



Quantification of Agricultural Drought:

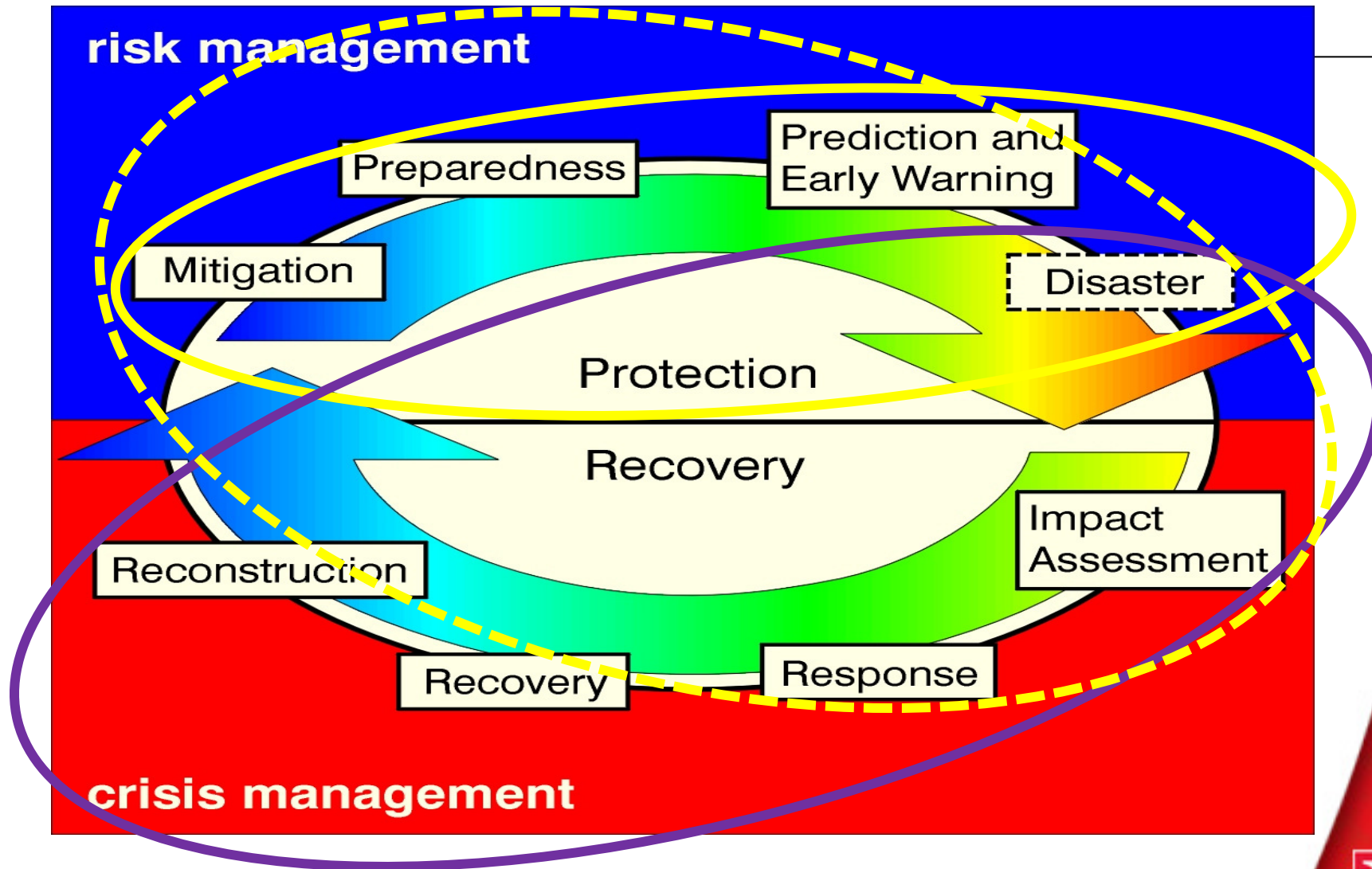
The Key Issues

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The Cycle of Disaster Management



Presentation Outline

- Drought characterization
 - Drought vs. Aridity
 - Drought vs. Water Scarcity
 - Drought definition and types
- Indicators vs. Indices
- Early warning and delivery systems
- Natural and social dimensions of drought
 - Risk and vulnerability
- Summary points
 - Is it feasible to select a single index for agricultural drought assessment?



Drought is a normal part of climate in virtually all climate regimes but differs by . . .

- Causal factors
 - Multiple
 - Regional in scale
 - Forcing functions not well understood
- Impacts
- Government/donor response capability
- Institutional capacity for monitoring, mitigation, and planning/policy
- Societal coping capacity (vulnerability/resilience)
- Government policies (e.g., data sharing across ministries, response measures)



Comparing drought to other natural hazards–

- slow onset, “creeping phenomenon”, a non-event
- difficult to determine drought onset and end
- absence of a precise, universal definition
- impacts are nonstructural and spread over large areas
- severity and impacts best defined by multiple indices and indicators



Comparing drought to other natural hazards–

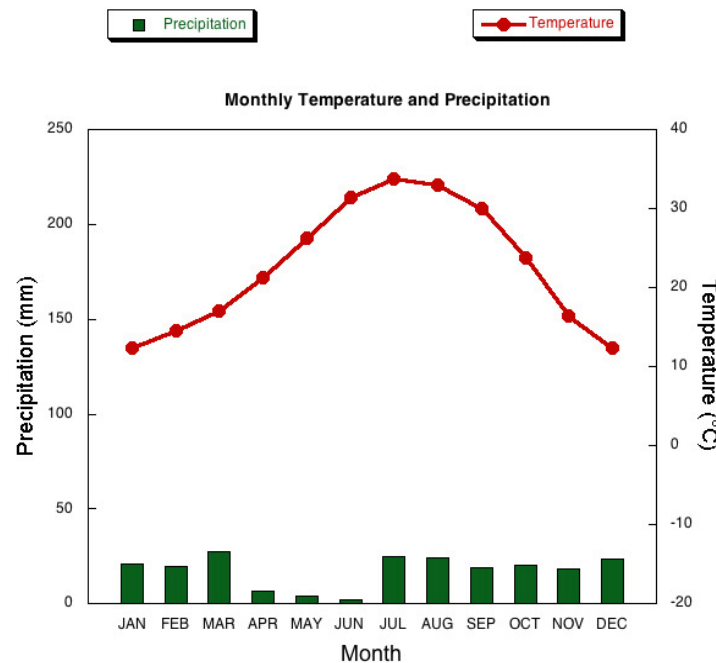
- no consistent methodology for assessing impacts or a data base for archiving impacts
- impacts are complex, affect many people, and vary on spatial and temporal timescales, multiple and migrating epicenters
- mitigation interventions are less obvious
- water shortages increase conflict—regulatory, legal authority (interstate and transboundary issues)
- **makes monitoring, early warning, impact assessment, response, mitigation, and planning difficult!**



Drought vs. Aridity

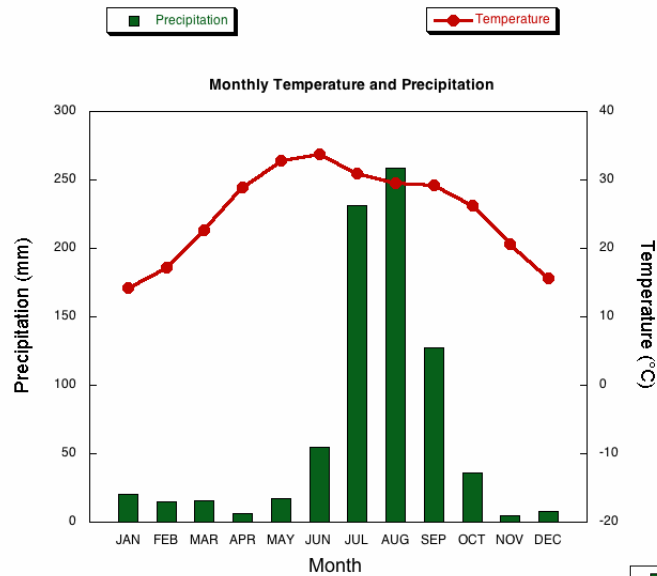
- Aridity is a permanent feature of climate.
- Drought is a temporary feature of climate, an aberration.

Phoenix

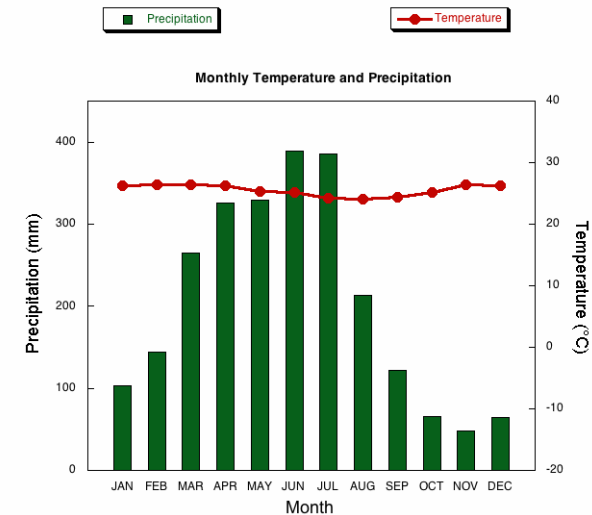


New Delhi vs. Recife vs. Nairobi

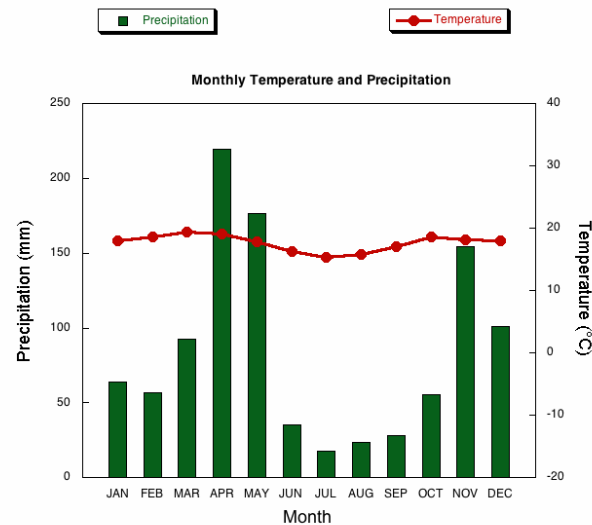
Drought is NOT the occurrence of a seasonal dry period during a portion of the year.



Recife



New Delhi



Nairobi



Drought vs. Water Scarcity

- Water scarcity = an excess of water demand over available supply (non-sustainable development). It can result from . . .
 - prevailing institutional arrangements, prices
 - overdevelopment or over allocation of the water resource
 - Indicators = mining of ground water, increasing conflicts between water use sectors, streams becoming intermittent or permanently dry, land degradation
 - scarcity may be a social construct, i.e., product of affluence, expectations
 - altered supply (e.g., climate change)



Droughts differ in terms of:

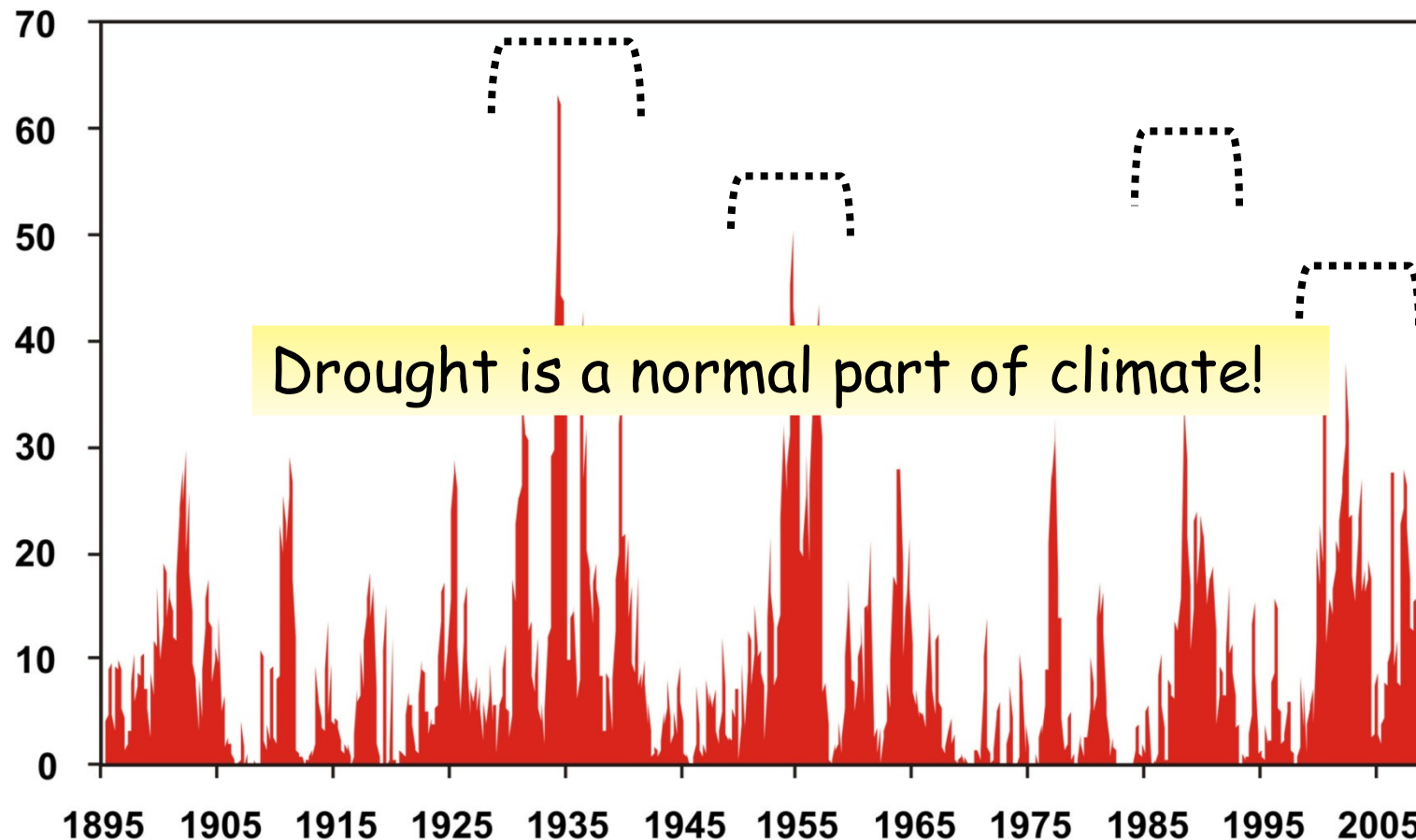
- *INTENSITY*
- Duration
- Spatial Extent

No two droughts are the same!



Percent Area of the United States in Severe and Extreme Drought

January 1895–August 2009



Drought is a normal part of climate!

Based on data from the National Climatic Data Center/NOAA



Drought : 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**).

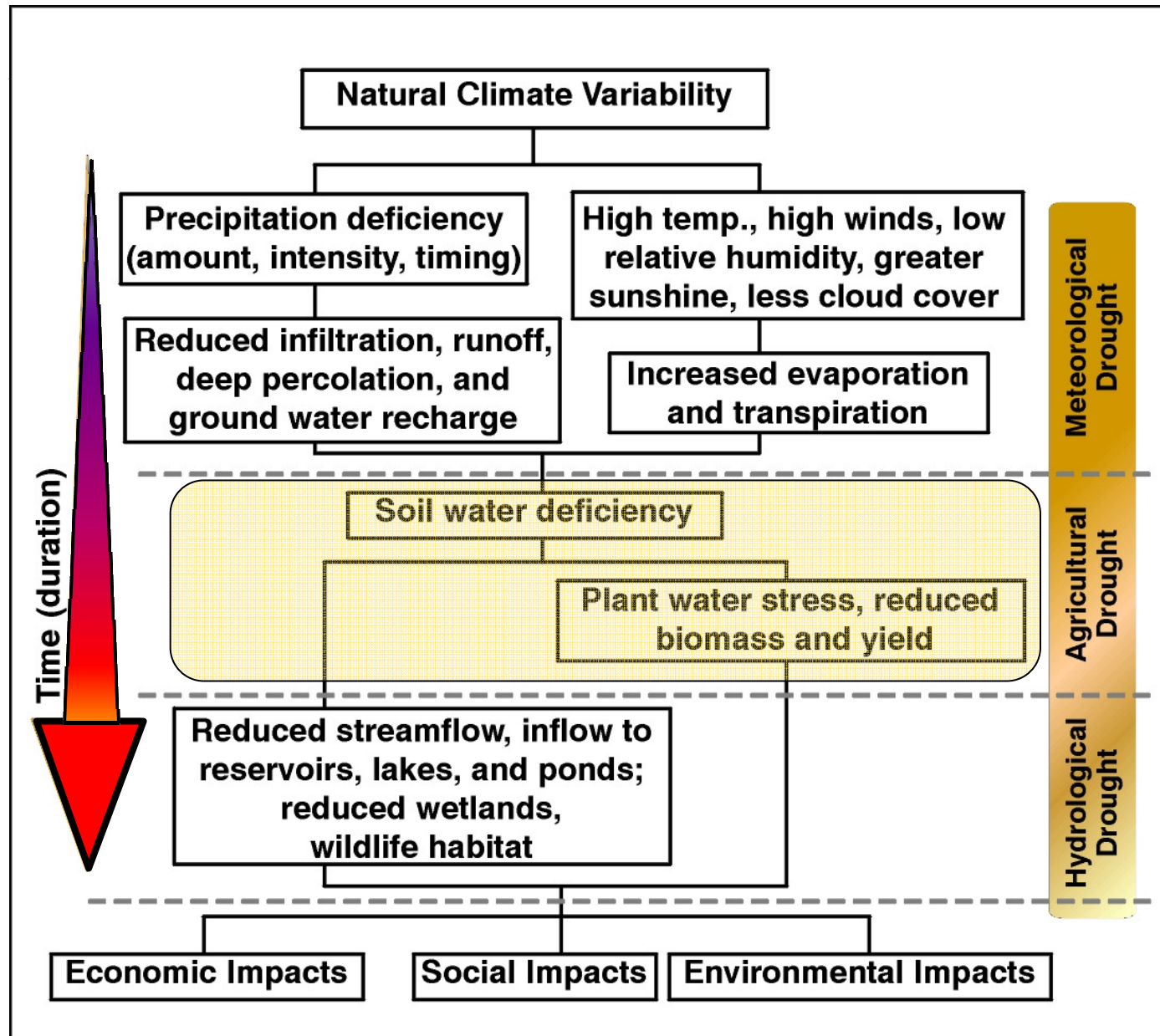
Agricultural drought

Hydrological drought

Socio-economic drought



Evolution of Drought Types



What are the indices and indicators?



Key Indicators for Monitoring Drought

- climate data (precipitation, temperature)
- soil moisture
- stream flow
- ground water
- reservoir and lake levels
- snow pack
- short, medium, and long range forecasts
- vegetation health/stress and fire danger
- sectoral impacts

Which of these are
important for
characterizing
Agricultural
Drought?



Drought Indices

- Percent of Normal
- Deciles
- Palmer Drought Severity Index (PDSI)
- Surface Water Supply Index (SWSI)
- Standardized Precipitation Index (SPI)
- Keetch-Byram Drought Index (KBDI)
- Vegetation Condition Index (VCI)
- And the list goes on



Drought impacts

- Each drought has different physical characteristics (intensity, duration and spatial characteristics)
- Society is dynamic so each drought event is superimposed on society—changing impacts reflect changing vulnerabilities
- Is it important to monitor and record drought impacts?
- How do you incorporate impacts into a drought monitoring and early warning system?



Drought Impact Assessment: A Complicated Issue

Impacts . . .

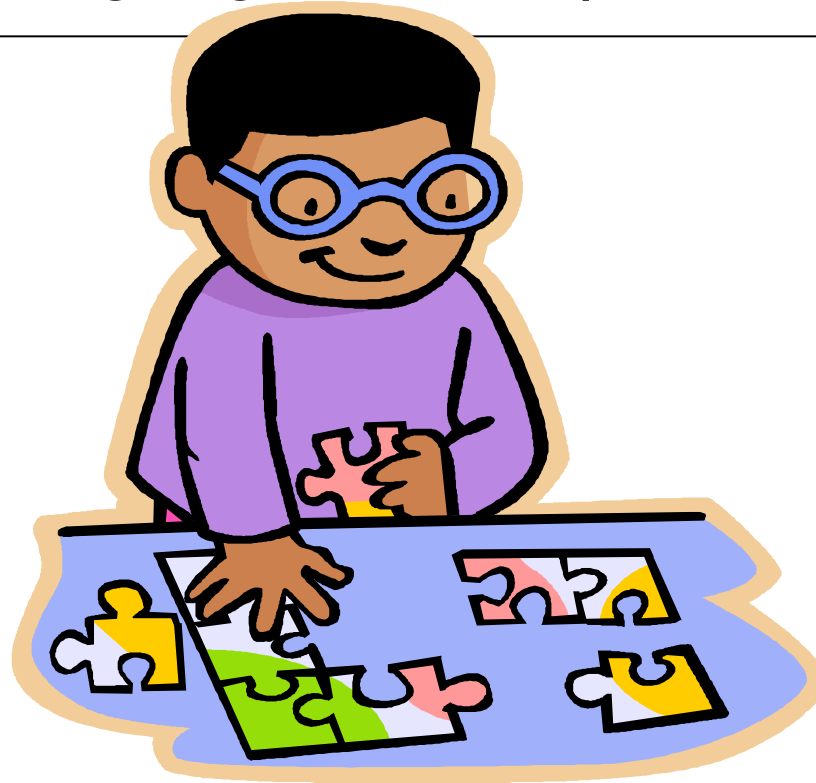
- are region-specific, reflect principal economic sectors
- reflect differing physical characteristics of the drought affected area, e.g., soils, access to irrigation.
- types of crops/livestock being produced
- vary depending on management practices, i.e., sustainable vs. non-sustainable, cultivation practices.
- may reflect government policies (e.g., insurance schemes, land use policies)

Is it important to incorporate impacts into drought assessments?

Can indices/indicators be used as triggers related to impacts?



Building an effective **drought early warning system** is like putting together the pieces of a puzzle.



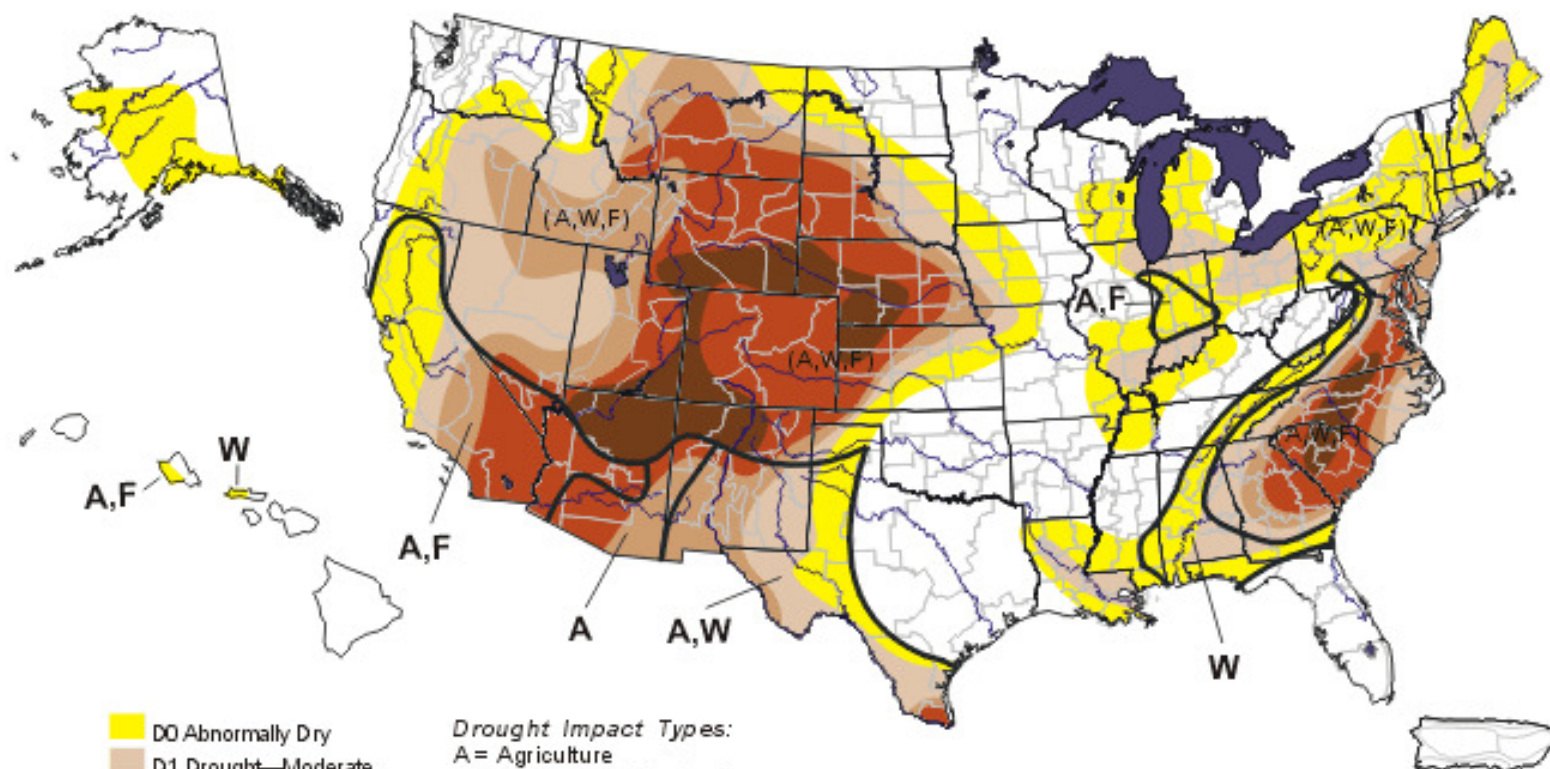
Each **index or indicator** represents a valuable piece of information to assess the severity of drought and its potential impact on people and the environment. We do not see the full picture until all pieces are in place.



U.S. Drought Monitor

July 30, 2002

Valid 8 a.m. EDT



- D0 Abnormally Dry
- D1 Drought—Moderate
- D2 Drought—Severe
- D3 Drought—Extreme
- D4 Drought—Exceptional

Drought Impact Types:
 A = Agriculture
 W = Water (Hydrological)
 F = Fire danger (Wildfires)
 — Delineates dominant impacts
 (No type = All 3 impacts)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://drought.unl.edu/dm>



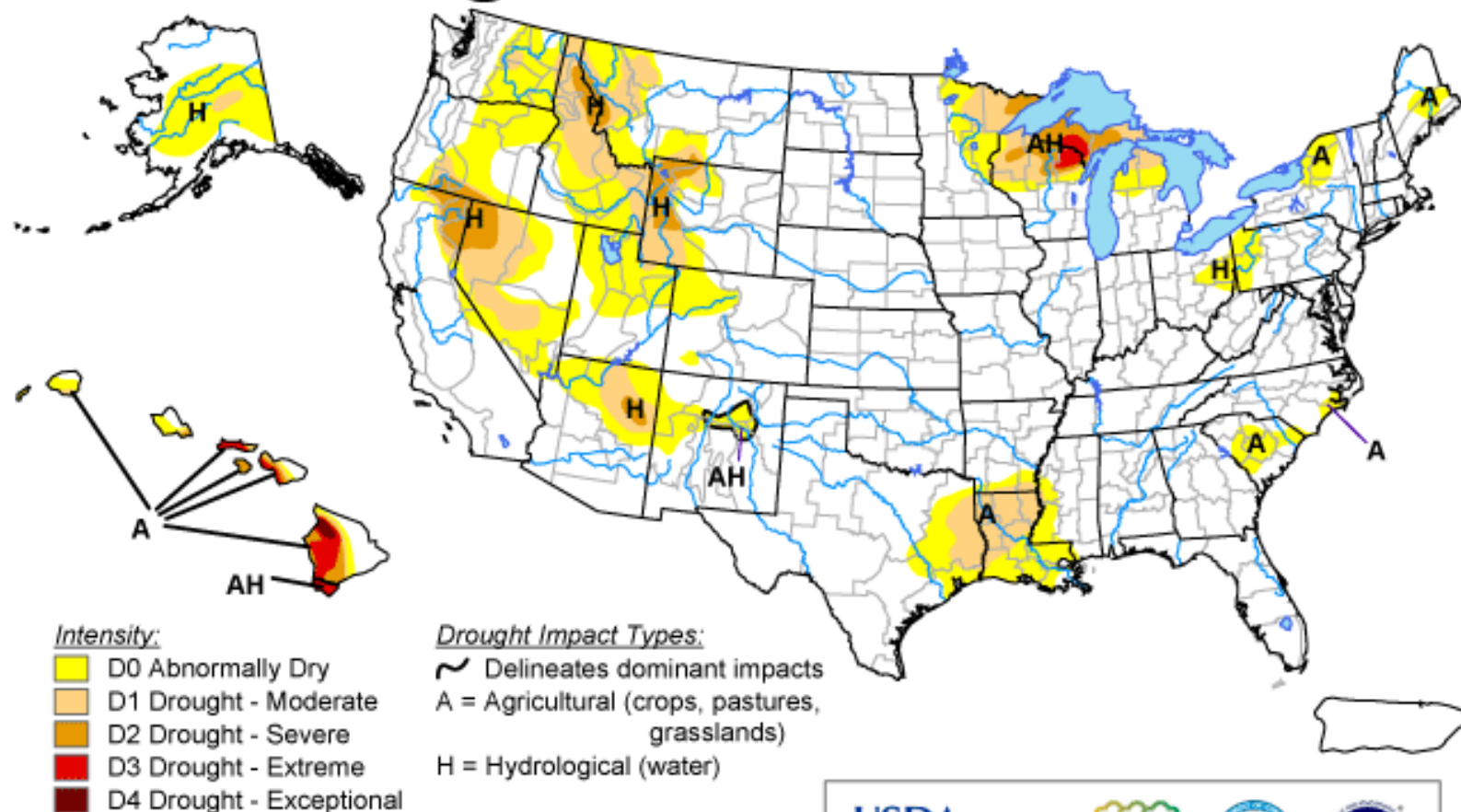
Released Thursday, August 1, 2002

Author: Rich Tinker, CPC/NWS/NOAA

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U.S. Drought Monitor

May 25, 2010
Valid 8 a.m. EDT



The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://drought.unl.edu/dm>



Released Thursday, May 27, 2010

Author: Eric Luebehusen, U.S. Department of Agriculture

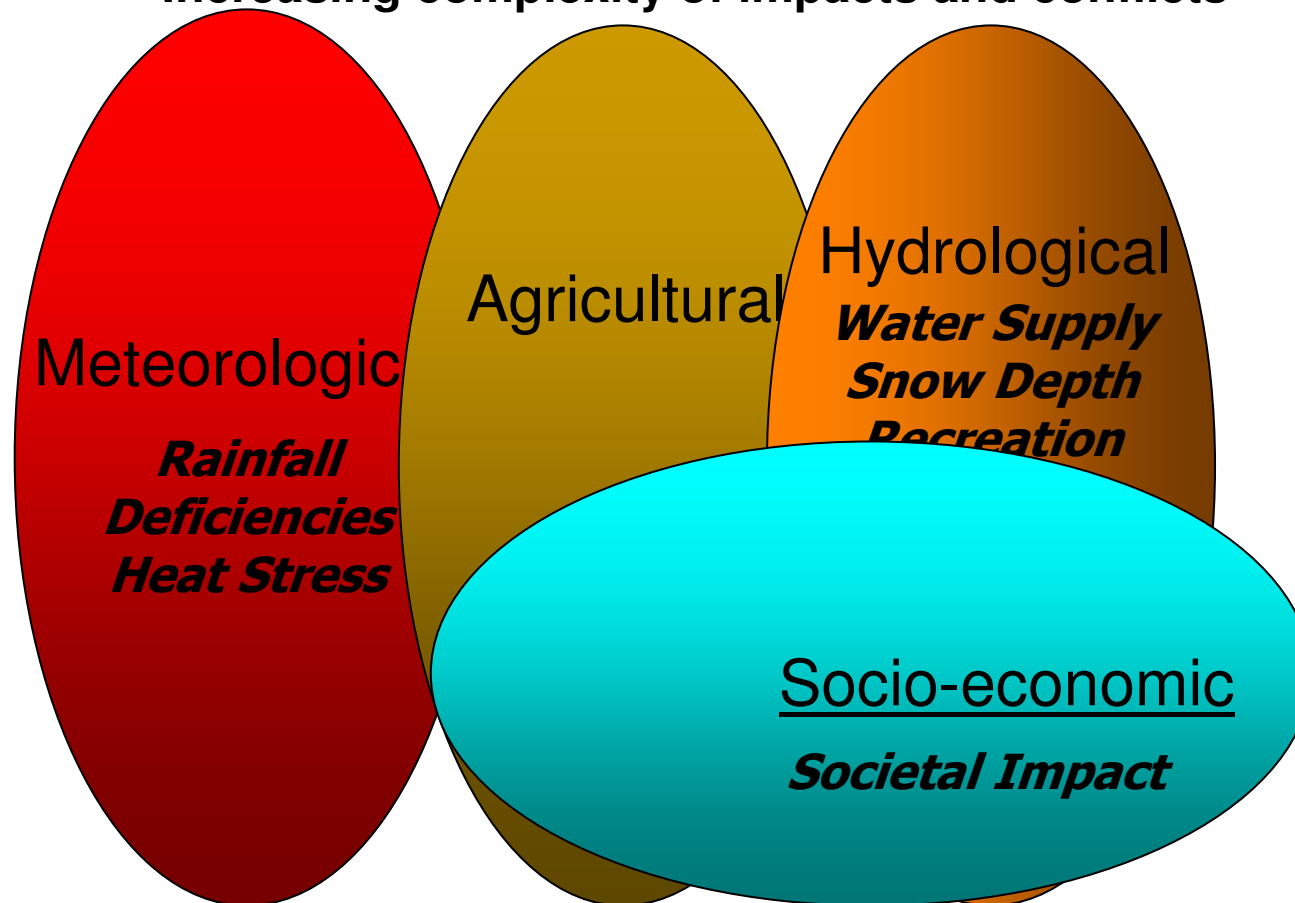
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Natural and Social Dimensions of Drought

Decreasing emphasis on the natural event (precipitation deficiencies)

Increasing emphasis on water/natural resource management

Increasing complexity of impacts and conflicts



Time/Duration of the event



Hazard **x** Vulnerability = Risk

EXPOSURE

- Severity/Magnitude
 - Intensity/Duration
- Frequency
- Spatial extent
- Trends
 - Historical
 - Future

SOCIAL FACTORS

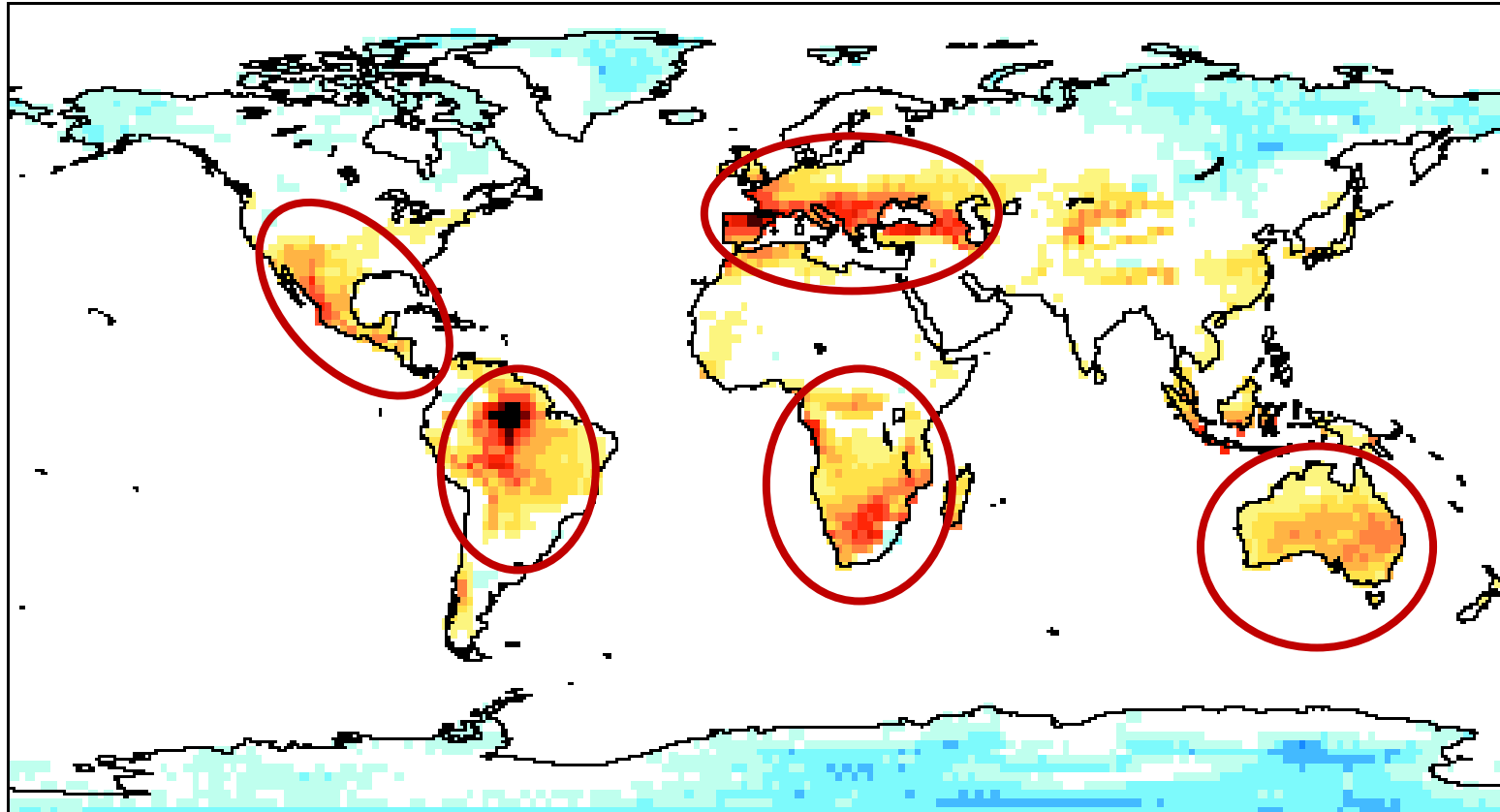
- Economic sectors
- Population growth
- Population shifts
- Urbanization
- Technology
- Land use changes
- Environmental Degradation
- Water use trends
- Government policies
- Environmental awareness

RISK



Where we're headed: Droughts

Drought projections for IPCC's A1B scenario



Percentage change in average duration of longest dry period, 30-year average for 2071-2100 compared to that for 1961-1990



Summary Points

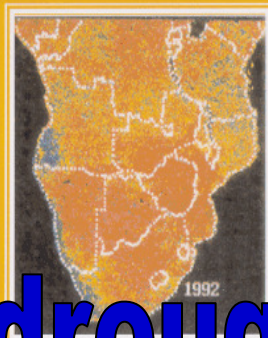
- Drought is a creeping phenomenon with no universal definition—definitions are **region** and **application** (impact) specific.
- Many indices and indicators are available to assist in the quantitative assessment of drought severity.
- Drought impacts are a key indicator of vulnerability.
- Data sources are varied and require interagency cooperation to assess drought severity, impacts, and mitigation strategies (institutional barrier).



Summary Points

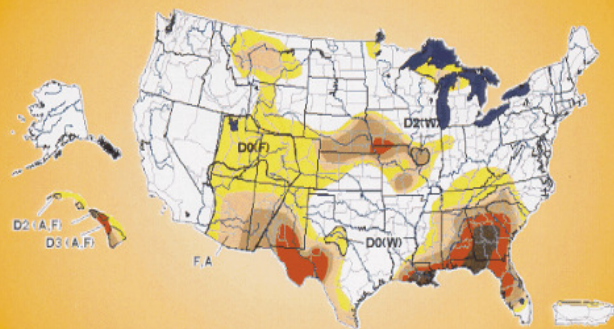
- Stakeholder involvement is a critical component of drought early warning & preparedness planning.
- Early warning systems are the foundation of effective drought mitigation and preparedness plans.
- Can one index capture the complexity of agricultural drought for all locations and regions?
 - Well tested, widely used, easy to calculate, not too data intensive



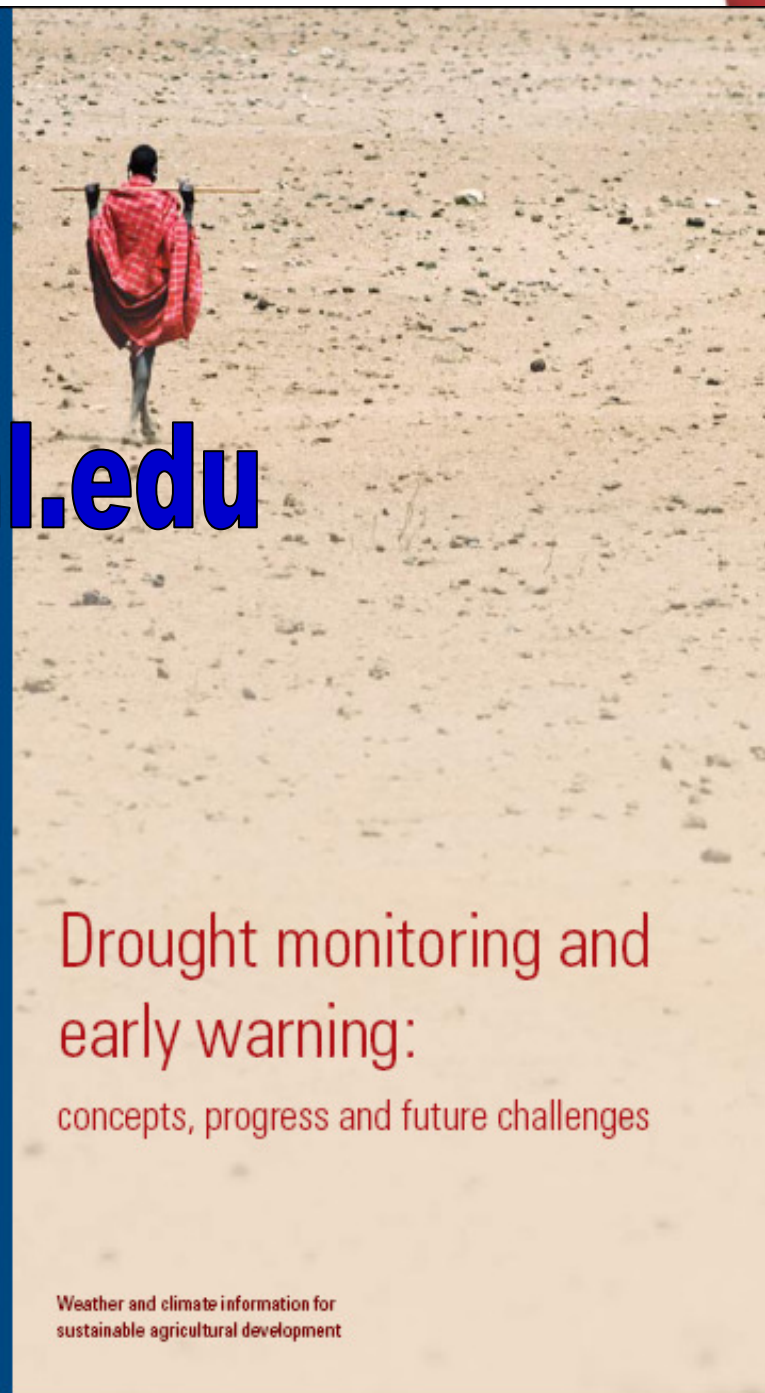


drought.unl.edu

*Early Warning Systems for Drought
Preparedness
and Drought Management*



World Meteorological Organization



**Drought monitoring and
early warning:**

concepts, progress and future challenges



World
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Organization
Weather • Climate • Water
WMO - No. 1016

Weather and climate information for
sustainable agricultural development

Thanks!

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