Brief note on the Inter-Regional Workshop on Indices and Early Warning Systems for Drought
8-11 December 2009, Lincoln, Nebraska U.S.A

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Background and objectives of the workshop

An Inter-Regional Workshop on Indices and Early Warning Systems for Drought was held at the University of Nebraska-Lincoln from 8 to 11 December, 2009. It was jointly sponsored by the School of Natural Resources of the University of Nebraska, the U.S. National Drought Mitigation Center, the World Meteorological Organization (WMO), the U.S National Oceanic and Atmospheric Administration (NOAA), the U.S Department of Agriculture (USDA), and the United Nations Convention to Combat Desertification (UNCCD). Fifty-four experts from 22 countries from all the different regions of the world attended the workshop.

There have been several intense droughts and heat waves in the recent years, such as those in Europe in 2003, southeast Australia in 2009, and Argentina in 2008/09, which have increased the concern that droughts may be increasing in frequency. The recent increase of drought and heat waves are consistent with the WMO/UNEP Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, which stated that the world has been more drought prone during the past 25 years. On the other hand, climatic projections for the 21st century indicate increased frequency of sever droughts in continental USA and Mexico, the Mediterranean Basin, parts of northern China, across southern Africa and Australia and parts of South America Under these circumstances, food security in vast regions of the world may be jeopardized.

Because of its frequency of occurrence and the profound impacts associated with droughts, a strategy or policy to reduce its economic, social and ecological consequences must be developed by nations. A key component of that strategy is a comprehensive drought monitoring system that can provide early warning in a timely fashion.

It is within this context that workshop aimed to examine drought indices and early warning systems for drought in use in various regions, drought impacts, hydrological and agricultural droughts, current and emerging technologies in drought monitoring and to propose standard indices for different types of droughts.

Specific objectives of the workshop were:

- To review and asses drought indices currently used around the world for the three types of drought (meteorological, agricultural, and hydrological);
- To review and assess the strengths, weakness and limitations of existing drought indices and early warning systems;
- To develop a consensus standard index for each of the three types of drought;
- To develop guidelines for members in implementing and improving drought early warning systems.

Organizational aspects

Keynote speeches on the drought definition, and past and present state of the art technologies on Early Warning Systems for Drought and on Integrated Drought Information systems were delivered by Prof. Don Wilhite (School of Natural Resources, University Nebraska), Dr. M.V.K. Sivakumar (World Meteorological Organization), and Dr. Roger Pulway (U.S. National Oceanic and Atmospheric Administration), respectively. Indicators of the Sectoral Impacts of Drought and current and emerging technologies were addressed by Dr. Mike Hays and Dr. Mark Svoboda both from the National drought Mitigation center, University of Nebraska. A session was specifically devoted to hydrological and agricultural droughts with presentations from USDA, Indian Agricultural Research Institute and Bureau of Meteorology of Australia.

Experts from each of the six regions, Africa, Asia, South America, North America, Southwest Pacific and Europe, presented discussion papers on drought indices currently in use in each region, their capacities for assessing drought impacts and technologies for drought monitoring.

A breakout session with three working groups on meteorological, agricultural and hydrological droughts was conducted with a view to engage all the participants in discussion on each of the papers. The expected outputs were the development of standards for drought indices and guidelines for early warning systems. Reports of each of these working groups were later discussed in the Plenary. Finally, the meeting considered a Panel discussion on implementing and improving Drought Early Warning Systems.

Key messages, conclusions, recommendations

Drought is recognized as a normal part of the climate cycle. However, equal levels of drought can have different impacts on people because the underlying conditions predispose people to different vulnerabilities.

Drought lacks a precise and universally accepted definition. These varied definitions and perspectives make it difficult to communicate with decision-makers. In this context, participants distinguished drought from aridity, a permanent climatic characteristic, and from water shortage, which may be a social construct.

Meteorological drought is usually defined by a precipitation deficiency threshold over a predetermined period of time. Agricultural, hydrological and socio-economic droughts place greater emphasis on the human or social aspects.

Agricultural drought is defined commonly by the availability of soil water to support crop and forage growth. Hydrological drought is normally determined by a departure of surface and subsurface water supplies from some average condition at various points in time. Socio-economic drought differs markedly from the other types of drought. It concerns the relationship between the supply and demand for some commodity or economic good that is dependent of precipitation.

Drought impacts are a key indicator of vulnerability, but there are no consistent methodologies and databases for assessing these impacts. Participants acknowledged that few examples exist of systematic attempts to gather information on the drought impacts of different sectors. In the absence of convincing quantitative analyses of estimated losses,

drought impacts tend to be underestimated. Addressing mitigation then is difficult, unless officials understand the economic cost and quantitative benefits of action.

Some presentations emphasized moving from a reactive to a more proactive approach to managing drought risks and impacts. To this end, the workshop emphasized the need for coordination between data monitoring agencies and the provision of dynamic, accessible and authoritative information on drought, including on impacts, to decision-makers. Participants also stressed the need for effectiveness of the regional initiatives, such as the Drought Management Center for Eastern and Southern Europe (DMCSE) supported by WMO, and UNCCD and the Drought Monitoring Canters for Eastern and Southern Africa.

The Workshop discussed the most useful indices to characterize meteorological, agricultural and hydrological droughts. Participants recognized that no one drought index fits all needs, but agreed that the Standardized Precipitation Index (SPI) should be used to characterize meteorological drought around the world.

The integration of drought information (indices and impact indicators) in a comprehensive framework (composite index and maps) was considered as a possible basis for developing drought monitoring systems. Emphasis was placed on the need for information that is statistically coherent (including uncertainty analysis), validated by feedback from the users and oriented towards providing timely and appropriate responses. The capability of satellite-based monitoring to complement *in situ*, that is, on the ground, observations of drought early warning systems was also recognized.

Participants concurred that defining and understanding hydrological droughts is more complex because it is basin specific. Therefore, participated agreed on the need to carry out a comprehensive review of all agricultural and hydrological drought indices documented at the workshop with a view to identify the prime drought indices for early warning systems most suited for use in the agriculture and water sectors.

The main outcome of the Workshop was the Lincoln Declaration on Drought Indices, which includes the following principal recommendations:

- Drought indices and early warning systems must be implemented from the beginning with the end-users in mind. To accomplish this goal, a multi-disciplinary approach incorporating user involvement is absolutely necessary.
- The National Meteorological and Hydrological Services (NMHSs) around the world are encouraged to use the SPI to characterize meteorological droughts and provide this information on their websites, in addition to the indices currently in use. WMO was requested to take the necessary steps to implement this recommendation.
- A comprehensive manual for the SPI should be developed that will provide a description of the index, the computation methods, specific examples of where it is currently being used, the strengths and limitations, mapping capabilities, and how it can be used.
- Two working groups with representatives from different regions around the world and observers from UN Agencies and Research Institutions (and water resource management agencies for hydrological drought) should be established to further discuss and recommend, by the end of 2010, the most comprehensive indices to characterize agricultural and hydrological droughts.

- Recognizing the need to develop a framework for an integrated approach to drought monitoring to address all sectoral needs, a comprehensive study is needed in order to develop a consensus drought indicator with potential for global application.
- A simple, systematic analysis of drought impacts in different sectors should be initiated in all affected countries in order to provide useful decision-making information for policy-makers.

Finally, the workshop urged WMO and other UN agencies and relevant governmental institutions to take into consideration these conclusions and recommendations.

A book containing the proceedings of the Workshops will be published in 2010.

Implications for UNCCD

The conclusions and recommendations agreed at the Lincoln Workshop provide a basis for developing a harmonized baseline and establishing impact indicators for drought mitigation measures to be included in NAPs.

They will also provide the basis for the information component on drought mitigation for the UNCCD knowledge management systems.

As co-founder of the DMCSEE, the UNCCD secretariat intends to further follow-up the scientific aspects and implications of the outcomes of the Workshop in the work of the Center, in the context of the work programme of the CST.
