Climate Change & Drought

The Impact on the Invisible 60% of Africa’s Population

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Drought

• Defining drought can be difficult. ...
• So if we say that a drought is when there isn't enough water,
• what does "enough" mean? And enough for what or whom?

• That is why scientists describe drought
  • conceptually, as an idea or concept; and
  • operationally, by how drought functions or operates in ways that can be measured.
Types of Drought

To help with drought classification and monitoring, scientists have defined several types of drought:

**Meteorological Drought**
When dry weather patterns dominate an area.

**Hydrological Drought**
When low water supply becomes evident in the water system.

**Agricultural Drought**
When crops become affected by drought.

**Socioeconomic Drought**
When the supply and demand of various commodities is affected by drought.

**Ecological Drought**
When natural ecosystems are affected by drought.
AGRICULTURAL DROUGHT IS ABOUT SOIL MOISTURE

Water required to meet the demand of evapotranspiration and metabolic activities of the crop together is known as consumptive use of water.

CLIMATE CHANGE THREAT
- Increased Temperature increase in PET
- Changes in Growing Season Precipitation
- Change in Intensity of Rainstorms – less infiltration
CLIMATE CHANGE IS DRIVING INCREASES IN VARIABILITY and EXTREMES

• AGRICULTURAL DROUGHTS WILL BE WORST UNDER CLIMATE CHANGE
• THE MAGNITUDE OF DROUGHTS INCREASE WITH GHG EMISSION

WHY?

• TEMPERATURE AND CROP WATER REQUIREMENT GOING UP
• PRECIPITATION EVENTS WILL BECOME LESS FREQUENT BUT MORE INTENSE
• MORE INTENSE RAINFALL CANNOT INFILTRATE AS WELL AND BECOMES RUNOFF (FLOODS) AND DOES NOT BECOME SOIL MOISTURE
Shifting means and rising uncertainty increase frequency of adverse climate and agricultural events

RESULTS FROM A JOINT IFPRI/MIT STUDY OF CLIMATE CHANGE, DROUGHT AND CROP YIELD IN SOUTHERN AFRICA
Right arrow shows change in frequency on 1-in-20-year event will happen every 3.5 years (2060REF) in Southern Africa.

The down arrow shows that the severity of a future 1-in-20-year event reduce the yield by another 16 percent.

Frequency of 1-in-20-year low rainfall events in Southern Africa: comparing level of the 2020s to the 2060s under the high emissions scenario

Frequency of 1-in-20-year low maize yield events in Southern Africa: comparing level of the 2020s to the 2060s under the high emissions scenario

WHO CAN COPE WITH THESE TRENDS?

GENERALLY, COMMERCIAL FARMERS WITH ACCESS TO RESOURCES:

Financial,
High Input Seeds,
Fertilizers,
Govt Information,
Forecast,
Irrigation,

What about the rest?
SMALL HOLDER/SUSISTENCE FARMERS

• The vast majority of farms (84%) are less than 2 ha in size (Lowder et al., 2021).

• Smallholder farmers produce around a third of the world’s food

• Smallholder farmers are responsible for about 80% of the food produced in Asia and sub-Saharan Africa (SSA) (Lowder et al., 2021).
Africa's population is 1,287,920,518

The rural population is 740,318,336

Most of the rural population is engaged in rainfed subsistence farming.
Over view of the situation

• Only 5.5% of cultivable land in Africa is irrigable – a natural phenomenon
• 94.5% of cultivable land is therefore rainfed
• 65% of the population is employed directly or indirectly in agriculture
• 80% of all agricultural activity is on smallholder rainfed farms
• Africa has the lowest crop yields and agricultural productivity in the world
• In 2016 Africa had 218 million undernourished population, up by 44 million from 1992
• **60% of the world’s unutilised arable land is in Africa**

AND Africa is importing food @ $35 billion per year which is expected to increase to $110 billion
WHY ARE THEY THE INVISIBLE?

- THE INVISIBLE 60% ARE GENERALLY NOT ACCOUNTED FOR IN OUR ECONOMIC MODELS OF CC OR WORST ARE VALUED BY THEIR GDP/CAP.

- THEY ARE REGARDED AS A NET DRAIN ON THE ECONOMY.

- OUT-OF-SIGHT AND OUT-OF-MIND, THEY ARE LEFT TO FEND FOR THEMSELVES WITH MINIMUM ALLOCATIONS OF PUBLIC EXPENDITURE.

- EXCEPT WHEN DROUGHTS OCCUR AND ALL THEIR COPING STRATEGIES ARE EXHAUSTED, UNTIL THEY ARE FURTHER IMPOVERISHED AND THEY NEED TO BE FED.

- REACTIVE FOOD IMPORTS COST SUB-SAHARAN AFRICA 35-42 $ BILLION PER YEAR. THIS IS PART OF THE COST OF DOING NOTHING – FOR DECADE UPON DECADE

- WE NEED PROACTIVE INVESTMENTS TO MAKE THE 60% RESILIENT TO CLIMATE EXTREMES
WHY ARE THEY VULNERABLE?

- Enhanced rainfed farming has the highest potential to improve food production and reduce poverty, enabled through managing green water in the vast tracts of rainfed cultivable land in Africa.
WHAT CAN WE DO TO MAKE SMALL HOLDER /SUBSISTENCE FARMER MORE RESILIENT

• LET’S TAKE A LOOK AT HISTORY ACROSS THE MEDITERRANEAN
NILE RIVER IRRIGATION

Noah, Joseph, and Operational Hydrology

BENOIT B. MANDELBROT

JAMES R. WALLIS

International Business Machines Research Center
Yorktown Heights, New York 10598

Dedicated to Harold Edwin Hurst

... were all the fountains of the great deep broken up, and the windows of heaven were opened. And the rain was upon the earth forty days and forty nights. Genesis, 6, 11-12

... there came seven years of great plenty throughout the land of Egypt. And there shall arise after them seven years of famine ... Genesis, 41, 29-30

Abstract. By 'Noah Effect' we designate the observation that extreme precipitation can be very extreme indeed, and by 'Joseph Effect' the finding that a long period of unusual (high or low) precipitation can be extremely long. Current models of statistical hydrology cannot account for either effect and must be superceded. As a replacement, 'self-similar' models appear very promising. They account particularly well for the remarkable empirical observations of Harold Edwin Hurst. The present paper introduces and summarizes a series of investigations on self-similar operational hydrology. (Key words: Statistics; synthesis; time series)

Benoit B. Mandelbrot was a Polish-born French-American mathematician and polymath and is recognized for his contribution to the field of fractal geometry.
Genesis 41: 28 -53 Lesson From the Nile Drought on Developing Resilience

• **Forecasting**: God has shown Pharaoh what he is about to do. Seven years of great abundance are coming throughout the land of Egypt, but seven years of famine will follow them.

• **Developing a plan** The plan seemed good to Pharaoh and to all his officials.

• **Developing Institutions** “Pharaoh appoint commissioners over the land to take a fifth of the harvest of Egypt during the seven years of abundance.

• **Developing Infrastructure** In each city he put the food grown in the fields surrounding it.

• **Implementing the Plan** Joseph stored up huge quantities of grain, like the sand of the sea; it was so much that he stopped keeping records because it was beyond measure.

• **Success needs resources** Then Pharaoh took his signet ring from his finger and put it on Joseph’s finger.
DROUGHT FORECASTING

Acting early against climate shocks
DROUGHT FORECASTING

About FEWS NET

FEWS NET is a leading provider of early warning and analysis on acute food insecurity around the world. FEWS NET relies on a global network of partners to report and provide insightful information on the severity of food insecurity in dozens of countries.

Providing evidence-based early warning information and analysis of food insecurity and its drivers worldwide

The United States Agency for International Development (USAID) established the Famine Early Warning Systems Network (FEWS NET) in 1985 in response to devastating famines in East and West Africa and a critical need for better and earlier warning of potential food security crises.
DEVELOPING A PLAN

Figure 3.3. Framework for Enhancing the Climate Resilience of Investment Projects

<table>
<thead>
<tr>
<th>STEP</th>
<th>OBJECTIVE</th>
<th>ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PreliminarySituation</td>
<td>To understand to what extent the project is exposed to climate hazards and the analytical requirements to evaluate resilience</td>
</tr>
<tr>
<td></td>
<td>Assess climate exposure and criticality</td>
<td>Screen for climate hazards, Assess criticality</td>
</tr>
<tr>
<td>2</td>
<td>Assess climate vulnerabilities</td>
<td>To understand the performance of the project under certain climate conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analyze project performance</td>
</tr>
<tr>
<td>3</td>
<td>Develop and evaluate strategies</td>
<td>To identify strategies that reduce vulnerability and build climate resilience for the project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identify immediate interventions, Develop strategies</td>
</tr>
<tr>
<td>4</td>
<td>Recommend a course of action</td>
<td>To select and recommend a robust strategy for building climate resilience</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Select a decision-making approach, Assess trade-offs, Develop recommendations</td>
</tr>
</tbody>
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### INFRASTRUCTURE

Selected CSA practices and technologies for production systems key for food security in Zimbabwe

<table>
<thead>
<tr>
<th>Smartness level</th>
<th>Degree of Adoption</th>
<th>Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>High</td>
<td>Zero tillage, Use of improved varieties, Intercropping, Integrated Soil Management (water conserving and intercropping), Water conservation techniques, Seedling nurseries-integrated and motorized, Use of improved varieties</td>
</tr>
<tr>
<td>9</td>
<td>Medium</td>
<td>Minimum tillage, Crop rotation, Use of improved varieties, Drip irrigation, Contour farming, Use of improved varieties (above-ground methods), Integrated Soil Fertility Management (above-ground), Use of improved varieties (above-ground)</td>
</tr>
<tr>
<td>8</td>
<td>Low</td>
<td>Minimum tillage, Water harvesting systems, Stalk recycling and value addition, Drip irrigation, Contour farming, Use of improved varieties, Integrated Soil Fertility Management (above-ground), Use of improved varieties (above-ground)</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Drip irrigation, Use of improved varieties (above-ground methods), 80x-energy production, Drip irrigation, Contour farming, Use of improved varieties (above-ground)</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Drip irrigation, Composting, establishment of irrigation systems, Drip irrigation, Use of improved varieties (above-ground methods), Integrated Soil Fertility Management (above-ground), Use of improved varieties (above-ground)</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Drip irrigation, Contour farming, Use of improved varieties (above-ground methods), Integrated Soil Fertility Management (above-ground), Use of improved varieties (above-ground)</td>
</tr>
<tr>
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<td>Drip irrigation, Use of improved varieties (above-ground methods), Integrated Soil Fertility Management (above-ground), Use of improved varieties (above-ground)</td>
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<td>Drip irrigation, Use of improved varieties (above-ground methods), Integrated Soil Fertility Management (above-ground), Use of improved varieties (above-ground)</td>
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<td>1</td>
<td></td>
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</tr>
</tbody>
</table>

*Width of the bars is based on production system area*

- **Maize**
- **Small grains**
- **Groundnut**
- **Cotton**
- **Tobacco**
- **Soybean**
- **Sugarcane**
- **Vegetable**
- **Wheat**
- **Cattle (meat)**
Food and Climate Systems Transformation (FACT) Alliance

Catalyzing stakeholder-driven research to solve the world’s most vexing food and climate challenges

The Food and Climate Systems Transformation (FACT) Alliance is a first-of-its-kind initiative, connecting researchers, the private sector, non-governmental organizations (NGOs), farming communities, and governments to drive innovation and inform better decision making for resilient and sustainable food systems. The effort is led by Greg Sixt, J-WAFS research manager for food and climate systems, and consists of over 20 global member institutions at the vanguard of research and policy on climate change and food systems.
The potential investments required and the possible yields in the dryland zones of Sub-Saharan Africa.

These investments are comparable to Africa’s food import bill, which costs the continent about $35 billion to $42 billion each year.

These estimates make a strong case for investing in enhanced rainfed agriculture by managing green water.

The question then arises as to how this can be done at scale to help regenerate rural economies across Africa, increase food security and contribute to the continent’s growth and development.

### Table 6: Investments and yields by water management type

<table>
<thead>
<tr>
<th>Agricultural water management type</th>
<th>Investment required</th>
<th>Possible annual yields</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large-scale commercial irrigation</td>
<td>$19 billion</td>
<td>18 million tons</td>
</tr>
<tr>
<td>Small-scale irrigation</td>
<td>$40.5 billion</td>
<td>22.7 million tons</td>
</tr>
<tr>
<td>Improved rainfed agriculture</td>
<td>$31.5 billion</td>
<td>126 million tons</td>
</tr>
</tbody>
</table>
WE ARE CALLED TO ACTION

• Smallholder farmers in developing countries, are often not empowered to do adaptations, since they often do not have the economic, institutional, educational or other support to take action (Bustamante et al., 2014; Smith et al., 2007).

• Smallholder farmers are often in the regions of the world most at risk from climate change, both gradual and through extreme events, such as droughts, floods and heatwaves (IPCC, 2022).

• It is important to support smallholder farmers to implement adaptation options in their farming practices, that also co-deliver the climate change mitigation (Smith & Olesen, 2010).

• Deuteronomy 15:11, “You shall open wide your hand to your brother, to the needy and to the poor, in your land.”

• Psalm 9:18 For the needy shall not always be forgotten, and the hope of the poor shall not perish forever.

• Let us not forget the Small Holders/Subsistence and their families and the Invisible 60% of Africa

• We have a call to action NOW and even more so in light of a Changing Climate