Chris Funk, Frank Davenport, Gary Eilerts, Nour Nourey, Gideon Galu

A woman tends her crops as part of the Kenya Horticulture Competitiveness Project. Photo by Neil Thoma. Source: USAID

CONTRASTING KENYAN RESILIENCE TO DROUGHT: 2011 AND 2017

Executive Summary: Despite repeated severe droughts in 2016/17, the severity of Kenyan food insecurity was substantially less than during the 2010/11 drought and substantially less than might be expected given historical relationships between drought severity and humanitarian need. In line with this, U.S. government expenditures were also substantially less (about half) than what might be expected based on historical relationships.

Key findings that support these observations include:

- Both the extent and depth of food insecurity was much smaller in 2017 than in 2011**. In 2011 the number of severely hungry (IPC 3 or 4) Kenyans was ~2.8 million, in 2017 it was ~1.75 million**.
- Based on the historical relationship between drought severity and humanitarian assistance, an estimated **500,000 fewer people were in need of humanitarian assistance (IPC 3 or 4) in 2017 than would be expected.**
- Despite three severe consecutive droughts, deflated **US Government food aid expenditures for Kenya in 2017 were about half (51% and 40%) of the expenditures during the last two severe crises in 2011 and 2009.**

Together these findings suggest that Kenya was substantially more resilient to these types of climatic shocks in 2017 than it was in 2011.

CLIMATE SHOCKS IN 2010/11 AND 2016/17

This report examines two main questions – i) how bad was the 2016/2017 drought in Kenya, compared to the signature recent drought in 2010/11, and ii) given the relative severity of the 2016/17 drought, was the depth of food insecurity and food assistance costs associated with responding to it less than what we might expect given historical outcomes?

We begin by comparing CHIRPS rainfall data (Figure 1) for 2010/11 and 2016/17. We will then relate these rainfall observations to food security, agriculture and market price outcomes.

Climatically, both 2010/11 and 2016/17 were associated with La Niña-like climate conditions, with relatively warm and cool sea surface temperature conditions in the western and eastern Pacific. The severity of the La Niña was more intense in 2010/11, while the warmth in the western Pacific was greater in 2016/17. **In general, the severity of the back-to-back October-December and March-May rainfall deficits appear generally greater in 2010/11 than 2016/17, especially in the Eastern Kenyan pastoral and agropastoral zone. However, it should also be noted that the 2011 October-December rains were above normal, while October-December 2017 rainfall performance was poor in many parts of Kenya**.

Also of note are some exceptionally large deficits (<-150 mm) in 2017 in many of the main crop growing regions of the Rift Valley and Central provinces of Kenya. Crop water requirement satisfaction index analyses for these years (not shown) indicate substantially poorer maize product in this recent year.

Rangelands water requirement satisfaction index analyses (not shown) show very poor outcomes for 2017. But in 2011, there was no start whatsoever to the long rains season in northeastern Kenya, where emergency, near-famine, conditions broke out.

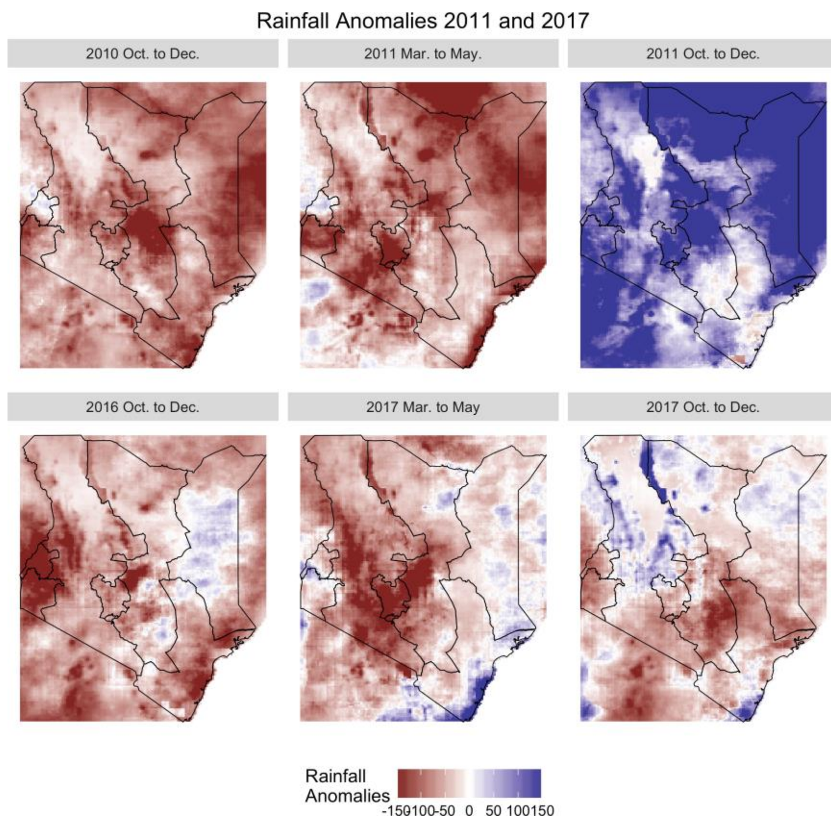

Figure 1. Figure 1. Rainfall Anomalies (the difference between rainfall totals and the long-term mean) for the key months leading up to and during 2011 and 2017.

KENYAN FOOD SECURITY IN 2011 AND 2017

We now use FEWS NET Food Security Outlook (FSO) maps and Food Insecure Population Estimates (FIPE)[1] to quantify the extent and depth of the 2011 and 2017 crises. Given that the 2016/17 drought more severe than 2011 in both the western grain-basket region and during the OND season, was the food security crisis better or worse than we might expect, given historical relationships? Below we present evidence that the 2017 Food Security conditions were relatively less severe than might have been expected, given the severity of the 2016/2017 rainfall deficits.

In late 2011, the FEWS NET Kenya Food Security Outlook indicated extremely high levels of food insecurity (Figure 2, left), with most of the country anticipated to experience crisis or emergency levels of food insecurity. In late 2017, the corresponding FEWS NET Kenya Food Security Outlook indicated widespread food insecurity, but with substantially less severity (Figure 2, right). The 2011 Food Security Outlook estimated a total food insecure population of 3.75 million people. The 2017 Food Assistance Outlook Brief estimated that between 0.5 and one million Kenyans faced IPC Phase 2 conditions, while one to 2.5 million Kenyans faced IPC phase 3 or higher. The mean of these figures yields an approximate total of 0.75+1.75=2.5 million food insecure Kenyans.

UN Estimates of Kenyan population for 2011 and 2017 are 42.5 and 49.7 million, resulting in 8.8% and 5.0% of the population being classified as food insecure in each year. Using assessments of IPC 3 and 4 populations from 2011, and FAOB Figures from October of 2017 (provided by the FEWS NET data warehouse) we estimate that ~2.8 million Kenyans were classified in IPC Phase 3 or higher in 2011, while only 1.75 million faced such conditions in 2017. From the 2011 report: "*An estimated 1.4 million September 2011 pastoralists residing predominantly in north and northeastern pastoral areas are at Emergency levels (IPC Phase 4) …. an additional 2.35 million pastoralists and marginal agricultural farmers are in Crisis (IPC Phase 3) and Stressed (IPC Phase 2) phases*". This latter assessment led us to assume one million more people were in phase 3. We also added the 400,000 refugees who were in the Dadaab refugee camp. ***In 2011 the number of severely hungry (IPC 3 or 4) people (~2.8 million) was substantially***

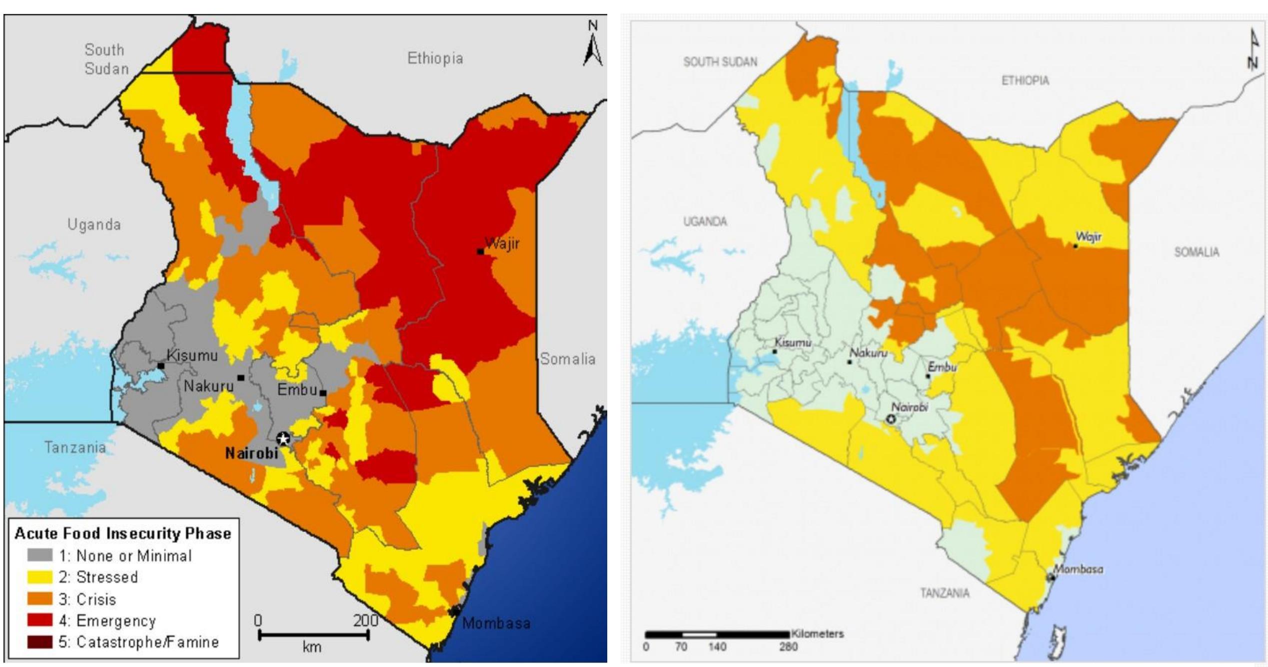

Figure 2. Food Security Outlook assessments made in October of 2011 (left) and October of 2017 (right) for October-January of 2011

[1] It should be noted that the FIPE estimation process and estimates are distinct from the IPC process and associated estimates. FIPE values are used in this analysis because they provide a consistent routinely updated data source stretching back to 2011.

larger than the number of severely hungry (IPC3+) Kenyans in 2017 (~1.75 million). However, it should be noted that the reported numbers are estimates, derived from a combination of quantitative and qualitative metrics and that the actual food insecure population might vary.

Food Security Outlook Brief data were graphed for October outlooks between 2011 and 2017 (Figure 3). The blue columns depict the total food insecure population (IPC 2+). The orange columns depict estimates of the very food insecure population (IPC 3+). This data indicates that while Kenyan food insecurity is quite prevalent and persistent in each intervening year, 2011, and to a lesser degree 2017, were substantially worse years. Overall food insecurity (IPC2+) was much more extensive in 2011 and 2017, and the depth (those classified as IPC 3 or above) of food insecurity was also substantially higher in 2011 than in 2017.

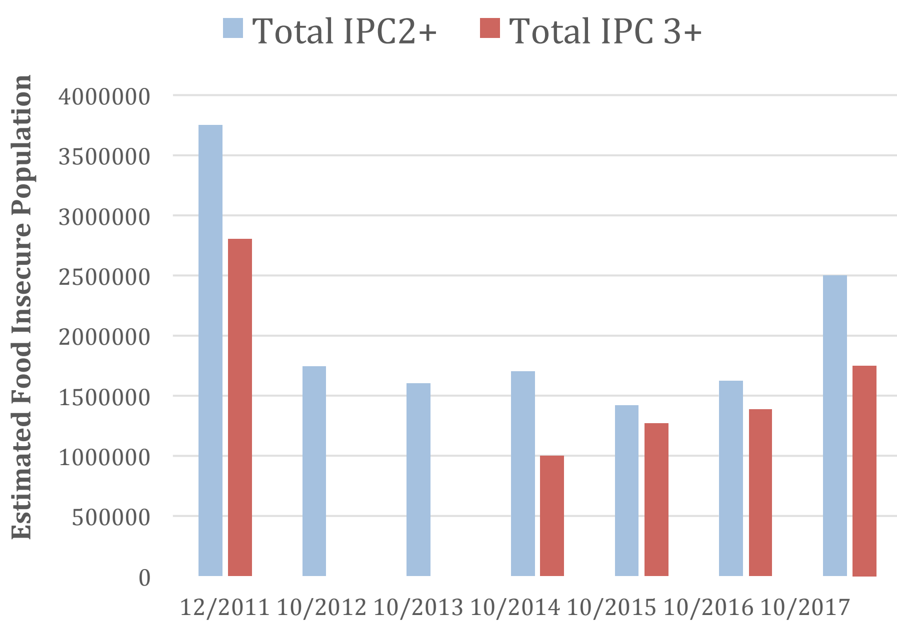

Figure 3. Time series of FAOB Food Insecure Populations for Kenya. IPC Phase 3+ estimates for 2012 and 2013 are not shown, since the data is not broken with this granularity.

We next use our historical October-December/March-May rainfall total time-series (Figure 4) to relate the depth of food insecurity in recent years with historical drought conditions. Estimates of the total number of IPC 3+ plus persons are used to represent the ***depth*** of food insecurity. Figure 4 shows rainfall totals and the number of IPC3+ people in 2011, 2014, 2015, 2016 and 2017. Overall, we find a strong but discontinuous relationship between consecutive seasonal rainfall totals and October Food Security assessments. Note the very large degree of rainfall variability, ranging from 200 mm to more than 500 mm. This corresponds to hydrologic conditions ranging from very poor (annual totals ~200 mm) to semi-humid (annual totals ~500 mm). At consecutive October-December/March-May totals of less than 300 mm, the number of food insecure people increases rapidly, and there appears to be a roughly linear relationship between rainfall and the extent of food insecurity. According to this metric, the total number of stressed or worse-off food insecure populations increased in proportion to rainfall deficits in 2011 and 2017, though we do see greater sensitivity in 2011 (red dot in Figure 4) than in 2017 (yellow dot in Figure 4). While it is hard to untangle all the complex factors that affect herd health, livestock terms of trade, immigration from Somalia, etc., **we would interpret these data as**

evidence of a substantial increase in resilience in Kenya, between 2011 and 2017. While the time-series of FIPE data does not extend back to 2008/09, including this time period might have further corroborated our results. FEWS NET reports from late 2009 indicate similar outlook conditions as shown for 2011 in Figure 3 – MOST of the country is classified as highly or severely food insecure, in stark contrast to 2017. While FIPE estimates and any estimation process will be inherently uncertain, the results from Figure 4 might suggest that an additional ~500,000 might have been in IPC3+, based on the sensitivity found for the 2010/11 crisis.

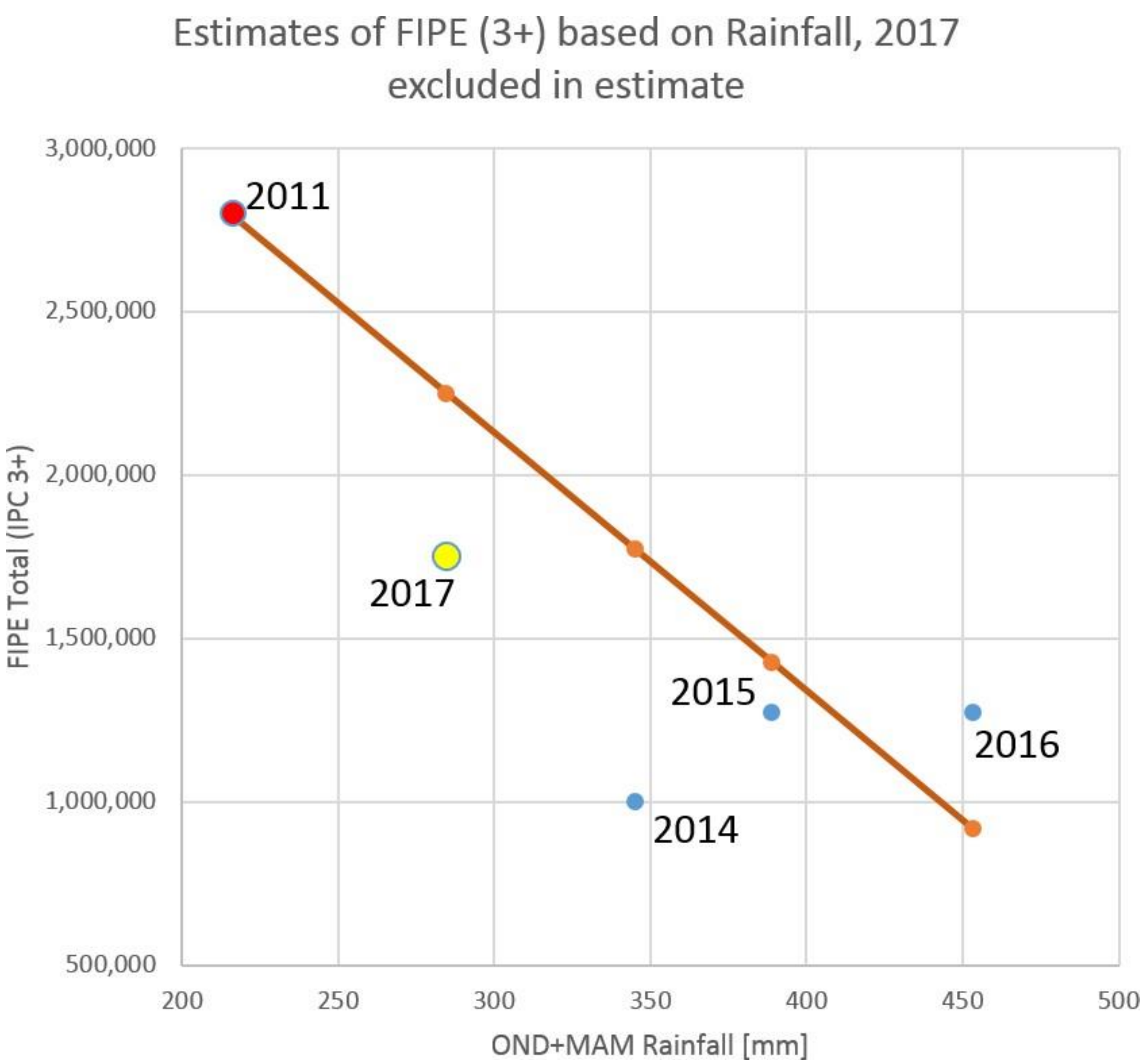

Figure 4. FIPE totals for IPC phase 3 or greater and back-to-back OND+MAM rainfall totals.

EXPENDITURES ON KENYAN FOOD SECURITY IN 2011 AND 2017

We now plot standardized rainfall time-series alongside deflated US government emergency relief expenditures in Kenya to show that the spending on the 2016/17 food emergency was much less than what might have been expected, given the relative severity of the drought. To represent drought intensity, we use analyses from October-December and March-May CHIRPS rainfall in the polygon shown in Figure 5. This region covers vulnerable arid and semi-arid land (ASAL) counties, as well as climatically exposed maize growing regions.

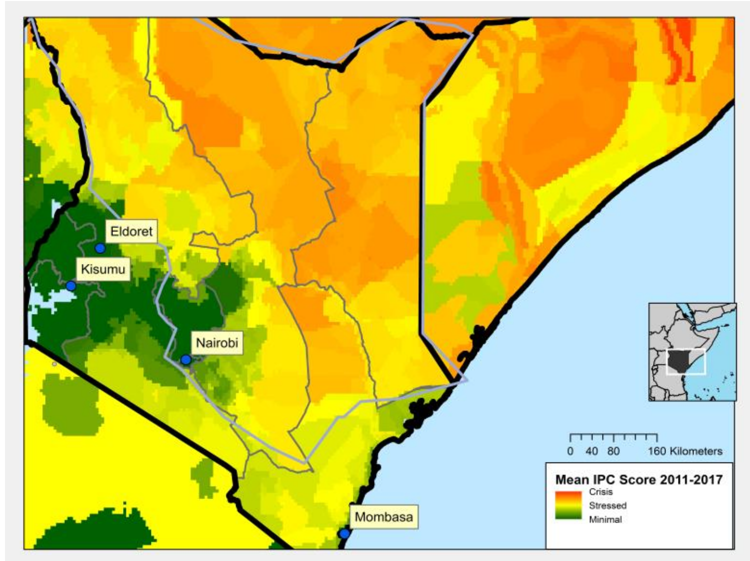

Figure 5. Average Integrated Phase Classification Scores from 2011-2017. The labeled points are the locations of major maize wholesale markets. The blue grey polygon shows the rainfall region used to characterize drought stress.

The spending data were derived from 2003-2015 International Food Assistance reports, updated for 2016 and 2017 using Food for Peace [emergency assistance figures](). These annual figures were deflated to 2009 levels using inflation estimates from the Kenya Statistical Agency. The years 2009, 2011 and 2017 clearly stand out as severe drought years that initiated substantial donor response expenditures. In US dollars the responses were $134, $125 and $96 million in in 2009, 2011 and 2017, respectively.

After accounting for inflation, the corresponding expenditures were $131, $101 and $52 million. Humanitarian responses require local grain purchases, logistics, transportation, and coordination – expenses which will scale with inflation in Kenya, which has been, on average, 8.6% since 2003. In inflation adjusted dollars, the overall magnitude of the US government humanitarian response in 2017 was relatively low ($52 million).

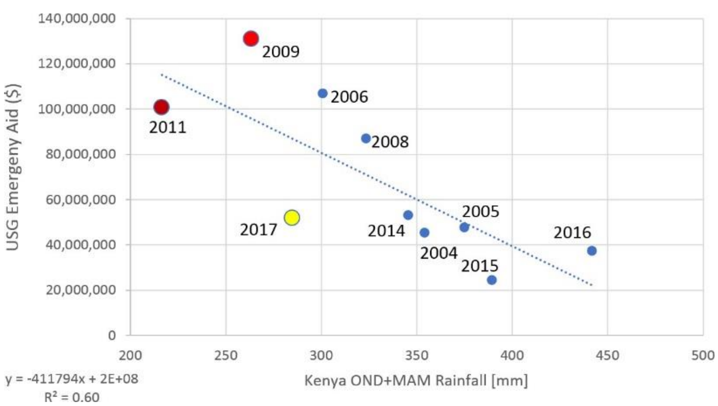

Figure 6. Inflation-adjusted USG emergency responses and CHIRPS rainfall

Screening wet years (OND+MAM rainfall > 480 mm), and examining the relationship between inflation-adjusted USG responses and rainfall (Figure 6), we find a strong linear relationship (R^2~0.6). This relationship was estimated without using 2017 values. **This historical relationship indicated an expected ~$95 million US dollar response (in 2009 Kenya shillings), whereas the actual USG response was ~$52 million.**

SUMMARIZING INCREASED RESILIENCE OUTCOMES

In the full report, we have also analyzed crop production and maize prices to reinforce the conclusions arrived at here. In this shorter version, we find that, in deflated dollars, 2017 US government emergency food aid cost $52 million US dollars. Historic relationships (Figure 6) indicate that it 'should' have been about $90 million. Similarly, historic relationships (Figure 4) also indicate that some 2.3 million people 'should' have been in IPC phase 3+, as opposed to the ~1.75 million identified by FEWS NET in 2017. Much of Kenya is still exposed to the impacts of severe drought, and the 2016/17 period pushed an expected number of people into some level of food insecurity, but **the depth and cost of this insecurity was substantially less than what we might have expected given the severity of the drought.**

Overall, these results appear to indicate a substantial, but partial, increase in Kenyan resilience to severe back-to-back hydrologic shocks. Poor Kenyans, and perhaps especially pastoralists, maintain high levels of exposure to consecutive severe droughts, which impact pasture conditions, food prices and terms of trade. In climatically bad years like 2010/11 and 2016/17, we see substantial increases in the **prevalence** of food insecurity, and overall prevalence rates still seem roughly proportional to the relative severity of the associated drought impacts. But, there also appear to be dramatic **reductions in the relative depth or intensity** of the increases in food insecurity. While the exact estimates of FIPE values for IPC class 3 and 4 are volatile and uncertain, it seems fairly safe to conclude (as seen in Figure 1) that the intensity of food insecurity in 2011 was far greater than in 2017. The extent of food insecurity was quite similar in both years, but the depth was much greater in 2017.

Of course, there are a great many factors complicating this comparison. In 2011, global price shocks and the Somali famine and Somali refugee crisis certainly added to Kenyan food pressures. In 2017, however, Somalia, and now South Sudan, faced severe food crises. Eastern Kenya also experienced poor 2016 long rains, and poor 2017 October-December rainfall as well.

The results suggest that Kenya still faces a fairly high level of chronic severe food insecurity, with more than one million people typically classified as IPC phase 3 or higher. **Furthermore, Kenya still faces serious climate-food access coupling, especially when consecutive droughts strike. On the other hand, the ability to cope with these shocks, at a household, community or national level, appears to have increased.** The specific mechanism for why this is the case remains a topic for further inquiry.