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International Federation of Red Cross and Red Crescent Societies

The Netherlands Red Cross

Seasonal forecast for East Africa & the possible consequences of El Nino

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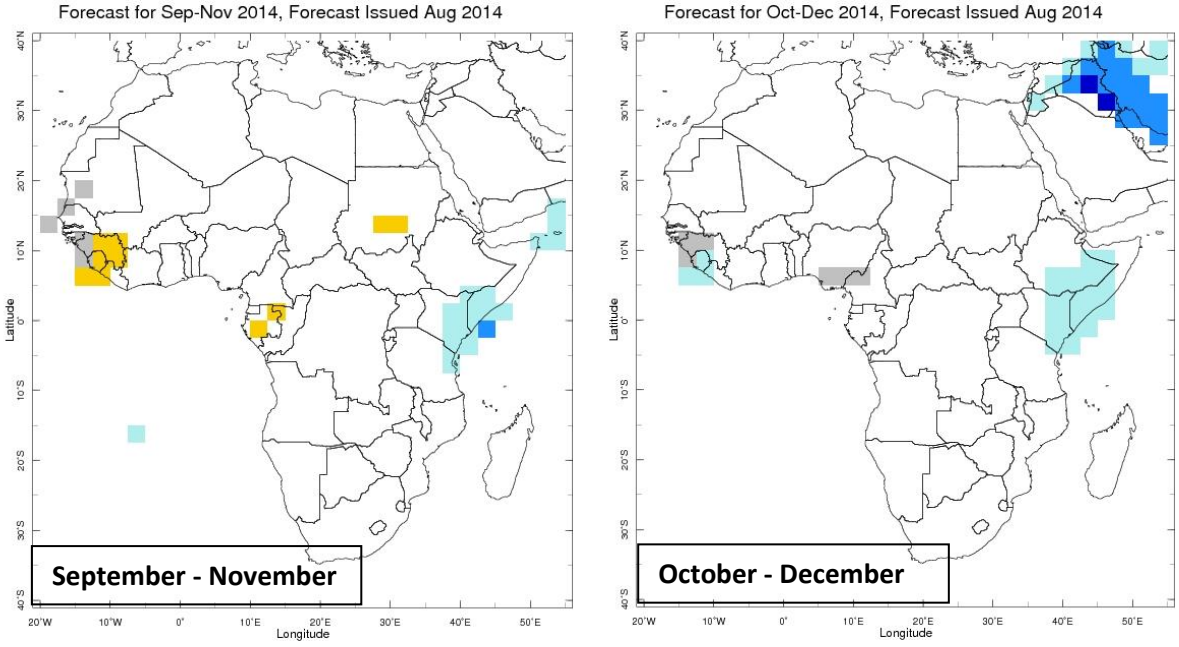
Introduction

This is a brief technical update on the seasonal rainfall forecast for the East Africa Region, the status of El Niño and its possible flood impacts.

Seasonal rainfall forecast

Seasonal rainfall forecasts are presented as deviations from the long-term average for that season; they therefore indicate whether a year will be exceptionally wet (a lot of rain compared to average) or dry (a little rain compared to average). There are different sources for seasonal climate forecasts. Here we present the forecast of the IFRC and the International Research Institute for Climate and Society (IRI) (available online here in an IFRC Map Room). A bulletin about these forecasts, produced by the Red Cross / Red Crescent Climate Centre, is available every month on DMIS, in addition to a guidance document on the availability and applicability of climate forecasts for different world regions that is available here. We also suggest checking your regional and local forecasts.

Below (Figure 1) are the seasonal forecasts for the three month periods of September-November, October-December, November-January, and December-February, respectively. The forecast shows an approximated 40% chance of above normal rainfall for Eastern Kenya, Southern Somalia, and Southern Ethiopia during each of these three month periods. There are no areas in East Africa where the highest probability is forecasted to be significantly dryer over this period (but there are such areas in West and Southern Africa).



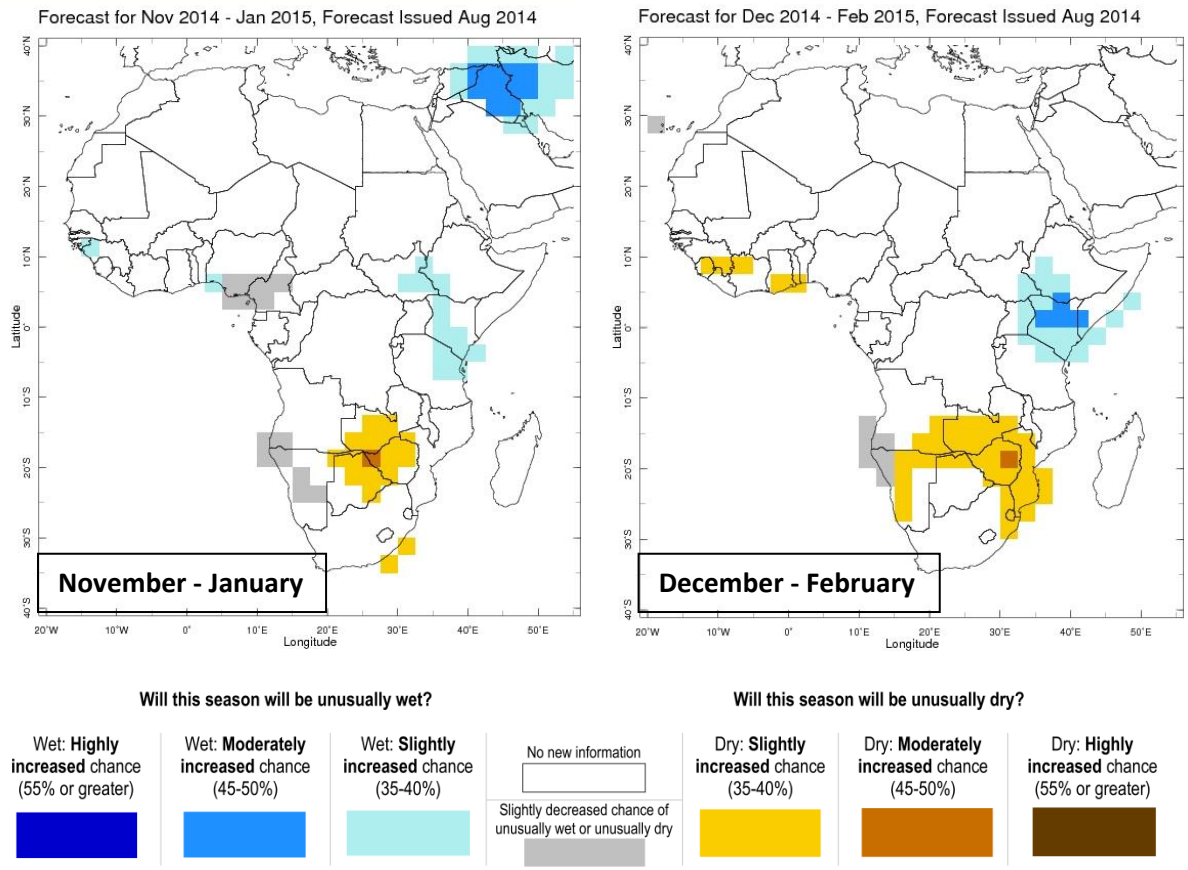


Figure 1: seasonal precipitation forecast for Africa, issued August 2014 (source: IFRC maproom and the International Research Institute for Climate and Society (IRI) (available online here)).

El Niño status and effects on streamflow

El Niño is a natural part of climate variability, and refers to a warmer than average period in the equatorial Pacific (the opposite of cold La Niña events). The accepted definition of El Niño is a warming of at least 0.5 °C averaged over the east-central tropical Pacific Ocean. In the last 20 years, we have experienced 5 moderate to strong El Niño events (1997-1998, 2002-2003, 2004-2005, 2006-2007, 2009-2010). Typically, El Niño happens at irregular intervals of two to seven years, and lasts nine months to two years. While El Niño can go unnoticed or even have beneficial impacts in many parts of the world, it can also be disruptive or cause extensive problems when some areas receive too much or too little rainfall. El Niño leads to a warming of the Indian Ocean at the African coast, which affects rainfall patterns across large parts of East Africa.

At the moment (1st September 2014) there is no El Nino (i.e. the warming of the Pacific Ocean is below 0.5°C). Several models are used to project the changes in ocean temperature in the future (see Figure 2, below). Currently, the chance that an El Niño will develop by approximately January is estimated at 65%. If this happens, the El Niño will most likely continue to the first few months of 2015.

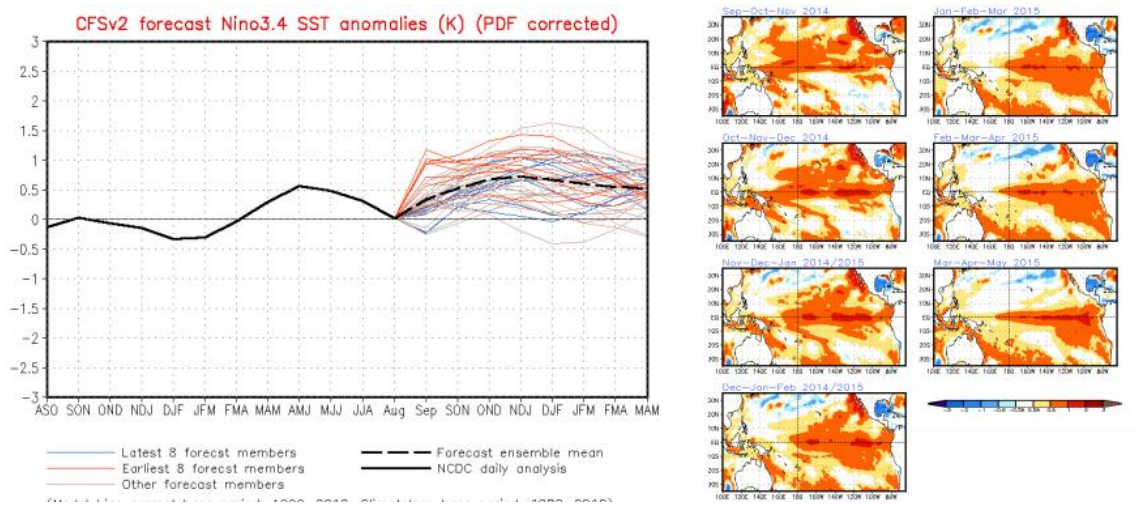


Figure 2: model predictions for the development of El Nino circumstances. An El Nino is developed when the ocean temperature anomaly (y-axis) reaches 0.5 °C and the rainfall patterns change as a result (source: NOAA Climate Prediction Center, available here)

If El Niño conditions develop, this could affect rainfall and streamflow (i.e. the amount of rainfall that is not absorbed by the soil, a good indicator for flooding) across East Africa. Below (Figure 3) are maps of the effect of El Niño on streamflow amounts. In red areas, streamflow values are higher in El Niño years, while in blue areas they are lower. A low value (white) means that there is little relationship between El Niño and streamflow in the respective region.

The main effects of El Niño are felt in October – January. In those months we see higher streamflows across large parts of the Region, especially Somalia, southern Ethiopia, Kenya, parts of Uganda and southern Sudan.

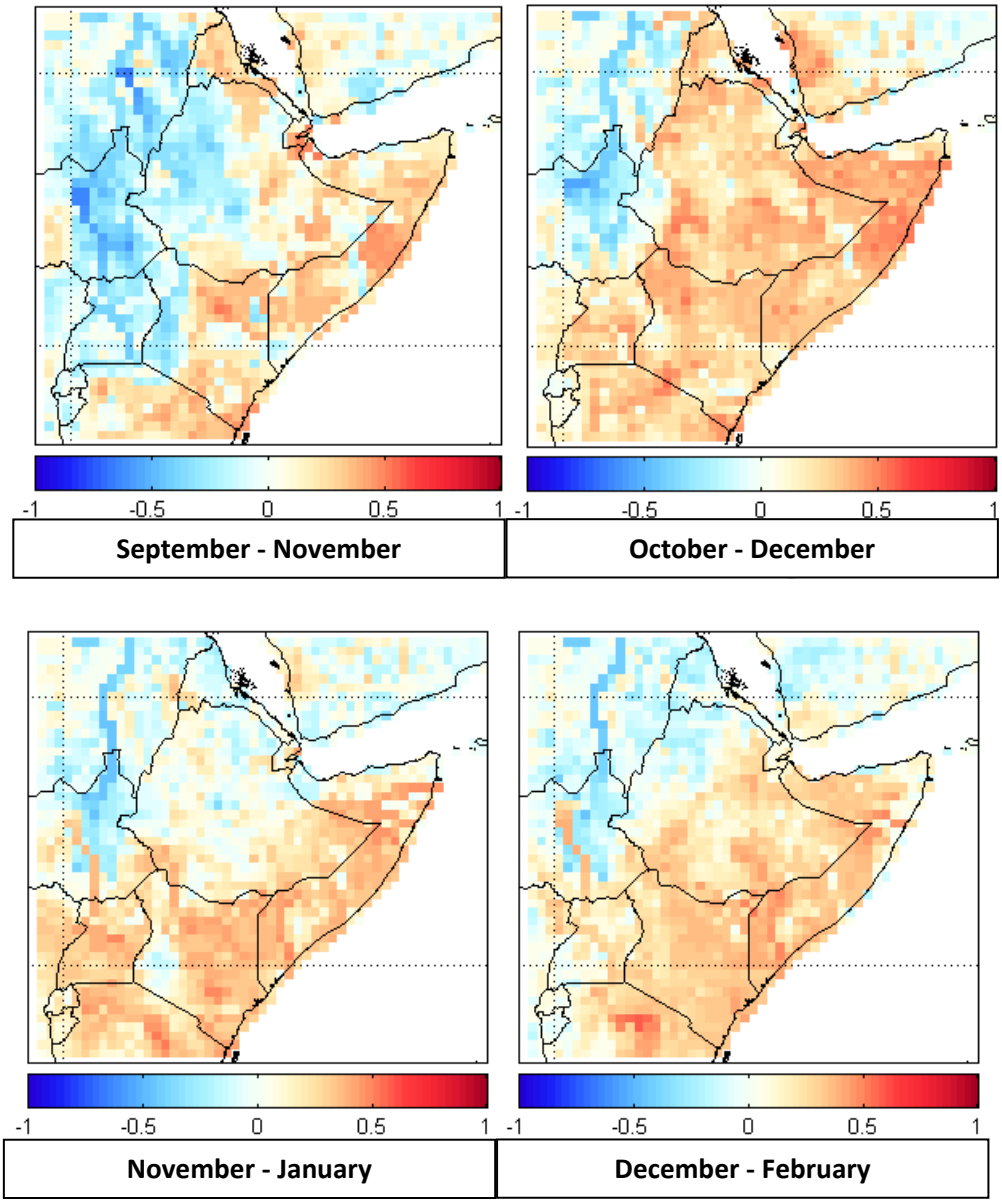


Figure 3: deviations of streamflow under El Nino circumstances. In red areas, streamflow values are higher in El Niño years, while in blue areas they are lower. A low value (white) means that there is little relationship between El Niño and streamflow in the respective region. Source: Paul Block & Donghoon Lee, University of Wisconsin, personal communication).

In the year 1977 we had a weak to moderate El Niño, somewhat similar to the one that is forecasted for this season. This led to relatively high streamflows in Somalia, Kenya and southern Ethiopia, mainly in October and November. The below maps (Figure 4) show the intensity of streamflow in the various months of that year - areas in black only have flows like this each 10 years or more (thus very extreme). It must be noted that every year is unique and even if the El Niño circumstances are similar, flood patterns this year can be substantially different compared to 1977.

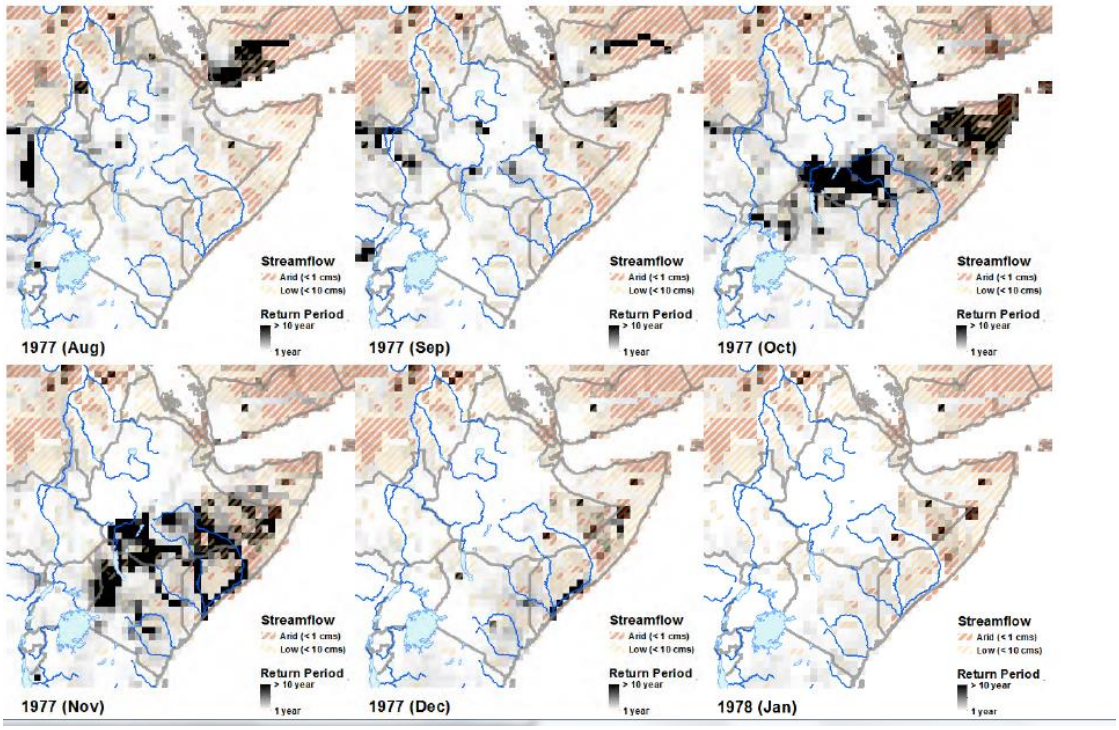


Figure 4: streamflow intensities that were modelled for the El Nino year 1977. Dark grey to black shading indicate areas with high stream flows (and likely floods) in the respective calendar month. Source: Paul Block & Donghoon Lee, University of Wisconsin, personal communication.

Impacts on flooding and food security

Areas with high expected rainfall are more likely to see flooding over the coming rainy season than areas where rainfall is expected to be lower. However, the actual occurrence of floods depends largely on the distribution of this rainfall over time (i.e. is there a lot of rain falling in a short period of time, or is it more spread out?) and on the hydrological situation (i.e. if rain is falling on already saturated soil and already filled rivers, or is there still capacity for the rain to flow away naturally?)

In general, we can identify two main types of flooding:

1. River flooding: occurs when rivers burst their banks after too much rainfall accumulates in them. This is the most common and destructive type of flooding. Due to the river network, river floods can impact areas far away (downstream) from the place where the rains were falling.
2. Flash flooding: occurs when a high amount of rain falls in a short period of time, leading to flooding in the immediate area. These are usually short, intense events, and are much harder to predict than river floods.

The below map (Figure 5) shows model results outlining the areas subject to river floods that statistically occur once every 100 years (1% annual probability of occurrence, representing extreme floods; flood modelling by Hessel Winsemius, Philip Ward, Brenden Jongman and colleagues, see

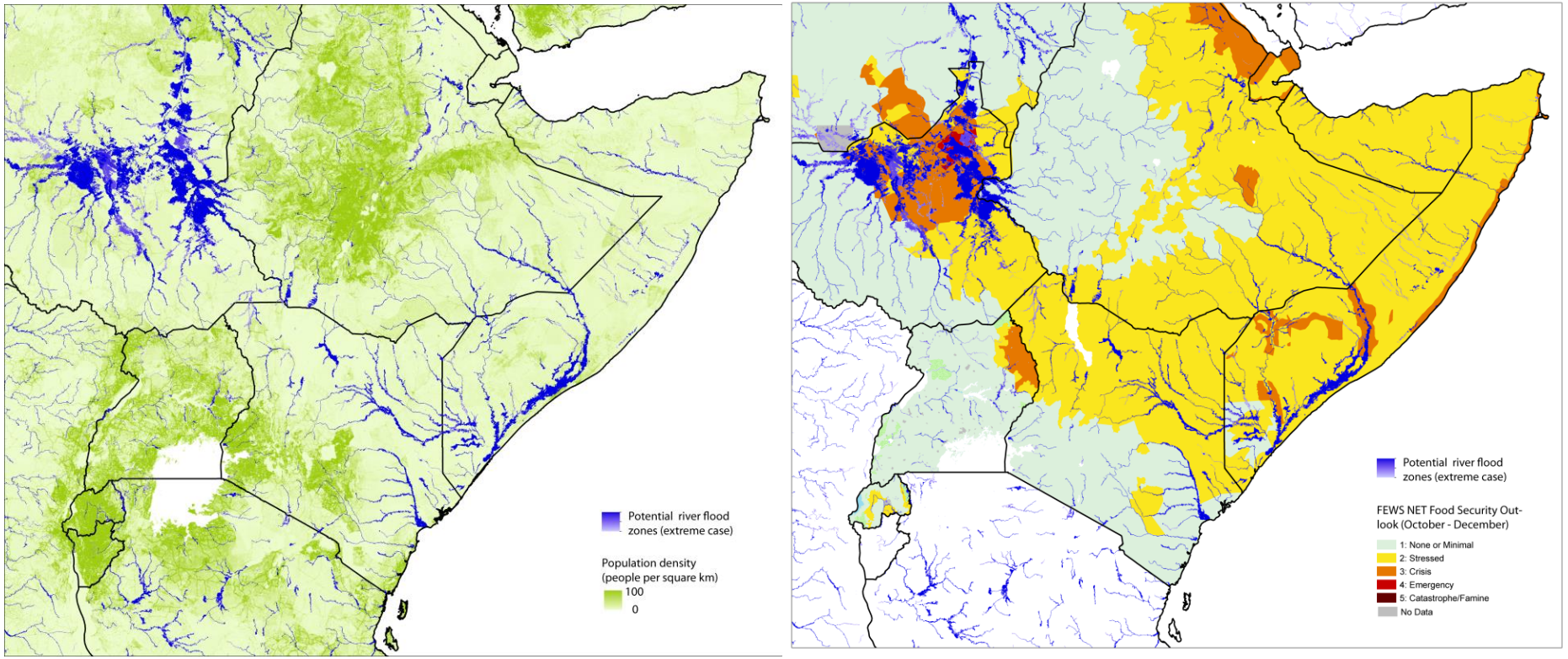


Figure 5: Population density (people per square km; left panel); FEWS Net food security outlook for October – December (right panel); and potential flood-prone areas (extreme floods); Source: Population data from LandScan (2007); flood modelling by Hessel Winsemius, Philip Ward, Brenden Jongman and colleagues (source and source); food security data from FEWS NET (source). We can see that several areas already classified as "crisis" are also places that could have river floods if there is heavy rainfall during this season. These are areas we should consider targeting strongly with preparedness measures.

source and source). In the rainy season, often parts of these potential flood areas see some level of inundation, depending on the intensity of the rainfall in the specific season. Some areas have indeed already been inundated over the past months, for example in South Sudan. The modelled flood zones in these maps therefore represent potential hazard areas for river flooding (not flash flooding) which could materialize at very high rainfall and river levels, and without further protective measures. Note that these maps do not represent a seasonal flood forecast, but can be used for potential risk assessment.

In the maps, the flood zones are overlayed with population density information (from LandScan, year 2007) and the October-December food security outlook by FEWS NET (source). We can see that several areas already classified as "crisis" are also places that could have river floods if there is heavy rainfall during this season. These are areas we should consider targeting strongly with preparedness measures.

Important! Seasonal Forecasts Do Not Provide Any Detailed Spatial Information. Weather forecasts are like a high-definition picture, giving you detailed information on exactly where rainfall is likely to occur. Seasonal forecasts however, are more big-picture (coarse resolution). Thus, it is not possible to make inferences about precisely where there are risks of increased or decreased rainfall. A forecast for increased risk of above-normal rainfall over West Africa, for example, should be taken as just that, and not as a forecast for above-normal rainfall in specific countries or parts of countries in West Africa.

Important! Seasonal Forecasts Only Give a General Sense of the Character of the Season by Providing a Forecast of Seasonal Rainfall Totals. The seasonal forecasts are for whether cumulative rainfall totals over 3 months are likely to be normal, above-normal or below-normal. This gives a general overview of the season, but does not elaborate on possible day-to-day weather fluctuations. Although it does not happen very often, it is possible for an area to receive a month's worth of rainfall in 1 day and thus suffer from floods, but end up having a seasonal total of below-normal rainfall consistent with the seasonal forecast.

Important! Seasonal forecasts are Probabilistic. If you had no forecast, you would have no idea of whether rainfall would be normal, above-normal, or below-normal, and so each of these three possible outcomes would have a probability of 33%. Seasonal forecasts can tell you if one of those three categories is more likely than the others. However, probabilities for the less likely events should not be ignored, to avoid being over-confident in the forecasts. For example, a 45% chance of above normal-rainfall means that there is an enhanced chance of getting rainfall totals that are above-normal for the season, but there is still a 55% chance of getting normal or below-normal rainfall. Seasonal forecasts therefore leave a large amount of uncertainty, but when combined with monitoring of weather forecasts on shorter timescales and a no-regrets early action strategy, can still be very beneficial by providing enhanced lead-time for preparedness.