Qualitative Assessment of the Impact of Droughts and Floods on Key Macroeconomic Variables

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Kenya Institute for Public Policy
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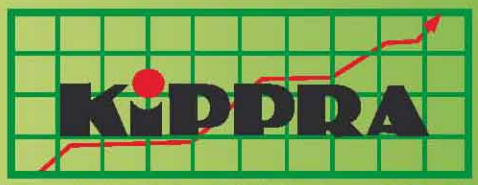

The KENYA INSTITUTE for PUBLIC POLICY RESEARCH and ANALYSIS

Qualitative Assessment of the Impact of Droughts and Floods on Key Macroeconomic Variables

Naomi Mathenge

DP/236/2020

THE KENYA INSTITUTE FOR PUBLIC POLICY RESEARCH AND ANALYSIS (KIPPRA)

Abstract

Adverse weather conditions have become more prevalent all over the world with devastating impact on economies. In Kenya, weather conditions are manifested in frequent occurrence of droughts and floods, and while droughts are widespread throughout the country, floods tend to be localized. The economic effects of droughts and floods are manifested in the disruption of production flows, resulting in production losses, income losses, loss of employment and increased operational costs. Droughts and floods do not occur in isolation and at times occur alongside other events, such as political unrest, high international commodity prices, etc. In this study, we identify patterns of disruption of production flows, decline in revenues and higher operational costs that typify disaster periods. Results show that the macroeconomic imbalances that result from drought and floods, though temporary in nature, arise either directly from the disasters and/or from governments' effort to mitigate the economy against the negative effects of the disasters. These impacts are manifested in increased government expenditure targeted at building resilience and mitigation measures, reduced government revenue from a decline in tax revenue collections, increased imports of food stuffs and price increases.

Abbreviations and Acronyms

ASALs	Arid and Semi-Arid Lands
CBK	Central Bank of Kenya
CHIRPS	Climate Hazards Group InfraRed Precipitation
COMESA	Common Market for Eastern and Southern Africa
FAO	Food and Agriculture Organization
FTA	Free Trade Area
GDP	Gross Domestic Product
ICT	Information and Communication Technology
KMD	Kenya Meteorological Department
KNBS	Kenya National Bureau of Statistics
NDMA	National Disaster Management Authority
NEMA	National Environmental Management Authority
SAM	Social Accounting Matrix
SPI	Standardized Precipitation Index
VAT	Value Added Tax

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1. Introduction

Output volatility is a key challenge in many developing countries, Kenya included. Among other factors, the macroeconomic environment plays a major role in determining the level and growth of output in a period. The stability of the macroeconomic environment, which ensures its predictability for supporting production, investment and ultimately growth cannot be overstated. Faced by frequent instabilities, a country's growth prospects can be greatly hampered. There are many factors that can either shape or destabilize the macroeconomic environment in a given country, and which emanate either domestically or externally. Among the factors that can bring about instability are climate change shocks that result in adverse weather conditions.

Adverse weather conditions have become more prevalent all over the world with devastating impacts on economies. In Kenya, adverse weather conditions are manifested in frequent occurrence of droughts and floods, and while droughts are widespread throughout the country, floods tend to be localized. Data obtained from Climate Hazards Group InfraRed Precipitation with Stations (CHIRPS)[1] shows that there has been an increase in frequency of occurrence of drought months in Kenya, ranging from mild to extreme drought. For example, in the 1980s, there were two extreme drought months, three extreme drought months in the 1990s and four extreme drought months in the 2000s. Between 2010 and 2015, the country experienced five extreme drought months. Additionally, data from the Kenya Meteorological Department (KMD) identifies 2017 as a severe drought year. Floods, though, do not exhibit a pattern but have become more frequent. The same data sources (CHIRPS and KMD) identify 1997/98, 2000, 2003, 2006, 2010, 2016 and 2018 as flood years.

The economic effects of drought and floods are manifested in the disruption of production flows resulting in production losses, income losses, loss of employment, and increased operational costs. These effects are compounded by lack of and/or inadequate infrastructure development such as storage facilities that can absorb surpluses during bumper harvests. Both droughts and floods do not occur in isolation but at times they occur in presence of other events that have effects on the economic system. These effects can either emanate externally, e.g. global downturns, changes in commodity prices, changes in aid flows or internally e.g. political instability, among others. This complicates the task of disentangling economic losses caused by droughts and floods from losses brought about by these other events. However, it is possible to identify patterns in the disruption of production flows, decline in revenues and higher operational costs that typify disaster periods.

1 http://chg.geog.ucsb.edu/data/chirps/

The economic structure in Kenya is such that its output is highly reliant on the agricultural sector, which largely depends on the prevailing weather conditions. Statistics show that the contribution of the agricultural sector to GDP averaged 25.9 per cent between 2002 and 2017 (KNBS), various Economic Survey). In analyzing the effect of drought and floods on the economy, we therefore place great emphasis on the effect of drought and floods on the sector. However, we also consider some of the other sectors whose output also depends on the prevailing weather conditions, e.g. hydroelectricity supply. In any given economy, there are backward and forward linkages among the sectors and Kenya is no exception. While some sectors (e.g. manufacturing) may not be directly affected by neither floods nor drought, their linkages with sectors directly affected (e.g. agriculture, transport, hydroelectricity production, etc) means that their output will also be affected. For this reason, we also consider these sectors.

The macroeconomic imbalances that result, though temporary in nature, arise either directly from the natural disasters and/or from government's efforts to mitigate the economy against the negative effects of drought. The main imbalances occur in the fiscal and the external sectors. Directly, natural disasters reduce government revenues following decreases in tax revenue collections brought about by production losses and destruction of productive fixtures. Expenditures also increase, especially expenditures related to building resilience and mitigation measures necessitated by the disasters.

While the country cannot avoid these disasters, it can be well prepared for their impact depending on the nature of their occurrence. Drought, for example, can be forecasted; its onset is not abrupt but slow compared to floods. This means that precautions against the adverse effects of drought can be taken. Policies can thus be put in place to cushion the economy from the devastating effects. Importantly, macroeconomic stability needs to be maintained as it is a necessary condition for the overall performance of the economy. This paper quantifies the impact of both floods and droughts on the economy, while stressing the macroeconomic imbalances that result thereof. By doing this, the paper aims to inform policy makers not only of the impact of the disasters, but also on the need for deliberate action to minimize the impacts while building resilience for all agents including households and firms.

The approach used for the analysis is qualitative. The study identifies patterns in the disruption of production flows, decline in revenues and higher expenditures that typify disaster periods. It also identifies changes in macroeconomic variables observed during disaster periods.

The rest of the paper is organized as follows. Section 2 identifies the drought years while section 3 presents an assessment of the economic losses from droughts and

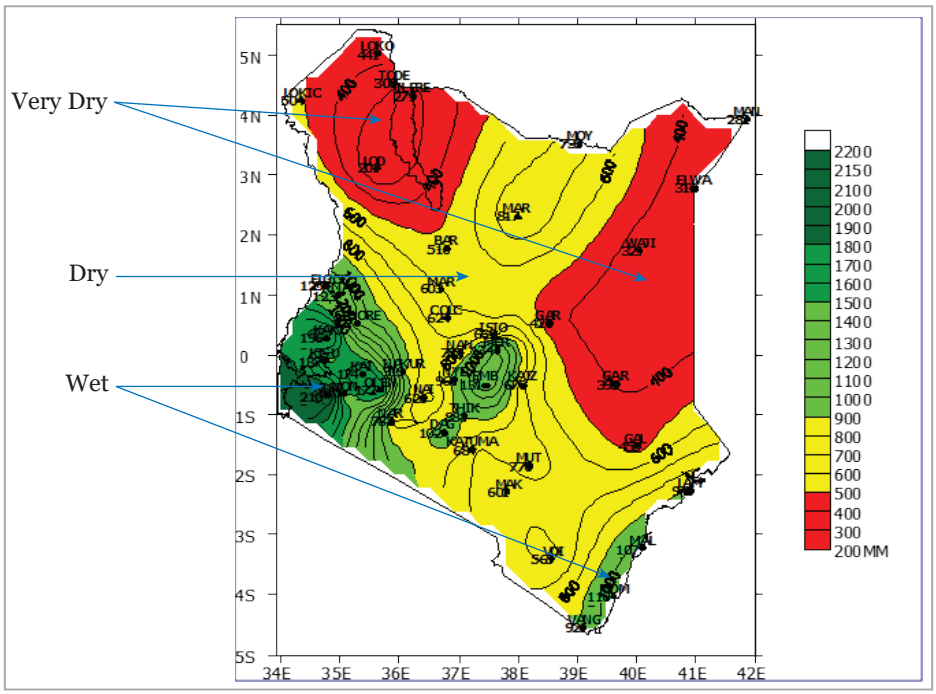
floods on selected sectors of the economy, and the macroeconomic imbalances that result. Section 4 concludes.

2. Identifying Drought Years

The land area in Kenya is 20 per cent semi-arid and 60 per cent arid and only 17 per cent of the country receives an average rainfall of 800mm per annum, the minimum required for rain-fed agriculture (NEMA, 2011). That Kenya is 80 per cent arid and semi-arid lands (ASALs) means that the country is highly vulnerable to drought. Figure 1 shows the main ecological zones with the mean annual rainfall distribution. As can be seen, the largest surface area is either dry or very dry and therefore reliance on rain-fed agriculture could be detrimental for the country's food security. It also means that the occurrence of drought will have a large impact on a large section of the population, especially those living in ASALs.

Rainfall data from ASALs is heavily relied on in providing information on the occurrence and severity of a drought in Kenya. Figure 1 shows the spatial mean annual rainfall distribution in the country. It is divided into very dry, dry and wet regions, which represent the major agro-ecological zones in Kenya.

Figure 1: Spatial mean annual rainfall distribution

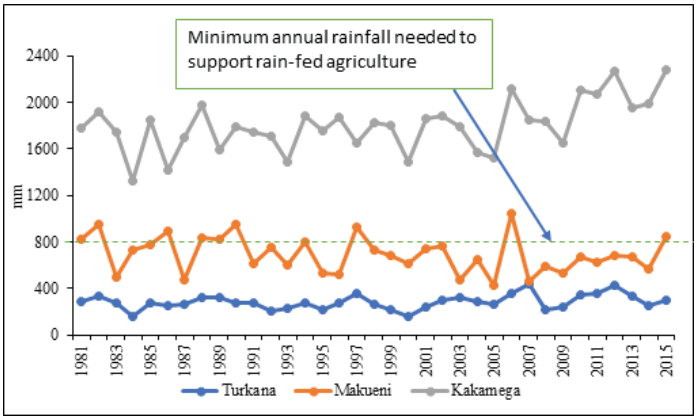


Source: Kenya Meteorological Department (KMD)

Drought years in Kenya are identified by the National Disaster Management Authority (NDMA), which is an agency of the Government of Kenya responsible for

monitoring drought in the country and ensuring that droughts do not result into emergencies. This was corroborated using the Standardized Precipitation Index (SPI) using data obtained from CHIRPS. Three counties (Kakamega, Turkana and Makueni) were selected from each of the above zones and their rainfall data used to calculate the SPI. Figure 2 shows the annual rainfall recorded for the three counties.

Figure 2: Rainfall distribution in selected counties



Source: http://chg.geog.ucsb.edu/data/chirps/

SPI is a normalized index that represents the probability of the occurrence of an observed rainfall amount compared with the rainfall climatology of a region observed over time (World Meteorological Organization, 2012). Its computation relies on monthly means of precipitation and its values can be either positive or negative. Negative values represent a deficit in rainfall while positive values represent surplus rainfall. For example, an SPI index greater than -2 represents extreme drought conditions while an SPI index greater than 2 represents flooding. It is therefore useful for providing information on meteorological drought. Table 1 below shows the various interpretations of the SPI index.

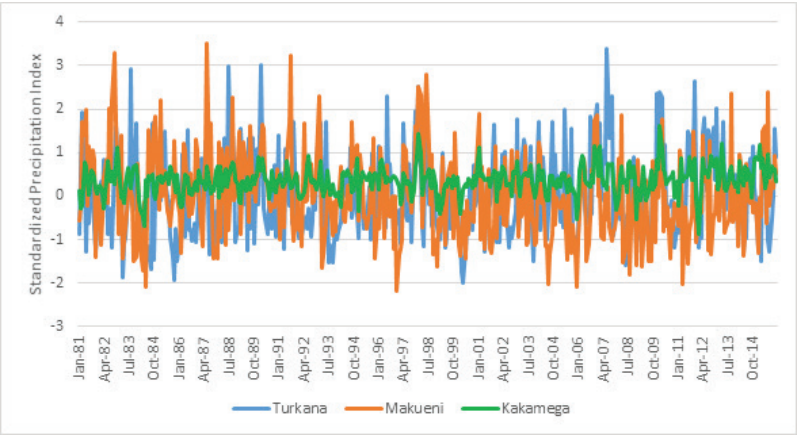
Table 1: SPI values

2.0 +	Extremely wet
1.5 to 1.99	Very wet
1.0 to 1.49	Moderately wet
-0.99 to 0.99	Near normal
-1.0 to -1.49	Moderately dry
-1.5 to -1.99	Very dry
-2.0 and less	Extremely dry

Source: World Meteorological Organization (2012)

From Figure 3, the SPI calculated from the three regions representing different agro-ecological zones shows that not all regions experienced drought or floods. For example, Kakamega, which represents the wet agro-ecological zone did not experience extreme drought conditions over the sample period compared to both Turkana and Makueni, which represent the very dry and dry agro-ecological zones. In these zones, conditions varied from flooding to extreme drought. From the figure, it is possible to identify drought periods for the different regions. For example, Makueni experienced more dry than wet periods between 2000 and 2014 compared to the 1980s and 1990s. It is only Kakamega that experiences near normal conditions. As noted earlier, ASALs, which comprise over 80 per cent of the total land surface area are normally used to identify drought periods in the country.

Figure 3: Variations of SPI in Turkana, Makueni and Kakamega



Source: Calculations based on data from http://chg.geog.ucsb.edu/data/chirps/

3. Estimating Economic Losses from Droughts and Floods

3.1 Sectoral Effects

The losses that occur on the productive sectors of the economy and the service sectors though difficult to isolate from other events[2] that could potentially have negative impacts can be estimated by comparing the output of non-disaster years[3] and the output of disaster years. This is akin to establishing a baseline (the pre-disaster output) and a post-disaster output. This is the approach used for the sectoral analysis and it is assumed will be a close approximation of the losses from both droughts and floods.

Ideally, a post-disaster scenario is best obtained from a survey. However, it is still possible to determine the effects on output following a disaster, but taking into consideration declines in production occasioned by the disaster. From this, and given the pre-disaster output, one can then estimate the losses by comparing the pre- and post-disaster outputs.

Data for this analysis is obtained from various annual Economic Surveys and Leading Economic Indicators from the Kenya National Bureau of Statistics (KNBS) and from the Central Bank of Kenya (CBK) websites. While not all sectors will be considered, we focus on a few sectors that have a significant contribution to GDP and those whose output is a key input in the production of output from other sectors, e.g. electricity generation. In selecting the sectors, we also considered sectors that indirectly impact on macroeconomic variables, for example sectors that will require increased imports to meet, for example, a shortfall in production as this will impact on the balance of trade. We are interested in estimating changes in production flows that arise from natural disasters.

3.1.1 Agriculture forestry and fishing sector

The agricultural sector is an important part of the Kenyan economy, contributing an average of 30 per cent of GDP[4]. Between 2013 and 2016, the sector accounted for an average of 20 per cent of the realized growth. Of the total private sector wage employment, the sector contributed 15.5 per cent in 2017 and was a major source of export earning, accounting for over 50 per cent of the total domestic export earnings (KNBS, 2018).

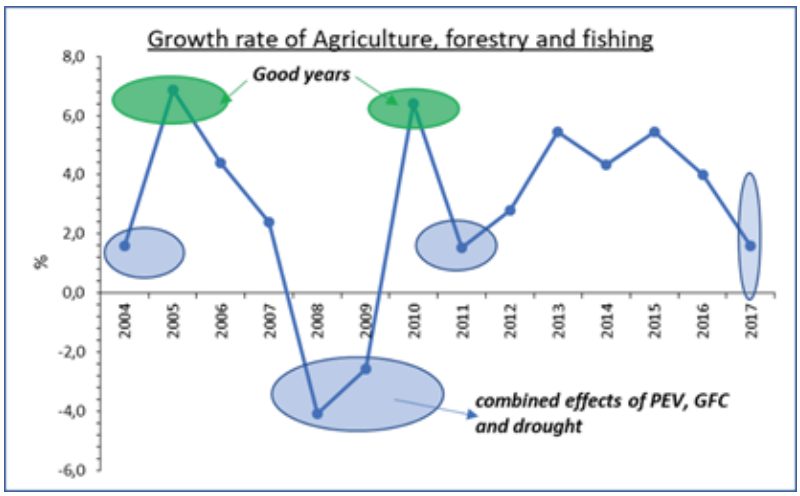
2 For example, election jitters by investors who hold back on investments awaiting election outcomes, post-election conflicts like the one experienced in 2007/2008.

3 Three-year average is considered a good approximation of the baseline.

4 The average contribution for 2013–2017 was 29.54 per cent as per Economic Survey, 2018.

Adverse weather conditions have had direct negative effects on agricultural production. Specifically, droughts have a more significant effect on production relative to floods because the onset of drought is slow and prolonged compared to floods which are abrupt and short lived. Figure 4 shows the growth rate of the sector from 2004 to 2017. Having earlier identified the drought years, we compare the growth of the sector in years when there was no drought (considered a good year). From the figure, we see that both 2005 and 2010 recorded positive growth rates of 6.9 and 6.4 per cent, respectively, compared to 2004, 2009, 2011 and 2017 with 1.6, -2.6, 1.5 and 1.6 per cent, respectively. We do, however, note that in 2008/2009, Kenya, alongside the global economy, went through the global financial crisis that started in the United States and spread across the globe. It is therefore possible that the negative effect in the agricultural sector may partly be attributed to depressed global trade as agriculture is a major contributor to export earnings. Likewise, there was the post-election violence experienced in the early part of 2008 that had a major negative effect on the sector. Nevertheless, comparing with other years when a drought was reported, there is a repeated pattern of dips in the growth rate, implying that there are significant losses from adverse weather.

Figure 4: Growth rate of the agricultural forestry and fishing sector

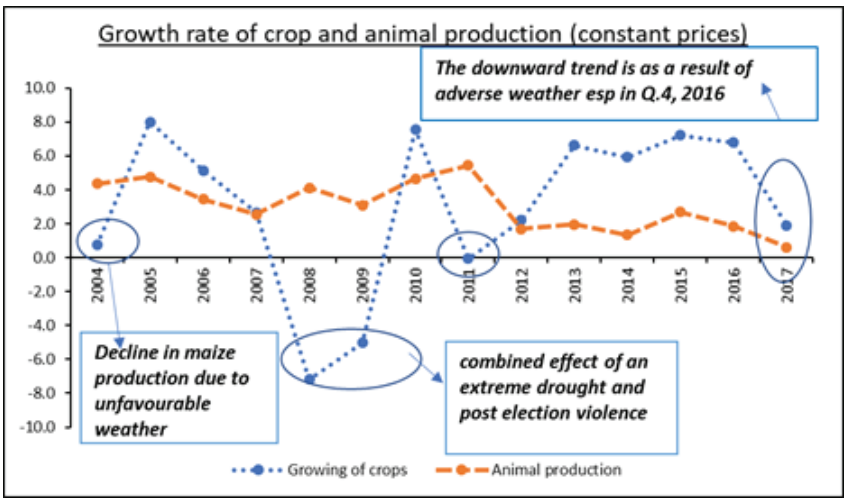


Data Source: KNBS (Various), Economic Survey

Figure 5 further highlights two of the sub-sectors in the agricultural sector; that is, crop and animal production. These two were considered as they make a greater

contribution to GDP compared to the others[5]. For crop production, it is observed that the overall pattern observed in the agricultural sector is replicated in this sub-sector. The decline in growth rates are, however, far greater. For example, while the growth rate in the sector was -2.6 and 1.5 per cent in 2009 and 2011, respectively, crop production grew by -5 and -1 per cent in the same period. Comparing with animal production, Figure 5 shows that although there were variations in the growth rate over the years, the effect in drought years is not as pronounced. It can therefore be deduced that crop production is affected more than animal production. However, there is an overall decline in animal production.

Figure 5: Growth rate of crop and animal production



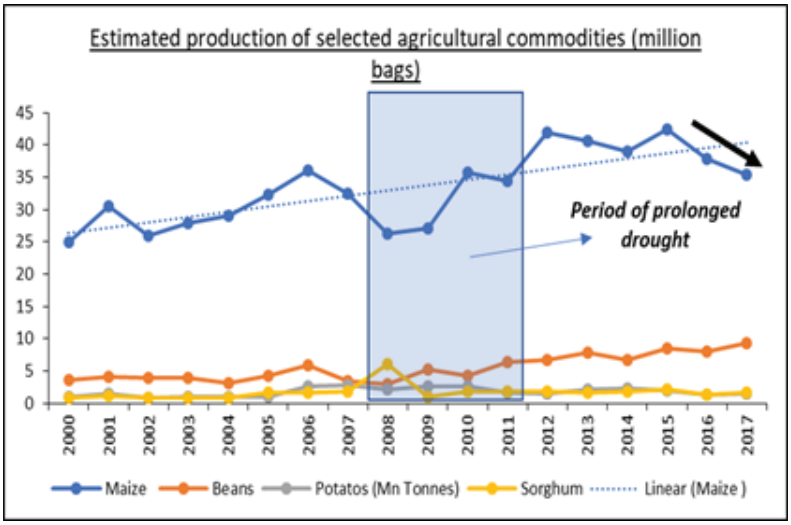
Data source: KNBS (Various), Economic Survey

Turning to specific crops, it is estimated that due to unfavourable weather conditions, maize production fell by 15 per cent in 2004 (KNBS, 2005). Other crops that registered declines in production include coffee and pyrethrum. Likewise, agricultural terms of trade declined during the period due to higher inputs and consumer goods prices relative to agricultural output prices. Figure 6 below, which shows the production of selected agricultural commodities, reveals the same pattern in maize production depicted from growth of the overall sector. We see that production from all crops declined in 2007 and this can be attributed to the election period, which was followed by post-election violence till March 2008. However, production of these commodities improved in 2008 except for dry beans and maize, which registered declines of 38 per cent and 19 per cent

5 The others include support activities to the agriculture sector, forestry and logging and fishing and aquaculture. For example, the average contribution of growing of crops and livestock was 22 per cent and 5 per cent, respectively, between 2013 and 2017, while support activities to the agriculture sector, forestry and logging and fishing and aquaculture contributed 0.6, 1.3 and 0.6 per cent, respectively.

respectively. While the political climate improved from the second quarter of 2008, this decline in maize and beans production can be attributed to adverse weather conditions that set in in 2008. This decline is again observed in 2011 and in 2016/2017.

Figure 6: Production of selected agricultural commodities (million bags)



Data source: KNBS (Various), Economic Survey

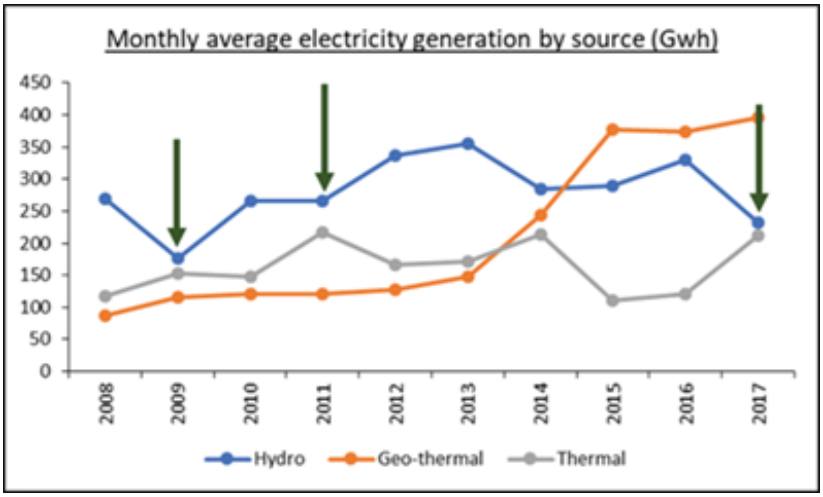
As will be shown later, the consequences of decreased food production are an increase in imports to cater for the shortfall and to ensure adequate food availability. For example, because of the impact of drought on crop production and livestock in 2016, the Food and Agricultural Organization (FAO) of the United Nations reported that about 2.7 million people were severely food insecure following the negative impact of poor 2016 "short-rains" (FAO, 2017).

3.1.2 Hydro-electricity production

Prior to 2014, the main source of electricity generation in Kenya was from hydro power generation. However, the latest data shows that renewable energy sources, mainly geothermal, are gaining prominence as important sources of electricity supply. Wind energy was also added to the grid in 2016.

It is expected that due to its reliance on adequate water, the quantity of hydro power is greatly reduced when the rains fail. As can be seen from Figure 7, the monthly average generation of hydro power declined in the reported drought years. Specifically, available data shows that 2009, 2011 and 2017 recorded declines in monthly averages of hydro power compared to the other years.

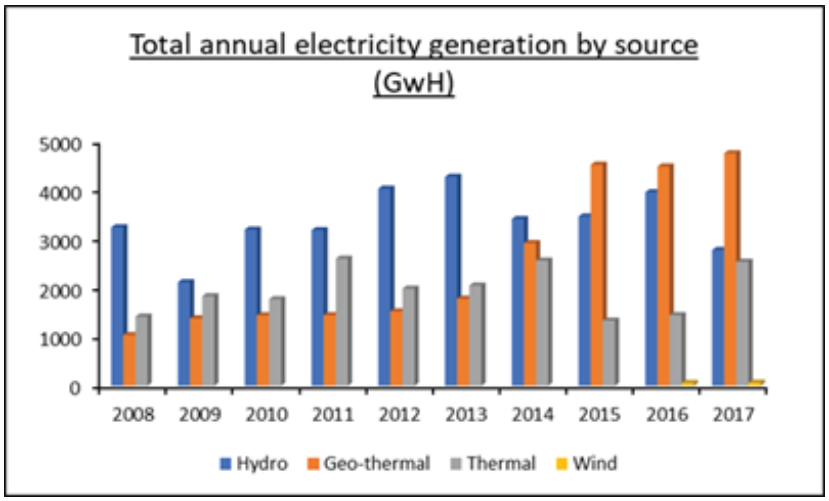
Figure 7: Monthly average electricity generation by source (Gwh)



Data source: KNBS (Various), Economic Survey

Likewise, the average monthly hydro electricity generation declined in 2009 and 2011, both extreme drought years.

Figure 8: Total annual electricity generation by source



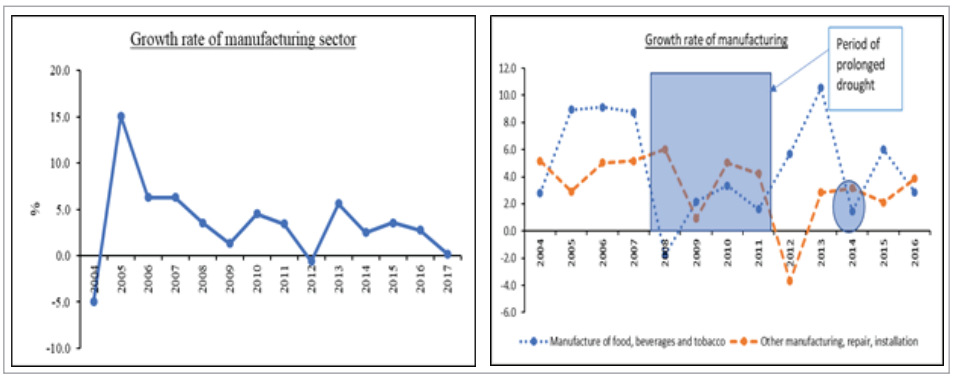
Data source: KNBS (Various), Economic Survey

3.1.3 Manufacturing sector

The manufacturing sector has linkages with the agricultural sector by way of provision of raw materials for the agro-processing industry. The sector is also highly affected by availability and cost of water and energy, which feed into the

cost of doing business. For example, data from the Kenya 2013 Social Accounting Matrix (SAM) shows that 38 and 53 per cent of the total intermediate consumption from the agricultural sector and electricity and water sector, respectively, went to manufacturing. We therefore expected the negative effects registered in the agricultural sector to spill over to manufacturing. As shown in Figure 9, there has been a general decline in the growth rate of the sector. However, this decline was more pronounced in 2009, 2011, 2012 and 2017. Except 2012, the rest were drought years. Looking at the components of the sector, manufacture of food, beverages and tobacco registered lower growth rates during the period of prolonged drought compared to other manufacturing, the latter being mostly affected in 2009.

Figure 9: Growth rate of manufacturing



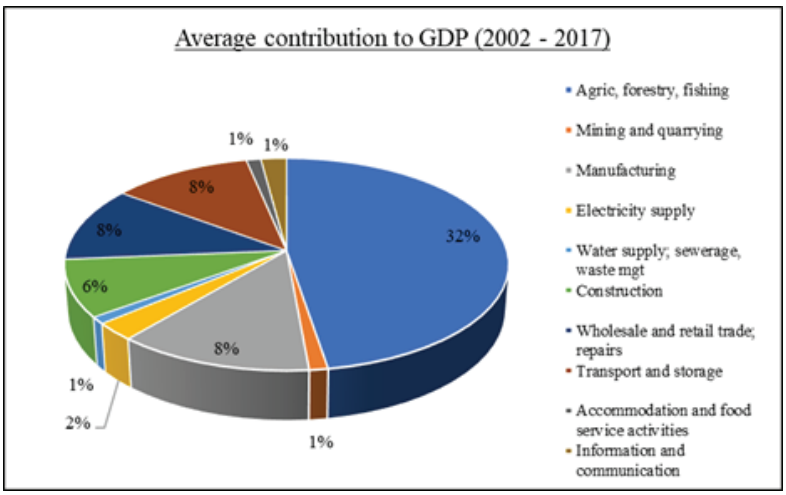
Data source: KNBS (Various), Economic Survey

3.2 Overall Effect on GDP

Economic growth in Kenya has been episodic. It can be deduced that growth prospects are dampened by drought, floods and political uncertainty. In this section, we present the economic losses arising from the effects of droughts and floods. First, we look at the contribution of selected sectors[6] to GDP. From Figure 10, we see that the agriculture, forestry and fishing sector has the highest contribution to GDP, followed by manufacturing, wholesale and retail trade, and transport and storage. An adverse effect on these sectors will thus have an adverse effect on the overall GDP given their importance in the economy. While the transport sector is not directly affected by drought, poor state of infrastructure especially in drought prone areas hampers effective preparedness, response and recovery efforts. Therefore, the effect of drought on the economy is made worse as response is slowed by poor infrastructure.

6 Only selected sectors are shown on the graph. These sectors, combined contribute 66 per cent to GDP.

Figure 10: Average contribution of selected sectors to GDP (2002-2017)

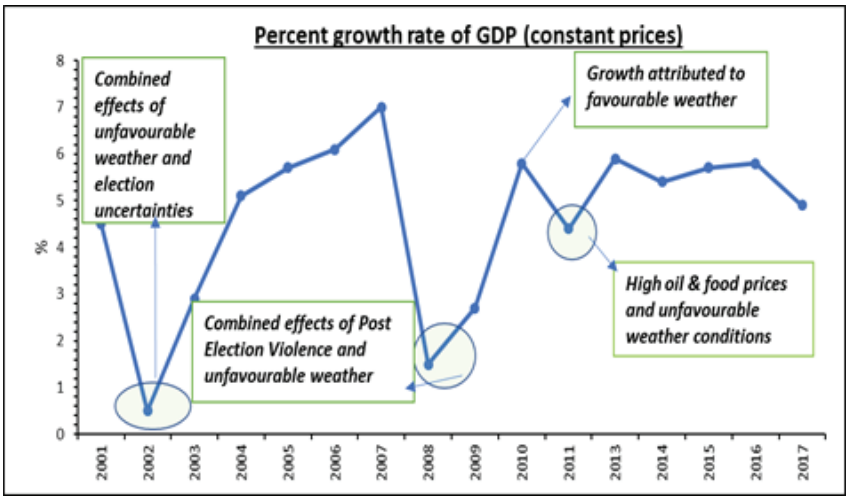


Source: KNBS (Various), Economic Survey

The overall effect of drought on economic growth was a pullback on the growth that would have been realized. For example, it is reported that during the drought of 2011, 0.2 per cent of GDP was lost, amounting to approximately Ksh 6.2 billion, while the drought of 2017 caused a one per cent pullback on GDP, amounting to approximately Ksh 71.6 billion (World Bank, 2011). A field survey carried out in 2011 by a joint assessment team drawn from the Government of Kenya line ministry staff, the World Bank, European Union, United Nations and other partners on post-disaster needs assessment for Kenya showed that during the 2008-2011 drought, the losses and damages incurred amounted to US$ 12.1 billion, with the livestock sector absorbing 72 per cent of the losses. What exacerbates the adverse effects is lack of preparedness and late response occasioned by poor road networks especially in the arid and semi-arid regions, which are the most vulnerable.

From Figure 11, economic growth is seen to decline during the years when there were unfavourable weather conditions, even though the unfavourable weather was combined with other events during the period.

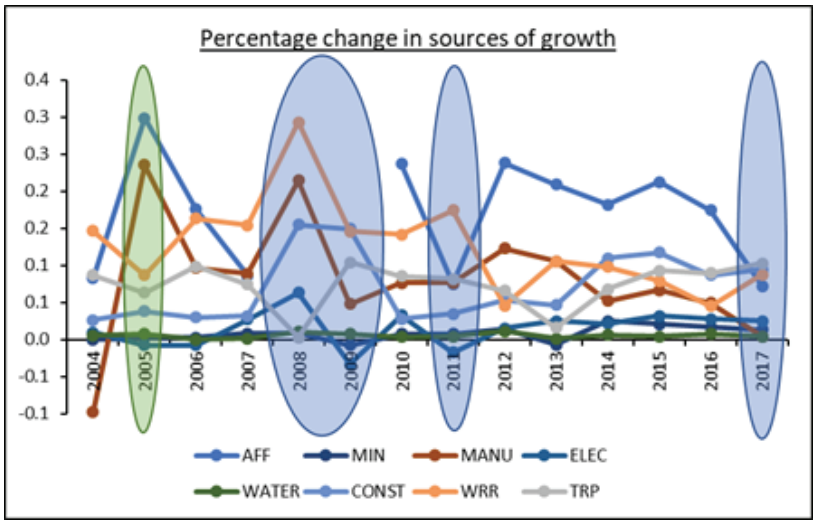
Figure 11: GDP growth rate



Data source: KNBS (Various), Economic Survey

Next, we look at the changes in the sources of growth to compare the sectors' contribution to growth over time. From Figure 12, and as expected from the previous section, agriculture and manufacturing sectors were the main sectors affected during the drought years. Their contribution to growth declined significantly in all the years when a drought was reported. The contribution by electricity supply declined in 2009 and 2011 but has since stabilized given the renewable sources of energy that seem to be taking over hydro electricity supply (Figure 12). What is unusual is the contribution of water supply, sewerage and waste management (WATER in the graph). It is expected that the water sector would be hard hit by drought hence lowering its contribution to growth. However, we observe that during the drought years of 2004, 2008 and 2009, its contribution was above the average of 0.5 per cent, with contribution in these years at 0.6, 1.0 and 0.8 per cent respectively.

Figure 12: Percentage change in the sources of growth



Data source: KNBS (Various), Economic Survey

*Green represents a good year and blue represents a drought year. 2008 and 2009 figures for agriculture have been omitted to make the graph easier to read. The figures for the two years are -60.8% and -21.3% respectively.

Table 2 shows the estimated economic loss due to drought in selected years. The unusually lower figure of 2011 is because it is estimated that the effect of adverse weather conditions in the period affected livestock more than it did crop production. However, as shown earlier, there was still a decline in the growth of crop production.

Table 2: Estimated effect of droughts on GDP

Year	Estimated % pullback on GDP growth	Econimic loss (Ksh millions)
2011	0.2	6,208
2013	0.7	25,480
2017	1	71,590

Estimated percentage pullback on GDP obtained from World Bank estimates obtained from various KEU reports.

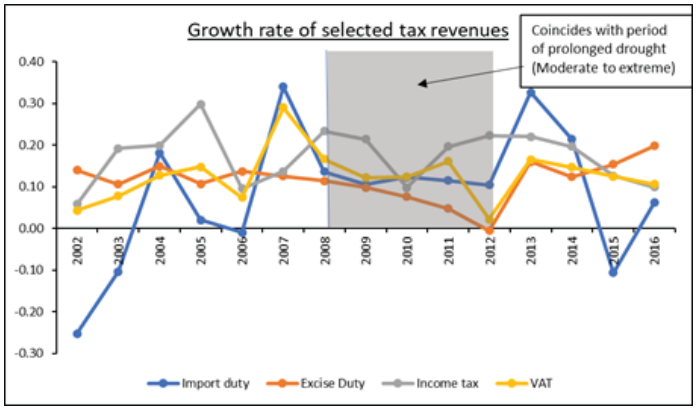
3.3 Macroeconomic Imbalances Arising from Droughts and Floods

These are the expected negative imbalances on key macroeconomic variables, which are temporary in nature, and which arise either directly from the natural disasters and/or from government efforts to mitigate the economy against the negative effects of disasters. The main imbalances occur in the fiscal and the external sectors. Below, we consider these imbalances.

3.3.1 Effects on public finance

Public finance, a reflection of how the government intends to spend the revenue it collects is not spared from the effects of droughts and floods. Directly, natural disasters reduce government revenue following decrease in tax revenue collections brought about by production losses and destruction of productive fixtures. For example, the prolonged drought of 2008 to 2011 slowed growth of tax revenue especially from VAT and Excise duty. Notable during this period were the tax exemptions given to importers. For example, between February 2007 and February 2008, importers of raw/mill sugar could import up to 89,000 metric tonnes duty free from COMESA Free Trade Area countries to curb the rising prices caused by drought[7]. Likewise, duty on imported maize was suspended in 2009, 2011 and 2017. Similarly, maize flour and bread were zero rated in 2017 to curb rising prices. It is not surprising, therefore, that despite the increase in imports to cater for production deficits, growth in import duty fell during this period. This has a direct implication on fiscal balance. Reports show that extreme droughts and floods are estimated to reduce long-term growth by 2.4 per cent of GDP, an estimated fiscal liability of Ksh 16 billion.

Figure 13: Growth rate of selected tax revenues



Source: Central Bank of Kenya (using data from https://www.centralbank.go.ke/central-government-expenditure/

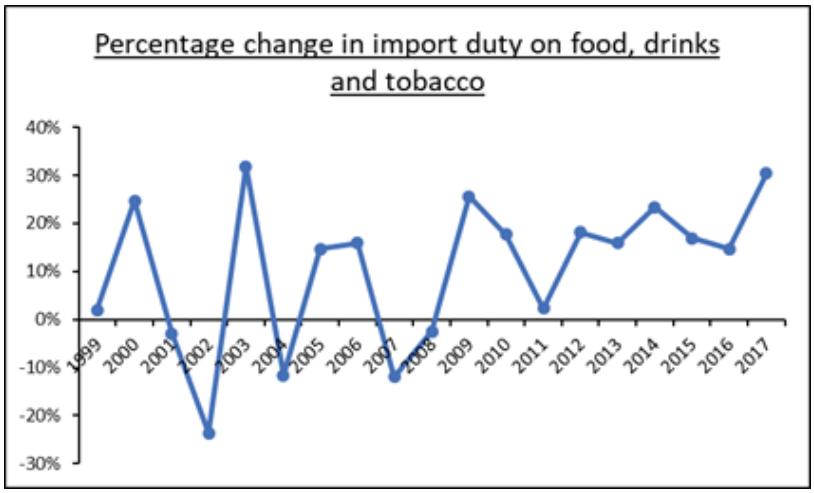
While imports increase during droughts to cater for the shortfall in production,

7 Kenya Gazette, vol CXIX-No.47.

where duty on such imports is subsidized to encourage imports, we expect to see a reduction in the growth of imports. As observed in Figure 13, the period 2008 to 2012 saw a reduction in the growth of tax revenue, especially VAT and Excise duty. Notable during this period are tax exemptions given to importers. For example, between February 2007 and February 2008, importers of raw/mill sugar could import up to 89,000 metric tonnes duty free from COMESA FTA countries to curb the rising prices caused by drought[8]. Likewise, duty on imported maize was suspended in 2009 and 2011. It is not surprising, therefore, that despite the increase in imports, import duty fell during this period.

Considering the import duty on food, drinks and tobacco (which constitute the largest share of import duties), Figure 14 shows that during the years when a severe drought was reported, import duty on these items dropped and this could be explained by either reduced imports or a waiver of import duty.

Figure 14: Percentage change in import duty on food, drinks and tobacco



Data source: KNBS (Various), Economic Survey

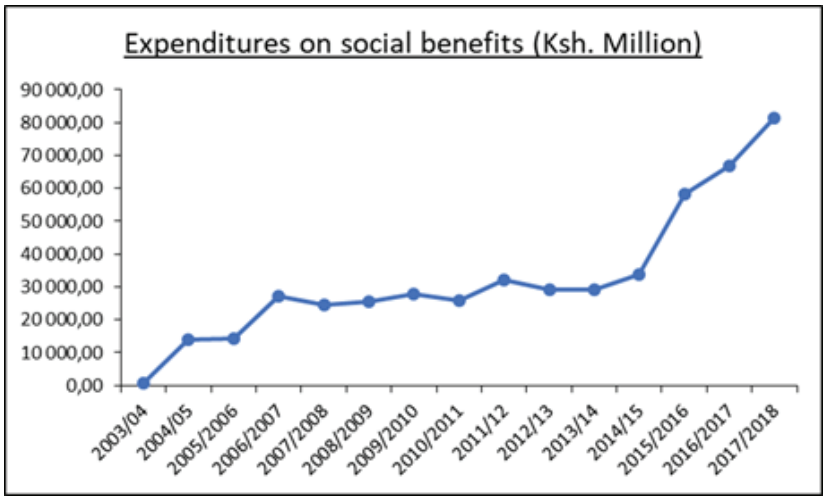
Government expenditures also increase especially those related to building resilience and mitigation measures necessitated by the disasters. For example, in February 2017, the Government declared drought a national disaster and Ksh 11 billion was set aside to cater for drought-related interventions, including providing food rations and cash transfers to affected households. An additional Ksh 3.8 billion was set aside in February 2018 to address drought-related effects in drought-hit parts of the country, out of which Ksh 2.5 billion was earmarked for food and cash transfer programmes. In the 2017/18 budget summary[9], the Government set

8 Kenya Gazette, vol CXIX-No. 47.

9 Government of Kenya (2017), the budget summary for the fiscal year 2017/2018 and the supporting information.

aside Ksh 46.6 billion for environment management and protection, flood control and water harvesting. Often, the Government supports the Red Cross through the flood relief kitty. Similarly, Ksh 194 million was set aside by Nairobi County to address the floods that rocked the city during the 2018 March, April and May long rain season. While these funds are not necessarily budgeted for, the fiscal responsibility principles provide for deviations from financial objectives of public revenues "only in a temporary basis and only where such deviation is caused by a major natural disaster, other significant unforeseen event…"[10]

Figure 15: Expenditures on social benefits (Ksh millions)



Source: KNBS (Various), Economic Survey

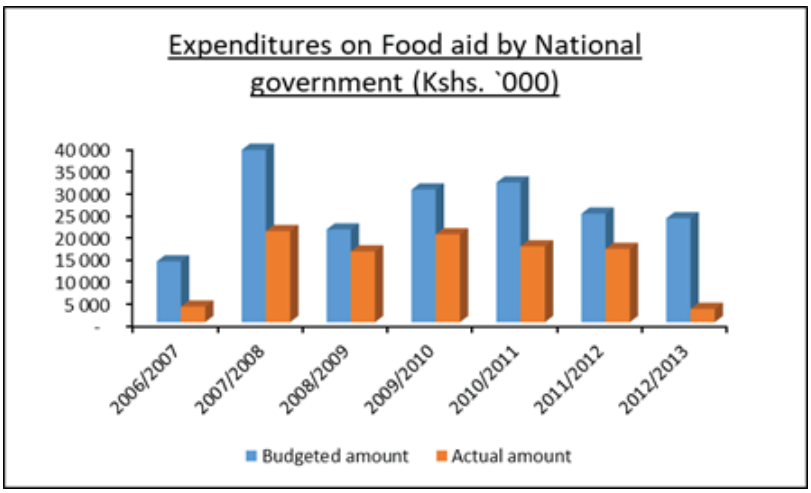
From Figure 15 above, we see a general increase in expenditure on social benefits. However, the rate of increase is higher from 2015/2016. It is worth noting that these expenditures include the normal cash transfers, with a large share going to older persons cash transfers, and it is increased every year. It also includes the hunger safety net programme that targets poor households. Whenever there is a drought, the programme is extended to households affected by the drought in terms of food shortages, and is later withdrawn once normalcy returns. The programme is also partly donor funded.

For example, in 2017, the Government declared drought a national disaster and Ksh 11 billion was set aside to cater for drought-related interventions, including provision of food rations and cash transfers to affected households. Likewise, in 2018, Ksh 4 billion was set aside for drought-related activities, out of which Ksh 2.5 billion was for relief food and cash transfers. Figure 16 below depicts the trends in expenditure on food aid by the National government. As can be seen, actual

10 The Public Finance Management Act, 2012.

expenditures were higher between 2007/2008–2011/2012 a period characterized by an extended drought, compared to 2006/2007 and 2012/2013 when normal weather was reported.

Figure 16: Expenditures on food aid by the national government (Ksh `000)



Data source: FAO, MAFAP

Financial requirements to deal with the impacts of droughts

Extreme droughts and floods are estimated to reduce long-term growth by 2.4 per cent of GDP, an estimated fiscal liability of Ksh 16 billion (World Bank, KEU)

Overall balance

The overall balance is determined by the extent of government operations in the economy. As noted earlier in this section, government intervenes during periods of drought and floods to cushion the economy against excess damage and to assist agents (households and firms) cope with the impact of the disasters. In this regard, funds have to be reallocated (in cases where there were no provisions in the budget to deal with disasters) and financial assistance (mainly from international donors) is sought to assist in managing the impacts.

3.3.2 Effect on the external sector and the balance of payments

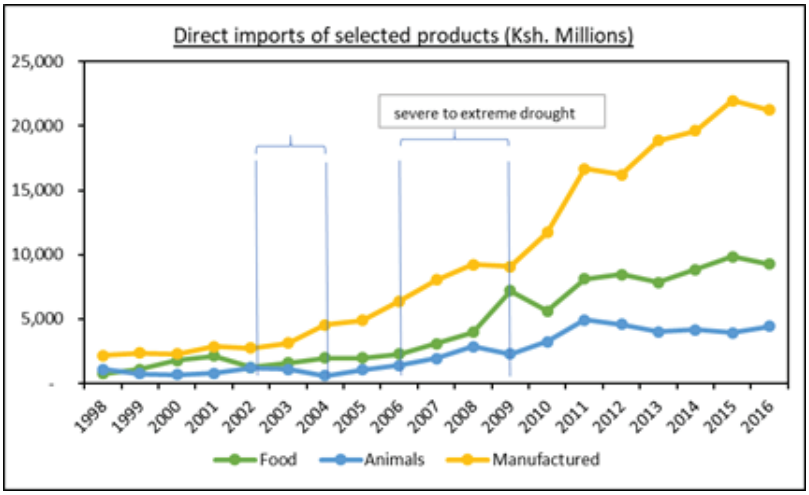
The current account of the balance of payments, in which the economic transactions of the economy with the rest of the world are recorded is expected to be negatively affected by the occurrence of droughts and floods. At the minimum, we expect that adverse weather conditions will necessitate an increase in imports,

specifically food imports to cater for the shortfall in production, where crop failure occurs. Likewise, we expect that there will be a decrease in the export of merchandise because of reduced production output. Such effects exert pressure on the exchange rate, leading to a depreciation of the Kenya shilling against major currencies, especially if exports of other major items decline.

Figure 17 presents the direct imports of selected products. It is obvious that imports have been on the rise, especially import of manufactured products that have risen faster than imports of food and livestock.

To estimate the economic effects on imports, we considered the expected trend in the absence of drought and floods and compared that with the actual trend in the presence of drought and floods. To do this, we first identified the periods in which the country experienced severe and extreme droughts, that may have necessitated an increase in imports over and above the normal trend. For example, it is estimated that a total of 241,800 tonnes of maize valued at Ksh 4.6 billion was imported in 2004 to cover the deficit from production (KNBS, 2004). Again, in 2011, imports of unmilled maize increased by 56.5 per cent to supplement local production. Figure 17 shows the cost of imported maize over the years. It is worth noting that the cost of imports in 2009, the year after the extreme drought of 2008 and in 2017, again a year followed by prolonged drought in 2016.

Figure 17: Direct imports of selected products (Ksh millions)



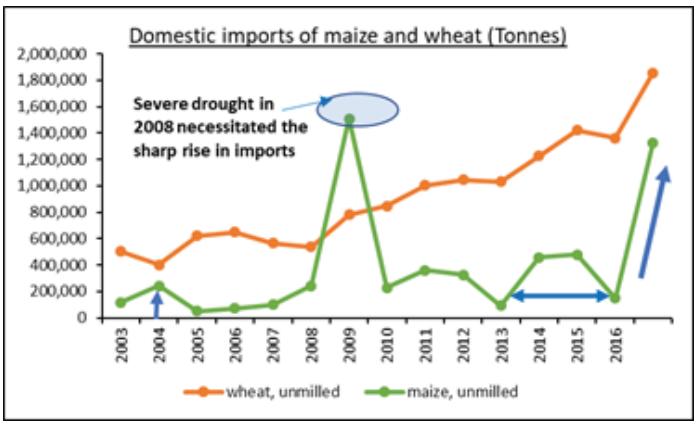
Data source: Central Bank of Kenya, https://www.centralbank.go.ke/value-direct-imports-per-commodities/

Looking at food imports, we observe the sharp increase in food imports in 2009. From the drought index information obtained from CHIRPs, an extreme drought was reported in 2008. Our assumption is that while food imports increased in the

drought year, they were higher in the year after the extreme drought to cater for the shortfall in production recorded in the previous year.

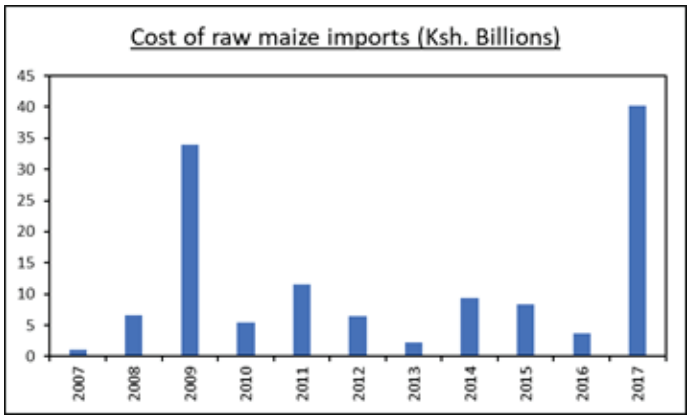
The increase in food and other imports is expected to put pressure on the exchange rate, leading to a depreciation of the Kenya shilling against major currencies, especially if exports of other major crops (tea, coffee and horticulture) decline. Figures 18 and 19 show the trend in domestic imports of unmilled maize and wheat and the cost of import of raw maize, respectively. Unlike wheat, there was a sharp increase in maize imports during the years when drought was reported and so did the cost of imports. Comparing this with exports of selected major crops (Figure 20), we see no clear pattern for coffee, tea or horticulture. However, domestic exports of unmilled maize dropped drastically from 2009 and is yet to recover to the levels recorded in 2007.

Figure 18: Domestic imports of maize and wheat (tonnes)



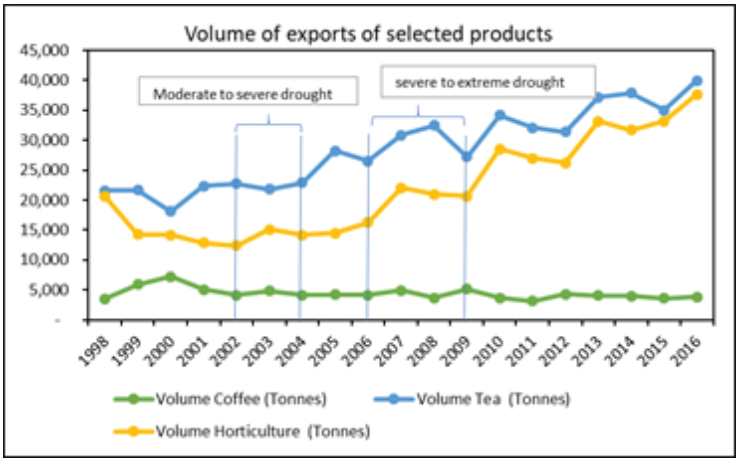
Data source: KNBS (Various), Economic Survey

Figure 19: Cost of import of raw maize (Ksh billions)



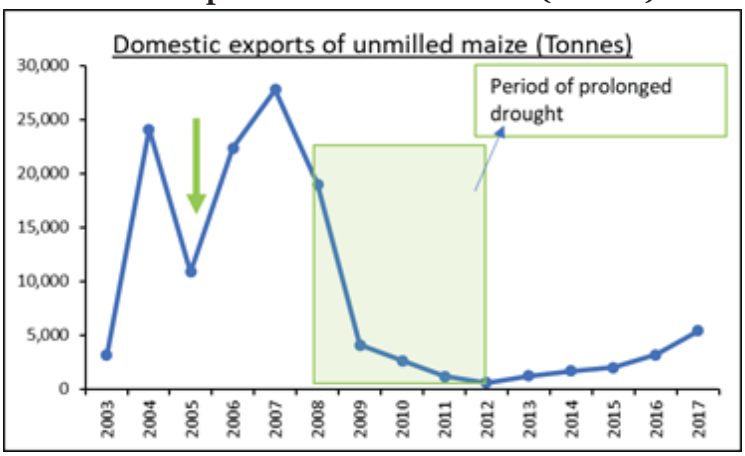
Data source: KNBS (Various), Economic Survey

Figure 20: Volume of exports of selected products



Data source: Central Bank of Kenya, https://www.centralbank.go.ke/value-direct-imports-per-commodities/

Figure 21: Domestic exports of unmilled maize (tonnes)

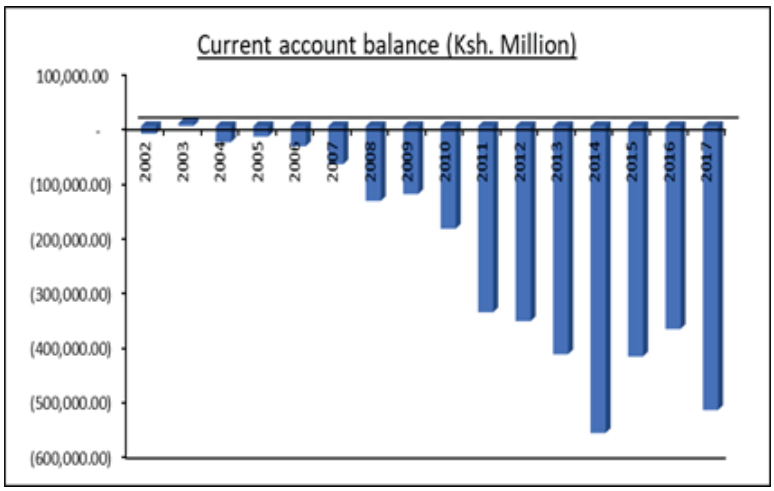


Source: KNBS (Various), Economic Survey

Current account balance

The current account deficit observed in Figure 22 is not necessarily due to the effects of drought, but increased imports and reduced exports during drought compounds the imbalance. For example, we see the deficit getting worse from 2008, which is the period when the prolonged drought set in but also coincides with the period of the global financial crisis which had an effect on the Kenyan economy (especially on tourism and exports).

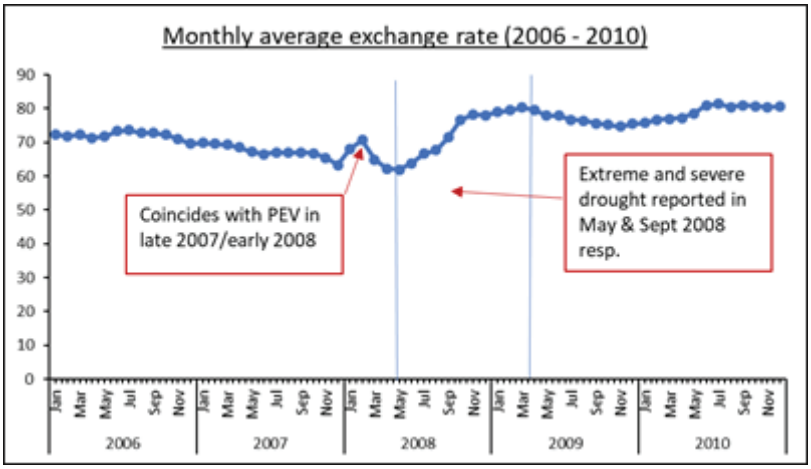
Figure 22: Current account balance (Ksh millions)



Data source: KNBS (Various), Economic Survey

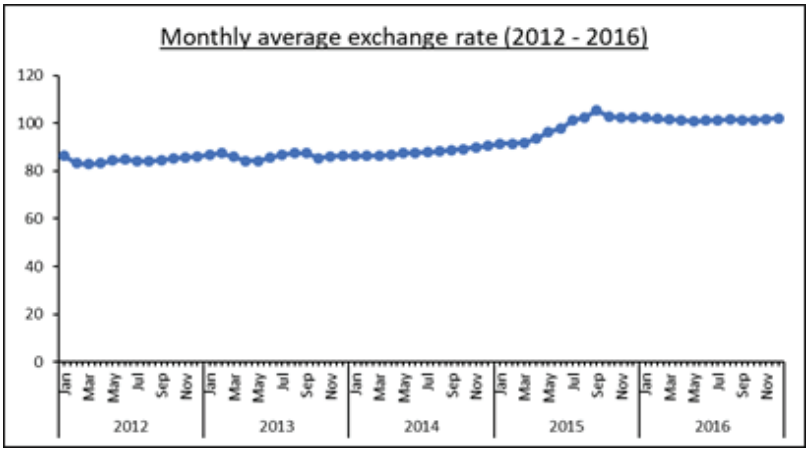
As noted above, an increase in imports relative to exports is expected to put pressure on the exchange rate, leading to a depreciation of the Kenya shilling against major currencies. Figure 23 shows that the highest depreciation was recorded between 2008 and 2009 when the global financial crisis was at its peak. It is therefore not conclusive that the drought had a major effect on the exchange rate.

Figure 23: Monthly average exchange rate (2006-2010)



Data source: Central Bank of Kenya, https://www.centralbank.go.ke/rates/forex-exchange-rates/

Figure 24: Monthly average exchange rate (2012-2016)

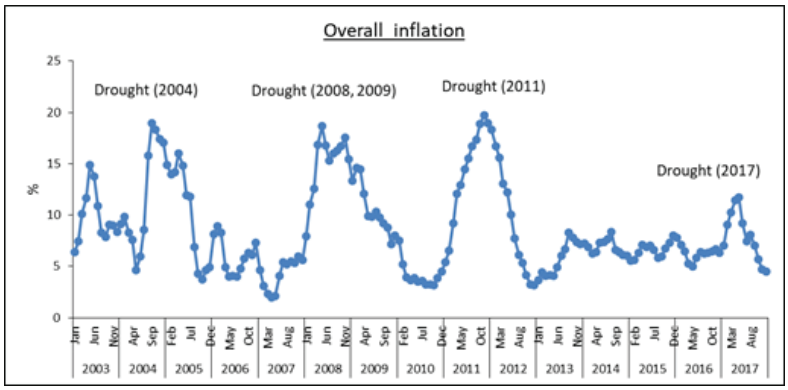


Data source: Central Bank of Kenya, https://www.centralbank.go.ke/rates/forex-exchange-rates/

3.3.3 Effect on prices and inflation

The effect on prices and inflation would be felt due to supply constraints brought about by crop failure that results to reduced production and increased costs of production. For example, food and electricity prices are bound to rise due to food shortages and reduced hydro power generation. With reduced and unreliable hydro power, there is bound to be an increase in industrial costs as firms seek alternatives, mainly thermal power that relies on imported fuel. The combined effects will be inflationary pressure on domestic prices. Below, we show the trends in inflation and its various components. Initial insights on the effect of disasters reveal that inflation was high during all drought years.

Figure 25: Overall inflation



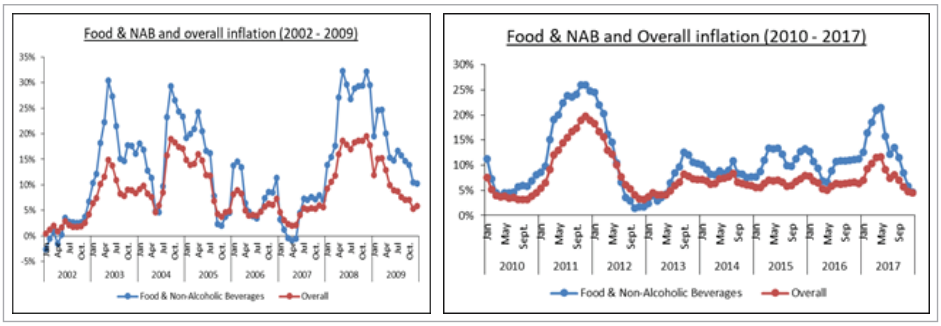
Source: KNBS (Various), Economic Survey

Overall inflation, food and electricity inflation

Overall inflation was also higher during the drought of January 2017 to May 2017, mainly fueled by increased food prices. This implies that drought had an effect of lowering agricultural food production, which consequently lowered supply of agricultural produce. Lower supply than demand for agricultural produce had the effect of pushing up food prices, thus causing inflationary pressures.

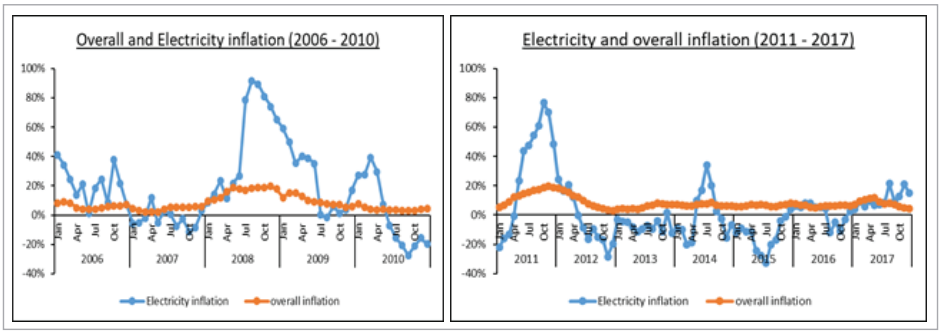
For example, food and electricity prices are bound to rise due to food shortages and reduced hydro power generation. A look at Figure 26 shows that food and non-alcoholic beverages inflation (which contributes 36% to overall inflation) rises sharply during the drought periods, contributing to increases in overall inflation. Maize, which contributes over 10 per cent to crop production in Kenya, plays a major role in the increase in food prices. For example, the high food inflation in 2017 was attributed mainly to increase in the prices of maize flour, sugar and beef. This necessitated Government intervention, which it did by subsiding the cost of maize flour to cushion consumers from the price rise.

Figure 26: Overall and food and non-alcoholic beverages inflation



Source: KNBS (Various), Economic Survey

Figure 27: Overall and electricity inflation



Source: KNBS (Various), Economic Survey

The cost of electricity, which is a major contributor to the cost of living, is expected to rise during drought years because of the country's heavy reliance on hydro power generation. However, the contribution of hydro power has been declining, with the increase in geo-thermal power generation as shown earlier in Figure 7. Nevertheless, as Figure 27 shows, there were sharp rises in electricity inflation during periods of depressed rainfall, over and above overall inflation. For example, between 2008 and 2011 when there was a prolonged drought, we see peaks reaching 80 per cent (2008 and 2011). The year 2010 is reported to have been a good year, with normal rainfall and as shown in Figure 27, electricity inflation was below that of overall inflation. This pattern thus leads us to conclude that the drought had a significant effect on inflation. The combined effects of increasing food prices and high electricity cost have inflationary pressure on domestic prices, and this is reflected in Figure 25.

4. Conclusion

This study sought to estimate the impact of droughts and floods on key macroeconomic variables. However, much of the analysis is biased towards the impact of droughts due to data availability. A qualitative approach was adopted aimed at quantifying the sectoral losses that occur during disaster periods, and the macroeconomic imbalances that result thereof. The study thus compared production flows both in the presence and absence of droughts and floods.

With the projected climate change, droughts are likely to become more frequent. The consequences of not being prepared for the disasters from a macroeconomic perspective means that the country will continue to experience economic costs with the likely exposure to macroeconomic imbalances that can hamper the country's development agenda. There is therefore need for the country to increase its efforts in managing and responding to disasters. Adequately considering the climate change effects in the macroeconomic framework is critical in sustaining macroeconomic stability.

Infrastructure including transport, storage and ICT is key in mitigating the effects of drought, especially in ensuring supply is stabilized, consequently reducing inflationary pressure. For example, as noted earlier, the current poor state of infrastructure especially in drought-prone areas hampers effective preparedness, response and recovery efforts. To reduce the effects of drought, it is necessary for the National and County governments to improve infrastructure development network by upgrading the existing infrastructure and expanding to areas with low coverage to allow for timely distribution of food from surplus and scarce areas and enhance access to the market. The design and mix of these infrastructure needs to consider climate change vulnerabilities.

In addition, there is need to integrate research and development into drought management and response. This will entail research on fast-growing and drought-resistant crops that have higher productivity under depressed rainfall. Agricultural production can also be enhanced through adoption of irrigation technologies to reduce over-reliance on rain-fed agriculture. This will be key in ensuring food security in the country.

To reduce the cost of power, diversifying the sources of energy becomes paramount. For example, the vast renewable energy resources such as geothermal, solar and wind should continue to be scaled up to increase their overall share in the country's energy mix. As Figure 8 showed, geothermal power generation has already overtaken hydro power generation. The generation of wind energy is, however, still low though this could be explained by the fact that wind energy

generation is a recent investment and we expect to see increases as investments continue to grow.

It is thus evident that addressing disaster related issues will be key in realizing the "Big Four" development agenda especially on food security, manufacturing and ensuring macroeconomic stability, which is a key enabler.

References

Food and Agriculture Organization - FAO (2017), Crop Prospects and Food Situation. Global Quarterly Report, June 13, 2017.

Government of Kenya (2017), The budget summary for the fiscal year 2017/2018 and the supporting information.

Kenya National Bureau of Statistics - KNBS (Various), Economic Survey. Nairobi: Kenya National Bureau of Statistics.

NEMA (2011), *Kenya State of the Environment and Outlook 2010, Supporting Delivery of Vision 2030*, NEMA, KENYA

The Public Finance Management Act, 2012 World Bank (2011), *Kenya Economic Update*, December 2011, Edition No. 5.

World Bank (2011), Kenya Economic Update, December 2011, Edition No.13: 5.

World Meteorological Organization (2012), *Standardized Precipitation Index User Guide* (M. Svoboda, M. Hayes and D. Wood). (WMO-No. 1090), Geneva.

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