Risk-based National Drought Policy: Background, Challenges and Opportunities

Dr. Donald A. Wilhite
School of Natural Resources
University of Nebraska-Lincoln

Capacity Development to Support National Drought Management Policies
Bucharest, Romania
July 9-11, 2013
Thanks for your Leadership!

- WMO
- FAO
- UNCCD
Presentation Outline

• The **DROUGHT AS HAZARD**— a growing sense of urgency
  • Drought characteristics, definition

• Building **SOCIETAL RESILIENCE**
  • Hydro-illogical Cycle/Crisis Management/Changing the Paradigm

• **CHALLENGES** of integrated drought management
  • Changing Climate
  • Changing Vulnerability/Risk/Impacts

• **OPPORTUNITIES** for integrated drought management
  • Drought policy
  • Drought preparedness planning
    • Monitoring/Early Warning
    • Risk and Impact assessment
    • Mitigation and Response

• **TAKEAWAY MESSAGES**
Drought Characteristics in the Context of Natural Hazards

• slow onset, “creeping phenomenon”
  – drought’s onset and end difficult to determine
  – commonality with climate change
It's behind me...

Isn't it...?

Drought— it sneaks up on you!
Drought Characteristics in the Context of Natural Hazards

- slow onset, “creeping phenomenon”
  - drought onset and end difficult to determine
  - commonality with climate change
- absence of a universal definition
- impacts are nonstructural and spread over large areas
- severity and impacts best defined by multiple *indices* and *indicators*
- impacts are complex, affect many people, and vary on *spatial* and *temporal* timescales, *multiple* and *migrating epicenters*
Weekly ‘snapshot’ of drought severity nationwide—1999

Based on multiple indicators and indices

Incorporates ground observations of impact into the assessment

Drought severity classification based on percentiles or probability of recurrence

Jointly prepared by the NDMC, NOAA and USDA
35 month animation—USDM, 2010-2013
Drought—as hazard

• a normal part of climate.
• occurs in virtually all climatic regimes.
• characteristics vary between regions.
• definitions must be region and application specific.
• impacts are a good measure of severity and an indicator of societal vulnerability or resilience.
Defining Drought

-Hundreds of definitions—application and region specific

Drought is a deficiency of *precipitation* (intensity) from expected or “normal” that extends over a season or longer period of time (duration) . . . .

---

**SPI Dec 2012 (12 months)**

GPCC first-guess analysis

- **Median**

---

- **extreme drought** $\text{SPI} \leq -2$
- **severe drought** $-2 < \text{SPI} \leq -1.5$
- **moderate drought** $-1.5 < \text{SPI} \leq -1$
Defining Drought

-Hundreds of definitions—application and region specific

Drought is a deficiency of precipitation (intensity) from expected or “normal” that extends over a season or longer period of time (duration) . . . . .

Meteorological Drought

and is insufficient to meet the demands of human activities and the environment (impacts).

Agricultural Drought

Hydrological Drought

Socio-economic Drought
It's so dry . . .
Evolution of Drought Types

Natural Climate Variability

Precipitation deficiency (amount, intensity, timing)

Reduced infiltration, runoff, deep percolation, and ground water recharge

High temp., high winds, low relative humidity, greater sunshine, less cloud cover

Increased evaporation and transpiration

Soil water deficiency

Plant water stress, reduced biomass and yield

Reduced streamflow, inflow to reservoirs, lakes, and ponds; reduced wetlands, wildlife habitat

What are the indices and indicators?

Cascading Impacts

Meteorological Drought

Agricultural Drought

Hydrological Drought

Economic Impacts

Social Impacts

Environmental Impacts
Natural and Social Dimensions of Drought

Decreasing emphasis on the natural event (precipitation deficiencies)

Increasing emphasis on water/natural resource management & policy

Increasing complexity of impacts and conflicts

Drought Risk Reduction

Meteorological
Rainfall Deficiencies
Heat Stress

Agricultural
Soils
Crops
Range
Livestock
Forests

Hydrological
Water Supply
Snow Depth
Irrigation
Recreation
Tourism
Hydropower
Socio-economic

Societal Impact

Time/Duration of the event
Breaking the Hydro-illogical Cycle: An Institutional Challenge for Drought Management

If you do what you’ve always done, you’ll get what you’ve always got.

We MUST adopt a new paradigm for drought management!
The Cycle of Disaster Management

Risk management increases coping capacity, builds resilience.

Crisis management treats the symptoms, not the causes.
**Hazard** x **Vulnerability** = **Risk**

**EXPOSURE**
- Severity/Magnitude
  - Intensity/Duration
- Frequency
- Spatial extent
- Trends
  - Historical
  - Future
- Impacts
- Early warning

**SOCIAL FACTORS**
- Population growth
- Population shifts
- Urbanization
- Technology
- Land use changes
- Environmental degradation
- Water use trends
- Government policies
- Environmental awareness

**RISK**
Challenges to Integrated Drought Management
Challenges of a Changing Climate

Estimated actual global mean temperatures (°C)

Difference (°C) from 1961 - 1990

- Annual mean
- Smoothed series
- 5-95% decadal error bars

<table>
<thead>
<tr>
<th>Period</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years</td>
<td>°C per decade</td>
</tr>
<tr>
<td>25</td>
<td>0.177±0.052</td>
</tr>
<tr>
<td>50</td>
<td>0.128±0.026</td>
</tr>
<tr>
<td>100</td>
<td>0.074±0.018</td>
</tr>
<tr>
<td>150</td>
<td>0.045±0.012</td>
</tr>
</tbody>
</table>
Impacts of Global Climate Change:
Increased frequency of extreme weather events along with heat waves, snow storms, etc.
The Climate Challenge for Drought Management

- Increase in mean temperature
- High temp. stress and heat waves/longer growing seasons
- Increased evapotranspiration
- Changes in precipitation amount, intensity and distribution
- Reduced soil moisture
- Changes in groundwater recharge
- Reduced runoff/stream flow resulting from reduced snowpack/sublimation
Mean Temperature Increase & Impact on Extreme Temperatures

![Graph showing the impact of mean temperature increase on extreme temperatures.](image-url)
Adapting to Changing Extremes

The previous two decades recorded the highest number of national 24-hour precipitation records. The highest number of broken National maximum temperature records occurred in 2001-2010 compared to the previous three decades. The lowest number of broken National minimum temperature records occurred in 2001-2010 compared to the previous four decades.

Fits with IPCC → more hot days and more heat waves.

→ Fewer cool nights

The previous two decades recorded the highest number of national 24-hour precipitation records. → Intensification of heavy rainfall.

Source: WMO country data.
U.S. 2012 Billion-dollar Weather and Climate Disasters

- U.S. Drought/Heatwave Summer 2012 (covering over half the U.S. during 2012)
- Western Wildfire Summer-Fall 2012
- Southern Plains/Midwest/Northeast Severe Weather May 25-30 2012
- Midwest/Ohio Valley Severe Weather April 28-May 1 2012
- Plains/East/Northeast Derecho & Severe Weather June 29-July 2 2012
- Southeast/Ohio Valley Tornadoes March 2-3 2012
- Hurricane Isaac August 2012
- Texas Tornadoes April 2-3 2012
- Midwest Tornadoes April 13-14 2012
- Sandy October 2012

NOAA/NCDC, 2013
Drought impacts are more complex today as more economic sectors are affected, creating more conflicts between water users, i.e., *societal vulnerability is dramatically different and changing*. 

- Agricultural production
- Food security
- Energy
- Transportation
- Tourism/Recreation
- Forest/rangeland fires
- Municipal water
- Water quality/quantity
- Environment
- Ecosystem services
- Health

Changes in Societal Vulnerability
Percent Area of the United States in Moderate to Extreme Drought

January 1895–December 2012

Based on data from the National Climatic Data Center/NOAA
Droughts differ in terms of:

- **Intensity**
- **Duration**
- **Spatial Extent**
Natural Catastrophes Worldwide 1980-2012

Risk = Hazard x Vulnerability

Source: Munich Re
Hazard $\times$ Vulnerability = Risk

EXPOSURE

SOCIAL FACTORS

RISK
Reducing Societal Vulnerability

• Improve **drought awareness**
• Develop/improve monitoring, early warning and **information delivery** systems
• Improve **decision support** tools
• Complete **risk assessments** of vulnerable sectors, population groups, regions
• Improve understanding and quantification of **drought impacts vs. mitigation costs**
• Develop and implement **drought preparedness plans**
• Create **national drought policies** based on the principles of risk reduction
What is “DROUGHT POLICY”? 
Types of Policy Responses

• Post-impact government interventions—relief measures (i.e., crisis management)

• Pre-impact government programs—mitigation measures to reduce vulnerability and impacts, including insurance programs
  – Are insurance programs financially viable and do they promote risk-based management?

• Preparedness plans and policies, organizational frameworks and operational arrangements
Emergency response has a place in drought risk management, but it can also lead to:

- greater vulnerability/decreased resilience to future drought events
- increased reliance on government and donor interventions vs. the goal of increased self-reliance.
A drought policy should be broadly stated and . . .

- Establish a clear set of principles or operating guidelines to govern drought management.
- Be consistent and equitable for all regions, population groups, and economic/social sectors.
- Be consistent with the goals of sustainable development.
- Reflect regional differences in drought characteristics, vulnerability and impacts.
A drought policy should

...(continued)

- Promote the principles of risk management by encouraging development of
  - Reliable seasonal forecasts;
  - Early warning and delivery systems;
  - Preparedness plans at all levels of government, within river basins, and the private sector;
  - Mitigation policies and plans that reduce drought impacts and the need for government intervention;
  - Coordinated emergency response that ensures targeted and timely relief during drought emergencies.
National Drought Policy Goals

- Proactive mitigation and planning measures, risk management, public outreach and resource stewardship.
- Greater collaboration to enhance the national / regional / global observation networks and information delivery systems to improve public understanding of, and preparedness for, drought.
- Incorporation of comprehensive governmental and private insurance and financial strategies into drought preparedness plans.
National Drought Policy Goals

- Recognition of a safety net of emergency relief based on sound stewardship of natural resources and self-help at diverse governance levels.
- Coordination of drought programmes and response in an effective, efficient and customer-oriented manner.
Principle Elements of Drought Risk Reduction Framework
What is ‘Drought Planning’?

- actions taken by individual citizens, industry, government, and others before drought occurs to reduce or mitigate impacts and conflicts arising from drought. **It can take two forms:**
  - **Response** planning (reactive)
  - **Mitigation** planning (pro-active)
Key Elements of a Drought Mitigation Plan

• Monitoring, early warning and information delivery systems
  – Integrated monitoring of key indicators
    • Precipitation, temperature, soil moisture, streamflow, snowpack, groundwater, etc.
  – Use of appropriate indices
  – Development/delivery of information and decision-support tools
Key Elements of a Drought Mitigation Plan

• Risk and impact assessment
  – Conduct of risk/vulnerability assessments
  – Monitoring/archiving of impacts

• Mitigation and response
  – Proactive measures to increase coping capacity
    • Strategic—longer term
    • Tactical—short term
    • Emergency--immediate
Drought Commission

Monitoring Committee (EW/Info. Systems)

Risk Assessment Committee

Assessment Reports

Situation Reports

Policy Direction

Drought Plan Organizational Structure

Citizens Advisory Committee (optional)

Working Groups, by sector
<table>
<thead>
<tr>
<th>Step 1</th>
<th>Appoint a drought task force or commission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2</td>
<td>State purpose and objectives of the drought plan</td>
</tr>
<tr>
<td>Step 3</td>
<td>Seek stakeholder participation and resolve conflict</td>
</tr>
<tr>
<td>Step 4</td>
<td>Inventory resources and identify groups at risk</td>
</tr>
<tr>
<td>Step 5</td>
<td>Develop organizational framework and prepare the drought plan</td>
</tr>
<tr>
<td>Step</td>
<td>Action Description</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>Step 6</td>
<td>Identify research needs and <strong>fill</strong> institutional gaps</td>
</tr>
<tr>
<td>Step 7</td>
<td><strong>Integrate</strong> science and policy</td>
</tr>
<tr>
<td>Step 8</td>
<td><strong>Publicize</strong> the drought plan, <strong>build</strong> public awareness</td>
</tr>
<tr>
<td>Step 9</td>
<td><strong>Develop</strong> education programs</td>
</tr>
<tr>
<td>Step 10</td>
<td><strong>Evaluate</strong>, <strong>test</strong> and <strong>revise</strong> drought plan</td>
</tr>
</tbody>
</table>
Components of a Drought Early Warning and Information System (DEWIS)

- Monitoring **AND** Forecasting
- Access to **timely** data (including **impacts**) and “value added” **information**
- **Synthesis/analysis** of data used to “trigger” set actions within a drought plan
- **Tools** for decision makers
- Efficient **dissemination/communication** (WWW, media, extension, etc.)
- Drought risk assessment and **planning**
- **Education** and Awareness
Building an effective **drought early warning system** is like assembling the pieces of a puzzle.

Each **indicator** represents a valuable piece of information to assess the severity of drought and its potential impact on people and the environment. We do not see the full picture until all pieces are in place.
Drought Impacts

- Droughts have different physical characteristics.
- Society is dynamic so each drought event is superimposed onto society—impacts reflect changing vulnerabilities.
- Does your country have a monitoring system for recording drought impacts?
- How do you incorporate impacts into a drought early warning system?
Risk Assessment: Purpose

- To identify those sectors, population groups, or regions most at risk from drought, most probable impacts, and mitigation actions that will reduce impacts to future events.

Who and what is at risk and why.

Vulnerability Profile
Risk Assessment Methodology

Steps:
1. Identify impacts of recent/historical droughts
2. Identify drought impact trends
3. Prioritize impacts to address
4. Identify mitigation actions that could reduce impacts (short vs. long term)
5. Identify triggers to phase in and phase out actions during drought onset or termination
6. Identify agencies and organizations to develop and implement actions
Checklist of Historical, Current, and Potential Drought Impacts

<table>
<thead>
<tr>
<th>H=Historical</th>
<th>C=Current</th>
<th>P=Potential</th>
</tr>
</thead>
</table>

**Economic**

- Costs and losses to agricultural producers
  - Annual and perennial crop losses
  - Damage to crop quality
  - Income loss for farmers due to reduced crop yields
  - Reduced productivity of cropland
  - Insect infestation
  - Plant disease
  - Wildlife damage to crops
  - Increased irrigation costs
  - Cost of new or supplemental water resources
Takeaway Messages

- Climate is changing—climate state and climate variability.
- Extreme climate events are increasing in frequency globally, managing impacts—increasing resilience critically important.
- Time is **NOW** to change the paradigm from crisis to drought risk management.
- Time is **NOW** for all drought-prone nations to adopt appropriate drought policies and preparedness plans that will reduce the impacts of future drought episodes through risk-based management.
Thanks for your attention!

Contact Information:
School of Natural Resources
University of Nebraska-Lincoln
dwilhite2@unl.edu