-20th-century/ (retrieved 10/12/2014)

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