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Drought and Flood Vulnerability in Kenya: What Needs to be Done?

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This policy brief highlights the findings of a study undertaken by KIPPRA to examine the nature and distribution of droughts and floods which are the dominate natural disaster in Kenya. A better understanding of these events is important in designing measures at the three phases of disaster risk reduction, namely: preparedness (before disaster), response (during disaster) and recovery (after disaster).

Kenya, like the rest of the Horn of Africa, is highly vulnerable to droughts and floods which result in severe humanitarian crisis. Drought refers to deficiency of precipitation over an extended period, usually a season or more, which results in a water shortage for some activity, group, or environmental sectors. Floods, on the other hand, are temporary inundation of water from a river, stream, lake, ocean or flash floods onto lands not normally covered by water.

The impacts of these climate extreme events are increasing exponentially, with immense costs to the economy and communities alike. Their occurrence is associated with a low performance of key economic sectors such as agriculture, energy and infrastructure which in turn negatively affects overall economic growth. Similarly, livelihoods of communities undergo major disruptions whenever a climate disaster occurs. This is particularly so in rural poor communities where natural resources comprise a big share of livelihoods. Direct impacts include destruction of properties and assets, infrastructure and at times loss of lives. When they occur in quick succession, climate extremes erode the adaptive capacity of the country and/or communities since there is no adequate time to recover from the previous one.

Several projections suggest that droughts and floods will likely become more frequent in Kenya because of climate change. This means that associated impacts will jeopardize the country's development goals as outlined in Kenya Vision 2030 and make it more difficult for the country to achieve the sustainable development goals. Importantly, such scenarios will weaken the capacity of the communities to cope using their own means, necessitating some form of social protection and a shift in public resources from development investment.

Climate impacts in Kenya are aided by human factors. For example, rising floods can be attributed to poor spatial planning of urban areas, land use change, poor watershed management, and decline in recharge of groundwater by extension of impermeable surfaces in urban areas. Low investments in infrastructure in drought-prone areas, and poor contingency planning also contribute to severity of droughts.

Responding to Climate Extremes

As a response to the 2010/11 drought, Kenya organized a summit for leaders of governments and states from Inter-Governmental Authority for Development (IGAD) region under the theme enhanced partnership to eradicate drought emergencies. The summit came up with a Nairobi strategy with twin track approach to drought risk management that emphasized preventive rather than reactive, and holistic rather than emergency oriented drought risk management. It resolved that droughts need

not, and should not, lead to famine and other disasters.

Under the ending-drought-emergency common programme framework, the government developed a sector plan for drought risk management and ending drought emergencies, 2013–2017, with a goal of ending drought emergencies by 2017. It aimed to strengthen people's resilience and strength monitoring of, and response to, droughts. Regarding institutional development, the National Drought Management Authority (NDMA) was established through Legal Notice No. 171 of 24 November 2011 (repealed through the NDMA Act, 2016) with the overall mandate to coordinate all matters relating to drought management in the country.

Initiatives made at the regional and national level buttress commitments made internationally on disaster risk reduction under the Hyogo Framework for Action (HFA) 2005-2015, and her successor the Sendai Framework for Disaster Risk Reduction 2015-2030. The goal of the latter framework is 'substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries'.

Despite government efforts, evidence from the 2016/17 drought, and the 2018 floods that affected many parts of the country, show that climate extremes remain an emergency in the country. Existing management approaches are largely reactive in design rather than preventive.

The ability to anticipate and respond to droughts before they occur can be strengthened through a better understanding of their distribution across space and time. However, low density of weather stations in the country's agro-climatic zones coupled with high data gaps constrain the use of observed data to monitor climate extremes across space and time.

This policy brief explores the use of satellite data to assess the patterns of drought and floods in Kenya's agro-ecological zones.

Distribution of Droughts and Floods Across Kenya's Agro-climatic Zones

Rainfall data between January 1981 and December 2015 was obtained from Climate Hazards Group InfraRed Precipitation with Stations (CHIRPS) database covering Garissa, Turkana, Makueni and Kakamega counties. The counties represent Kenya's main agro-climatic zones of very arid, arid, semi-arid and humid and semi-humid, respectively.

CHIRPS data was downloaded from http://chg.geog.ucsb.edu/data/chirps/ and transferred to GIS platform. The data was projected and clipped using county boundaries before extracting rainfall values to tables to enable analysis in excel. Data from the pixels in each county was averaged to obtain monthly rainfall after which it was transformed into a gamma distribution function to generate Standardized Precipitation Index (SPI). The drought conditions were categorized using World Metrological Organizations schemes (as shown in the Table below).

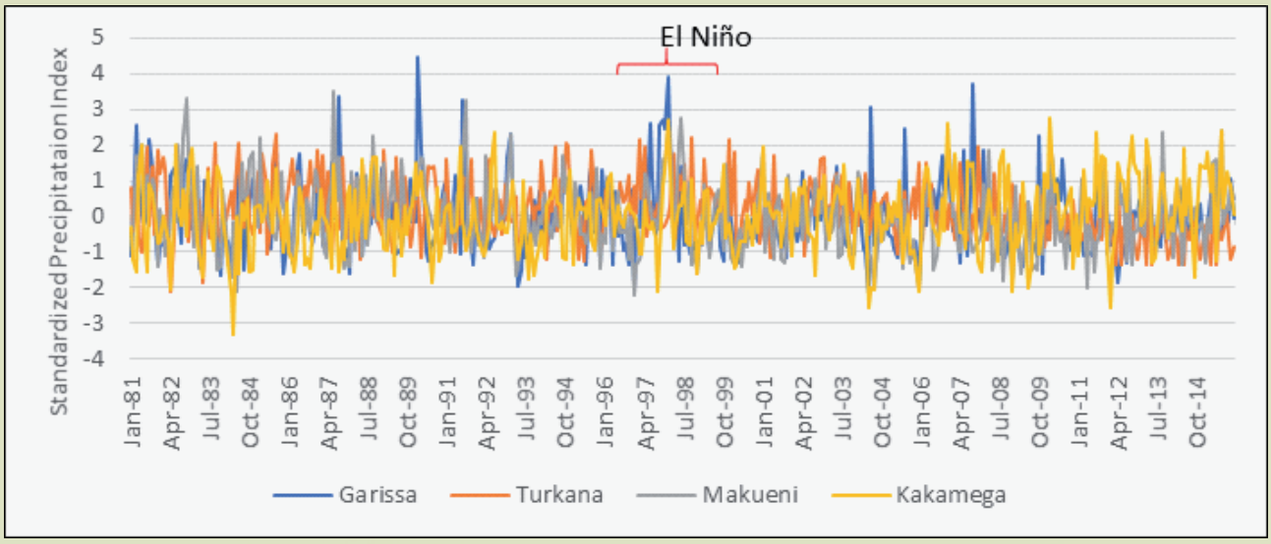
Scheme for categorizing drought conditions

SPI value	Drought category
>2.0	Extreme wet
1.5 - 1.99	Very wet
1.0- 1.49	Moderate wet
0.99 - -0.99	Near normal
-1.0 - - 1.49	Moderate wet
-1.50 - -1.99	Severe drought
< -2.0	Extreme drought

The results of the SPI analysis show that out of a total of 420 months analyzed, 44 per cent were categorized as flood months while 36 per cent were drought months as shown in the chart below. Twenty-seven (27) months experienced extreme wet conditions (with SPI value > 2), suggesting likelihood of flooding while 14 months recorded extreme drought with SPI value <-2). Unlike conventional thinking that climate extremes are exclusive to ASALs, the results show that the occurrence of these events are widespread, affecting all agro-climatic zones. Indeed, Kakamega, representing humid to semi-humid counties, experienced extreme droughts throughout the period under review, followed by Makueni and Garissa.

The highest extreme wet conditions were recorded in Garissa with SPI values of 4.44 in February 1990, 3.89 in January 1998, and 3.70 in September 2007. Extreme droughts were recorded in Kakamega in April 1984 (SPI, -3.30), January 2012 (SPI, -2.57) and May

Trends in droughts and floods in Kenya between 1981 and 2015



2004 (SPI, -2.54). Thus, despite the localized nature of floods, whenever they occur their intensity is higher compared to droughts. The concentration of high SPI values in between February-May 1998 corresponds to the El niño phenomena that hit the country with adverse consequences on the economy.

The occurrence of extreme floods is rather sudden as extreme months are seldomly followed by severe or moderate wet conditions. This characteristic makes monitoring of floods extremely difficult, unlike drought which creeps in slowly. Another finding from the analysis relates to the duration of the occurrence of the event. While floods are more extreme, they last a relatively short time compared to the dry spells.

In the period prior to 2007, Garissa County experienced extreme wet conditions compared to the rest of the zones, but Kakamega and Makueni recorded extreme wet conditions in the years thereafter. This suggests a shift in vulnerability in flooding from very dry to humid and semi-humid zones in Kenya. Surprisingly, the results for Turkana show a consistent shift towards dry conditions, pointing to encroachment of desert-like conditions southward of the county.

The stationary nature of the SPI values across the agro-climatic zones reveals that prolonged dry spells and wet conditions occur in quick succession. What this means is that the affected society, economy and environmental systems are knocked off their feet by one shock without adequate time to bounce back before the next one hits. Most projections agree that the frequency and intensity of droughts and floods will likely increase in future due to climate change and result in rising vulnerability.

In terms of decadal comparisons, the period 1980s experienced on average 6.4 extreme wet months and 4.0 extreme dry months, and 0.9 mild while the decade 2010 had update 2015 recorded an average of 6.6 extreme wet conditions and 6.2 extreme dry spell. This confirms that climate extremes will likely become more frequent and more severe under current changing climate regime. Even with response actions, it will not be possible to completely avoid the associated risks.

Conclusions and Policy Implications

The preliminary analysis presented in this brief show that drought and floods pose a serious threat to Kenya's socio-economic transformation. Indeed, with projections predicting a rise in both the frequency and intensity of these events, it will be increasingly difficult for the government to realize the "Big Four" agenda and the overall Vision 2030 targets. The period after year 2000 is characterized by shifting patterns of these climate driven events, with Turkana and Garissa experiencing reduced wet conditions while Kakamega is gravitating towards more humid conditions. In other words, dry zones are becoming drier and humid zones more humid. These findings amplify what scientists generally

view as the creeping in of the desert southwards. Such patterns make Kenya unique in the East Africa region and presents opportunities for a holistic approach to disaster management; one that straddles the country's agro-climatic zones.

Opportunities exist for reducing the country's vulnerability and exposure to extreme events by pursuing many measures, which target the underlying drivers of risks. These include but not limited to the following;

1. Strengthen monitoring/assessment of drought and floods through better early warning system (EWS) to inform preparedness, response and recovery efforts spanning from local to national level. This requires the Kenya Meteorological Department to increase the network of weather stations to generate data across the various agro-climatic zones. EWS should be localized considering Kenya's different agro-climatic zones.

2. There is need to pursue economic and urban development choices which are less vulnerable to floods and droughts. This will entail reducing the dominance of climate sensitive sectors in the economy and improving physical urban planning to open water ways. For example, developing and enforcing spatial plans covering rural and urban areas will be an important starting point towards flood management.

3. Investment in infrastructure and human capital development will be key in developing the necessary capacity for disaster preparedness, response and in recovery. With likely increase in these events, efforts should be made to revisit the design and building codes to ensure they are climate-proofed so that they can withstand extreme weather conditions. Further, including disaster risk management in professional training will ensure that they are integrated in all aspect of economic planning.

4. Another area requiring attention is curbing the degradation of the environment through integrated land and water management, including irrigation. The goal is to let the environment continue playing her role in reducing the adverse effects of floods and droughts. Thus, efforts to reclaim lost forests should be expedited alongside programmes to increase the country's tree cover. Other critical resources such as wetlands should also be secured to enable them perform their flood mitigation functions.

5. Finally, there is need to strengthen institutional frameworks at national and county government level. These are essential in ensuring better management of floods and drought emergencies. The functions as assigned in Schedule IV of the constitution should be fully operationalized by encouraging county governments to put in place the necessary frameworks for disaster management. At the national level, given the intertwined nature of floods and drought, the mandate of NDMA should be extended to cover flood management as well.

Further reading

Government of Kenya (2013), Sector Plan for Drought Risk Management and Ending Drought Emergencies: Second Medium Term Plan 2013–2017. Nairobi: Ministry of Devolution and Planning.

Government of Kenya (2015), Ending Drought Emergencies Common Programme Framework. Nairobi: Ministry of Devolution and Planning.

United Nations (2015), Sendai Framework for Disaster Risk Reduction 2015 - 2030. https://www.unisdr.org/we/inform/publications/43291

About KIPPRA Policy Briefs

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