El Niño and its implications for acute food insecurity in Southern Africa

Famine Early Warning Systems Network

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Introductions
Speakers

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Southern African Development Community
www.sadc.int

FUNDING GAP US$ 2.4B

23M People in need of emergency assistance.
10 out of 15 countries requiring humanitarian assistance.

PERCENTAGE OF AFFECTED RURAL POPULATION

2.4B

CEREAL, TONNAGE 1.7MT
Tons of maize required for 23M in emergency conditions.

ACCESS TO DRINKING WATER
71% Population with access to safe drinking water.

STUNTING RATES IN SADC
8 - 47%

FUNDING REQUIREMENTS (US$)
PEOPLE IN NEED
SAID RURAL POPULATION

FEWS NET
USAID
FROM THE AMERICAN PEOPLE
2023-2024 El Niño

Acknowledgements: Andrew Hoell (NOAA), Laura Harrison (UCSB CHC), Weston Anderson (NASA GSFC)
Overview

The El Niño-Southern Oscillation
Naturally occurring, arising from tropical atmosphere-ocean relationship

El Niño Characteristics
Identifiable features, including intensity and flavor

Forecast
Ongoing El Niño most likely to be strong in late 2023 and early 2024
Overview

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The El Niño – Southern Oscillation (ENSO)

Consists of three phases

- ENSO Neutral
- La Niña
- El Niño

Source: NOAA Climate.gov
The El Niño – Southern Oscillation (ENSO)

**ENSO Neutral**: The easterly trade winds push warm surface waters into the west Pacific and cool subsurface water surfaces in the eastern Pacific.
The El Niño – Southern Oscillation (ENSO)

**La Niña:** The easterly trade winds strengthen, the warmest surface waters move further westward and cool subsurface water surface in the east Pacific.

Source: NOAA Climate.gov
The El Niño – Southern Oscillation (ENSO)

**El Niño:** The easterly trade winds weaken, allowing warmer surface water to remain in the central and eastern Pacific Ocean.
ENSO-related changes in temperature and wind patterns in the Pacific Ocean have global effects.
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No Two El Niño Events are the Same

Generally characterized by the strength of sea surface temperature departures from average (intensity) and the location of the departures (flavor)
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Generally characterized by the strength of sea surface temperature departures from average (intensity) and the location of the departures (flavor)

**Intensity:** Strong  
**Flavor:** Eastern Pacific

1997-1998

**Intensity:** Weak  
**Flavor:** Central Pacific

2004-2005

**Intensity:** Moderate  
**Flavor:** Central Pacific

2009-2010

Sea Surface Temperature Departure From 1951-2022 Average (°C)

Source: NOAA Physical Sciences Laboratory
How we monitor ENSO

Calculate average Sea Surface Temperature anomalies over equatorial Pacific Ocean
How we monitor ENSO

Calculate average Sea Surface Temperature anomalies over equatorial Pacific Ocean
How we monitor ENSO
How we monitor ENSO

Historical Nino 3.4 Sea Surface Temperature Anomaly

- El Nino
- Neutral
- La Nina

Time Period
Dec-Feb rainfall during past El Niño events since 1981 (CHIRPS)

1997/98 2002/03 2004/05 2006/07 2009/10
2014/15 2015/16 2018/19
El Nino Strength

Historical Nino 3.4 Sea Surface Temperature Anomaly

Strong El Nino

Moderate El Nino

Weak El Nino
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*Ongoing El Niño most likely to be strong in late 2023 and early 2024*
El Niño Most Likely Through at Least Early 2024

Source: NOAA Climate Prediction Center
2023-24 El Niño Most Likely to be Strong

Source: NOAA Climate Prediction Center
2023-24 El Niño Most Likely to be Strong

NMME Forecast for December 2023 – February 2024 (from August 2023)

Source: NOAA Climate Prediction Center
2023-24 El Niño Most Likely to End by Mid-2024

Experimental Probabilistic ENSO Forecast

PSL-CIRES model-analog ENSO forecast initialized from JUL 2023

ENSO state based on Niño 3.4 SST Anomaly

Dash line is equivalent to 0.75 signal-to-noise ratio for a Gaussian forecast distribution

Models: CMIP6: CESM2; CESM1; ESM1G; GFDL; ESM1; HadGEM2-ES; CCSM4, MIROC5; MRI; CSIRO5; CCSM3-CC31; MIROC5; CSIRO5-LL; MIROC5-CC31

(Apriori ensemble forecasts are determined relative to a 1982-2010 equatorial climatology)

* indicates verification category

Source: NOAA Physical Sciences Laboratory
Precipitation and Temperature Forecasts
Anticipated 2023-2024 outcomes

- We are **on watch** for large impacts in teleconnection regions
  - Consistent with forcing from a moderate-strong event
    - Looking to historical outcomes during past events
    - Agreement from model precipitation forecasts in some regions
  - Potential non-typical impacts
    - Large range of outcomes during past events
    - Currently weak atmospheric coupling in tropical Pacific, but lots of opportunity for development
    - Already very high global temperatures ~ higher chances of heat stress and extreme rain events
El Niño global precipitation patterns

Precipitation tendency during active El Niño conditions

Fig. 2. Timing of wet and dry conditions related to El Niño.

Wet and dry conditions are based on observed precipitation during the 22 El Niño events since 1950. Wet and dry correspond to an increase in the frequency of precipitation in the upper and lower thirds of historical values. From FEWS NET Agroclimatology Series.
Unprecedented conditions for 2023-24 El Niño

No previous strong El Niño has developed under such warm conditions

Record high global 2m air temperatures during Summer 2023, and temperatures compared to 2022 and analog moderate-strong El Niño years. From ClimateReanalyzer.org and NCEP CFS data. 
Very high temperatures expected into 2024

Probability of 80th percentile or higher 2m temperatures November 2023 to January 2024

C3S multi-system seasonal forecast
Prob(highest 20% of climatology) - 2m temperature
Nominal forecast start: 01/06/23
Unweighted mean

C3S forecast for probability of upper quintile 2m temperatures, for November 2023-January 2024
Southern Africa outcomes for moderate-strong El Niño

Well below-average October-February rainfall tends to occur in moderate-to-strong El Niño

Higher maximum temperatures tend to occur in moderate-strong El Niño

Frequency of Oct-Feb rainfall in lower 20th percentile during analog moderate-strong El Niños, from UC Santa Barbara CHIRPS data

Frequency of upper tercile Oct-Mar average monthly maximum 2m temperatures for moderate-strong El Niño. UCSB Santa Barbara CHIRTSmax.

Atmospheric evaporative demand is an important variable driving water supply and demand.

**Factors for higher evaporative demand**
- More solar radiation
- **Higher temperatures**
- Lower humidity
- Higher wind speed


*Water cycle graphic from Missouri American Water*
Early season versus Mid/late season rainfall impacts

Oct-Dec

OND Frequency of < 33rd percentile for El Nino’s since 1981

Dec-Mar

DJFM Frequency of < 33rd percentile for El Nino’s since 1981
Southern Africa model forecasts

NMME indicates below-normal rainfall Dec 2023 to Feb 2024

Low predictability regarding start of season

Above-normal temperatures very likely across Africa

NMME forecast for October to December 2023

NMME forecast for December 2023 to February 2024

Probabilistic forecast for Oct-Dec 2023 precipitation tercile, from NOAA PSL

Probabilistic forecast for Dec 2023 – Feb 2024 precipitation tercile, NOAA CPC NMME
Very high temperatures expected into 2024

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C3S multi-system seasonal forecast
ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
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C3S forecast for probability of upper quintile 2m temperatures, for November 2023-January 2024
Regional/local climate drivers

- **Subtropical Indian Ocean Dipole**
  - tends to be negative during El Nino

- **Indian Ocean Dipole**
  - tends to be positive during El Nino
Forecasts summary

- Forecast for southern Africa appear largely driven by forecast El Nino
- Strong El Nino Forecast gives high predictability for
  - reduced rainfall
  - higher temperature
  - higher atmospheric demand
  - impacts crop, livestock, water availability
- “Transition zones” have lower predictability
- Local and regional factors can influence regional El Nino impacts:
  - Indian Ocean,
  - Atlantic Ocean
  - Regional atmospheric circulation
  - close monitoring required
Crop Yield Forecasts
El Niño - Typical Crop Yield Outcomes

Figure 1: Global-scale yield anomalies relative to expected yields during past El Niño events. Boxplots show the interquartile range and median of the yield anomalies, with the mean denoted by a white square. The size of each point corresponds to the strength of the El Niño in Oct-Dec during that year.

Figure 2: Historical crop yield conditions during El Niño events for wheat, maize, sorghum, rice, and soybeans. In countries with more than one crop affected the color reflects the strongest effect.
Maize yields

Figure 3: Fractional maize yield anomalies during El Niños
Maize yields

Figure 3: Fractional maize yield anomalies during El Niños (top row) and the consistency of the teleconnection (bottom row) as measured by the fraction of El Niño years in which the sign of the yield anomaly agrees with that of the mean yield anomaly. Areas that are shaded green indicate that more than 60% of El Niño years have a yield anomaly consistent with the mean.
Maize yields

Figure 3: Fractional maize yield anomalies during El Niños (top row) and the consistency of the teleconnection (bottom row) as measured by the fraction of El Niño years in which the sign of the yield anomaly agrees with that of the mean yield anomaly. Areas that are shaded green indicate that more than 60% of El Niño years have a yield anomaly consistent with the mean.
Acute Food Insecurity Implications
Current Situation
Seasonal calendar for a typical year

- Winter/ 2\textsuperscript{nd} planting
- Land prep
- Main planting
- Rainy season
- Lean season
- Tobacco and cotton sales and auction
- MZ: 2\textsuperscript{nd} harvest
- Peak agricultural labor demand
- Vegetable gardening peak
- MW Winter harvest
- ZA, ZW: Wheat harvest
- SA Wheat harvest
- Cassava harvest

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2022/23 seasonal rainfall

Percent of 1981-2010 average rainfall, Oct. 2022 to May 2023

CHIRPS season precipitation rank compared to 1981-2022 record, Oct. 2022 to April 2023

Source: USGS

Source: Climate Hazards Centers
2023 Production

End of season maize conditions, June 28, 2023

Condition:
- Exceptional
- Favourable
- Watch
- Poor
- Failure
- Out-of-Season
- No Data

Countries:
- Early Warning Countries
- Non-Early Warning Countries

Drivers:
- Wet
- Dry
- Hot
- Cool
- Extreme Event
- Pest & Disease
- Socio-economic
- Conflict

Source: GeoGlam
2023/24 market supply

Regional maize supply estimates (000 000s MT)

Source: USDA FAS
2023 harvest estimate by country

Source: USDA FAS
Regional price trends

Source: FEWS NET
Macroeconomic conditions

Annual inflation rates in Southern Africa

<table>
<thead>
<tr>
<th>Country</th>
<th>Inflation rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angola</td>
<td>12.12 (July)</td>
</tr>
<tr>
<td>DRC</td>
<td>26.67 (May)</td>
</tr>
<tr>
<td>Lesotho</td>
<td>4.50 (July)</td>
</tr>
<tr>
<td>Madagascar</td>
<td>11.75 (May)</td>
</tr>
<tr>
<td>Malawi</td>
<td>28.4 (July)</td>
</tr>
<tr>
<td>Mozambique</td>
<td>5.68 (July)</td>
</tr>
<tr>
<td>South Africa</td>
<td>4.70 (July)</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>77.20 (August)</td>
</tr>
</tbody>
</table>

Source: TradingEconomics

Inflation trends, August 2022 to August 2023

Source: FEWS NET using data from TradingEconomics
Regional assumptions
Staple food prices

Maize price projection, Chokwé, Mozambique

Maize meal price projection, Maseru, Lesotho

Maize price projection, Randfontain, South Africa

Source: FEWS NET
Looking forward through January 2024

- Based on historical trends in years with El Niño conditions, an erratic and delayed start to the 2023/24 rainy season is expected between October and January, particularly in southern and central areas.

- The forecasted erratic and delayed rains are expected to impact planted area, in turn limiting the availability of agricultural labor opportunities and household income-earning in late 2023/early 2024.

- Food prices are anticipated to remain elevated amid weak and unstable economies.
Household food stocks in areas where the 2023 harvest was below average will likely deplete atypically early.

The immediate concern during the October-January outlook projection period is the impact on income-earning, which will further limit household purchasing power and access to food during the lean season.

In these areas, households will likely face food consumption gaps and Crisis (IPC Phase 3) outcomes are expected prior to the peak of the lean season.

Food assistance needs are expected to rise during the peak of the 2024 lean season, which will occur in January-March 2024.
Regional food assistance needs

Areas of greatest concern between October 2023 and February 2024

- Eastern DRC
- Southern Malawi
- Southern and western Zimbabwe
- Cabo Delgado and southern Mozambique
- Southern Madagascar

October 2023 to February 2024 projected assistance needs compared to the same months of 2020 to 2022

Source: FEWS NET
Long-term considerations and alternative El Niño-related events

Period of highest concern for Southern Africa

Events that could lead to worse than anticipated outcomes in Southern Africa:

- Widespread drought
  - A consecutive below-average harvest in southern Zimbabwe, southern Malawi, and southern Mozambique
- Damage from a cyclone that makes landfall
Questions
FEWS NET’s approach to early warning analysis – Scenario Development

1. **STEP 1**: Set scenario parameters
2. **STEP 2**: Describe and classify current food security
3. **STEP 3**: Develop key assumptions
4. **STEP 4**: Describe impacts on HH income sources
5. **STEP 5**: Describe impacts on HH food sources
6. **STEP 6**: Describe and classify projected HH food security
7. **STEP 7**: Describe and classify projected area food security
8. **STEP 8**: Identify events that could change the scenario
### IPC acute classification

#### Household classification

- **None (IPC Phase 1)**
  - Household is able to meet their basic food and non-food needs without engaging in unsustainable coping.

- **Stressed (IPC Phase 2)**
  - Household has minimally adequate consumption but is unable to afford essential non-food needs without negative coping.

- **Crisis (IPC Phase 3)**
  - Household either has food consumption gaps or is only minimally meeting their food needs by negative coping.

- **Emergency (IPC Phase 4)**
  - Household either has large food consumption gaps or is only minimally meeting their food needs by extreme coping including asset depletion.

- **Catastrophe (IPC Phase 5)**
  - Household has an extreme lack of food even after full employment of coping strategies; starvation; death and destitution evident.

#### Area classification

- **Minimal (IPC Phase 1)**
  - >80% of the population facing IPC Phase 1 outcomes

- **Stressed (IPC Phase 2)**
  - ≥20% of the population facing IPC Phase 2 or worse outcomes; acute malnutrition & hunger-related mortality increasing

- **Crisis (IPC Phase 3)**
  - ≥20% of the population facing IPC Phase 3 or worse outcomes; acute malnutrition & hunger-related mortality increasing

- **Emergency (IPC Phase 4)**
  - ≥20% of the population facing IPC Phase 4 or worse outcomes; acute malnutrition & hunger-related mortality are high

- **Famine (IPC Phase 5)**
  - ≥20% of the population facing IPC Phase 5; acute malnutrition levels ≥30%; ≥2/10,000/day dying due to hunger-related causes

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Humanitarian food assistance urgently needed

Phase classification would likely be at least one phase worse without current or programmed humanitarian assistance.