Early Warning Systems for Drought: Past and Present

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• Introduction

• Drought in 2009

• What are Early Warning Systems for Drought

• Early Warning Systems – past

• Early Warning Systems - present

• WMO’s contributions in Early Warning Systems for Drought

• Conclusions
“Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such.

How to look at water as a resource is thus no straightforward matter.”

Water Framework Directive
European Union
“Drought is the most obstinate and pernicious of the dramatic events that Nature conjures up. It can last longer and extend across larger areas than hurricanes, tornadoes, floods and earthquakes...causing hundreds of millions of dollars in losses, and dashing hopes and dreams.”

Kenya is currently experiencing the worst drought spell in a decade.
A severe drought in northern China – considered the country's breadbasket – has hit almost 43% of the country's wheat crop.
Thirsty camels face bullet after terrorizing Australian town
CSIRO estimates:

- **By 2030**, drought frequency increases by up to 20% over most of Australia.

- **By 2070**, drought frequency increases by 20-80% in south, 20-40% in Qld, 0-20% elsewhere (except central WA).
Drought – the main hazard in Africa

- The South African Development Community (SADC), Intergovernmental Authority On Development (IGAD), and Economic Commission For West African States (ECOWAS) established that their DRR activities converge on reducing weather and climate related risks that affect agriculture and food security, water resource development and management, disaster prevention and mitigation, human and animal health, and transport and communication.

- Drought is the highest concern for all the sub-regions followed by floods, epidemics, environmental degradation (desertification and erosion), tropical cyclones and strong winds.

The declines in 1973-76 and 1978-80 were partly attributed to the droughts in 1974 and 1979 affecting agriculture.

GDP = Agriculture + Industry + Government services
Need for EWS for Droughts

• Since 1967, droughts have affected one in two people out of the 2.8 billion that have suffered from weather-related disasters. In the same period (since 1967), drought has been responsible for millions of deaths and has cost hundreds of billions of dollars in damage.

• In developed countries the damage is mainly economic, but in developing countries droughts can cause human suffering and loss of life. It is important to be able to detect or predict a drought as soon as possible, so that the implementation of emergency measures and the organisation of aid will be given enough time to minimise the damage.
EWS is an Essential Component of Drought Management

Drought management has three major components:

- Monitoring and early warning
- Risk and impact assessment
- Mitigation and response
What is an Early Warning System for Drought?

- A universally accepted definition of an early warning system does not yet exist.

- The formal UN definition is as follows: “The provision of timely and effective information, through identifying institutions, that allow individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response” (ISDR, 2003).

- Early Warning System (EWS) has become a practical tool for implementing timely and appropriate responses to droughts and famine in the form of food aid and other mitigation strategies.

- Early warning involves forecasts based on climate projections and the area’s drought history, possible outcomes of developing drought events, and answering questions about how long a drought might last and how severe it might be.

- Effective early warning systems should involve both technology and all interested parties in drought planning and response.
EWS for Drought - Past

Drought has been referred to as early as 3000 B.C. in the world's first heroic legend, “The Epic of Gilgamesh”

Written records of droughts in China go back to at least 206 B.C.

Sage Parashara (400 B.C.) in his book “Krishi-Parashara” described the techniques of rainfall prediction and measurement, along with agricultural practices for crop production
Early Warning Systems in Ethiopia - past

- History of droughts and famine occurrence in Ethiopia dates back to 253-242 BC. However, the frequency of drought occurrence and its spatial coverage is tremendously increasing, particularly since 1972.

- There were no disaster management systems before 1973/74 drought that have claimed for the loss of about 200,000 peoples’ lives in central and northern highlands of the country.
Traditional indicators have been extensively for early warning of droughts:

Indicators may roughly be divided into two categories, the observed behavior of animals and plants in response to changes in meteorological conditions and cycles that correspond to observed longer-term weather patterns. The movement of astral bodies including the sun, moon, planets and stars mark the cycles of the latter.

Varahamihira (505-587 AD) used positions of Sun, Moon, planets and stars for rainfall prediction e.g. When the Sun is between Venus and Mercury, there is break in monsoon i.e., for some days there will be dry spell.
Until recently, multiyear cycles of drought and rain were regarded as a strong indication of the weather that might be anticipated in a given year e.g. the most commonly cited indicator for drought in Kenya is the cycle of eight years i.e. every eighth year is anticipated to be drought. Septi (Saturday) is traditionally a year of drought. The years 1959, 1966, 1973, 1980, 1987, 1994, and 2001, were all Septi years. With the exception of 1966, all of these years have drought recorded, in at least one of the oral histories recorded by the communities.

Pratt (2002)
In general, birds are expected to be active, singing and nesting when the coming season will be good. The absence of this activity indicates the possibility of drought.

When drought is coming, the “Nightjar” bird is heard singing very early in the morning (around 4am). If normal rains are expected however, it is heard in the early evening (around 10pm).

Trees are regarded as the most important indicator of possible rain e.g. when the coming season is drought, the Arabic gum does not flow.

Pratt (2002)
Early warning systems have evolved considerably during the past two decades. They gained much attention in the 1970s and 1980s during the extended droughts and famines in the West African Sahel and in the Horn of Africa.

Famine early warning systems were created in at-risk countries and regions in sub-Saharan Africa and in various agencies in donor countries and international organizations. They were set up primarily for humanitarian purposes.

Today, formal EWSs exist for just about every hazard – technological, hydrological, meteorological, and anthropogenic. They have also been created for conflict, ecological changes, health-related and complex humanitarian crises. Their functions have shifted (perhaps, more correctly, expanded) toward societal risk and vulnerability reduction and toward sustainable development.
Meteorological Drought Indicators

- Deciles of Precipitation
- Precipitation Departures from Normal
- Palmer Drought Severity Index (PDSI)
- Standardized Precipitation Index (SPI)
Hydrological Drought Indicators

- Standardized Water Level Index (SWI)
- Surface Water Supply Index (SWSI)
- Reclamation Drought Index (RDI)
Agricultural Drought Indicators

- Aridity Index (SWI)
- Moisture Adequacy Index (MAI)
- Crop Moisture Index (CMI)
- Crop Water Stress Index (CWSI)
Remote Sensing Tools in EWS

- Data regarding the Earth’s vegetation resources collected remotely by sensors onboard aircrafts or spacecrafts, have become increasingly available and financially affordable.

- Low spatial resolution remote sensors such as Advanced Very High Resolution Radiometer (AVHRR), VEGETATION, and the Moderate resolution Imaging Spectroradiometer (MODIS) are one of the best data sources for large area land cover mapping and drought monitoring.

- Satellite rainfall estimates (RFE) fill in gaps in station observations, and serve as input to drought index maps and crop water balance models.
Drought Related Indices from Remote Sensing

- Normalized Difference Vegetation Index (NDVI)
- Enhanced Vegetation Index (EVI)
- Vegetation Condition Index (VCI)
- Temperature Condition Index (TCI)
International Programs and Agencies providing Early Warnings

- WMO’s World Weather Watch (WWW)
- World Climate Programme
- FAO’s Global Information and Early Warning System on Food and Agriculture (GIEWS)
- USAID’s Famine Early Warning System (FEWS)
- Southern African Development Community (SADC) Regional and National Early Warning System
- African Centre for Meteorological Applications and Development
A Drought Resilient Society (adapted from UNISDR Ad Hoc Drought Discussion Group, 2003).

- Society exposed to a natural hazard: Extended Period of Unusually Low Precipitation
  - Drought Policy Mainstreamed & Implemented
    - Drought Preparedness
      - Authorities aware and Accountable to vulnerable populations
        - Appropriate land tenure arrangements
          - Incentives for preparedness
    - Early Warning System(s)
      - Political Capital
        - Policies to enhance Social Adaptive Capacity, at both local and national scales
          - Appropriate Relationships with International Economy

- Lessons Learned
- Impacts Mitigated
- Information Culture
- Nature
  - Society Resilient to Drought
  - Drought Mitigation Policies Mainstreamed and Implemented
    - Culture of Prevention, early warning system
      - Environment Governance
        - Societal Response to living with risk
          - Consequences, Reinforcement
Needs and Short Comings of Early Warning Systems

- Data Networks
- Data Sharing
- User friendly Products
- Drought Forecasts
- Drought Monitoring Tools
- Integrated Drought/Climate Monitoring
- Impact Assessment Methodology
- Weak Delivery Systems
- Global Early Warning Systems
WMO’s contributions in Early Warning Systems for Drought

- WMO Vision
- Coordinated Networks in Support of EWS
- Support to Developing Countries through Regional and National Projects
- Publications and Information Dissemination
To provide world leadership in expertise and international cooperation in weather, climate, hydrology and water resources, and related environmental issues, and thereby to contribute to the safety and well being of people throughout the world and to the economic benefit of all nations
“WMO IS THE ORIGINAL NETWORKER. THERE IS NO DOUBT THAT THE ROLE OF WMO WILL BE EVEN MORE IMPORTANT IN FUTURE”
WMO Coordinated Networks in Support of Early Warning Systems

WMO Integrated Global Observing System (WIGOS)

Global Telecommunication System

Coordinated Satellite Activities
WMO Supports Developing Countries Through National and Regional Projects

- Modernization of NMHSs and observing networks.
- Implementation of national operational multi-hazard early warning systems.
- Strengthening of hazard analysis and hydro-meteorological risk assessment tools.
- Strengthening NMHSs cooperation with civil protection and disaster risk management agencies.
- Coordinated training and public outreach programmes.
Drought Monitoring Centres (DMCs) for Eastern and Southern Africa

- 24 participating countries
- Two operational centres in Nairobi and Harare charged with timely monitoring of drought intensity, geographical extent, duration and impact on agricultural production; and issuing early warnings
- Improved applications of meteorological and hydrological data and products
- 10-day weather advisories, decadal climatological summaries, decadal agromet conditions and impacts, decadal synoptic review and weather outlook
- Monthly drought monitoring bulletins for the sub-regions
Historical Background of DMCs

• Established in 1989/90 by African Governments with WMO as Executing Agency.

• Initial funding from UNDP

• At the end of the UNDP funded Project in 1998 and due to the increased demand for climate information and prediction services, the Nairobi and Harare components started operating independently.
The 10th Summit of the IGAD Heads of State and Government that was held in Kampala, Uganda in October 2003 ratified the decision to absorb DMC, Nairobi as an autonomous specialized Institution of IGAD.

Since April 2002, core activities of DMC, Harare are funded by SADC.

However, programme activities are still being funded by cooperating partners: WMO, USAID, NOAA and others.
Role of DMCs

• The provision of early warning for the formulation of appropriate strategies to combat the adverse effects of climate extremes affords greater opportunity to decision-makers for development of prudent plans for mitigating the negative impacts on socio-economic sectors.

• Since, establishment, the DMCs have played an important and central role in providing the sub-region with weather and climate advisories and more importantly, timely early warning on drought, floods and other extreme climate events.
WMO helped establish the DMC for South Eastern Europe (DMCSEE)

- Oct. 2004: Poiana/Brasow Workshop
- Apr. 2006: Sofia Workshop
- Sep. 2006: Decision on DMCSEE hosting country
- Nov. 2006: Technical meeting in Geneva
- Preparation of project proposal, Jan. – Apr. 2007
- Kick-off meeting in Ljubljana, Apr. 2007
- Two International Steering Committee Meetings in 2008 and 2009
- Funding received from the European Union
WMO currently working on establishing the DMC for Central Asia (DMCCA)

- WMO, the Secretariat of the United Nations Convention to Combat Desertification (UNCCD) and the Organization for Security and Cooperation in Europe (OSCE) working together to establish the DMCCA.

- Technical Seminar on preparation towards Terms of Reference for a Regional Drought Centre in Central Asia (20-21 November, 2007, Tashkent, Uzbekistan)

- Second Workshop on establishing a Drought Management Centre in Central Asia (29-30 May 2008, Bishkek, Kyrgyzstan)

- WMO Consultant visited the five Central Asian countries ie., Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan in November 2009 to consult with all the relevant organizations and institutions and prepare the project proposal.
Conclusions

• Given the increasing intensity and frequency of droughts, there is now an urgent need to establish effective early warning systems for drought, especially in the developing countries.

• There is a pressing need to discuss and recommend standard indices for droughts of different categories to improve EWSs.

• Advances in Information and Communication Technologies (ICTs) must be fully utilized to improve the production and dissemination of EWSs.