Drought early warning

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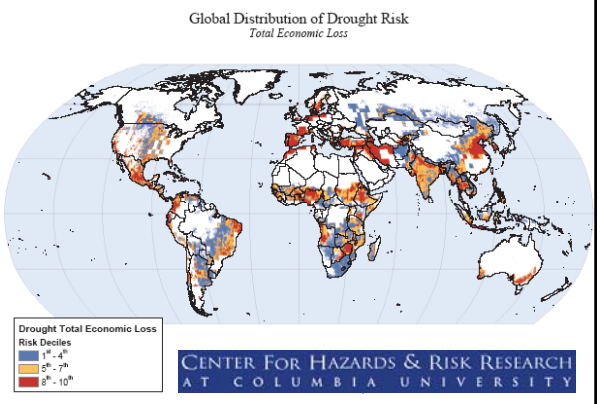

2006

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Drought—a vision of the future

- Increased frequency and severity of meteorological droughts
- Increased impacts associated with increased vulnerability
- Combination of the two—increasing risk because of greater frequency of meteorological drought and increased vulnerability and greater impacts

Question

- Policy-makers often base their decisions on **economic** considerations; yet there seems to be a gap in the availability of economic **evidence** that drought preparedness is less costly than conventional emergency response.
- **How** can the assessment of socio-economic consequences of drought be used to change this **perception** of drought preparedness?

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Imagine you have a forecast

- What to do?
- How to do it?

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A range of overlapping phenomena that lead to different cultures of water management

Water Scarcity Regime	Nature produced	Man induced
Temporary	**Drought**	**Water shortage**
Permanent	**Aridity**	**Desertification**

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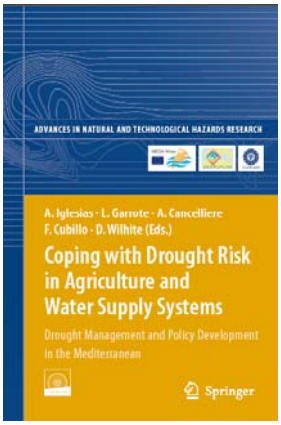
Arabic
English
Farsi
French
Greek
Italian
Spanish



Iglesias A, Garrote L, Cancelliere A, Cubillo, Wilhite D (2008) Coping with drought risk in Agriculture and water supply systems. Springer: Advances in natural and technological hazards research, Dordrecht, The Netherlands, 312 pp

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Hazard, risk, vulnerability

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Multiple dimensions of drought, increasing complexity

- Meteorological drought
- Hydrological drought
- Ecosystems and agriculture drought
- Social and economic drought

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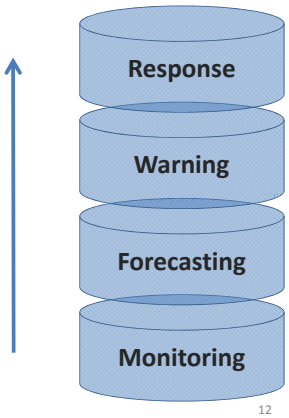

Process adapted from the concept of Hagget, 1998

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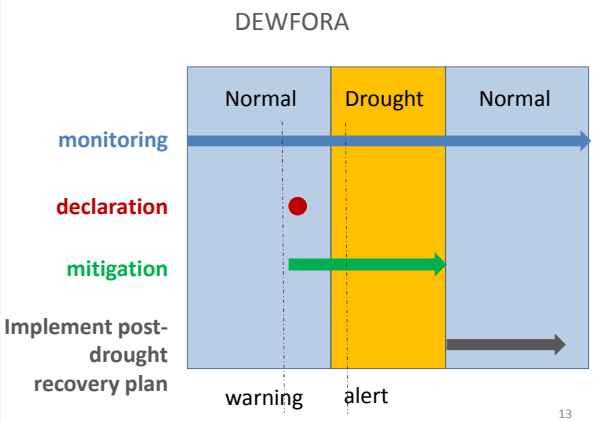

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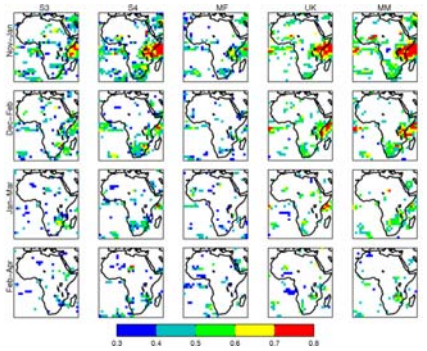

Anomaly correlations of the different seasonal forecasts (columns) starting in November for different lead times
Source: DEWFORA 4.2

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Meteorological index	Description	Comments
Percent of Normal Precipitation	percent of precip	+ simple, widely used, effective for comparing regions - precipitation distribution not normal
Deciles	deciles of precip	+ simple, widely used, accurate statistical - requires a long climatic data record Gibbs and Maher (1967)
Standardized Precipitation Index (SPI)	based on probability of precip for a time scale widely used	+ widely used, may provide insight of hydrological drought - caution when precipitation does not have a normal distribution (McKee et al, 1993)
Palmer Drought Severity Index (PDSI)	includes soil moisture	+ widely used, very comprehensive, effective for agricultural drought - Lags emerging droughts, less well suited for complex topography, comparability Palmer (1965); Alley (1984)

Hydrological Index	Description	Comments
Palmer Hydrological Drought Index (PHDI)	based on moisture inflow, outflow, and storage	+ represents surface water supply and management (storage and irrigation) - formulation unique to each basin, does not take into account the long-term trend Karl and Knight (1985)
Surface Water Supply Index (SWSI)	developed from PHDI, accounts for snowpack	+ represents surface water supply and management (storage) - Formulation unique to each basin, does not take into account the long-term trend
Reclamation Drought Index (RDI)	based on temp, precip, snowpack, reservoir levels	+ accounts for evaporation - formulation unique to each basin Bureau of Reclamation (1988)
Water Exploitation Index (WEI)	ratio of water demand to total	+ allows priority setting and comparability - data intensive EEA (2009)

Agricultural Index	Description	Comments
Palmer Moisture Anomaly Index (Z-index)	Based on PDSI/ current moisture anomaly	+ responds quickly to changes in soil moisture, effective for agricultural drought - Complicated formulation Palmer (1965); Karl (1986)
Crop Moisture Index (CMI)	based on PDSI	+ identifies potential agricultural droughts in the short term - may not be a good long-term drought monitoring tool Palmer (1968)
Soil Moisture Anomaly Index	Precip and evapotransp.	+ characterise droughts on global basis, intermediate btw rapid CMI and slow PDSI - Difficult to calculate Bergman et al. (1988)
Normalised Diff. Vegetation Index (NDVI)	Veg. state from satellite images	+ widely used, vegetation health - technical and analytical difficulties, vegetation health not only due to drought

Indicator Social	Description	Comments
Drought Vulnerability Index	based on Human Development Index	+ comprehensive, includes underlying causes of drought damage to society - data at administrative level, social assumptions difficult to convey Iglesias et al (2009)
Socio-economic drought vulnerability index	based on World Bank Indicators	+ includes considerations of potential social alternatives - data at administrative level, social assumptions difficult to convey IWMI (2009)

Drought Vulnerability Index

Source: Iglesias et al., 2009

Component	Indicators
Human capital	literacy rate; Population with level of education; Rural population
Economic development	% of GDP from agriculture/GDP per capita, Life expectancy at birth % Access to drinkable water
Mechanisms of risk sharing	Insurance, Agricultural policies
Institutional response	Drought regulations; Drought management plans; Institutional drought agencies; Access to financial services
Environmental aspects	Soil degradation
Agricultural Aspects	Cultivation techniques; Crop varieties

Drought Vulnerability Index

DATA: FAO, UN, World Bank

Scale 0 to 1 (Least to most vulnerable)

Some results:
Algeria = 0.23
Egypt = 0.74
Libya = 0.16
Morocco = 0.37
Tunisia = 0.23
Spain = 0.46

Source: Iglesias et al., 2009

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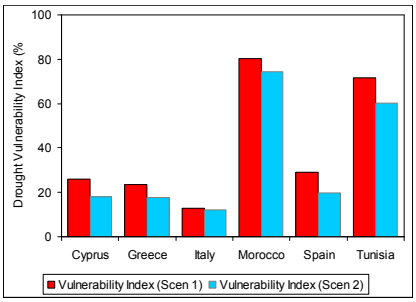
Drought Vulnerability Index



Scen 1 All components weighted equally
Scen 2 Human and civic resources more important

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Linking science to solutions

What is the science available?

What are the societal capacities?

How can science be translated into policy?

How can society benefit from the forecast?

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Operational component

Defines the strategy and the measures

Permanent measures

Measures to be implemented during drought

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INDICATORS (permanent monitoring, forecast)
meteorological, hydrological, environmental, socio-economic

PRE-ALERT	ALERT	EMERGENCY
Initial stage of danger	Drought will have impacts	Impacts have occurred and supply is not guaranteed

ACTIONS (taken in response to drought)
should be triggered by indicators

PRE-ALERT	ALERT	EMERGENCY
Voluntary, focus on raising awareness	Mandatory, non structural, directed to limit water use	Restrictive, structural or new abstractions

Implementation of drought policy

- Australia: One level (Exceptional Circumstances)
- Spain: 3 levels
- USA: from 2 to 5 levels

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Selecting the actions

1. Establishing priorities
2. Management objectives
3. Defining thresholds
4. Defining actions

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Shortcomings of DEWS

- Data networks
- Data sharing
- Early warning system products
- Drought forecasts
- Drought monitoring tools
- Integrated drought/climate/water supply monitoring
- Impact assessment methodologies
- Delivery systems
- Global early warning systems

A wish list

- More reliable seasonal forecasts
- More reliable and timely water impact assessments
- Higher resolution analysis of policy support

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Experts help the DEWFORA team address critical issues,
40 people, 18 countries