

Drought

Living With Risk:
An Integrated Approach to Reducing
Societal Vulnerability to Drought

ISDR Ad Hoc Discussion Group on Drought



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Introduction

Drought is a normal part of climate; an extreme climatic event, often described as a natural hazard¹. Drought by itself does not trigger an emergency. Whether it becomes an emergency depends on its impact on local people. And that, in turn, depends upon their vulnerability to such a 'shock'. Drought results in substantial impacts in both developing and developed countries, although the characteristics of these impacts differ considerably. The ability to cope with drought also varies from country to country and from one region, community or population group to another.

Understanding people's vulnerability to drought is complex, yet essential for designing drought preparedness, mitigation and relief policies and programmes. Vulnerability can be defined as 'defenselessness, insecurity, exposure to risk, shocks and stress' and difficulty in coping with them². A complete vulnerability analysis requires an assessment of both the macro and micro contexts, and of local people's response to that context. For example, the impact of the current drought in southern Africa must be understood in the context of violent conflict in countries such as Zimbabwe and Angola, a major health crisis in the form of the HIV/ AIDS pandemic, and deepening poverty in many parts of the region. Added to this are well-documented cases of damaging government policy, for example the mismanagement of strategic grain reserves. This is the macro context that has resulted in large numbers of people who are more vulnerable to the impact of drought now than they were ten years ago. The micro context varies, of course, from one location to another. Both the micro and macro context is also important in developed countries such as the United States, Canada, and Australia where recent droughts have resulted in widespread and severe impacts in many sectors. In these instances, greater institutional capacity and resources are available to monitor, prepare for, and respond to drought, but the impacts are still devastating to livelihoods, as well as to the environment and social fabric.

To understand what is happening at the micro level requires an understanding of local livelihoods and of local coping strategies. How diverse and drought-proof are local people's livelihoods? How strong is their asset base to

tide them over a prolonged period of drought? What claims can the most vulnerable groups make on the less vulnerable? Understanding all of these dynamics is essential to understand vulnerability, the likely impact of drought, and therefore an appropriate response.

One way to better understand vulnerability is through a livelihoods approach, especially if it captures what is happening at both macro and micro levels, and if it captures both long-term trends which affect vulnerability and the impact of short-term shocks. Much work has been done by operational agencies and by researchers to develop various livelihoods frameworks, to make sense of the complex ways in which individuals, households and communities achieve and sustain their livelihoods, and the likely impact of an external shock like drought, on both lives *and* livelihoods³. The essence of a livelihoods approach is that it puts people at the centre of the analysis. And it is cross-sectoral, taking into account economic, political, social and cultural factors. Understanding the asset base is also crucial, including physical assets such as land and livestock, human capital, and social capital. Generally speaking, the stronger and more diverse the household's asset base, the more drought-resilient it is likely to be, and the greater its options in terms of switching between different livelihood strategies.

There are subtle differences between different agencies' frameworks for analysing and understanding livelihoods. Some are stronger than others in incorporating the macro context. But, political factors and power relationships are often underplayed. Nevertheless, a livelihoods framework offers a valuable tool for assessing vulnerability by taking *all* these factors into account, and thus for understanding the potential and actual effects of drought on people. The goal of this paper is to suggest a new approach to improving drought management, an approach which places people and a reduction of their vulnerability to drought at the focal point. This approach must emphasize both an improved understanding of the natural hazard and human exposure to this climatic extreme as well as a better understanding of the micro and macro context of people's vulnerability to drought.

1 Wilhite, D.A., 2000, 'Drought as a Natural Hazard: Concepts and Definitions,' (Chapter 1). In: D.A. Wilhite (ed.), Drought: A Global Assessment (Volumes 1 and 2), Routledge Publishers, London.

2 Chambers, R., 1989, 'Vulnerability: How the Poor Cope', IDS Bulletin, Vol. 20, No. 2, Sussex: IDS

3 See, for example, www.livelihoods.org; Young et al, 2001, 'Food-security assessments in emergencies: a livelihoods approach', HPN Network Paper No. 36, London: ODI; Save the Children (UK), The Household Economy Approach: A Resource Manual for Practitioners, 2000.

I. Drought Vulnerable versus Drought Resilient Society

The ISDR Discussion Group on Drought proposes a new paradigm to improve drought preparedness and mitigation in all settings ranging from local to national and from developing to developed countries. Figures 1 and 2, respectively, represent our current approach to drought and the discussion group's new vision for drought management.

Figure 1. Drought Vulnerable Society

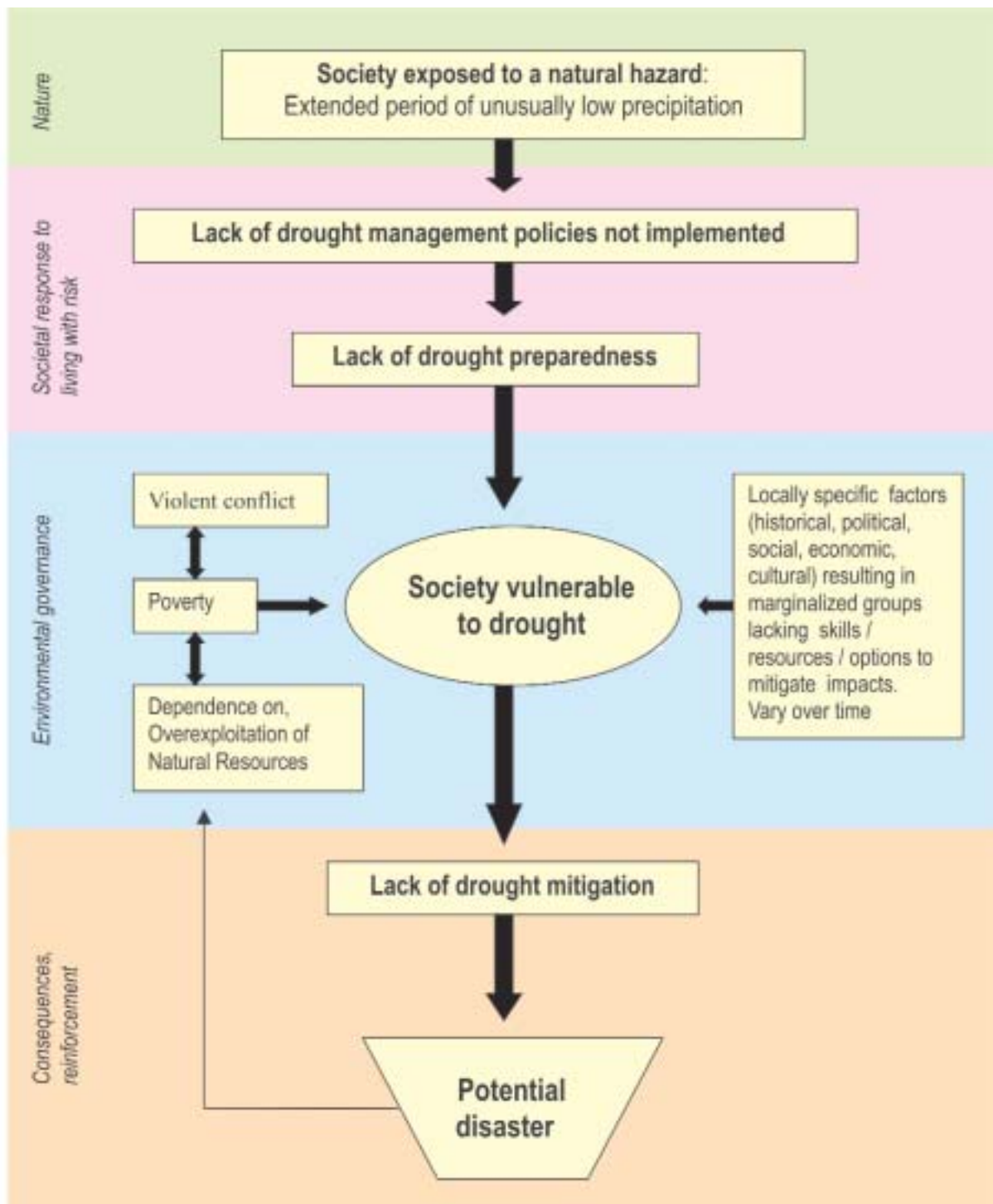
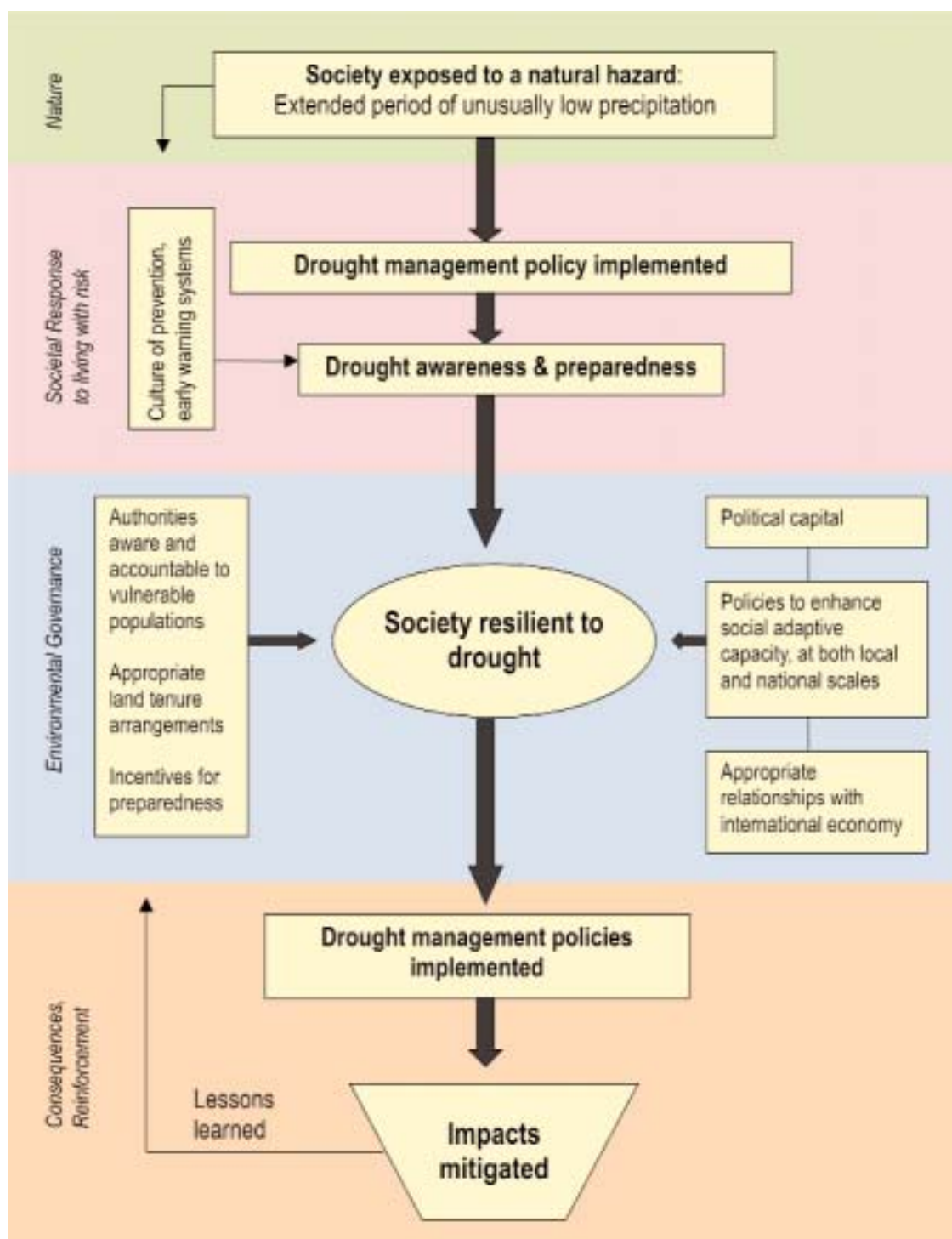


Figure 2. Drought Resilient Society



II. Drought as a Natural Hazard

Drought may be considered in general terms a consequence of a reduction over an extended period of time in the amount of precipitation that is received, usually over a season or more in length. It is a temporary aberration, unlike aridity, which is a permanent feature of the climate. Seasonal aridity (i.e., a well-defined dry season) also needs to be distinguished from drought. It should be noted that drought is a normal, recurrent feature of climate, and it occurs in virtually all climatic regimes. Most other natural hazards such as cyclones, floods, earthquakes, volcanic eruptions, and tsunamis, are quick onset events that typically result in immediate and structural effects.

Droughts differ from other natural hazards in several important ways:

- no universal definition exists;
- slow-onset, creeping phenomenon that makes it difficult to determine the onset and end of the event;
- duration may range from months to years and the core area or epicenter will change over time, reinforcing the need for continuous monitoring of climate and water supply indicators;
- no single indicator or index can identify precisely the onset and severity of the event and its potential impacts-multiple indicators are more effective;
- spatial extent is usually much greater than for other natural hazards, making assessment and response actions difficult, since impacts are spread over larger geographical areas;
- impacts are generally non-structural and difficult to quantify;
- impacts are cumulative and the effects magnify when events continue from one season or year to the next.

III. Drought definition and types

Absence of a precise and universally accepted definition of drought can lead to confusion as to whether a drought exists and its severity. Furthermore, this uncertainty can lead to confusion on the part of policy makers at all level of government and in the private sector, as well as within international organisations and non-governmental organisations. This confusion often affects decisions on whether or not to take action. A comprehensive early warning system that relies on multiple physical and social indicators and indices can help to resolve this confusion and facilitate implementation of appropriate coping or mitigation actions and response programs. Furthermore, drought is often forgotten once it ends, and consequently governments will again be ill-prepared when the next drought occurs. In the most drought-prone regions, drought may recur before the area has recovered from the most recent event.

Many definitions of drought exist because the characteristics of drought differ between regions. Drought impacts also vary significantly between locations because of differences in economic, social, and environmental characteristics at the micro and macro scales. Drought definitions should be impact or application specific and region specific. All droughts originate from a deficiency of precipitation.

Three types of drought are commonly noted: meteorological, agricultural, and hydrological. Meteorological drought is principally defined by the deficiency of precipitation from expected or "normal" amount over an extended period of time. This type of drought is focused on the physical characteristics of drought, i.e., the departure of precipitation from normal, rather than on the impacts associated with this departure. Agricultural drought may be characterized by a deficiency in water availability for crop or plant

IV. Drought Early Warning Systems (DEWS)

growth. Although precipitation deficiencies are important, agricultural drought severity is usually more closely associated with deficiencies in soil moisture, the most critical factor in defining crop production potential. Agricultural drought lags the occurrence of meteorological drought because it is associated with the level of soil water reserves in the soil profile. Some soils are more resilient to drought because of high water holding capacity. Vulnerability is highest on soils with a low water holding capacity, although appropriate soil management practices can reduce the impacts of drought on crops. Hydrological drought is best defined by deficiencies in surface and subsurface water supplies, which lead to a lack of water availability to meet normal and specific water demands. Hydrological or water supply drought lags the occurrence of agricultural drought because considerable time elapses between precipitation deficiencies and declines in ground water and reservoir levels. Likewise, these components of the hydrologic system are usually the last to recover from longer-term droughts. There are clearly strong relationships between the three types of drought especially during prolonged periods of rainfall deficiency, although with leads and lags in terms of their respective onsets and departures.

Drought has some unique characteristics that require different approaches to monitor its development and cessation and assess potential impacts on people and society at the local, regional, and national level. Common indicators of drought include meteorological variables such as precipitation and evaporation, as well as hydrological variables such as stream flow, ground water levels, reservoir and lake levels, snow pack, and soil moisture. Numerous climate and water supply indices are in widespread use to identify the severity of drought conditions, and to represent it in a probabilistic perspective. Each index has strengths and weaknesses, which need to be clearly understood as they are integrated into drought early warning systems. In many countries, especially in Africa, early warning systems for drought are also coupled to those developed for early warning of famine and food shortages more generally. In these cases, many additional variables are monitored as indicators of stress on lives and livelihoods.

Because of the slow-onset nature of drought, it is essential that early warning systems have the capacity to detect the early emergence of rainfall deficiencies, which will normally be the best indicator of an incipient drought period. There is a need for the application of climatic indices to evaluate the status of climate and water supply conditions and potential impacts in specific sectors (e.g., agriculture, wildfires). This information should be supplemented by long range or seasonal forecasts whenever possible. A drought early warning system (DEWS) must not only encompass mechanisms and procedures for the collection and analysis of information in a timely manner, but also for the dissemination of that information through locally appropriate channels to potential end users. Training end users about the value of this information to decision making is essential. Once an incipient drought period is identified or forecast, there should be continuous information flow on expected onset and timing, intensity, cessation, duration, spatial extent and changes in spatial coverage through time, and the

estimation of economic, social, and environmental impacts. Meteorological, agricultural, and hydrological scientists need to work together and with social scientists to design products that better communicate information to decision makers in climate-sensitive sectors in order to reduce the risks associated with drought. These scientists should also solicit input from end users to better understand their need for information so climate-based products can be tailored to their specific needs.

Drought early warning systems are an essential component of drought preparedness plans and policies, and the investigation of them is within the mandate of Inter-Agency Task Force on Disaster Reduction (IATF/DR) Working Group 2. A World Meteorological Organization (WMO) expert group meeting recently identified several shortcomings of current DEWS that must be addressed for many nations to improve their level of preparedness to drought⁴. These shortcomings included the following:

- Data networks - inadequate density and data quality of meteorological and hydrological networks and lack of data networks on all major climate and water supply parameters;
- Data sharing - inadequate data sharing between government agencies and the high cost of data limit the application of data in drought preparedness, mitigation, and response;
- Early warning system products - data and information products are often not user friendly and users are often not trained in the application of this information to decision making;
- Drought forecasts - unreliable seasonal forecasts and the lack of specificity of information provided by forecasts limit the use of this information by farmers and others;
- Drought monitoring tools - inadequate indices for detecting the early onset and end of drought, although the Standardized Precipitation Index (SPI) was cited as an important new monitoring tool to detect the early emergence of drought;
- Integrated drought/climate monitoring - drought monitoring systems should be integrated and based on multiple indicators to fully understand drought magnitude, spatial extent, and impacts;
- Impact assessment methodology - lack of impact assessment methodology hinders impact estimates and the activation of mitigation and response programs;
- Delivery systems - data and information on emerging drought conditions, seasonal forecasts, and other products are often not delivered to users in a timely manner;
- Global early warning-no historical drought data base exists and there is no adequate drought assessment product available to help international organizations, non-governmental organizations, and others identify emerging drought areas.

⁴ Wilhite, D.A., M.K.V. Sivakumar, and D.A. Wood (eds.). 2000. Early Warning Systems for Drought Preparedness and Management (Proceedings of an Expert Meeting), World Meteorological Organizational Meeting, Geneva, Switzerland.

V. Understanding Drought Risk

The risk associated with drought for any region or population group is a product of the exposure to the natural hazard and the vulnerability of the society to the event. Exposure to drought varies regionally and over time, and there is little, if anything, that can be done to alter its occurrence, because drought is a normal part of climate. It is critically important for scientists to understand the probability of drought events at various levels of intensity and duration. It is also essential to understand precipitation and temperature trends, including changes in variability, because these key meteorological variables may indicate potential changes in the frequency and severity of future drought episodes.

The mandate of the IATF/DR Working Group 1 is focused on climate and natural disasters, and in view of the longer time-scales associated with drought, is especially relevant to this particular case of reducing drought-related disasters. The approach to drought in the past has been generally reactive and response oriented, i.e. through crisis management. Societal vulnerability to drought is increasing in many parts of the world because of the numerous factors mentioned previously, and this is an area of special focus for Working Group 3. One of the features of the climate system that has been linked with worldwide occurrences of extreme weather and climate events, such as droughts, floods and wildland fires (as noted by Working Group 4), is the El Niño/Southern Oscillation (ENSO) phenomenon; although it should be noted that the ENSO phenomenon is not the only cause of the extreme weather and climate events. Further, it has been noted, in particular by the Intergovernmental Panel on Climate Change (IPCC), that in recent years and in some regions of the world, there is evidence of significant changes in the trend, frequency and intensity of some extreme climate events such as drought. This trend has led to the increased incidence of wildfires, food shortages, and other highly visible impacts in many sectors and regions.

Drought-prone regions should conduct risk assessments to determine who and what is most at risk to drought

and why. A vulnerability profile is an invaluable tool in assessing risk and should be completed as part of drought preparedness planning. The most vulnerable sectors, people, and regions can be systematically addressed as part of this planning process.

The ISDR Discussion Group on Drought has noted that droughts are a natural, recurrent component of the climate system and also that drought-related hazards are expected to increase in the future as society places an ever growing pressure on the natural resource base. This increase in the drought hazard may result from an increased frequency and severity of meteorological drought, increased societal vulnerability to drought, or a combination of the two.

Several efforts are underway at international, regional and national levels to address the challenges of increasing drought risk, although most of these efforts are not well coordinated at the moment. International and regional efforts include drought monitoring, prediction, early warning and disaster preparedness programmes and activities of organisations such as WMO, Food and Agriculture Organization (FAO), UN Development Programme (UNDP), World Food Programme (WFP), International Fund for Agriculture Development (IFAD), International Research Institute for Climate Prediction (IRI), Asian Disaster Preparedness Center (ADPC), African Centre of Meteorological Applications for Development (ACMAD), Drought Monitoring Centres (in Harare, Zimbabwe and Nairobi, Kenya), National Oceanic and Atmospheric Administration (NOAA), US Geological Survey (USGS), and the US National Drought Mitigation Center at the University of Nebraska. For example, FAO responded to the serious drought occurrences in the Near East and North African countries during 1999/2000. This drought event resulted in an enhanced awareness of the need for greater drought management and preparedness measures. A number of the countries in the region have requested technical assistance from FAO and other international and regional organisations for developing national and

regional plans for drought preparedness and mitigation. The Regional Network on Drought Mitigation in the Near East and the Mediterranean Region was created by FAO, International Center for Agricultural Research in the Dry Areas (ICARDA), and International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM), and endorsed by the European Union in 2001. The activities under this initiative need to be linked to funding recently received by CIHEAM from the EU for the development of drought preparedness guidelines and a Mediterranean regional drought network since this activity overlaps with the countries included in the existing FAO network. Coordination between agencies and regions is essential to avoid duplication and maximize resource investments in regional networks and other drought-related preparedness activities aimed at building greater institutional capacity.

Another example of United Nations involvement in Drought Preparedness and Mitigation (DPM) are activities carried out by UNDP's Drylands Development Centre. The goal of these activities is to promote capacity development for timely and effective response to drought situations in affected African countries. The initiative is implemented in collaboration with concerned subregional organisations and other external partners, including the WMO. An assessment on the status of drought preparedness and mitigation in Africa has been carried out involving Southern Africa Development Community (SADC), Intergovernmental Authority on Development (IGAD) and Permanent Interstate Committee for Drought Control in the Sahel (CILSS). A Regional Drought Management Strategy has also been prepared with UNDP assistance, to be presented to the SADC Council of Ministers of Agriculture and Natural Resources for endorsement.

A second component of the DPM programme promotes the use of climate information in farmer level decision making. Reviews of farmers' use of traditional and contemporary information have been performed in six African countries (Ethiopia, Kenya, Mali, Mozambique,

Senegal and Zimbabwe) and were presented at an international workshop in Harare in October 1999, organized in partnership with WMO, National Drought Mitigation Center/Interim National Drought Council (NDMC/IDIC), and NOAA. It was agreed that a continuation of the programme would focus on: (a) improving dissemination of climate information, (b) tailoring products to user needs and (c) harmonizing traditional and contemporary information systems. Following resource mobilization, a follow-up programme began in 2000. The DPM programme is being implemented in collaboration with WMO, NOAA and national and regional partners.

A particularly interesting programme is a current Global Environment Facility (GEF) funded DDC project entitled 'Coping with drought and climate change: Best use of climate information for reducing land degradation and conserving biodiversity', which draws heavily on indigenous knowledge in national level drought assessments and decision-making. Finally, broad support has been given for DPM through technical and financial support given to 60 countries to prepare their CCD National Action Plans and, under the DDC's Integrated Drylands Development Programme, development of policy frameworks to manage vulnerability and create capacity for multiscale monitoring and mitigation in 16 African countries and Yemen. Finally, regional drought networking activities are currently being developed in Africa and the Middle East by the DDC in cooperation with a number of partners.

It is the ISDR's mandate to be involved, in close collaboration with other relevant UN agencies and international, regional and national institutions, in efforts to reduce the impacts of climate related disasters, including those associated with drought. In the area of drought preparedness and mitigation, there are a number of coordinated and collaborative initiatives that could be undertaken within the framework of the IATF/DR and its four Working Groups on climate-related disasters, early warning, vulnerability and impact assessment, and wildland fires respectively.

VI. Drought: Linkages to UNCCD and UNFCCC

Drought is an important issue for the United Nations and is linked to both the UN Convention to Combat Desertification (UNCCD) and the UN Framework Convention on Climate Change (UNFCCC). Drought, especially prolonged drought, leads to land degradation and desertification. Indeed, the objective of the UNCCD, as specified in Article 2.1, is "to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa, through effective action at all levels, supported by international cooperation and partnership arrangements, in the framework of an integrated approach which is consistent with Agenda 21, with a view to contributing to the achievement of sustainable development in affected areas." Article 1 (d) of the UNCCD defines "mitigating the effects of drought" as "activities related to the prediction of drought and intended to reduce the vulnerability of society and natural systems to drought as it relates to combating desertification".

Under the UNCCD process, six Thematic Programme Networks (TPNs) have been developed in the Asian region: (i) Desertification Monitoring and Assessment (hosted by China); (ii) Agroforestry and Soil Conservation in Arid, Semi-Arid and Dry Sub-humid Areas (hosted by India); (iii) Rangeland Management and Fixation of Shifting Sand Dunes (hosted by Iran); (iv) Water Resources Management for Agriculture in Arid, Semi-Arid, and Dry Sub-Humid Areas (hosted by Syria); (v) Strengthening Capacities for Drought Impact Management and Desertification Control (hosted by Mongolia); and (vi) Assistance for the Implementation of Integrated Land Area Development Programmes (LADPs) Initiatives (hosted by Pakistan). So far only the first four TPNs have been officially launched. TPNs 5 and 6 are expected to be officially launched in 2003.

The UNCCD also has developed a Subregional Action Programme for West Asia and for Central Asia. Thus, it is appropriate for any future ISDR activities on drought in the Asian region to be linked to the above activities, especially those of TPN5.

Two of the possible major impacts of climate change are the shift in seasonal and latitudinal precipitation patterns, and the increase in extreme weather events, both of which could have significant implications for drought. In addition, the frequency, persistence and magnitude of El Niño are projected to increase under the climate change scenario. El Niño induces drought in western Pacific and many other parts of the world. Thus, under the UNFCCC, there are at least two areas where activities related to drought can be undertaken: (i) adaptation to the impacts of climate change; and (2) research and systematic observation.

Article 4.1 (e) of the UNFCCC commits all Parties to "Cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods", and Article 4.1 (g) commits all Parties to "Promote and cooperate in scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives related to the climate system and intended to further the understanding and to reduce or eliminate the remaining uncertainties regarding the causes, effects, magnitude and timing of climate change and the economic and social consequences of various response strategies".

VII. Critical Issues and Recommendations to the ISDR Inter-Agency Task Force

Article 5 of the UNFCCC specifies that "In carrying out their commitments under Article 4, paragraph 1(g), the Parties shall (a) Support and further develop, as appropriate, international and intergovernmental programmes and networks or organisations aimed at defining, conducting, assessing and financing research, data collection and systematic observation, taking into account the need to minimize duplication of effort; (b) Support international and intergovernmental efforts to strengthen systematic observation and national scientific and technical research capacities and capabilities, particularly in developing countries, and to promote access to, and the exchange of, data and analyses thereof obtained from areas beyond national jurisdiction; and (c) Take into account the particular concerns and needs of developing countries and cooperate in improving their endogenous capacities and capabilities to participate in the efforts referred to in subparagraphs (a) and (b) above."

This report from the ISDR Discussion Group on Drought provides a summary of the potential scope of areas that could be followed up within the framework of the ISDR. The group identified wide ranges of critical issues during its deliberations. These issues include:

- Supporting and strengthening programmes for the systematic collection and processing of meteorological and hydrological observations;
- Building and strengthening scientific networks for the enhancement of scientific and technical capacities in meteorology, hydrology and other related fields;
- Developing an inventory of climate and water resources indicators and indices;
- Improved understanding of the drought climatology (frequency, intensity, and spatial extent) of drought patterns;
- Understanding the principal causes of drought at local, regional, and global levels;
- Development of decision support models for the dissemination of drought-related information to end users and appropriate methods for encouraging feedback on climate and water supply assessment products, and on other forms of early warning information;
- Development and dissemination of vulnerability/risk assessment tools that are appropriate for different social and environmental conditions;
- Dissemination of drought planning methodologies that could be adopted by drought-prone countries in the preparation of plans;
- Development of national and regional drought management policies that emphasize monitoring and early warning, risk assessment, mitigation, and response as an essential part of drought preparedness;
- Support development of regional networks for drought preparedness that would build greater institutional capacity at the local, national, and regional capacity by sharing lessons learned in

drought monitoring, prediction, vulnerability assessment, preparedness, and policy development;

- Education and awareness of policy makers and the public regarding the importance of improved drought preparedness as a part of integrated water resources management;
- Enhancement of collaboration between regional and international organisations, not only within regions but also between regions because of overlapping responsibilities and jurisdictional issues.

The Discussion Group on Drought recommends the following concrete actions related to drought that could form the basis for a coherent and systematic process to tackle current and projected drought challenges.

1. ISDR's Ad Hoc Discussion Group on Drought, including new members recently added to the group and possible additional members to be added in the future, should continue to collaborate on how to implement actions designed to achieve the integrated approach to reducing societal vulnerability to drought, the central theme of this report. The continued interaction of this group will primarily occur through email contact between members of the discussion group. The discussion group could report semi-annually or annually to the Inter-Agency Task Force, as appropriate, on its progress and resource needs to address this issue.
2. UN/ISDR should provide base funding, through fundraising activities jointly with partners, for continued collaboration between the group members and for an annual group meeting.
3. UN/ISDR should develop jointly with relevant UN and non-UN technical institution, a proposal

for the further development of a global network on drought preparedness modeled on the approach of the NDMC/IDIC and related approaches from the existing international, regional, and national institutions. Relevant institutions will include: UNCCD, IFAD, UNFCC, World Bank, FAO, WMO, UNDP, UNEP, UN Regional Commissions, other regional Organizations, the NDMC/IDIC at the University of Nebraska, The IRI/Columbia University, DMC's, ACMAD, Global Fire Monitoring Center, and other key partners. This network could help to achieve the vision of the group by building greater institutional capacity on all aspects of drought management and preparedness at the local and national level by promoting training and the exchange of information and lessons learned on drought early warning systems, indigenous coping strategies, mitigation strategies, preparedness planning methodologies, and risk-based drought management policies.

4. UN/ISDR should further consult the proposal for a global drought preparedness network with additional relevant organizations for the purpose of involving them gradually in the networking process.
5. UN/ISDR should play a critical role in fostering the further development of regional drought preparedness networks, resource mobilization to support these networks, and coordinating activities between the regions. For example, a partnership between UN/ISDR, NDMC/IDIC, and the Economic and Social Commission for Asia and the Pacific (ESCAP) will seek funding for the establishment of regional networks on drought preparedness for the Asian and Pacific regions with ESCAP as the lead within the region. FAO and ICARDA have developed a regional drought

network for the Near East. In partnership with CIHEAM/Zaragoza and the EU, FAO is linking this network with the countries in the Mediterranean region and the NDMC/IDIC. Sub-Saharan Africa, one of the most affected regions of the world should be considered with special attention and UN/ISDR Africa could play a critical role, in close collaboration with DMC's, UNDP's Drylands Development Center and other key partners. UN/ISDR should investigate possibility of participating in the European Commission Sixth Framework Programme and dialogue with the relevant DGs (DG Research, DG Environment, DG Joint Research Centre, etc.) for guidance regarding funding possibilities and participation in the forthcoming Integrated Projects and Network of Excellence, and to identify synergies and possible collaboration strategies in the field of drought and desertification management and risk reduction. The development of regional networks could begin to address many of the critical issues identified by the Discussion

Group on Drought . These networks could play a substantial role in raising the visibility of drought preparedness and in the development of mitigation strategies aimed at the reduction of societal vulnerability to drought and will promote the new paradigm of building more drought resilient societies proposed in earlier.

6. UN/ISDR should facilitate development of an information clearinghouse on drought management, building on the experience of the NDMC/IDIC's information clearing house and other relevant international, regional and national organizations and programmes, working in the field of reducing risk and vulnerability to drought. This could rapidly enhance the availability of information on drought preparedness to a broad global audience and support the global network on drought preparedness envisioned by the ISDR Discussion Group on Drought .

Annexes

Annex 1

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Annex 2

Proposed Terms of Reference for the Global Drought Risk Reduction Network

I. OBJECTIVE

The drought network will help to better share the experiences and lessons learned from various drought-prone regions and will promote the new paradigm of building more drought resilient societies. This network can increase institutional capacity in all aspects of drought management and preparedness at the local and national level by promoting training and the exchange of information and lessons learned. This is particularly relevant for matters of drought early warning systems, indigenous coping strategies, mitigation strategies, preparedness planning methodologies, and risk-based drought management policies.

The development and expanded use of regional networks, based on geographical proximity or homogeneity of drought climatology or impacts, represent critical first steps that deserve immediate attention. These networks can play a substantial role in the advancement of preparedness planning and the reduction in societal vulnerability to drought.

This network's goal relates to the overall ISDR objectives in relation to drought, which are:

- Increase public awareness for understanding risk, vulnerability and risk reduction globally
- Enhance commitment of public authorities for the implementation of reduction policies and actions
- Stimulate multidisciplinary and intersectoral partnerships, including the expansion of risk reduction networks
- Improve the application of scientific knowledge for the reduction of vulnerability and risk.

II. RATIONALE

There is a need to establish a strategy and platform that could help change the common perceptions and management approach to drought.

The strategy should be based on a new approach-one that is more focused on the human dimensions of drought, including vulnerability reduction through risk assessment activities at the local and national levels.

ISDR's mandate focuses on vulnerability and risk assessment on an inter-agency basis involving UN agencies, regional organisations and elements of civil societies. UN/ISDR also aims to become a clearinghouse on disaster reduction based on a dialogue on drought risk reduction, vulnerability and risk assessment in close collaboration with the partners mentioned above.

UN/ISDR and the NDMC/IDIC can play a critical role in fostering network development and in coordinating activities.

II. PRINCIPLES AND CRITERIA:

- This initiative will be based on existing initiatives from UN and non-UN partners.
- It will also be based on on-going initiatives within the ISDR framework, on climate change and climate variability, early warning and the work on indexes and reference databases-
- UN/ISDR, Geneva will coordinate the process at the global level with the support from UN partners (WMO, UNDP, FAO, UNCCD, UNFCCC, WFP, IFAD...etc) and with the technical support from NDMC/IDIC-USA
- UN/ISDR will contribute together in association with the efforts of the NDMC to the establishment of an Information clearinghouse on drought management.
- A project proposal will be elaborated based on the recommendation of the group and UN/ISDR will assist in resource mobilization to support the activities of the networks in close collaboration with key partners.
- Five regional Networks are established or will be established: Asia/Pacific, Sub-Saharan Africa,

North America, Europe, Mediterranean and Near-East.

- Regional networks are facilitated or coordinated by one or more institutions in each region.
- ISDR Secretariat will be a partner at the regional level in supporting the coordinating institution(s). A first partnership could be set up between UN/ISDR, NDMC and ESCAP for the Asia/Pacific network.
- Regional networks can be subdivided into sub-regional networks, if warranted and deemed necessary to address regional goals and objectives.

III. ACTIVITIES

- Organize regional workshops to launch the regional networks and identify partners and coordinating institutions, as well as the primary objectives and activities of the regional network;
- Organize a workshop in Geneva to launch the global process and identify partners, donors, common goals for the regional networks, and

appropriate coordinating mechanisms;

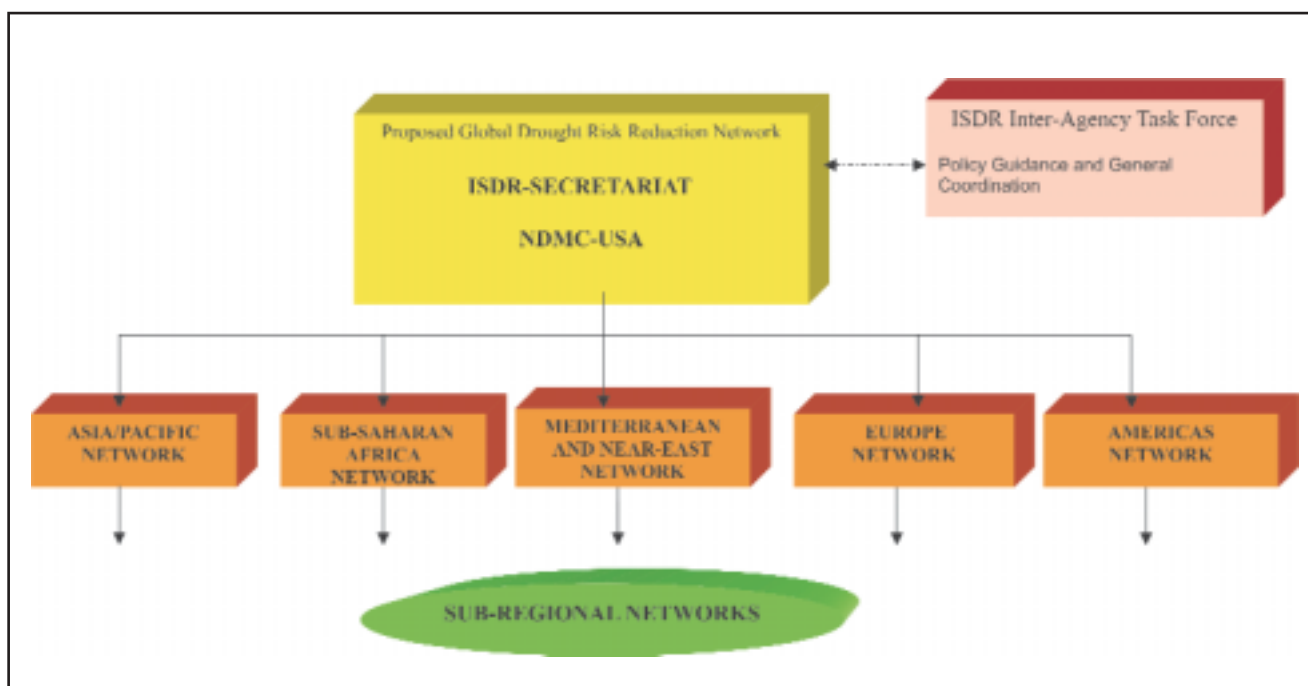
- Establishment of a global website, managed by UN/ISDR with the support of NDMC-USA, and linked with regional websites;
- Identify activities to bring together natural and social scientists to implement the vision of drought management proposed by the ISDR Discussion Group on Drought .

IV. PARTNERS

UNCCD, IFAD, Worldbank, FAO, WMO, UNDP, UNEP, UN Economic Commissions, others regional Organizations, the NDMC/IDIC at the University of Nebraska, The IRI/Columbia University, DMC's, ACMAD, Global Fire Monitoring Center, and other key partners at the regional and national level.

V. TIMEFRAME

2003-2004



Annex 3

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Annex 4

Related Weblinks

Climate and Weather

<http://www.drought.noaa.gov>
NOAA's Drought Information Center

<http://www.met.utah.edu/mesowest>
MesoWest is a great source for current weather conditions around the Intermountain West

<http://mac1.pn.usbr.gov/agrimet>
Pacific Northwest Cooperative Agricultural Weather Network is part of the Bureau of Reclamation's AgriMet weather station network

<http://www.esig.ucar.edu/lanina>
La Nina Summit hosted by NCAR/UNEP provides a comprehensive review of the causes and consequences of cold events

<http://lwf.ncdc.noaa.gov/oa/climate/severeweather/extremes.html>
Extreme Weather and Climate Events page links to all sites within NOAA that are related to climatic extremes, weather events, climate change, El Nino/La Nina, natural disasters, and US climatologies

<http://www.boi.noaa.gov/firewx.htm>
National Fire Weather Page from the National Weather Service offers many worthwhile products and links

<http://www.ncar.ucar.edu/ncar/>
National Center for Atmospheric Research's (NCAR)

<http://www.ucar.edu/ucar/weather.html> Weather section has satellite images and links to many weather and climate resources on the WWW. Another good website is that of the <http://www.esig.ucar.edu> Environmental and Societal Impacts Group (ESIG), a division of NCAR

<http://iri.ldeo.columbia.edu>
International Research Institute's (IRI) experimental climate forecasts provide an alternative look into the future

<http://www.cpc.ncep.noaa.gov/index.html>
Climate Prediction Center (CPC), formerly the Climate Analysis Center, monitors regional and global climate anomalies, which can be indicators of potential target areas for drought. They also provide many other products, including climate variation predictions, long-lead forecasts, the monthly Climate Diagnostics Bulletin, Palmer Drought Index maps, and El Nino advisories.

<http://www.cdc.noaa.gov>

Climate Diagnostic Center (CDC) is an excellent archive of historical studies on climatic variability, El Nino/SO (Southern Oscillation), La Nina, and earth's atmosphere energy balances and relationships

<http://www.cdc.noaa.gov/map>

Map Room has a lot of good global climate and weather information from the National Meteorological Center

<http://lwf.ncdc.noaa.gov/oa/ncdc.html>

National Climatic Data Center (NCDC)

<http://lwf.ncdc.noaa.gov/oa/climate/onlineprod/drought/xmgr.html>

CLIMVIS program graphs historic drought data for any U.S. climate division, 1895--present, using the Palmer Drought Severity Index (PDSI). The NCDC also has an area dedicated to climate change analysis called the Global Climate Perspectives System (GCPS). The monthly Climate Variations Bulletin is located here, too.

<http://www.nws.noaa.gov>

National Weather Service's (NWS) <http://iwin.nws.noaa.gov/> Interactive Weather Information Network (IWIN) has raw data from a variety of sources.

<http://iwin.nws.noaa.gov/iwin/national.html>

National Products has national and international crop summaries

<http://www.gcrio.org/index.shtml>

U.S. Global Change Research Information Office (GCRIO)

<http://grads.iges.org/home.html>

Institute of Global Environment and Society/Center for Ocean Land Atmospheric Studies (IGES/COLA). Proceed to <http://grads.iges.org/ellfb/home.html> Experimental Long-Lead Forecast Bulletin (ELLFB), where you'll find long-lead predictions independent from the NWS forecasts.

<http://lwf.ncdc.noaa.gov/oa/climate/regionalclimatecenters.html>

Regional Climate Centers (RCCs) An index to the six regional climate centers in the United States, some of which give you regional climate and drought products by climatic division. The Southeast RCC has a page dedicated to drought, and the West and Northeast RCCs also refer to drought-related issues and data. Contact persons are listed for all of the climate centers; they can advise you on what's available in their region or at their center

<http://www.wrcc.dri.edu/>

Western Regional Climate Center (WRCC) has a great mapping tool for the <http://www.wrcc.dri.edu/spi/spi.html> Standardized Precipitation Index (SPI) and other climatic parameters for the United States over the last 6 years. This is updated each month

Federal Government

<http://www.fsa.usda.gov/indc/>

Interim National Drought Council was formed in September 2000 to establish a more comprehensive, integrated, and coordinated approach to reducing the impacts of drought through better preparedness, monitoring and prediction, risk management, and response to drought emergencies in the United States.

<http://www.nrcs.usda.gov/>

Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service, is home to the <http://www.wcc.nrcs.usda.gov/> National Water and Climate Center, where they monitor water supplies in the West

<http://www.fsa.usda.gov/pas/default.asp>

Farm Service Agency's (FSA) services/programs area has information about conservation, commodity programs, crop insurance, and farm loans, along with state and county contacts.

<http://www.fema.gov/>

Federal Emergency Management Agency (FEMA) has excellent materials on preparedness and mitigation philosophy for an array of disasters

<http://www.usda.gov/nass/>

National Agriculture Statistics Service (NASS) has NASS publications and <http://www.usda.gov/oce/waob/jawf/wwcb.html> Weekly Weather and Crop Bulletins as well as crop progress/production reports and national and state forecasts. Go to "Publications" for useful situation and outlook reports from NASS, ERS (Economic Research Service), and WAOB (World Agricultural Outlook Board)

<http://www.usda.gov/agency/oce/waob/waob.htm>

World Agricultural Outlook Board (WAOB) This site contains outlook reports of agricultural developments, world agricultural supply and demand estimates, and more

<http://www.usda.gov/agency/oce/waob/jawf/index.html>

Joint Agricultural Weather Facility (JAWF) The Weekly Weather and Crop Bulletin, Major World Crop Calendars, and PDSI and CMI maps can be found here

<http://www.usgs.gov/>

United States Geological Survey (USGS) Visit the nation's largest earth-science research and information agency. Go to

http://www.usgs.gov/public/press/public_affairs/press_releases/index.html

USGS News Releases to see the latest advisories, warnings, and events.

<http://water.usgs.gov/>

Water Resources of the United States contains more links

http://water.usgs.gov/cgi-in/dailyMainW?state=us&map_type=dryw&web_type=map

Drought Watch site provides real-time streamflow information for locations in the United States

State Government

<http://lwf.ncdc.noaa.gov/oa/climate/aasc.html>

American Association of State Climatologists (AASC) site is a good place to start your search for climate and/or drought data products for states

<http://www.aces.edu/drought/>

Alabama Drought Emergency Relief Effort provides updates on drought in the state

http://www.uaa.alaska.edu/enri/ascc_web/ascc_home.html

Alaska State Climate Center

<http://climate.gi.alaska.edu/>

Alaska Climate Research Center

<http://watersupplyconditions.water.ca.gov/>

California Drought Preparedness Home Page, from the <http://www.dwr.water.ca.gov/> Department of Water Resources

http://cwcb.state.co.us/owc/Drought_Planning/2002_Drought_Information.htm

2002 Drought Information from the <http://cwcb.state.co.us/> Colorado Water Conservation Board

<http://climate.atmos.colostate.edu/> Colorado Climate Center, from <http://www.colostate.edu/> Colorado State University, is monitoring climate in time scales of weeks to years

http://www.coaps.fsu.edu/climate_center/

Florida Climate Center is a public service unit of the <http://www.ispa.fsu.edu/> Institute of Science and Public Affairs at the Florida State University

<http://interests.caes.uga.edu/drought/>

Drought in Georgia provides the latest information on drought in the Peach State

<http://lumahai.soest.hawaii.edu/cgi-bin/hawaiianwx.cgi>

University of Hawaii Department of Meteorology

<http://www.prh.noaa.gov/pr/hq/>

National Weather Service Pacific Region Headquarters monitors conditions in Hawaii and other islands in the basin.

<http://www.kwo.org/Reports/drought.htm>

Kansas Drought Report

<http://www.gwpc.ca.uky.edu/drought.html>

Kentucky and National Drought Information

<http://www.mde.state.md.us/drought/default.asp>
Maryland 2002 Drought Information

http://climate.umn.edu/doc/drought_2000.htm
Drought Information Resources

<http://www.dnr.state.mo.us/geology/droughtupdate.htm>
Missouri Water Resources Program, Drought Information, from Geological Survey and Resource Assessment of the
<http://www.dnr.state.mo.us> Department of Natural Resources

<http://nris.state.mt.us/Drought/>
Montana Drought Monitoring

<http://linux1.nrc.state.ne.us/carcunl/>
Nebraska Climate Assessment and Response Committee (CARC) is responsible for drought-related activities in the state

<http://www.njdrought.org/>
New Jersey Drought Information, from the <http://www.state.nj.us/dep/> Department of Environmental Protection

<http://www.state.nj.us/dep/watersupply/precip.htm>
New Jersey Hydrologic Conditions

<http://weather.nmsu.edu/drought/index.htm>
New Mexico Drought Planning Team mission is to develop a drought response plan that focuses on assessing where the state is vulnerable to drought impact and what can be done to minimize the impact of a drought before it occurs

http://www.dwr.ehnr.state.nc.us/Water_Supply_Planning/Drought_Monitoring_Council
North Carolina Drought Monitoring Council has information about drought monitoring activities in North Carolina

<http://www.ces.ncsu.edu/drought/index.html>
North Carolina State University has a nice set of drought information leaflets on managing drought

<http://www.ag.ndsu.nodak.edu/drought/drought.htm>
North Dakota State University Extension Service's Coping with Drought

<http://www.state.ok.us/%7Eowrb/features/drought.html>
Oklahoma Water Resources Board monitors the state's droughts, or emerging droughts, and water resources

<http://www.dep.state.pa.us/dep/subject/hotopics/drought/> The Pennsylvania Department of Environmental Protection Drought Information Center has all of the state's drought-related activities

<http://water.dnr.state.sc.us/climate/sco/drought.html>
South Carolina Drought Information Center

<http://www.txwin.net/dpc/index.htm>
Texas Drought Preparedness Council

<http://agnews.tamu.edu/drought>
Texas Drought was developed by the Texas Agricultural Extension Service and Experimental Station to provide information and alternatives that might reduce further losses to the agricultural industry in Texas.

http://www.twdb.state.tx.us/DATA/DROUGHT/drought_toc.htm
The Texas Water Development Board Drought page contains current climatic, drought index, and water supply conditions.

<http://twri.tamu.edu>
Search the Texas Water Resources Institute for the latest headlines and stories on drought in Texas

<http://www.ecy.wa.gov/programs/wr/drought/droughthome.html>
Washington Department of Ecology, Water Resources site has drought updates and information

<http://www.westgov.org/> Western Governors' Association (WGA) was formed to provide leadership for many vital issues in the West. The Association identifies and addresses key policy and governance issues in natural resources, the environment, human services, economic development, international relations, and public management

International

<http://www.sequia.edu.mx/>
Mexico's Centro de Investigaciones Sobre la Sequia (National Drought Research Center) is housed at the Institute of Ecology in Chihuahua, Mexico

<http://members.ozemail.com.au/%7Esjhop/prayer.htm>
Drought Floods & Prayer is an information resource for those concerned with the effects of drought and floods on people and the environment

<http://www.cnpm.embrapa.br/>
Embrapa researches and spreads knowledge in the areas of remote sensing and digital cartography for agriculture and the environment of Brazil

<http://www.funceme.br/beta/funceme/index.html>
FUNCEME helps to monitor the climate and environment in northern Brazil
<http://www.ibwc.state.gov/> International Boundary and Water Commission provides environmentally sensitive and timely boundary and water services along the border of the United States and Mexico

<http://www.affa.gov.au/content/output.cfm?ObjectID=3E48F86-AB1C-11A1-B6300060B0AA00004>
Bureau of Rural Sciences (Canberra, Australia) Take a look at their work in the areas of drought and climate change

<http://www.longpaddock.qld.gov.au/>
The Long Paddock is rich in graphics and information on drought, ENSO, and climate in eastern Australia. You'll want to visit this worthwhile site from Queensland and the land down under

<http://epix.hazard.net/>
Canada's EPIX (Emergency Preparedness Information eXchange) provides information about prevention of, preparation for, recovery from, and mitigation of risk associated with natural hazards

<http://www.ema.gov.au>
Emergency Management Australia (EMA) emphasizes development of measures to reduce the risk and manage the consequences of natural disasters.

<http://www.ema.gov.au/5virtuallibrary/inforecent.html>
INFO recent newsletter has some drought-related articles

<http://www.bom.gov.au>
Bureau of Meteorology Australia

<http://www.lwrrdc.gov.au/>
Land & Water Australia provides information and documents on climate variability and drought research in relation to Australian agriculture

<http://www.fao.org/default.htm>
Food and Agriculture Organization (FAO) of the United Nations has a search form to query FAO's databases. Go to the <http://www.fao.org/waicent/search/default.asp?lang=en> WAICENT Information Finder (World Agriculture Information Centre) for access to FAO's vast library of information on global agriculture, fisheries, forestry, nutrition, and rural development. You will want to look at the <http://www.fao.org/english/newsroom/global/2002/index.html> Global Watch section for Weather and Crop Situation reports for both the Sahel and sub-Saharan regions of Africa. The <http://www.fao.org/waicent/faoinfo/economic/giews/english/giews.htm> Global Information and Early Warning System (GIEWS) is also a strong starting point

<http://www.wmo.ch/index-en.html>
WMO (World Meteorological Organization of the United Nations)

<http://www.fas.usda.gov/>
Foreign Agriculture Service (FAS) is a source of news on international agricultural production and trade

<http://www.adpc.ait.ac.th/general/adpc.html>
Asian Disaster Preparedness Centre (ADPC)

<http://www.weathersa.co.za/>

South African Weather Service has information on climate, forecasts, and projects in South Africa

<http://www.zamnet.zm/siteindex/Links/weather.html>

Zambia Department of Meteorology has forecasts and analysis for Zambia

<http://www.uwin.siu.edu/IWRN/>

Inter-American Water Resources Network (IWRN) is building an impressive directory of water resources organizations

http://www.earlywarning.nl/earlywarning/ew_index.htm

Monitoring and Early Warning, from <http://www.ears.nl/index.htm> Environmental Analysis and Remote Sensing Ltd. (EARS), has up-to-date maps of the crop growth situation in Africa and Europe

<http://www.agr.gc.ca/pfra/drought/default.htm>

Drought Watch on the Prairies provides an overview on the risk of drought in western Canada

<http://www.c-ciarn.ca/home.asp>

Canadian Climate Impacts and Adaptation Research Network is a national network that facilitates the generation of new climate change knowledge

<http://www.dmc.co.zw/>

SADC Drought Monitoring Centre

<http://www.iac.br/ciiagro/>

Center of Agricultural Information

Disaster

<http://www.reliefweb.int/w/rwb.nsf>

ReliefWeb is a great source for materials and timely dissemination of reliable information on prevention, preparedness, and disaster response. Use their search engine for current drought news around the world

<http://disaster.ceos.org>

Disaster Information Server, from the Committee on Earth Observation Satellites (CEOS) Disaster Management Support Group, provides great information on a variety of hazards

<http://www.colorado.edu/hazards>

Natural Hazards Center publishes a monthly newsletter, <http://www.colorado.edu/hazards/dr/currentdr.html> Disaster Research. This is a good place to find contacts, and it is also loaded with disaster information covering all sorts of organizations and areas of interest, including drought

<http://hrrc.tamu.edu/>

Hazard Reduction and Recovery Center research focuses on hazard analysis, emergency preparedness and response, disaster recovery, and hazard mitigation

<http://www.redcross.org>

American Red Cross (ARC) has news about the ARC's relief activities. Here you can find the latest on disasters, warnings, and relief efforts in the states

<http://ndrd.gsfc.nasa.gov>

Natural Disaster Reference Database is a bibliographic database from NASA on research, programs, and findings on disaster mitigation using remote sensing technology

<http://www.unisdr.org>

International Strategy for Disaster Reduction (ISDR) succeeded the International Decade for Natural Disaster Reduction (1990-99) in 2000.

<http://www.vita.org>

Volunteers in Technical Assistance (VITA) has information on current and past disasters of all types

Sustainability

<http://www.undp.org/seed/unso>

Dryland Web comes from the Office to Combat Desertification and Drought (UNSO)

<http://www.sustainable.doe.gov>

Smart Communities Network is housed in the Department of Energy's Office of Energy Efficiency and Renewable Energy Network

<http://bcn.boulder.co.us/basin>

Boulder Area Sustainability Information Network (BASIN) is a great example of sustainability (water and environment) issues on a local level

<http://www.greatplains.org/gpidn/index.htm>

Great Plains International Data Network covers sustainable development, remote sensing, GIS, and data activities within the Great Plains region of Canada and the United States. The Great Plains Partnership promotes and tests alternative approaches to stewardship

<http://www.iisd.org/default.asp>

International Institute for Sustainable Development (IISD) is a super source for sustainable agriculture and development issues. The <http://www.iisd.ca/linkages/enbvol/enb-background.htm> Earth Negotiations Bulletin is another useful source

<http://www.ecouncil.ac.cr>

Earth Council was created to facilitate the implementation of the Earth Summit Agreements

<http://www.nasm.edu/ceps/drylands>

Bright Edges of the World brings you information on drylands, desertification, drought, and sustainability as well as threats and/or risks to the people around the world who are "living on the edge" of producible regions

<http://ag.arizona.edu/OALS/IALC/Home.html>

International Arid Lands Consortium (IALC) has information on sustainable practices and research on arid or semiarid lands

<http://www.agry.purdue.edu/links>

Agronomic Links Around The Globe has state, national, international, and commercial links that offer information about crops, soils, climate, sustainable practices, and environmental issues

<http://archive.greenpeace.org/%7Eclimate/ctb/index.html>

Greenpeace International Climate Time Bomb has information on various natural disasters

<http://www.climateark.org>

Climate Ark (Climate Change & Renewable Energy Portal) is dedicated to promoting public policy that addresses global climate change

Remote Sensing

<http://orbit-net.nesdis.noaa.gov/crad/sat/surf/vci>

Vegetation and Temperature Condition Index (VT) Home Pages from NOAA's NESDIS group monitor conditions around the globe via satellite

<http://www.osei.noaa.gov>

NOAA's Operational Significant Event Imagery home page provides daily reports and links (to satellite imagery) on the most recent natural hazards occurring worldwide

<http://www.fs.fed.us/land/wfas/welcome.htm>

The USDA Forest Service Wildland Fire Assessment System has a large suite of products and maps covering current national conditions on fire danger, drought, satellite-derived vegetative greenness, and current fire weather observations and forecasts

<http://edc.usgs.gov>

EROS (Earth Resources Observation System) Data Center contains the world's largest collection of space and aircraft remotely sensed imagery. Their data holdings are impressive and can be ordered and/or downloaded via the Internet and FTP

<http://eosps0.gsfc.nasa.gov>

Earth Observing System (EOS) is a super source of information on NOAA/NASA's Pathfinder satellite program. NASA also has a <http://gcmd.gsfc.nasa.gov/Resources/pointers/sat.html> comprehensive list of servers with satellite and remote sensing materials

<http://www.ccrs.nrcan.gc.ca>

Canada Centre for Remote Sensing (CCRS) is the source for Canadian remote sensing data and products

<http://www.vtt.fi/tte/research/tte1/tte14>

Technical Research Centre of Finland (VTT) has an exhaustive list of international remote sensing servers - scroll down to the "Virtual Library"

Hydrology

<http://www.state.nj.us/drbc>

Delaware River Basin Commission maintains an excellent

<http://www.state.nj.us/drbc/drought/droughtpframeset.htm> Drought Information section

<http://www.srbc.net>

Susquehanna River Basin Commission also keeps up with the latest drought information and declarations for the basin

<http://www.oieau.fr>

International Office for Water contains an inventory of web sites concerning water and environment on an international scale

<http://www.iwr.usace.army.mil>

Institute for Water Resources from the U.S. Army Corps of Engineers provides technical analysis and research, as well as many online reports

<http://www.waterwiser.org/index.html>

WaterWiser is a good source of water efficiency and water conservation information

<http://www.getwise.org>

Living Wise/Learning to be Water Wise. Try this fun site to educate yourself and others on water and energy conservation measures

<http://water.usgs.gov>

USGS (United States Geological Survey) Water Resources Information of the United States. This is the place for current hydrologic information and status reports on our nation's water resources. Go to

http://water.usgs.gov/local_offices.html Local Offices for Water Resources to find resources and home pages for many states and. If you want the best place to start, this is it

<http://www.nws.noaa.gov/oh/hic/conds.html>

The National Weather Service Hydrologic Information Center provides water supply outlooks

<http://www.nohrsc.nws.gov>

National Operational Hydrologic Remote Sensing Center offers many services and products related to hydrometeorology. Snow cover (pack) and extent, river conditions (flow and levels), and forecasts are a few examples

<http://twri.tamu.edu>

Texas WaterNet - The source for information on Texas and its water resources. Search the

<http://twri.tamu.edu/subjindex> Subject Index for links to articles on drought, conservation and reuse, hydrology and runoff, and other topics

<http://groundwaterwatch.usgs.gov>

USGS Ground Water Climate Response Network provides access to realtime groundwater level data at sites considered reflective of climatic conditions

Other Drought Monitoring Tools

<http://drought.unl.edu/monitor/tools.htm>

Drought, Moisture, and Vegetation Indices

<http://www.cdc.noaa.gov/Drought>

Climate Diagnostics Center maintains an area that monitors emerging drought regions in the United States

<http://www.wrcc.dri.edu>

Western Regional Climate Center (WRCC) is actively using the SPI in their monitoring efforts. Their

<http://www.wrcc.dri.edu/monitor/wdccmon.html> Western States Climate Monitoring section contains many useful links that deal with conditions in the West.

<http://www.wrcc.dri.edu/spi/spi.html>

SPI Mapping Matrix Tool. Once you choose a climatic parameter and time scale, a map is generated for the United States through the current month. Don't forget to click on any given climate division within the maps you create to pull up a lot of very useful information observed during the past 6 years for that climate division. Percentile or probability of non-exceedance maps are located here as well. You can use these maps to determine how often a value of magnitude observed (wet or dry) is seen

<http://iri.ldeo.columbia.edu/climate/monitoring/>

International Research Institute's Climate Monitoring site houses many products and information dealing with monitoring, forecasting, and impacts

<http://205.156.54.206/pr/hq/>

National Weather Service's Pacific Region Office serves as a gateway to all relevant monitoring links in Hawaii and the basin. Here you can find the latest conditions, forecasts, and links to the International Tsunami Information Center and the Central Pacific Hurricane Center

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/palmer.gif Palmer Drought Severity Index (PDSI) map is the most commonly used drought index in the United States. This index, based on the supply and demand concept of the water balance equation, was developed as a tool for assessing long-term meteorological drought. It is a useful index when monitoring the agricultural impacts of drought

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/cdus/palmer_drought/

Climate Prediction Center's Palmer drought information page gives weekly and projected values by region for the U.S.

<http://lwf.ncdc.noaa.gov/oa/climate/onlineprod/drought/main.html>

CLIMVIS, a tool located at the National Climatic Data Center, allows the user to analyze the Palmer Drought Index and other data by climatic division for the entire United States

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/cmi.gif

Crop Moisture Index (CMI), a map from the Climate Prediction Center within NOAA, was developed by W.C. Palmer in 1968 to evaluate short-term moisture conditions. The rapid response to changing moisture conditions allows the CMI to be effective at monitoring week-to-week crop conditions. As a result, however, the CMI may be misleading in analyzing long-term drought situations

<http://www.cpc.ncep.noaa.gov/products/precip/realtime/index.html>

U.S. Daily Precipitation Analysis

http://www.fs.fed.us/land/wfas/fd_class.gif

Fire Danger Maps and <http://www.fs.fed.us/land/wfas/kbdi.gif> Keetch-Byram Index Map from the USDA Forest Service

<http://www.boi.noaa.gov/firewx.htm>

Fire Weather site from the National Weather Service offers many worthwhile products and links

<http://orbit-net.nesdis.noaa.gov/crad/sat/surf/vci/index.html>

Weekly Vegetation and Temperature Condition Index (VT) Values for many areas around the world are monitored by satellite

<http://www.fs.fed.us/land/wfas/welcome.htm>

The USDA-Forest Service Wildland Fire Assessment System (WFAS) monitors vegetation conditions (NDVI) nationally: <http://www.fs.fed.us/land/wfas/vg1panel.gif> Weekly National Visual Greenness Map and

<http://www.fs.fed.us/land/wfas/rg1panel.gif> Relative Greenness Map. <http://www.fs.fed.us/land/wfas/4pannd.gif>

Other WFAS products are also available

<http://wa.water.usgs.gov/drought/index.html>

United States Geological Survey (USGS) Drought Watch site for the Pacific Northwest States provides real-time streamflow information for locations in Washington, Oregon, and Idaho

Forecasts and Advisories

<http://iwin.nws.noaa.gov/iwin/graphicsversion/bigmain.html>

Interactive Weather Information Network (IWIN) from the National Weather Service provides up-to-the-minute forecasts, watches, warnings, products, and news on weather in the United States and around the world

<http://www.cpc.ncep.noaa.gov/products/forecasts/>

The Climate Prediction Center's Forecast Products include 6-10 day, monthly, and multi-season forecasts

<http://grads.iges.org/pix/wx.html>

COLA/IGES Weather Forecasts area provides current products and analysis from the National Center for Environmental Prediction

<http://iri.ldeo.columbia.edu/climate/forecast/>

International Research Institute's (IRI) experimental climate forecasts provide an alternative look into the future

<http://www.cpc.ncep.noaa.gov/products/predictions/threats/>

The CPC's U.S. Hazards Assessment guide provides emergency managers, planners, forecasters, and the public advance notice of potential threats related to climate, weather, and hydrologic events

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/index.html

The latest ENSO Advisory from the Climate Prediction Center

<http://tropical.atmos.colostate.edu/forecasts/>

Hurricane forecasts from Bill Gray's team at Colorado State University

<http://hurricane.terrapin.com/>

Hurricane and Storm Tracking System for the Atlantic and Pacific Oceans

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/

CPC-Weekly Climate Monitoring Tool: Just click on the map for current climate information

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/bulletin/index.html

Current Climate Diagnostics Bulletin

<http://www.ncdc.noaa.gov/publications/cvb/cvb.html>

NCDC's Current Climate Variations Bulletin

<http://www.usda.gov/agency/oce/waob/jawf/wwcb.html>

Joint Agriculture Weather Facility (JAWF) Weekly Weather and Crop Bulletins

<http://www.usda.gov/nass/pubs/staterpt.htm> National Agricultural Statistics Service (NASS) has Weekly Weather and Crop Reports for the U.S. and most of the states as well

Water Supply Conditions

<http://www.wcc.nrcs.usda.gov/water/quantity/westwide.html>

Western U.S. Water Supply Outlook from the Natural Resources Conservation Service

<http://water.usgs.gov/waterwatch/>

USGS's Water Watch

<http://www.nws.noaa.gov/oh/hic/current/>

The National Weather Service's Hydrologic Information Center provides current conditions, and water supply outlooks, along with <http://www.nws.noaa.gov/oh/hic/current/drought/index.html> drought and

http://www.nws.noaa.gov/oh/hic/current/fln/fln_sum.shtml flood statements issued by NWS offices throughout the country

<http://www.hpc.ncep.noaa.gov/>

Hydrometeorological Prediction Center provides the entire meteorological community with quantitative precipitation forecasts and numerical modeling interpretation

http://www.wrcc.dri.edu/snotel_climate.html

SNOTEL climate maps for river basins in the Western United States

<http://www.dhnl.wr.usgs.gov/>

Water Resources of Hawaii and the Pacific are monitored by the USGS District Office in Honolulu

<http://www.nohrsc.nws.gov/>

Weekly Snow-Pack Data for the U.S.

Global Climate and Drought Monitoring

<http://orbit-net.nesdis.noaa.gov/crad/sat/surf/vci/global.html>

Global VCI Imagery

<http://www.bom.gov.au/silo/>

SILO contains a rich source of meteorological and agricultural information/products for Australia. The latest national <http://www.bom.gov.au/climate/drought/drought.shtml> Drought Statements are found here

<http://www.longpaddock.qld.gov.au/QueenslandDroughtMonitor/QueenslandDroughtReport/>
Current Drought Status in Queensland, Australia

<http://lwf.ncdc.noaa.gov/servlets/SSMIBrowser>
NCDC's SSM/I Monthly Image Products page allows for global analysis of land surface temperature, wetness, and snow cover

<http://www.agr.gc.ca/pfra/drought/default.htm>
Drought Watch is a product of Agriculture and Agri-Food Canada. A great source for current information on drought and its impacts across Canada

http://www.msc-smc.ec.gc.ca/climate/index_e.cfm
Canadian Climate and Water Information site provides a comprehensive listing of data sources north of the border

<http://www.fao.org/waicent/faoinfo/economic/giews/english/esahel/sahtoc.htm>
Sahel Weather and Crop Situation reports from the FAO

<http://www.fao.org/waicent/faoinfo/economic/giews/english/giews.htm>
FAO's Global

Information and Early Warning System (GIEWS) for Africa

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/GLOB_CLIM/
Weekly Global Climate Highlights from CPC

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/index.html
CPC's ENSO Advisory

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/
Global Climate Monitoring Tool

http://www.cpc.ncep.noaa.gov/products/african_desk/index.html
CPC's African Products

<http://www.fews.net/>
USAID's Famine Early Warning System (FEWS) contains current bulletins and reports on conditions in Africa

<http://www.ncdc.noaa.gov/climatereport>
NCDC's Climate of 2002 is an analysis of global and U.S. data

Current Drought-Related Impacts and Humanitarian Issues

<http://drought.fsa.usda.gov/>

USDA's Drought Information Page provides comprehensive information on USDA's drought assistance programs and other related resources. All Secretarial Disaster Designations for drought are included here in map form

<http://www.disastercenter.com/drought.htm>

Disaster Center maintains an Agricultural Disaster Drought and Water News section that includes links to all relevant disaster information for each state

<http://205.156.54.206/om/sigwx.shtml>

The National Weather Service's Significant Weather Event Maps

<http://www.cip.ogp.noaa.gov/>

NOAA's Climate Information Project provides excellent daily updates as well as weekly and monthly summaries of climate-weather related impacts from both near and far. They also archive these reports

<http://www.disasterrelief.org>

Disaster Relief provides worldwide disaster aid and up-to-date information

<http://www.usda.gov/oce/waob/wasde/wasde.htm>

WAOB Outlook Reports contain information and forecasts of world supply-use balances of grains and products

<http://www.fao.org/waicent/search/default.asp>

FAO-World Agricultural Information Centre

<http://www.fsa.usda.gov/pas/default.asp>

Farm Service Agency

<http://www.fas.usda.gov/>

Foreign Agricultural Service

<http://www.cidi.org/sitreps.htm>

VITA Situation Reports via the Center for International Disaster Information

<http://www.ifrc.org/news/appeals.asp>

International Federation of Red Cross and Red Crescent Societies Appeals and Situation Reports

<http://members.ozemail.com.au/%7Eesjhopp/prayer.htm>

Drought, Floods, & Prayer provides a forum for prayer response to drought and flood events around the world

<http://www.reliefweb.int/w/rwb.nsf>

ReliefWeb is an excellent resource for information about current droughts and other natural disasters

Annex 5

Experts: Drought Monitoring, Policy, and Planning

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