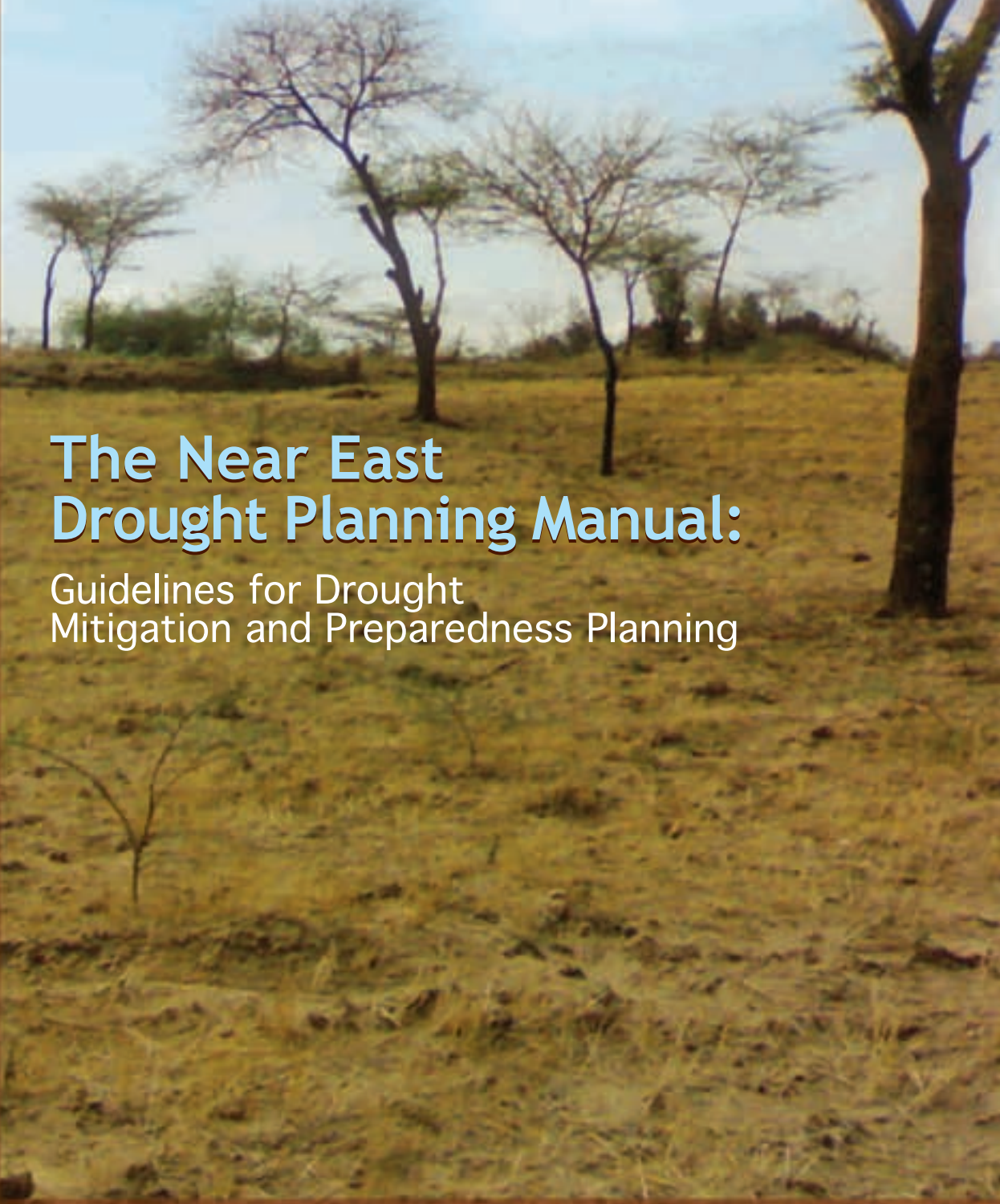

The Near East Drought Planning Manual:

Guidelines for Drought Mitigation and Preparedness Planning

Food and Agriculture Organization
of the United Nations
Regional Office for the Near East,
Cairo, Egypt

National Drought Mitigation Center
University of Nebraska, Lincoln,
Nebraska - USA

ISBN 978-92-5-106046-9

9 789251 060469

TC/M/I0284E/1/08.08/200

The Near East Drought Planning Manual:

Guidelines for Drought Mitigation and Preparedness Planning

Food and Agriculture Organization of the United Nations
Regional Office for the Near East, Cairo, Egypt

National Drought Mitigation Center
University of Nebraska-Lincoln, Nebraska, USA

September 2008

Food and Agriculture Organization of the United Nations Regional Office for the Near East

University of Nebraska Lincoln

National Drought Mitigation Center

Note: In 2004, the FAO Agriculture and Land and Water Use Commission for the Near East (ALAWUC) met and discussed progress achieved in developing strategies for drought mitigation and preparedness planning in the Near East Region. Based on these discussions, they developed a list of recommendations for future actions to enhance drought risk reduction efforts.

One of the recommendations made by the Commission was for the creation of guidelines to assist countries in the preparation and implementation of national action programs for combating drought. This guide was developed to help address this need.

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

ISBN 978-92-5-106046-9

All rights reserved. Reproduction and dissemination of material in this information product for educational or other non-commercial purposes are authorized without any prior written permission from the copyright holders provided the source is fully acknowledged. Reproduction of material in this information product for resale or other commercial purposes is prohibited without written permission of the copyright holders. Applications for such permission should be addressed to:
Chief
Electronic Publishing Policy and Support Branch
Communication Division
FAO
Viale delle Terme di Caracalla, 00153 Rome, Italy
or by e-mail to:
copyright@fao.org

© FAO 2008

Table of Contents

1. Introduction to Drought Planning 1
   - 1.1 Effects of Drought in the Near East Region 1
   - 1.2 New Emphasis on Proactive Drought Planning 3
   - 1.3 Integration of Drought Planning and Sustainable Development 3

2. Explanation of Drought Concepts 5
   - 2.1 Definitions 5
   - 2.2 The Nature of Drought 7
   - 2.3 The Effects of Drought 7

3. How to Develop a Drought Plan 9
   - Step 1: Creating Political Momentum and Authority 9
   - Step 2: Coordinating Strategic Drought Planning 12
   - Step 3: Fostering Involvement and Developing Common Understandings 15
   - Step 4: Investigating Drought Monitoring, Risk, and Management Options 16
   - Step 5: Writing a Drought Plan 33
   - Step 6: Implementing a Drought Plan 33

4. Example of National Drought Planning: The Islamic Republic of Iran 35
   - 4.1 Overview of the Iran National Strategy and Action Plan on Drought Preparedness, Management, and Mitigation in the Agricultural Sector 36
   - 4.2 Steps in the Development of the Iran National Strategy and Action Plan on Drought Management and Mitigation 36

5. Drought Planning and Risk Management Resources 41
   - 5.1 United Nations System 41
   - 5.2 International Networks and Centers 45
   - 5.3 Regional Networks and Organizations 46
   - 5.4 Country-Based Organizations 47

6. References 50

List of Boxes

Box 1. Example effects of the 1998-2001 drought in the Near East 2
Box 2. National drought plans 3
Box 3. Climate change in the Near East Region 4
Box 4. Terminology 5
Box 5. Essential drought planning messages 11
Box 6. Creating a National Steering Committee in Jordan 14
Box 7. Objectives of a drought monitoring committee 18
Box 8. Drought early warning system for Syrian rangelands 21
Box 9. Tasks to complete as part of a drought risk assessment 23
Box 10. United Nations Economic and Social Commission for Western Asia drought vulnerability assessment 29
Box 11. Typology of drought risk management measures 30
Box 12. Potential drought mitigation actions in Tajikistan 32
Box 13. Steps taken in the development of the Iranian National Strategy and Action Plan on Drought Preparedness, Management, and Mitigation in the Agricultural Sector 37

List of Figures

Figure 1. Percent of total number of people affected by drought from 1900 to 2004 by continent 1
Figure 2. Percent of total number of people affected by natural disasters from 1978-2007 in the Near East Region 1
Figure 3. Relationships between meteorological, agricultural, hydrological, and socio-economic drought 6
Figure 4. Drought Task Force organizational structure 16
Figure 5. An example of a simplified agricultural impact tree diagram 28

List of Tables

Table 1. Intraseasonal droughts at Tel Hayda, Syria 8
Table 2. Summary of common drought indices 19
Table 3. Drought indicators and means of monitoring in Syria 21
Table 4. Economic, social, and environmental impacts commonly associated with drought 25
Table 5. Drought impact decision matrix 27
Table 6. Matrix of drought risk reduction measures and responsible stakeholders 31

1. Introduction to Drought Planning

Drought planning involves identifying objectives and strategies to effectively and equitably prepare for, respond to, and recover from the effects of drought, as well as the development of a plan to implement the strategies.

1.1 Effects of Drought in the Near East Region

Drought is a complex phenomenon that caused more deaths during the last century than any other natural disaster, and Asia and Africa rank first among continents in the number of people directly affected (Figure 1). Similarly, as shown in Figure 2, drought has affected more people than any other natural hazard in the Near East Region during the last thirty years. Conservative estimates report that at least 77 million people have been affected by drought in the region from 1979 to early 2008 (EM-DAT, 2008).

The Center for Research on the Epidemiology of Disasters <http://www.emdat.be/> has an emergency events database (EM-DAT), which includes statistics of the number of people killed or affected by natural disasters around the world. For example, the database reported that, in 1983, especially severe drought in Sudan killed an estimated 150,000 people and affected another 8.4 million people for the next several years. Sudan was again struck by drought in 1991 when 8.6 million people were affected.

More recently, drought from 1998 to 2001 was reported to be the worst in 50 years, affecting millions of people across the Near East. According to EM-DAT, in 1999, nearly 40 million people were affected, including 37 million in Iran and another 3 million in Morocco, Jordan, Pakistan, and Syria. By 2000, the number had grown to nearly 50 million people as drought expanded across much of the Near East from Morocco to Tajikistan. The drought continued unabated through 2001 before beginning to lessen in most areas by 2002.

Examining the effects of the recent drought demonstrates its wide-reaching impacts on society and the environment (Box 1). For example, the drought caused widespread crop failures and livestock losses; increased drinking water and food shortages; increased disease, stress, and other social problems; reduced hydropower generation and increased soil erosion and fire occurrence; forced mass migrations to urban areas and other countries; and generally increased debt and reduced security at the local and national levels (FAO/NDMC, 2008).

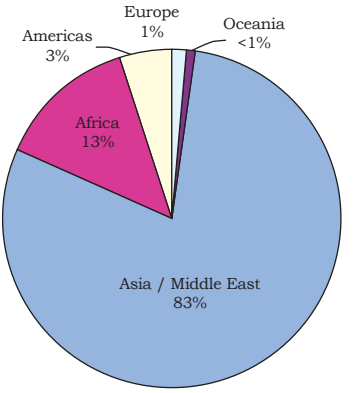

Figure 1. Percent of total number of people affected by drought from 1900 to 2004 by continent (Below rt al., 2007)

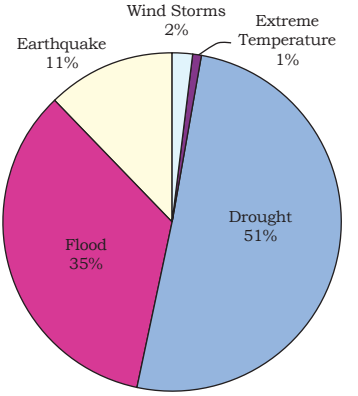

Figure 2. Percent of total number of people affected by natural disast from 1978 to 2007 in the Near East Region (EM-DAT, 2008)

Box 1. Example Effects of the 1998-2001 Drought in the Near East

Afghanistan

- 12 million people affected and 5 million lacking access to food and water by 2001
- Cereal deficits in the millions of tons and 40% reduction in livestock numbers
- Hundreds of thousands of Afghans refugees from drought and conflict

Cyprus

- Reduced water in reservoirs and severe water restrictions
- Reduced agricultural production and related livelihood problems

Iran

- 37 million people (> 50% of the population) experienced food and water insecurity
- US$4.2 billion in agricultural losses from 2000 to 2001, resulting in a 12% reduction in the gross domestic product of agriculture and livestock
- Widespread migration and increased disease (e.g., cholera, diphtheria, typhoid, etc.)

Jordan

- 180,000 farmers and herders affected, and food insecurity for 4.75 million people
- 1% of cereals and 40% of red meat and milk harvested

Morocco

- 1 million hectares of cropland affected, resulting in 5 million tons of wheat imports in 2001 (US$500 million in total cereal imports)

Pakistan

- At least 349,000 rural people affected by drought in 2001
- Cereal shortfalls and 40-60% of livestock affected
- US$1.2 billion in losses because of reduced hydropower production and increased oil purchases in 2001

Syria

- 47,000 nomadic households forced to liquidate their livestock assets
- Urban water shortages and hydropower reductions

Tajikistan

- 3 million people affected and US$160 million in agricultural losses, 2000-2001
- Malnutrition increase (up to 17.3% in 2001) and relief aid to millions of people
- $100 million in relief aid delivered from 2000 to 2002
- Reduced drinking water availability and increased water-related diseases

Tunisia

- Agricultural losses and US$46 million in intervention actions (i.e., livestock vaccinations and nutrition products, subsidizing forage product prices, and attribution of yearly credit for farmers)

Turkmenistan

- Rain-fed wheat yield losses of 42-70% and pasture productivity reduction of 21-57%
- Stream flow reduction causing irrigated cotton shortfalls of 21% and 37% in 2000 and 2001, respectively
- Adverse health and social effects reported (e.g., among women and children)

Uzbekistan

- US$130 million in agricultural crop losses from 2000 to 2001
- Rural income loss, unemployment, malnutrition, and out-migration
- Reduced drinking water availability and increased water-related diseases

Source: Food and Agriculture Organization (FAO) of the United Nations/National Drought Mitigation Center (2008)

1.2 New Emphasis on Proactive Drought Planning

To reduce the likelihood of drought impacts occurring again in the future, increased emphasis is being placed on developing drought plans that outline proactive strategies that can be implemented before, during, and after drought to increase societal and environmental resiliency and enhance drought response and recovery capabilities. Several countries in the Near East have already begun the process of developing national drought plans (Box 2).

Drought planning provides an opportunity for decision makers to identify sectors that are vulnerable to drought and investigate management options before a crisis occurs. With this information, decision makers can identify and implement the most appropriate and cost-effective strategies available in a strategic and systematic manner. This will foster a more informed decision-making process and the development of efficient drought management programs.

This focus on proactive drought planning is essential for reducing drought impacts and expenditures, and also for supporting capacity building, collaboration, and sustainable development. For example, drought planning can create opportunities for a broad range of stakeholders to participate in the decision-making process, which can foster capacity building, conflict resolution, and collaborative relationships. Over the course of time, the skills and relationships gained during these activities can be applied well beyond the realm of drought planning.

Box 2. National Drought Plans

Researchers and policy makers in several Near East countries have already begun investigating the development of national drought mitigation and preparedness plans (FAO/NDMC, 2008). These countries include:

- Jordan
- Iran
- Syria
- Azerbaijan
- Kazakhstan
- Kyrgyz Republic
- Tajikistan
- Turkmenistan
- Uzbekistan

Several other countries around the world have also developed national drought plans such as Australia, South Africa, and Namibia (UN/ISDR, 2007).

1.3 Integration of Drought Planning and Sustainable Development

Drought planning is an essential component of combating desertification and climate change and increasing the resiliency and sustainability of communities and nations to natural hazards in the Near East Region. Because of the integrated nature of these issues, increasing efforts to better prepare for and respond to drought have the potential to help address a wide variety of other management issues.

For example, the United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992 and entered into force in 1994. The Convention states that each signatory party (that includes all Near East countries except Iraq and Somalia) should take precautionary measures to anticipate, prevent, or minimize the causes of climate change and mitigate its adverse effects (UNFCC, 1992). This includes developing appropriate plans to protect regions affected by drought. Therefore, drought planning and climate change objectives can be integrated under the Convention.

This is especially relevant in the Near East since several studies state that water stress and climate change will increasingly challenge the region in the near future (see Box 3). For example, several countries in northern Africa are expected to exceed the limits of their economically usable land-based water resources before 2025, even without climate change (Boko et al., 2007). Climate change is expected to add to the problem by increasing evaporation and reducing precipitation and/or the timing of precipitation in the Near East

Box 3. Climate Change in the Near East Region

The current trend of reduced precipitation is likely to continue in the southern and central parts of the region throughout the 21st century. In the southern and easternmost parts of the region, most models agree that rainfall could increase, although precipitation and temperature patterns may change, affecting precipitation availability.

In terms of drought,

- Water availability could decrease up to 40 mm per year by 2080-99
- The number of dry days could increase in most portions of the region
- The number of frost days should decrease, heat waves could increase in more continental areas, and growing seasons should decrease in many instances
- A 3°C rise in temperature could cause maize yields in North Africa to fall by 15-25% and crop yields in West Asia to fall by 25-35%
- Less soil moisture in arid lands will exacerbate degraded lands even further
- The mean cost of climate change in the region, especially the Middle East, is predicted to result in about a 2.5% and 1.9% loss in gross domestic product (GDP), respectively, compared to a world without climate change.

Source: Food and Agriculture Organization (FAO) of the United Nations (2007a)

region, which could increase the occurrence of drought and water shortages in some areas (Freiwan and Al-Nsour, 2007; Cruz et al., 2007).

In addition, the United Nations Convention to Combat Desertification (UNCCD) was adopted in 1994 and its implementation began in 1996. The UNCCD and its signatory countries (which include every country in the Near East) are obligated to carry out activities to combat desertification and mitigate the effects of drought (UNCCD, 1994). Similarly, the landmark Hyogo Framework for Action 2005-2015 was adopted by United Nations Member States in 2005. The Framework outlines priorities to enhance the resilience of nations and communities to natural hazards, including drought. Fully implementing this Framework will require an increased emphasis on drought planning (UN/ISDR 2007).

The UNCCD and UNFCCC initiatives and the Hyogo Framework for Action all advocate the importance of drought risk reduction through more proactive planning. Recent drought and increasing demands on available water resources, along with unfavorable climate change scenarios, have brought greater awareness of the need to plan for future drought events in the Near East Region. An increased emphasis on drought planning will help protect lives and livelihoods, as well as help meet the obligations of a broad range of initiatives to help build more resilient and sustainable societies.

2. Explanation of Drought Concepts

There are differences between terms such as drought, aridity, and desertification (Box 4). A drought may also be different from a water shortage. However, people often use the terms interchangeably and incorrectly. People also tend to envision withering crops, cracked stream beds, and human suffering when they think of drought. However, they don't have a good understanding of the wider effects of drought on society and the environment. People can often tell you about droughts that have occurred in the past, but most likely will not know the frequency of such droughts, or what time of year they are most likely to occur. Understanding these types of issues is essential for understanding drought and communicating in a common language.

2.1 Definitions

Precipitation plays a major role in the availability of water in many Near East countries; accumulations range from as little as 51 mm/yr in Egypt to 691 mm/yr in Tajikistan in the more water-rich eastern portion of the region. Because of naturally low rainfall amounts throughout much of the year, most of the region is classified as a hot, arid desert (Kottek et al., 2006). This ***aridity*** is a natural, permanent feature of the climate in these areas.

Not only is rainfall scarce in most areas of the region, but rivers are highly variable and difficult to manage, ground water is being mined at an increasing rate, and water pollution is reducing the availability of quality water (Shetty, 2006). These factors, combined with high population growth rates and increasing urbanization, competition among communities and industrial and service sectors, land use practices that degrade the environment, inefficient water supply systems, and recurrent drought, raise concerns over the sustainability of water resources in the region (Shetty, 2006; De Pauw, 2005; ESCWA, 2005). In fact, in 2005, more than one-third of the Near East countries had water resources less than 500 m^3/inhabitant, half had less than 1,000 m^3/inhabitant, and two-thirds less than 1,700 m^3/inhabitant, below which the countries are considered facing ***absolute water scarcity***, ***water scarcity***, and ***water stress***, respectively (FAO, 2007). These water scarcity and stress terms denote a permanent condition of imbalance between water resources and water demands in a region.

This imbalance, along with changing climate conditions and inappropriate land uses, can result in desertification. ***Desertification*** is the degradation of land in arid, semi-arid and other areas with a dry season; caused primarily by overexploitation and inappropriate use interacting with climatic variance. The main desertification processes observed in North Africa and the Middle East are soil degradation, water and wind erosion, and salinization and water-logging associated with irrigation (Nasr, 1999).

Box 4. Terminology

Aridity: natural, permanent climatic condition with very low average annual or seasonal precipitation.

Water scarcity and stress: indicates a permanent condition of imbalance between water resources and water demands in a region (or in a water supply system).

Desertification: the degradation of land in arid, semi-arid and other areas with a dry season; caused primarily by over-exploitation and inappropriate use interacting with climatic variance.

Drought: a significant deficiency of precipitation from "normal" over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector.

Water shortage: temporary water imbalance. Water shortage in a water supply system represents a water deficit with respect to the demand, which can occur due to a drought or other human-induced causes (e.g., low water quality, poor management, or infrastructure problems).

Sources: Iglesias et al. (2007), Nasr (1999), National Drought Mitigation Center (2008a)

Drought exacerbates aridity and water scarcity/stress issues by making a difficult situation even worse. Although specific definitions of drought may vary by sector and region, drought generally originates from a significant deficiency of precipitation over an extended period of time, resulting in a ***water shortage*** for some activity, group, or environmental sector (NDMC, 2008). This is different than a temporary ***water shortage*** because of other human-induced or environmental causes, such as faulty infrastructure or poor water management.

More specifically, Wilhite and Glantz (1985) describe four types of drought (see Figure 3):

- ***Meteorological drought*** refers to a deficiency of precipitation, as compared to average conditions, over an extended period of time.

- ***Agricultural drought*** is defined by a reduction in soil moisture availability below the optimal level required by a crop during each different growth stage, resulting in impaired growth and reduced yields.

- ***Hydrological drought*** results when precipitation deficiencies begin to reduce the availability of natural and artificial surface and subsurface water resources. It occurs when there is substantial deficit in surface runoff below normal conditions or when there is a depletion of ground water recharge.

- ***Socio-economic drought*** occurs when human activities are affected by reduced precipitation and related water availability. This form of drought associates human activities with elements of meteorological, agricultural, and hydrological drought.

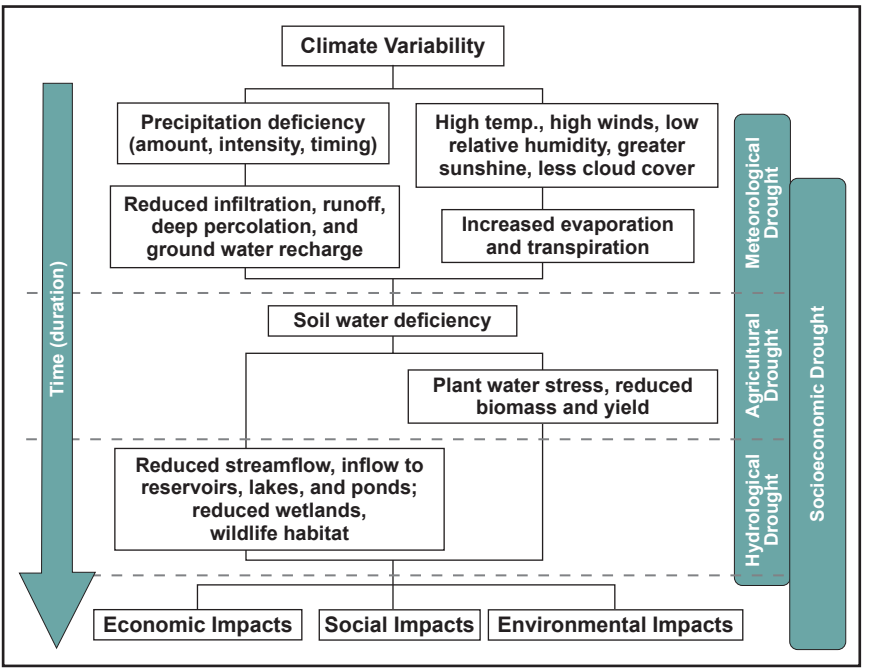

Figure 3. Relationships between meteorological, agricultural, hydrological, and socio-economic drought (Source: National Drought Mitigation Center, University of Nebraska-Lincoln, USA).

2.2 The Nature of Drought

Drought is a natural component of climate. In most years, precipitation amounts throughout the year will be adequate to meet the needs of people and the environment. However, during some years, precipitation amounts will fluctuate more widely, resulting in flooding or drought. These normal fluctuations can be expected to occur periodically.

Although drought occurs in nearly every region on Earth, some places are more prone to drought disasters either because of an increased frequency or severity of the hazard or because local populations or the environment are more vulnerable to the effects of drought. A precipitation deficiency will more easily turn into a disaster when pressure on existing water supplies is high and capacities for effectively preparing for and responding to the effects of drought are low (e.g., lack of drought planning and policies, lack of access to non-conventional sources of water, poor land-use practices, conflicts, poverty, etc.). Because each location is unique, the number of people affected by drought and the types of effects experienced will vary by region. In developing countries, however, drought ranks as the single most common cause of severe food shortages and is regularly listed as a cause in the majority of food emergencies (FAO, 2003).

The frequency of drought occurrence is also highly variable from location to location and each drought is unique in its intensity, duration, and spatial extent. An event may persist for a few months or for several years and, for some locations, for a decade or more. It's also common for a drought to occur on a large, regional basis, affecting millions of people and many different sectors. For example, the recent 1998-2001 drought affected many countries in the Near East Region simultaneously, especially Iran, Iraq, Jordan, Morocco, and Syria (Shetty, 2006).

Although droughts can affect entire nations or regions, they can also be extremely variable in their spatial and temporal dimensions. For example, De Pauw (2005) notes, "In Syria, the drought of 1999 initiated a severe decline in the productivity of the rangelands and barley areas at the steppe margins, which continued for several years. However, the drought had comparatively little effect on the production of wheat and tree crops in the higher rainfall areas, which recovered from 2000 onward."

Furthermore, De Pauw (2005) showed that drought can occur during any time of the growing season (e.g., early season, mid-season, and late season). Table 1 shows the occurrence of mild to severe drought within the growing season at Tel Hayda, Syria, for the 1978-2001 period to demonstrate the portion of the growing season when drought has occurred. In this case, late-season drought is most common, but early- and mid-season droughts are also likely to occur.

2.3 The Effects of Drought

The effects of drought produce a complex web of impacts that span many sectors of the economy and reach well beyond the area experiencing physical drought. These drought impacts are commonly referred to as direct or indirect (NDMC, 2008). Reduced cropland, rangeland, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat are a few examples of direct impacts. The consequences of these impacts illustrate indirect impacts. For example, a reduction in cropland, rangeland, and forest productivity may result in reduced income for farmers and agribusiness, increased prices for food and timber, unemployment, reduced tax revenues because of reduced expenditures, increased crime, foreclosures on bank loans to farmers and businesses, migration, and disaster relief programs. Direct or primary impacts are usually biophysical. Conceptually speaking, the more removed the impact from the cause, the more complex the link to the cause. In fact, the web of impacts becomes so diffuse that it is often very difficult to come up with financial loss estimates.

In the Near East Region, the agricultural sector is especially vulnerable to the effects of drought. In most Near East countries, irrigation is utilized to sustain agricultural production and reduce drought losses. In half of the Near East countries, agricultural withdrawals account for more than 90% of all water withdrawals (i.e., including agricultural, industrial, and domestic withdrawals), and in all countries, except Malta and Djibouti, they account for more

Table 1. Intraseasonal droughts at Tel Hayda, Syria (De Pauw, 2005)

	Early season	Mid-Season	Late Season
1978-79	1		1
1979-80			
1980-81			
1981-82			
1982-83			
1983-84		1	
1984-85			2
1985-86	1		1
1986-87			
1987-88			
1988-89		2	2
1989-90		1	2
1990-91	2		
1991-92			
1992-93			
1993-94	1		2
1994-95		2	
1995-96			
1996-97		1	
1997-98			
1998-99			
1999-00	2		
2000-01			1

1 = mild drought 2 = severe drought

than 50%. Although the proportion of the population involved in agriculture is decreasing, the segment still makes up a large portion of society in many Near East countries. As a whole, approximately 35% of the economically active people in the Near East Region are involved in the agricultural labor force[1], ranging from less than 1% in Bahrain, Kuwait, and Qatar to 65-75% in countries such as Afghanistan, Djibouti, and Somalia (FAO, 2007). Therefore, even though agriculture often contributes a diminishing portion to the region's gross domestic product, it is still a key area for drought planning.

In summary, drought is a complex natural hazard that can affect a variety of sectors at local and regional scales. It can occur during relatively short time spans at any time of year, or last several seasons or years. The impacts of drought are just as varied, depending on local and national vulnerabilities and the options available to prepare for and respond to drought.

1 Part of the economically active population engaged in or seeking work in agriculture, hunting, fishing, or forestry (agricultural labor force). The economically active population refers to the number of all employed and unemployed persons (including those seeking work for the first time). It covers employers, self-employed workers, salaried employees, wage earners, unpaid workers assisting in a family farm or business operation, members of producers' cooperatives, and members of the armed forces. The economically active population is also called the labor force. Data are imported from FAOSTAT (http://faostat.fao.org/).

3. How to Develop a Drought Plan

An increasing number of resources have been developed around the world to assist countries in developing drought plans. For example, the National Drought Mitigation Center (USA) has created the "10-Step Drought Planning Process" and the "How to Reduce Drought Risk Guide" that governments in both developed and developing countries have utilized to develop drought plans (Wilhite et al., 2005; Knutson et al., 1998).

In addition, the Mediterranean Agronomic Institute of Zaragoza and Universidad Politécnica de Madrid, Spain, coordinated (in collaboration with scientists and stakeholders from Cyprus, Greece, Italy, Morocco, Spain, and Tunisia) the creation of the MEDROPLAN drought management guidelines to assist Mediterranean countries in developing drought plans (Iglesias et al., 2007).

Similarly, the United Nations secretariat of the International Strategy for Disaster Reduction (UN/ISDR) and the National Drought Mitigation Center partnered to develop "Drought Risk Reduction Framework and Practices: Contributing to the Implementation of the Hyogo Framework for Action" (UN/ISDR 2007). The document provides information to assist countries in reducing their drought risk and meeting the terms of the "Hyogo Framework for Action 2005-2015" (see http//www.unisdr.org/hfa).

The planning process presented in this guide draws from these resources but is tailored for the Near East Region. It includes specific case studies of drought-related projects in the region, and presents a practical planning methodology relevant for the needs of Near East drought planners.

In particular, this chapter proposes six steps that are fundamental in developing and implementing a national drought plan:

Step 1: Creating Political Momentum and Authority
Step 2: Strategic Planning and Coordination
Step 3: Fostering Involvement and Developing Common Understandings
Step 4: Investigating Drought Monitoring, Risk, and Management Options
Step 5: Writing a Drought Plan
Step 6: Implementing a Drought Plan

Step 1. Creating Political Momentum and Authority

Drought planning is undertaken within a broad range of contexts. It may be mandated by legislation or agency responsibilities, or fostered by a perceived need of stakeholders at the grassroots level. Some drought planning efforts are well funded with substantial political support while other projects are developed through in-kind support with little political backing or implementation authority. In some cases, national drought planning activities will focus on a number of sectors such as agriculture, water resources, energy, health, tourism, and the environment, while other planning efforts will focus more on a single sector such as agriculture.

Regardless of the context, drought planning requires fostering the political will necessary to initiate and sustain the planning process. Drought planning will be much more effective if the appropriate level of leadership is involved. Gaining the endorsement of high-ranking officials and scientists will (1) lend credibility to the effort, (2) help motivate a wider group of stakeholders to participate, and (3) potentially provide the authority and responsibility for government agencies to participate in the planning process and produce a drought plan. However, fostering the motivation for these individuals to support drought planning is often challenging.

Fostering the Motivation to Initiate a Drought Planning Process

The motivation to initiate a drought planning process is often fostered by the occurrence of a severe drought event. For example, drought that occurred in the Near East from 1998 to 2001 provided the impetus for the FAO, the World Bank, and the Canadian International Development Agency (CIDA) to begin working with several Near East countries (e.g., Iran, Syria, Jordan, Azerbaijan, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan) on the development of national drought plans.

The drought event created a "policy window", a time during which the public's and policy makers' attention was directed toward a particular issue, creating an advantageous political environment for addressing the problem. In this case, the drought revealed the need for enhanced mitigation and drought relief coordination, and the cause was advanced by drought planning advocates in each country and several international organizations. As devastating as disasters are for people and the environment, they can also serve as a catalyst for change.

However, less suffering would be inflicted on people and the environment if natural hazard planning occurred without having to experience the trauma of a disaster. Ideally, natural hazard preparedness activities are undertaken before a disaster strikes to reduce the potential for suffering. This requires awareness building and the persistent efforts of forward-thinking advocates who continuously promote the need for natural hazard planning and seek avenues to accomplish it.

These advocates are essential for raising awareness, building stakeholder networks, and keeping drought planning on the political agenda. Depending on the situation and opportunities, an advocate could promote drought planning by:

- fostering the passage of legislation requiring the development of a national drought strategy,
- seeking or sponsoring a drought planning grant or technical assistance project,
- sponsoring a workshop or conference to raise drought awareness and seek collaborative support, and
- conducting and presenting individual drought-related research at relevant meetings and conferences.

All of these activities can be utilized to raise the profile of drought and foster drought planning activities.

Messages to Motivate Drought Planning

Several messages can be disseminated that may help convince stakeholders to advance drought planning programs (Box 5).

The first message is that drought is a natural hazard. Because of its slow-onset characteristics and lack of structural impacts, it is often disregarded by natural hazard planners and policy makers. This lack of recognition has been an impediment to obtaining adequate research and financial support and, in many instances, an obstacle to building awareness among policy makers at the local, national, regional, and international level.

This lack of awareness in turn has resulted in an underappreciation of drought and its far-reaching impacts. Communicating the wide range of drought impacts and the need for multiple definitions and climatic/water supply indicators appropriate for various sectors, applications, and regions is also a critical part of the awareness-building process.

Box 5. Essential Drought Planning Messages

Developing a proactive drought planning mentality requires ingraining the following messages into society:

1. Drought is a significant natural hazard that affects a wide range of sectors
2. Drought is a natural part of climate that will occur again
3. Proactive measures can be taken to reduce the effects of drought
4. Pre-drought mitigation and preparedness actions, such as drought planning, are more cost-effective than drought response measures alone
5. Drought planning is an essential component of combating desertification and climate change and increasing the resiliency and sustainability of communities and nations to natural hazards

A second message is that drought is a natural part of climate. Drought is often considered to be a rare and random event - thus, the lack of emphasis on proactive planning. An improved understanding of the nature of drought (e.g., historical occurrence, trends, etc.) will reveal that drought is a natural part of climate and something to be expected and included in water and hazard management.

The perceived rarity and randomness of drought has perpetuated the process of dealing with drought in a crisis mode when the knowledge and technology necessary to implement mitigation and preparedness measures to reduce the effects of drought are readily available.

A third message is that society can reduce the effects of drought. Many people consider drought to be purely a physical phenomenon that we have little control over. While it's true that drought originates from a deficiency of precipitation, many social factors determine how we are affected by reduced precipitation.

Like other natural hazards, drought has both a physical and a social component. It is the social factors in combination with our exposure that determines risk to society. Some of the social factors that determine our vulnerability are level of development, population growth and its changing distribution, demographic characteristics, demands on water and other natural resources, government policies (sustainable versus unsustainable resource management), technological changes, social behavior, and trends in environmental awareness and concerns. It is obvious that well-conceived policies, preparedness plans, and mitigation programs can greatly reduce societal vulnerability and therefore the risks associated with drought.

A fourth message is that investments in proactive planning are more cost effective than post-impact assistance or relief programs alone. Evidence from around the world, although limited, illustrates that there is an escalating trend of losses associated with drought in both developing and developed countries. Also, the complexity of impacts is increasing. It seems clear that investments in proactive planning will pay large dividends in reducing the impacts of drought.

The Multihazard Mitigation Council (2005) in the United States calculated that every dollar spent by the U.S. Federal Emergency Management Agency (FEMA) on grants for earthquake, wind, and flood hazard mitigation (i.e., proactive projects or policies to limit the adverse effects of hazards) provides the nation with approximately $4 in avoided future losses. It is likely that similar benefits would be accrued through the implementation of drought mitigation measures.

A fifth message is that drought planning is an essential component of combating desertification and climate change and increasing the resiliency and sustainability of

communities and nations to natural hazards. As stated previously, the United Nations Convention to Combat Desertification, United Nations Framework Convention on Climate Change, and the Hyogo Framework for Action all advocate the importance of developing drought mitigation and preparedness plans. These programs are all interrelated, and drought planning efforts could benefit multiple objectives.

Developing the Authority for Drought Planning

The culmination of fostering motivational messages and activities is the development of a program, project, or legislation that authorizes the initiation of a drought planning process. The particular drought planning avenue will undoubtedly vary by country.

For example, the need for national drought planning in the Near East was highlighted during the first session of the Agriculture, Land and Water Use Commission (ALAWUC) for the Near East, held in March 2000. At this meeting, member countries requested that the FAO Regional Office for the Near East (RNE) assist them in the formulation of long-term drought action plans. In response, RNE initiated two technical assistance projects to assist Iran and Jordan in developing national drought plans. Working with national representatives in each country, the projects were able foster the political will and authority necessary to carry out drought planning activities in each country.

Similarly, in response to the 2000-2001 drought in Central Asia and the Caucasus, CIDA (under the Canada Climate Change Development Fund) supported research and analysis by the World Bank to better understand the effects of drought, as well as national needs and capabilities in its management (see http://go.worldbank.org/8J56VSUEZ0). The effort resulted in two reports that outlined drought occurrence, impacts, vulnerabilities, climate change scenarios, and potential drought management strategies in several countries within the Near East region, including Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan (World Bank, 2005 and 2006). The results of the research were incorporated into Draft National Drought Plans for Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan.

Outside of the Near East Region, the government of Namibia also established a task force to draw up a national drought plan while introducing a package of short-term relief measures in response to drought in 1995 (UN/ISDR 2007). They utilized the policy window to institute a long-term planning task force, which convened several consultations until the endorsement of the national drought policy by the government in 2005.

No matter which path is chosen, there must be some impetus to initiate a drought planning process. While the occurrence of drought is a strong motivator, the ideal drought planning process would be initiated by proactive, forward-thinking planners and decision makers before a drought disaster occurs.

Step 2. Strategic Planning and Coordination

Once the authority to undertake a drought planning process is obtained, the involvement of stakeholders necessary to develop a drought plan and implement actions outlined in the plan is essential. A core group of stakeholders should be appointed as part of a coordination team or task force. The task force has two purposes. First, the task force will supervise and coordinate plan development. Second, after the plan is developed and during times of drought when the plan is activated, the task force will coordinate actions, implement mitigation and response programs, and make policy recommendations to the appropriate person or elected official and legislative body. A task force chairperson or permanent drought coordinator should also be implemented to keep the planning on task.

Whenever possible, the task force should reflect the multi-disciplinary nature of drought and its impacts, including representatives of state or provincial government, districts, villages, and the national government. It is also imperative that experts from universities be included, where appropriate. A representative from the national executive office (e.g., Office of the President, Prime Minister, etc.) or governor's office should be a member of the task force, depending on the scale of the drought plan.

Committees (or other research and outreach activities) will also need to be established to assist in drought monitoring, risk assessment, and identifying and implementing appropriate risk management actions. If establishing committees, at least two are generally recommended: a drought monitoring committee and a risk assessment committee. Duties of each committee are described in Step 4.

In some cases, consultants may be hired to provide input on drought and planning issues relevant to each country to complement the committees, or replace them as a last resort. The latter may be the case where interactions between agencies are limited or an individual planning project may not warrant the establishment of permanent committees. These consultants could research and report on existing drought-related programs and a variety of drought monitoring, risk assessment, and risk management issues.

For example, the government of Jordan requested FAO technical assistance for elaborating a national strategy for drought. This assistance was authorized by FAO in May 2005 under its Technical Cooperation Programme. As part of the programme, a project National Steering Committee was formed (see Box 6) and FAO provided funds for one senior technical specialist on drought management to serve as the team leader, a project water resources/irrigation management specialist, and six national consultants to conduct studies on:

- water resources policies and programs
- water resources and irrigation system management
- a drought early warning system
- drought data analysis and information system management
- drought risk assessment and identification of the economic, environmental and social impacts of the 1998-2000 drought
- the role of the major stakeholders in drought mitigation
- policies and programs for drought mitigation

The information obtained from these studies was utilized in developing the Jordan national drought strategy.

It should be recognized that a drought policy or plan is only as good as the information and ideas that go into its creation. So, care should be taken in choosing the best alternatives possible for gathering information and feedback during the planning process.

All of these activities will also require funding. It is essential to secure adequate funding for the drought planning process. Funding and resources will often determine the scope of the planning process, the degree of collaboration in the process, and the quality of the final product.

Box 6. Creating a National Steering Committee in Jordan

The government of Jordan requested FAO technical assistance to help the country undertake a project to better understand drought and its management in Jordan, and to develop a framework for carrying out a national drought planning process. This project was authorized by FAO in May 2005 under its Technical Cooperation Programme. One of the goals of the project was to create a National Steering Committee of relevant stakeholders to help oversee and lead the project.

To lead the project and assist in recruiting committee members, a National Project Coordinator (NPC) from the Ministry of Agriculture was first appointed. The NPC, an FAO representative, and an international drought consultant held meetings with as many Jordanian ministries, departments, and NGOs as time would permit. The purpose of the meetings was to inform the various groups about the project, its expected outputs, and the need for their cooperation. In particular, each ministry, department, and NGO was asked about their potential interest in being a member of the steering committee that would be established to provide feedback on the project.

Project planners felt that the meetings were extremely helpful because they not only informed others about the project but allowed the project leaders to become more familiar with the institutional arrangements and capacity of the various organizations that exist in Jordan and their potential support for this project. An added benefit was the identification of potential candidates to serve as national consultants for the project to prepare papers and assessments on various topics where more information was required.

After these meetings, the NCP drafted an invitation letter to the relevant ministries and other organizations to participate on the project's steering committee. The draft letter and the list of suggested members of the National Steering Committee were submitted to the Ministry of Agriculture for approval. The subsequent National Steering Committee was composed of representatives from the following institutions:

- Secretary General, Ministry of Agriculture, Chairman
- Hashemite University
- National Centre for Agricultural Research and Technology Transfer
- Meteorology Department
- Ministry of Water and Irrigation
- Ministry of Interior
- Ministry of Environment
- Royal Jordanian Geographic Centre
- Jordanian Society for Desertification Control and Badia Development
- Directorate of Land and Water, Ministry of Agriculture
- Directorate of Projects, Ministry of Agriculture
- FAO Technical Cooperation Programme National Project Coordinator

The committee met on several occasion throughout the project to review information and suggest activities to be carried out.

The project resulted in a document that provided a "roadmap" for Jordan to follow in developing a formal drought plan. As the national drought planning process continues, project leaders have recommended that the steering committee be transformed into a permanent National Drought Task Force with, perhaps, an even greater diversity of members.

Sources: Wilhite (2005) and Bazza (2006)

Step 3. Fostering Involvement and Developing Common Understandings

Social, economic, and environmental values often clash as competition for scarce water resources intensifies. This is especially true in the case of drought that affects a wide range of sectors. Therefore, it is essential for task force members to identify citizen groups that have a stake in drought planning (stakeholders) and their interests.

Whenever possible, these groups should be involved early and continuously in a drought planning process to develop a planning "community", enable fair representation, and foster effective drought management and planning. Airing concerns early in the process gives participants a chance to develop understanding of one another's various viewpoints, and to generate collaborative solutions. Although the level of involvement of stakeholders will vary notably from country to country, the power of public interest groups in policy making can sometimes be considerable.

A series of stakeholder meetings is usually necessary to build a common understanding on drought issues and foster project unity and involvement. For example, a national drought planning workshop was held in Amman, Jordan, in 2007 to bring together national ministries and organizations to make suggestions on the development of a drought planning framework for Jordan (Wilhite, 2007). This workshop helped educate participants on the drought planning process and allowed stakeholders groups to ask questions about the process and suggest ways they could participate.

Similarly, during recent national drought efforts in Iran from 2004 to 2006, planners implemented a combination of strategies to foster project understanding and unity. First, field visits were made to drought-affected provinces to assess the extent of impacts, learn stakeholders' perceptions of current drought management strategies, and hold training seminars to explain the project objectives and expectations and the necessity of moving toward proactive drought risk reduction strategies. Then, visits were made to several universities and research centers that play a role in drought management throughout the country. The interactions provided an opportunity for two-way information flow about the project and drought management issues, which helped clarify the objectives of the drought planning project and build support for the initiative.

South Africa provides another example of how local stakeholders can be incorporated into national planning efforts. The country has invested a great deal of time and effort into developing a cohesive national drought policy. These efforts were accelerated by the creation of the National Consultative Forum on Drought in 1992, which was composed of representatives of government, church organizations, trade unions, and NGOs (Wilhite, 2003). The Forum led to a shift from an exclusive emphasis on commercial farmers to a more comprehensive program that includes rural farmers, rural poor and farm workers. The inclusion of additional stakeholders led to policy changes that included greater equity for recipients of assistance.

Another method to facilitate public participation is to establish a citizen's advisory council as a permanent feature of the drought plan. This panel could help the drought task force keep information flowing and resolve conflicts between stakeholders. District or regional councils could also be a possibility to help formulate regional strategies.

Step 4. Investigating Drought Monitoring, Risk, and Management Options

A drought plan requires at least three components: (1) monitoring and early warning; (2) risk assessment; and (3) risk management options. Committees or other similar groups (e.g., sub-groups within an agency) should be established to focus on these needs. A drought monitoring committee will cover monitoring and early warning issues, while a risk assessment committee will evaluate risk and potential management options. However, of course, the drought task force will, in most instances, decide on the final management actions to be implemented. The suggested organizational structure for the plan is illustrated in Figure 4.

The committees will have their own tasks and goals, but well-established communication and information flow between committees and the task force is necessary to ensure effective planning.

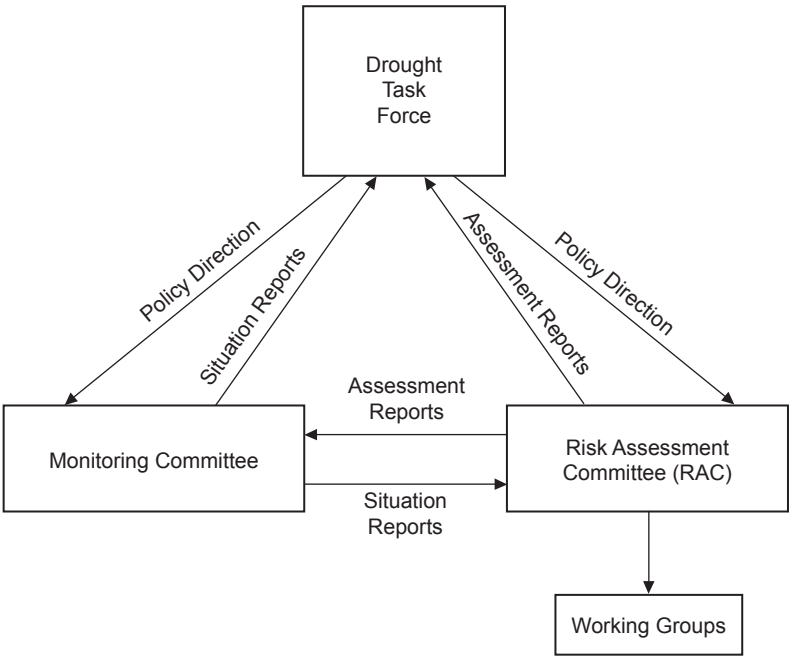

Figure 4. Drought Task Force organizational structure (Source: National Drought Mitigation Center, University of Nebraska-Lincoln)

A. Monitoring and Early Warning Committee

1. Committee Organization

A reliable assessment of water availability and its outlook for the near- and long-term is valuable information in both dry and wet periods. During drought, the value of this information increases markedly.

The monitoring committee should include representatives from agencies with responsibilities for monitoring climate and water supply. Data and information on each of the applicable indicators (e.g., precipitation, temperature, evapotranspiration, seasonal climate forecasts, soil moisture, streamflow, ground water levels, reservoir and lake levels, and snowpack) should be considered in the committee's evaluation of the water situation and outlook. The agencies responsible for collecting, analyzing, and disseminating data and information will vary considerably from country to country and province to province.

In some cases, specialized units are formed to provide monitoring and early warning functions. For example, the government of Morocco established a National Drought Observatory in 2001 with the goal of collecting, analyzing, and delivering drought-related information in a timely manner (Oweis, 2002). This includes assessing the frequency, severity, and extent of droughts, as well as their various effects on crop, livestock, environment, and living conditions of rural populations using objective, measurable scientific criteria.

Similarly, a food security and drought early warning unit is being established within the Jordanian National Center for Agricultural Research and Technology Transfer (NCARTT), with support from the World Food Programme (Wilhite, 2007; WFP, 2008). As part of this activity, WFP is providing equipment and training to NCARTT to help it effectively monitor drought and food insecurity risks. According to the report *Framework for a National Strategy and Action Plan for Drought Management - Hashemite Kingdom of Jordan,* released by the FAO in 2007 (Wilhite, 2007), NCARTT is expected to lead a national drought monitoring and early warning committee, and establish a memorandum of understanding with the Jordan Ministry of Agriculture, the Meteorological Department, the Royal Jordanian Geographical Center, and other appropriate ministries and organizations to ensure information sharing for drought monitoring and early warning activities. Products from this early warning system would then be released through the drought early warning unit at NCARTT, with proper credit given to all participating ministries and units.

Regardless of the groups or agencies chosen to participate in the drought monitoring and early warning committee, it should meet regularly, especially in advance of the peak demand season. Following each meeting, reports should be prepared and disseminated to the drought task force, relevant government agencies, and the media. The chairperson of the monitoring committee should be a permanent member of the drought task force. If conditions warrant, the task force should brief the appropriate senior-ranking government official about the contents of the report, including any recommendations for specific actions.

The public must receive a balanced interpretation of changing conditions. The monitoring committee should work closely with public information specialists to keep the public well informed.

2. Committee Objectives

The primary objectives of the monitoring and early warning committee, summarized in Box 7, are to:

A. Establish drought management areas; that is, subdivide the province or region into more conveniently sized districts by political boundaries, shared hydrological characteristics, climatological characteristics, or other means such as drought probability

Box 7. Objectives of a Drought Monitoring Committee

The drought monitoring committee will include representatives from agencies with responsibilities for monitoring climate and water supply, and will provide periodic updates and outlooks on drought occurrence. The primary objectives of the monitoring committee are to:

1) Establish drought management areas, which are convenient for regionalizing drought monitoring and management
2) Inventory data quantity and quality from current observation networks
3) Determine the data needs of primary users
4) Adopt a workable definition of drought that could be used to phase in and phase out levels of local, state, or federal actions in response to drought (e.g., establish drought triggers)
5) Develop a drought monitoring system to track drought conditions and provide early warning information
6) Develop or modify current data and information delivery systems to ensure useful dissemination of drought early warning information

or risk. These subdivisions may be useful in drought management because they may allow drought stages and mitigation and response options to be regionalized.

B. Inventory data quantity and quality from current observation networks. Many networks monitor key elements of the hydrologic system. Most of these networks are operated by federal or provincial agencies, but other networks also exist and may provide critical information for a portion of a province or region.

Meteorological data are important but represent only one part of a comprehensive monitoring system. The other physical indicators (soil moisture, streamflow, reservoir and groundwater levels) must be monitored to reflect impacts of drought on agriculture, households, industry, energy production, transportation, recreation and tourism, and other water users.

C. Determine the data needs of primary users. Developing new or modifying existing data collection systems is most effective when the people who will be using the data are consulted early and often. Soliciting input on expected new products or obtaining feedback on existing products is critical to ensuring that products meet the needs of primary users and, therefore, will be used in decision making. Training on how to use or apply products in routine decision making is also essential.

D. Adopt a workable definition of drought that could be used to phase in and phase out levels of local state or provincial and federal actions in response to drought. The group may need to adopt more than one definition of drought in identifying impacts in various economic, social, and environmental sectors because no single definition of drought applies in all cases. Several indices are available (Table 2), including the Standardized Precipitation Index (McKee et al., 1993, 1995), which is gaining widespread acceptance (Guttman, 1998; Hayes et al., 1999; also see http://drought.unl.edu/whatis/indices.htm).

The trend is to rely on multiple drought indices to trigger mitigation and response actions, which are calibrated to various intensities of drought. The current thought is that no single index of drought is adequate to measure the complex interrelationships between the various components of the hydrological cycle and impacts.

It is helpful to establish a sequence of descriptive terms for water supply alert levels, such as "Advisory," "Alert," "Alarm" and "Emergency," (as opposed to more generic terms such as "phase 1" and "phase 2," or sensational terms such as "disaster"). Review the terminology used by other entities (i.e., local utilities, provinces, river basin authorities) and choose

Table 2. Summary of common drought indices (Tsakiris et al., 2005, Hayes 2008)

Index	Description and Use	Strengths	Weaknesses
Meteorological Drought Indices			
Percent of Normal Precipitation and Accumulated	Simple calculation Used by general audiences	Effective for comparing a single region or season	Precipitation does not have a normal distribution Values depend on location and season
Deciles Gibbs and Maher (1967)	Simple calculation grouping precipitation into deciles Used by Australian Drought Watch System	Accurate statistical measurement Simple calculation Provides uniformity in drought calculations	Accurate calculations require a long climatic data record
Standardized Precipitation Index (SPI) McKee et al. (1993)	Based on the probability of precipitation for any time scale. Used by many drought planners	Compute for different time scales, provides early warning of drought and helps assess drought severity	Value based on preliminary data that may change Precipitation is the only parameter used May be less useful during short-term, low rainfall periods
Palmer Drought Severity Index (PDSI) Palmer (1965) Alley (1984)	Soil moisture algorithm calibrated for relatively homogenous regions	The first comprehensive drought index, used widely Very effective for agricultural drought since it includes soil moisture	PDSI may lag emerging droughts. Less well suited for mountainous areas of frequent climate extremes Complex Categories not necessarily consistent, in terms of probability of occurrence, spatially or temporally
Reconnaissance Drought Index (RDI) Tsakiris (2004)	Similar to SPI Basic variable P/PET	Drought is based on both precipitation and potential evapotranspiration Appropriate for climate change scenarios	Data needed for calculation of PET
Hydrologic Drought Indices			
Palmer Hydrological Drought Index (PHDI)	Same as PDSI but more exigent to consider a drought end. The drought terminates only when the ratio of Pe (moisture received to moisture required) is 1	Same as PDSI	Same as PDSI
Surface Water Supply Index (SWSI) Shafer and Dezman (1982)	Developed from the Palmer Index to take into account the mountain snowpack	Represents surface water supply conditions and includes water management Simple calculation Combines hydrological and climatic features. Considers reservoir storage.	Management dependent and unique to each basin, which limits inter-basin comparisons Does not represent extreme events well

terms that are consistent so as not to confuse the public with different terms in areas where there may be authorities with overlapping regional responsibilities. These alert levels should be defined in discussions with both the risk assessment committee and the task force.

In considering emergency measures such as rationing, remember that the impacts of drought may vary significantly from one area to the next, depending on the sources and uses of water and the degree of planning previously implemented. For example, some cities may have recently expanded their water supply capacity while other adjacent communities may have an inadequate water supply capacity during periods of drought. Imposing general emergency measures on people or communities without regard for their existing vulnerability may result in political repercussions and loss of credibility.

A related consideration is that some municipal water systems may be out of date or in poor operating condition, so that even moderate drought strains a community's ability to supply customers with water. Identifying inadequate (i.e., vulnerable) water supply systems and upgrading those systems should be part of a long-term drought mitigation program.

E. Develop a drought monitoring system. The quality of meteorological and hydrological networks is highly variable from country to country and region to region within countries. Responsibility for collecting, analyzing, and disseminating data is divided between many government authorities. The monitoring committee's challenge is to coordinate and integrate the analysis so decision makers and the public receive early warning of emerging drought conditions.

Considerable experience has developed in recent years with automated weather data networks that provide rapid access to climate data. These networks can be invaluable in monitoring emerging and ongoing drought conditions. Investigate the experiences of regions with comprehensive automated meteorological and hydrological networks and apply their lessons learned, where appropriate.

In some cases, social indicators of drought are also an important source of monitoring information. Proxy indicators, such as increasing cereal prices, increased livestock sales or movements, human migrations, etc., could supplement other observational monitoring networks.

F. Develop or modify current data and information delivery systems. People need to be warned of drought as soon as it is detected, but often they are not. Information needs to reach people in time for them to use it in making decisions. In establishing information channels, the monitoring committee needs to consider when people need what kinds of information. These decision points can determine whether the information provided is used or ignored.

Syria is one country that has developed has developed a useful drought monitoring and early warning system for its rangelands (Box 8). The Food and Agriculture Organization of the United Nations worked with the government of Syria from 2004 to 2006 to develop an effective drought monitoring and early warning system for the Syrian rangelands. As a result, an early warning system office and a steering committee were organized; a series of drought indicators were identified; systems were implemented for the collection, organization, and processing of drought monitoring data (physical and social data); monthly drought bulletins have been produced regularly since 2005 in both English and Arabic; and the technical capacity to operate a drought warning system in Syria was successfully developed.

However, recent scientific reviews have concluded that most countries in the Near East Region do not have well-functioning drought monitoring systems (De Pauw, 2000 and 2005). Even though the meteorological networks in most Near East countries are adequate and well equipped, they are poorly prepared to function effectively as drought monitoring or early warning systems because of inadequate analytical tools required for drought monitoring, unsuitable information products, and insufficient data sharing.

Box 8. Drought Early Warning System for Syrian Rangelands

The Food and Agriculture Organization of the United Nations worked with the government of Syria from 2004 to 2006 to develop an effective drought monitoring and early warning system for the Syrian Badia (i.e., rangelands). Specifically, a project office for the early warning system was established within the Rain Enhancement Project (REP) of the Ministry of Agriculture and Agrarian Reform (MAAR), and a field office was established in the Talila Project offices in Palmyra. In consultation with local communities and with reference to similar work in other countries, a series of drought indicators were selected to provide information on changes in the environments, rural economy and human welfare. The indicators and means used for monitoring are shown in Table 3.

Table 3. Drought indicators and means of monitoring in Syria (Source: FAO 2006, 2007b)

INDICATOR GROUP	INDICATORS	MEANS OF MONITORING
Those signaling changes in the environment	Rainfall	Rain gauges
	Water supplies (domestic, livestock)	Household surveys
	Vegetation cover/greenness	Satellite imagery (NDVI)
	Adequacy of grazing	Household surveys
Those signaling changes in the rural economy as well as changes in the environment	Livestock: flock sizes births & deaths sales & slaughter distribution animal condition milk production feed supplementation	Household surveys
	Domestic economy: expenditure on food expenditure on feed extent of borrowing /debt sale of assets	Household surveys
Those signaling changes in human welfare	household size births, deaths movements in/out nutrition & health (especially children)	Household surveys

Based on these indicators, a system of drought status classification was developed, which recognizes 4 stages of drought:

ADVISORY Indicators remain generally within the expected seasonal ranges

ALERT Marked negative changes in environmental indicators, cumulative rainfall <70% of mean, and/or an unusually low asset status due to previous losses

ALARM Marked negative changes in environmental and rural economy indicators and/or cumulative rainfall <50 of mean

EMERGENCY Strongly negative changes in environmental, economic, and human welfare indicators prevail

Several projects were undertaken to gather the drought indicator data. For example, a sampling framework for household surveys was developed based on a 2% sample size of households with flocks of approximately 10-100 head. The flock size limits were chosen in order to concentrate on poorer herders but exclude those not primarily dependent upon livestock. Approximately 365 households, in 22 communities, across 6 of the 9 rangeland provinces were sampled in monthly household surveys. A customized database management system was also developed in Microsoft Access and SPSS for entering, processing, analyzing and summarizing the survey data.

For rainfall data, a database containing 25 years of monthly rainfall data for 144 rainfall stations across the country was established. Of these, only 20 stations are in the Badia, which occupies 55% of the country, hence the project established 12 additional stations within the Badia. Rainfall data are analyzed to provide monthly totals of cumulative rainfall in the current season expressed as a percentage of the long-term cumulative average for the same period.

Based on this information, monthly drought bulletins have been produced regularly since June 2005 in both English and Arabic. The front page shows the drought status in each province of the Badia, a map of cumulative rainfall expressed as a percentage of the long-term mean for the same period overlaid by provincial boundaries, and an NDVI map for Syria also overlaid by provincial boundaries. The inside pages carry a situation overview followed by more detailed information on drought status and trends in different parts of the Badia, as determined from the early warning indicators. Finally, there are recommendations for intervention, where considered necessary.

This problem is not unique to the Near East. As stated by the World Meteorological Organization (2006), some of the most pressing challenges in developing early warning systems around the world include:

- enhancing data quality and collection network densities,
- reducing the cost and increasing the sharing of data,
- making early warning information more accurate and user friendly,
- integrating physical and social drought indicators into systematic and comprehensive monitoring and early warning systems, and
- providing support to create and maintain systems.

These issues must be addressed for the development of effective early warning systems. These systems are essential for providing a better understanding of drought occurrence and also for triggering proactive mitigation and response actions to reduce the effects of drought before it becomes a disaster.

B. Risk Assessment Committee

Many people perceive drought to be largely a natural or physical event. In reality, drought, like other natural hazards, has both a natural and social component. The risk associated with drought for any region is a product of both the region's exposure to the event and the vulnerability of society. That is, the threat of harm from drought is based on a combination of the frequency, duration, and severity of drought events experienced and the susceptibility of people or activities to the negative effects associated with drought. Some regions, people, and activities are more likely to be at risk for a variety of reasons. Therefore, drought risk is explained by the equation:

Drought Risk = Hazard x Vulnerability

Exposure to drought varies regionally and there is little, if anything, we can do to reduce the recurrence, frequency, or incidence of precipitation shortfalls. However, measures can be taken to reduce our vulnerability to drought events.

The drought monitoring committee can provide information on the regional occurrence of drought, but it is the responsibility of the risk assessment committee to ask questions about *who* and *what* are vulnerable to drought and *why*, and identify a range of potential options to reduce these vulnerabilities.

The membership of the risk assessment committee should include representatives of economic sectors, social groups, and ecosystems most at risk from drought. The committee's chairperson should be a member of the drought task force. Experience has demonstrated that the most effective approach to follow in determining vulnerability to and impacts of drought is to create a series of working groups under the aegis of the risk assessment committee.

The number of working groups will vary considerably between countries or provinces, reflecting the principal impact sectors. The more complex the economy and society, the larger the number of working groups will be necessary to reflect these sectors. Working groups may focus on some combination of the following sectors: agriculture, recreation and tourism, industry, commerce, drinking water supplies, energy, environment, wildfire protection, and health.

The responsibility of the committee and working groups is to assess sectors, population groups, and ecosystems most at risk and identify appropriate and reasonable measures to address these risks. Working groups would be composed of technical specialists representing those areas referred to above. The chair of each working group, as a member of the risk assessment committee, would report directly to the committee. Following this model, the responsibility of the risk assessment committee is to direct the activities of each of the working groups and make recommendations to the drought task force on actions that can be taken to reduce drought risk.

Once the risk assessment committee organizes the working groups, each of these groups should assess relevant drought impacts, vulnerabilities, and management options, as shown in Box 9.

Task 1: Conduct a Drought Impact Assessment

Conducting a drought impact assessment is a good place to begin when investigating populations and activities at risk from drought. An impact assessment examines the consequences of a given event or change. For example, drought is typically associated with a number of outcomes. Drought impact assessments begin by identifying direct consequences of the drought, such as reduced crop yields, livestock losses, and reservoir depletion. These

Box 9. Tasks to Complete as Part of a Drought Risk Assessment

Task 1: Conduct a Drought Impact Assessment

Task 2: Rank the Most Pressing Impacts

Task 3: Conduct a Vulnerability Assessment

Task 4: Identify Risk Management Options

Task 5: Prioritize Risk Management Options

direct outcomes can then be traced to secondary consequences (often social effects), such as the forced sale of household assets or land, dislocation, or physical and emotional stress. This initial assessment identifies drought impacts but does not identify the underlying reasons for these impacts.

Drought impacts can be classified as economic, environmental, or social, although many impacts may span more than one sector. Table 4 provides a checklist of many potential impacts that could affect a region or location. To perform an assessment using the checklist, members of the relevant committee would check the box in front of each drought impact that applies to their study area. Depending on the kind of event chosen as the basis for the impact reduction strategy, the checklist selections can be based on either common or extreme droughts, or a combination of the two. For example, many planners find it useful to identify the "drought of record" (the worst ever recorded), examining its actual effects and projecting what the effects would be if the same drought were to occur at the present time and/or the near future. Impacts could also be investigated under anticipated climate change scenarios.

If enough time, money, and personnel are available, it may be beneficial to conduct impact studies based on common droughts, extreme drought(s), and the "drought of record" for your region. These analyses would yield a range of impacts related to the severity of drought. In addition, by highlighting past, current, and potential impacts, trends may become evident that will also be useful for planning purposes. These impacts highlight sectors, populations, or activities that are vulnerable to drought, and when evaluated with the probability of drought occurrence, identify varying levels of drought risk.

To assist in tracking drought-related impacts over time and better understanding their occurrence, it is beneficial to develop a drought impact tracking and archival system. For example, the National Drought Mitigation Center in the United States has created the "Drought Impact Reporter" (http://droughtreporter.unl.edu/), which is a searchable database of news stories and other reports on the effects of drought across the country.

Similarly, Syria, as part of its rangelands early warning system, has created a drought impact reporting system in which community members in rural areas are trained to monitor drought-related impacts. The impact information is then submitted to a national depository, where it is entered into a Microsoft Access and SPSS database for entering, processing, analyzing, and summarizing the impact data (FAO, 2004 and 2007b). This type of archive is essential to track and document the effects of drought over time, since these impacts are the symptoms of underlying vulnerabilities.

Task 2: Rank the Most Pressing Impacts

After each working group has completed the checklist in Table 4, the unchecked impacts can be omitted. This new list will contain the relevant drought impacts for your location or activity. From this list, prioritize impacts according to what work group members consider to be the most important. To be effective and equitable, the ranking should consider concerns such as cost, areal extent, trends over time, public opinion, fairness, and the ability of the affected area to recover.

Be aware that social and environmental impacts are often difficult, if not impossible, to quantify. Each work group should complete a preliminary ranking of impacts. The drought task force and other work groups can participate in a plenary discussion of these rankings following the initial ranking iterations. A matrix (see an example in Table 5) may be helpful to help prioritize impacts. From this list of prioritized impacts, each working group should decide which impacts should be addressed and which can be deferred.

Table 4. Economic, social, and environmental impacts commonly associated with drought. (Source: National Drought Mitigation Center, University of Nebraska-Lincoln, USA)

H = Historical Drought; C = Current Drought; P = Potential Drought

H	C	P	**Economic:**
G	G	G	Annual and perennial crop losses
G	G	G	Damage to crop quality
G	G	G	Income loss for farmers due to reduced crop yields
G	G	G	Reduced productivity of cropland (wind erosion, loss of organic matter, etc.)
G	G	G	Insect infestation
G	G	G	Plant disease
G	G	G	Wildlife damage to crops
G	G	G	Increased irrigation costs
G	G	G	Cost of new or supplemental water resource development (wells, dams, pipelines)
G	G	G	Reduced productivity of rangeland
G	G	G	Reduced milk production
G	G	G	Forced reduction of foundation stock
G	G	G	Closure/limitation of public lands to grazing
G	G	G	High cost/unavailability of water for livestock
G	G	G	Cost of new or supplemental water resource development (wells, dams, pipelines)
G	G	G	High cost/unavailability of feed for livestock
G	G	G	Increased feed transportation costs
G	G	G	High livestock mortality rates
G	G	G	Disruption of reproduction cycles (delayed breeding, more miscarriages)
G	G	G	Decreased stock weights
G	G	G	Increased predation
G	G	G	Range fires
G	G	G	Wildland fires
G	G	G	Tree disease
G	G	G	Insect infestation
G	G	G	Impaired productivity of forest land
G	G	G	Direct loss of trees, especially young ones
G	G	G	Damage to fish habitat
G	G	G	Loss of fish and other aquatic organisms due to decreased flows
G	G	G	Decreased land prices
G	G	G	Loss to industries directly dependent on agricultural production (e.g., machinery and fertilizer manufacturers, food processors, dairies, etc.)
G	G	G	Unemployment from drought-related declines in production
G	G	G	Strain on financial institutions (foreclosures, more credit risk, capital shortfalls)
G	G	G	Revenue losses to federal, state, and local governments (from reduced tax base)
G	G	G	Reduction of economic development
G	G	G	Fewer agricultural producers (due to bankruptcies, new occupations)
G	G	G	Rural population loss
G	G	G	Loss to manufacturers and sellers of recreational equipment
G	G	G	Losses related to curtailed activities: hunting and fishing, bird watching, boating)
G	G	G	Increased energy demand and reduced supply because of drought-related power curtailments
G	G	G	Costs to energy industry and consumers associated with substituting more expensive fuels (oil) for hydroelectric power
G	G	G	Revenue shortfalls and/or windfall profits
G	G	G	Cost of water transport or transfer
G	G	G	Cost of new or supplemental water resource development
G	G	G	Loss from impaired navigability of streams, rivers and canals
G	G	G	Increase in food prices
G	G	G	Increased importation of food (higher costs)

H C P	**Environmental:**
G G G	Reduction and degradation of fish and wildlife habitat
G G G	Lack of feed and drinking water
G G G	Greater mortality due to increased contact with agricultural producers, as animals seek food from farms and producers are less tolerant of the intrusion
G G G	Disease
G G G	Increased vulnerability to predation (from species concentrated near water)
G G G	Migration and concentration (loss or overabundance of wildlife)
G G G	Increased stress to endangered species
G G G	Loss of biodiversity
G G G	Lower water levels in reservoirs, lakes, and ponds
G G G	Reduced flow from springs
G G G	Reduced streamflow
G G G	Loss of wetlands
G G G	Estuarine impacts (e.g., changes in salinity levels)
G G G	Increased groundwater depletion, land subsidence, reduced recharge
G G G	Water quality effects (e.g., salt concentration, increased water temperature, pH, dissolved oxygen, turbidity)
G G G	Loss of biodiversity
G G G	Loss of trees from urban landscapes, shelterbelts, wooded conservation areas
G G G	Increased number and severity of fires
G G G	Wind and water erosion of soils, reduced soil quality
G G G	Air quality effects (e.g., dust, pollutants)
G G G	Visual and landscape quality (e.g., dust, vegetative cover, etc.)
H C P	**Social:**
G G G	Mental and physical stress (e.g., anxiety, depression, domestic violence)
G G G	Health-related low-flow problems (e.g., contamination, diminished sewage flows, increased pollutant concentrations, reduced fire fighting capability, etc.)
G G G	Reductions in nutrition (e.g., high-cost food limitations, dietary deficiencies)
G G G	Loss of human life (e.g., from heat stress, suicides)
G G G	Public safety from forest and range fires
G G G	Increased respiratory ailments
G G G	Increased disease caused by wildlife concentrations
G G G	Water user conflicts
G G G	Political conflicts
G G G	Management conflicts
G G G	Other social conflicts (e.g., scientific, media-based)
G G G	In rural areas
G G G	In specific urban areas
G G G	Population migrations (rural to urban areas, migrants into the United States)
G G G	Loss of aesthetic values
G G G	Disruption of cultural belief systems (e.g., religious views of natural hazards)
G G G	Reevaluation of social values (e.g., priorities, needs, rights)
G G G	Public dissatisfaction with government drought response
G G G	Perceptions of inequity in relief, possibly related to socioeconomic status, ethnicity, age, gender, seniority
G G G	Loss of cultural sites
G G G	Increased data/information needs, coordination of dissemination activities
G G G	Recognition of institutional restraints on water use

This checklist of drought's effects can help planners anticipate problems that might arise in future droughts. Many planners find it useful to identify the "drought of record" (the worst ever recorded), examining its actual effects and projecting what the effects would be if the same drought were to occur under current conditions and in the future.

If enough time, money, and personnel are available, it might be useful to conduct impact studies based on common droughts, extreme drought(s), and the "drought of record" for your region. This would yield a range of impacts related to different degrees of severity.

Table 5. Drought Impact Decision Matrix

Impact Description	Cost?	Equally Distributed?	Growing Problem?	Public Priority?	Equitable Recovery?	Impact Rank

Task 3: Conduct a Vulnerability Assessment

Vulnerability assessment provides a framework for identifying the social, economic, and environmental causes of drought impacts. It bridges the gap between impact assessment and policy formulation by directing attention to the underlying causes of vulnerability rather than the result, the negative impacts, which follow triggering events such as drought (Ribot, 1996).

For example, the direct impact of precipitation deficiencies may be a reduction of crop yields. However, there may be other underlying vulnerabilities that also contribute to crop losses, such as farmers planting inappropriate crop types. Irrigation may also be under- or over-utilized in the region, reducing supplemental water availability. Another example could be farm foreclosure. The underlying causes of this vulnerability might include a lack of credit for diversification options, farming on marginal lands, limited knowledge of possible farming options, a lack of local industry for off-farm supplemental income, or government policies.

Linking climate-associated impacts to causality, vulnerability analysis can provide a sound basis for policy since it is through responding to the causes of impacts that vulnerability can be effectively reduced (Ribot, 1996). A clear understanding of local drought-related impacts and underlying vulnerabilities, and how they are changing over time, is critical for making decisions about which mitigation and response actions should be implemented (Blaikie et al., 1994; Cutter, 1996).

Therefore, for each of the prioritized impacts from Table 4, begin asking why these impacts have occurred or might occur. Begin tracing outward from each impact the multiple environmental, social, and economic underlying factors that contribute to the resulting impact (Ribot, 1996). In this type of process, climatic events are placed among the many relationships that accentuate the negative consequences of drought. There are many ways to illustrate these causal linkages, such as impact tree diagrams, scenario building, or “brainstorming” sessions (Knutson et al., 1998; Hayes et al., 2004).

Figure 5 demonstrates a typical agricultural impact tree diagram. Depending on the level of analysis, this process can quickly become somewhat complicated, which is why working groups must be composed of the appropriate mix of people. The tree diagram illustrates the complexity of understanding drought impacts. The example provided is not meant to be comprehensive or represent an actual location. Its main purpose is to demonstrate that impacts must be examined from several perspectives to expose their true underlying causes. For this assessment, the lowest causes on the tree diagram, the items in boldface, will be referred to as basal causes. These basal causes are the items that have the potential to be acted on to reduce the associated impact. Of course, some of these impact causes should not or cannot be acted on for a wide variety of reasons, as will be discussed in Tasks 4 and 5.

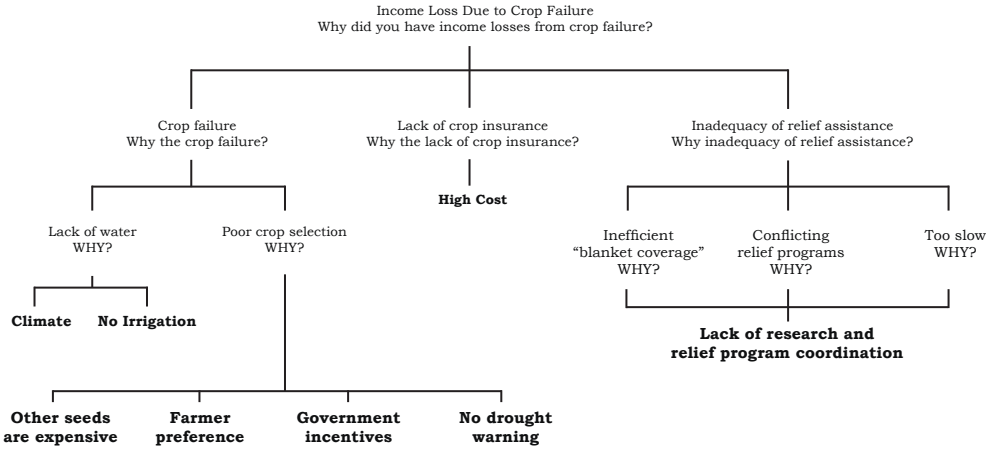

Figure 5. An example of a simplified agricultural impact tree diagram. Notice the boldface items represent the underlying causes of the listed impact. Although these items may be broken down further, this example illustrates the vulnerability assessment process (Source: National Drought Mitigation Center, USA).

The United Nations Economic and Social Commission for Western Asia (ESCWA) recently undertook research to better understand drought vulnerabilities in the region (see Box 10). The study focused on identifying indicators and mapping socio-economic drought vulnerability, and proposing guidelines and recommendations for including socio-economic concerns in drought preparedness and mitigation activities in the region. In general, the studies found a lack of understanding and awareness of drought and its impacts, as well as a capacity to mitigate it, in West Asia.

The Food and Agriculture Organization of the United Nations Near East Regional Office also helped the countries of Iran and Jordan to better understand drought impacts and vulnerabilities (FAO, 2006 and 2007c). As part of these projects, FAO commissioned a series of consultants' reports in each country to investigate the range of drought impacts and vulnerabilities in the respective regions. These studies provided insights that were essential for developing and targeting drought mitigation and response actions to be carried out by the governments of Jordan and Iran.

In response to the 2000-2001 drought in Central Asia and the Caucasus, the Canadian International Development Agency, under the Canada Climate Change Development Fund, also supported research and analysis by the World Bank to better understand the impacts of drought and needs and capabilities in its management and mitigation (see http://go.worldbank.org/8J56VSUEZ0). The effort resulted in two studies and reports that outlined drought occurrence, impacts, vulnerabilities, climate change scenarios, and potential drought management strategies in several Asian countries, including Azerbaijan, Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan (World Bank, 2005 and 2006).

Other resources for gathering information on vulnerable populations in the Near East Region, particularly in regard to famine, include programs such as the Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS - www.fivims.net), the World Food Programme's Vulnerability Analysis and Mapping system (VAM - http://vam.wfp.org/), and the Food and Agriculture Organization of the United Nations food security system (faostat.fao.org) (UN/ISDR, 2007).

Box 10. United Nations Economic and Social Commission for Western Asia Drought Vulnerability Assessment

The United Nations Economic and Social Commission for Western Asia recently undertook research to better understand the vulnerability of the region to drought (ESCWA, 2005). Seeing a need for more research and information on water development and drought, the ESCWA secretariat initiated a series of development reports focused on water resources in the region from 2004 to 2005. The study focused on examining the various components of socio-economic drought and identifying indicators and mapping socio-economic drought vulnerability in the ESCWA region, and proposed guidelines and recommendations for including socio-economic concerns in drought preparedness and mitigation activities in the region.

The study utilized three case studies (i.e., Jordan, the Syrian Arab Republic, and Yemen) to investigate drought vulnerability and how countries in the region are currently mitigating and managing drought. For each country, the study investigated climatic, water resource, agricultural, environmental, and socio-economic vulnerabilities, and drought early warning and mitigation strategies. In general, the studies found that there is a lack of understanding and awareness in terms of drought and its impacts, as well as a capacity to mitigate it, in the ESCWA region. The researchers recommended that efforts should be enhanced to build institutional and technical capacity, harmonize and monitor socio-economic drought methodologies and indicators, monitor drought and conduct regional vulnerability assessments, and reduce vulnerability through integrated policy planning.

Source: United Nations Economic and Social Commission for Western Asia (ESCWA) (2005)

FIVIMS are networks of national information systems that assemble, analyze, and disseminate data on food insecurity and vulnerability. VAM uses a wide variety of technological sources and analytical methods (e.g., satellite imagery and spatial analysis, monitoring of food prices, household surveys) to understand the nature of food insecurity and the risks to livelihoods. The Food and Agriculture Organization of the United Nations also supplies food security statistics and maps.

This information and reports from other government agencies and NGOs (e.g., ReliefWeb, International Federation of Red Cross and Red Crescent Societies, etc.) are essential for analyzing drought impacts and vulnerabilities and helping decision makers target mitigation and response actions that will help address the true underlying causes of drought impacts.

Task 4. Identify Risk Management Options

Once there is a good understanding of drought occurrence, impacts, and vulnerabilities, risk management options can be investigated. These management options should focus on reducing the impacts and vulnerabilities identified during the previous steps. Several categories of drought risk reduction actions can be implemented before, during, and after drought. The categories include mitigation, preparedness, response, and recovery measures (see Box 11 for definitions).

In the past, government efforts have been biased toward implementing drought response efforts. Although often beneficial, they fail to reduce the long-term risk of drought when implemented in isolation from other measures. The new paradigm of drought risk management focuses on increasing the implementation of drought preparedness and mitigation measures, so that the need for response and recovery measures will be reduced.

Box 11. Typology of Drought Risk Management Measures

Drought preparedness is defined as established policies and specified plans and activities taken before drought to prepare people and enhance institutional and coping capacities, to forecast or warn of approaching dangers, and to ensure coordinated and effective response in a drought situation (contingency planning)

Drought mitigation refers to any structural/physical measures (e.g., appropriate crops, sand dams, engineering projects) or non-structural measures (e.g., policies, awareness, knowledge development, public commitment, and operating practices) undertaken to limit the adverse impacts of drought

Drought response efforts include the provision of assistance or intervention during or immediately after a drought disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration

Drought recovery measures are decisions and actions taken after a drought with a view to restoring or improving the pre-drought living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce drought risk

Source: UN/ISDR Terminology of Disaster Risk Reduction (http://www.unisdr.org/)

Table 6 shows a matrix of the types of drought risk reduction measures and the relevant stakeholders that are responsible for implementing the actions. Planners should consider how to develop a balanced distribution of drought risk reduction measures and responsibilities across the range of themes and actors.

This would include determining which actions are to be taken before drought to build long-term resilience to drought, during drought situations to respond to immediate needs, and during the drought recovery process, or which actions are to be taken during each of the drought declaration stages outline in a drought plan (e.g., advisory, alert, and emergency stages).

The following sequence of questions may be helpful in identifying potential actions:

- Can the vulnerability be addressed before drought strikes to reduce the likelihood of harm (are preparedness or mitigation actions appropriate)? If yes, then how?
- Can the vulnerability and/or impacts be addressed during a drought (are response and recovery options appropriate)? If so, then how?
- Are there some vulnerabilities, or aspects of vulnerabilities, that cannot be modified and must be accepted as a drought-related risk for this activity or area?

Table 6. Matrix of drought risk reduction measures and responsible stakeholders
Source: Modified from Davies (2000)

Stages	Actors					
	Micro		Meso		Macro	
	Individuals and Households	Community Institutions	District or Provincial Government	NGOs	National Government	International Donors
Preparedness						
Mitigation						
Response						
Recovery						

Task 5. Prioritize Risk Management Options

After each group identifies a list of potential management actions, the next step is to select the sequence of actions to take as part of the risk reduction planning exercise.

The selection of the appropriate combination of drought risk reduction measures must be evaluated in the context of numerous constraints: time, financial and personnel resources, geography, feasibility, the level and nature of development and vulnerability, legality, public acceptance, and liability. In general, choices must be realistic, as well as socially and environmentally appropriate. The activities must also take place on a scale that is meaningful to those who must act, whether at the national, regional, or local level. In choosing the appropriate actions, you may want to ask some of the following questions:

- What are the cost/benefit ratios for the actions identified?
- Which actions do the general public consider feasible and appropriate?
- Which actions are sensitive to the local environment (i.e., sustainable practices)?
- Do the actions address the right combination of causes to adequately reduce the relevant impact?
- Do the actions address short- and long-term solutions?
- Which actions would fairly represent the needs of affected individuals and groups?

This process has the potential to lead to the identification of effective and appropriate drought risk reduction activities that may reduce future drought impacts.

For example, from 2004 to 2005, the Canadian International Development Agency, World Bank, and national stakeholders in Central Asia and the Caucasus investigated potential drought mitigation actions that could be implemented to reduce drought risk in the region (see http://www.worldbank.org/eca/drought). As a result of this process, planners in Tajikistan proposed a wide range of mitigation strategies that could reduce the country's drought risk. These priority actions, shown in Box 12, were selected in accordance with their advantages for development, cost-effectiveness, advisability and reliability, market potential, socio-economic significance, and their potential for reducing unfavorable drought-related impacts in the future.

Box 12. Potential Drought Mitigation Actions in Tajikistan

1. Improvement of RT Law "On legal regime of state of emergency" (1999)
2. Development of National Program of Hydrometeorological Service in terms of drought forecasts
3. Rehabilitation and improvement of current hydrometeorological network
4. Improvement of automatic sensors of snow accumulation, air temperature, and precipitation
5. Modernization of gathering facilities, processing, analysis, interpretation and operative data dissemination, GIS database development and computer-assisted models of drought and its impact
6. Development of state policy at national and regional levels on water resource allocation
7. Increasing of efficiency of economic mechanisms in water resource management
8. Development of differentiated tariffs for water use depending on water delivery costs, etc.
9. Development of program of study of water resources by academy of sciences and SRIs
10. Introduction of international methods and standards of statistical records of water resources
11. Formation of automatic control system and water consumption on the basis of GIS technologies
12. Establishment of structures for introducing modern irrigation methods
13. Arranging training and seminars and exchange of data with countries that have advanced irrigation technologies and methodologies on drought control
14. Amending a system of remuneration of labor
15. Amending Law on Nature Preservation, taking into account wide development of dehqan and private farms, including ecological criteria of land tenure under drought conditions
16. Establishment of social insurance fund for combating desertification and droughts
17. Zoning of territory for optimal afforestation with the aim of reducing drought exposure
18. Establishment of work group to develop projects on optimal location of windbreaks
19. Conducting surveys and approbation of highly productive varieties of wood species
20. Conducting agro-meteorological surveys for identification of climate impacts on soils and productivity of agricultural crops
21. Introduction of fast-ripening, disease-resistant, and heat-resistant varieties of cotton
22. Improvement of cotton irrigation efficiency on the basis of water saving technologies
23. Zoning of pastures based on its vulnerability to droughts
24. Regulating and optimization of pasture load
25. Scientific research on the assessment and forecasting of the climate change impacts on the state and productivity of ecosystems and examples of reference sites of nature (national parks, reserves)
26. Improvement of the set of measures on prevention of infectious diseases under drought conditions
27. Change of regime of work and rest to reduce time spent outside under maximal high temperatures
28. Poverty liquidation, particularly amongst the most vulnerable droughts groups
29. Zoning of the territory based on its vulnerability to SHE and climate changes
30. Strengthening of collaboration on drought forecasting and early warning system improvement
31. Development of national concept on drought surveys
32. Improvement of existing and development of new mechanisms of coordination for the formation of favorable conditions for the most effective implementation of drought mitigation measures
33. In accordance with the regulations of Orhus Convention to improve legislative-normative basis to ease access to documents of different agencies
34. Introduction of modern methods of forecasting and modeling droughts
35. Establishment of Scientific Coordinating Board on Droughts
36. Conducting regular meetings on exchange of experience and staff of different groups of population
37. Implementing programs for science-technical training and preparing highly qualified personnel
38. Timely issue of bulletin with information on droughts
39. Creation of web-site for exchange of data on drought at both national and international levels
40. Improvement of the system for continuous education of the population on ecological education
41. Adoption of normative-legislative basis for improving drought awareness among the public
42. Improvement of legislation of community participation in decision making and data access
43. Enhancing work of Social Ecological Board
44. Establishment of Informational Center for Drought
45. Alteration of educational ecology programs that were introduced in institutes of higher education
46. Issue illustrated magazine covering drought issues in Tajikistan and other ecological problems
47. Preparation of cycle of TV and radio programs on drought issues
48. Improving access to the Internet

Source: Safarov et al. (2006)

Step 5. Writing a Drought Plan

With input from each of the committees and working groups, the drought task force will choose the final actions to be included in the drought plan and, with the assistance of professional writing specialists, draft the plan.

The task force, as originally defined, is composed of senior policy makers from various government agencies and, possibly, key stakeholder groups. It is expected that they would have a great deal of knowledge and experience with drought, risk analysis (economic, environmental, and social aspects), and drought-related decision-making processes at all levels of government. Therefore, the task force is in an excellent position to recommend or implement mitigation actions, request assistance through various federal programs, or make policy recommendations to a legislative body or political leader.

After completion of a working draft, public meetings or hearings at several locations should be held to explain the purpose, scope, and operational characteristics of the plan, and to gather final input from stakeholders before the plan becomes final. A public participation specialist for the drought task force can facilitate the hearings and work with communication specialists and the media to prepare an overview of the plan and news stories to announce the meetings.

A copy of the final plan should be available through the drought task force website and in hard copy form for distribution. The plan should not be considered a static document that sits on a shelf. Steps must be taken to ensure the plan is implemented, and that it is updated periodically to incorporate changing conditions and needs.

Step 6. Implementing a Drought Plan

There are formal and informal methods of implementing and sustaining a national drought plan. In many cases, legislation will be required to ensure that essential activities identified in the plan are implemented before, during, and after drought. For example, legislation may be enacted to ensure that the task force meets regularly to re-evaluate the plan and to continuously monitor drought conditions. The task force may also be authorized to enact the plan when drought conditions appear imminent, and to downgrade actions as the drought subsides.

Other actions may be left to the discretion of supporting agencies to implement as budgets and priorities allow. For example, many of the mitigation actions identified during the drought planning process will be long-term land management and social programs that will be implemented as part of an agency's mandate.

Periodic testing, evaluation, and updating of the drought plan are also essential to keep the plan responsive to local, state, provincial, or national needs. To maximize the effectiveness of the system, you must include two modes of evaluation: ongoing and post-drought.

A. Ongoing Evaluation

An ongoing or operational evaluation keeps track of how societal changes such as new technology, new research, new laws, and changes in political leadership may affect drought risk and the operational aspects of the drought plan. Drought risk may be evaluated quite frequently whereas the overall drought plan may be evaluated less often. An evaluation under simulated drought conditions (i.e., drought exercise) before the drought plan is implemented and periodically thereafter is recommended. It is important to view drought planning as a continual process rather than a discrete event.

B. Post-Drought Evaluation

A post-drought evaluation or audit documents and analyzes the assessment and response actions of government, nongovernmental organizations, and others and provides a mechanism to implement recommendations for improving the system. Without post-drought evaluations, it is difficult to learn from past successes and mistakes, as institutional memory fades.

Post-drought evaluations should include an analysis of the climatic and environmental aspects of the drought; its economic and social consequences; the extent to which pre-drought planning was useful in mitigating impacts, in facilitating relief or assistance to stricken areas, and in post-recovery; and any other weaknesses or problems caused or not covered by the plan. Attention must also be directed to situations in which drought-coping mechanisms worked and where societies exhibited resilience; evaluations should not focus only on those situations in which coping mechanisms failed. Evaluations of previous responses to severe drought are also a good planning aid.

To ensure an unbiased appraisal, governments may wish to place the responsibility for evaluating drought and societal response to it in the hands of nongovernmental organizations such as universities or specialized research institutes.

4. Example of National Drought Planning: The Islamic Republic of Iran

Iran

Iran provides a case study of a country in the Near East Region that has recently undertaken a national drought planning initiative. This effort is particularly important given that Iran is an arid and drought-prone country with increasing drought vulnerabilities.

For example, as a result of previous droughts and overexploitation of available water resources, per capita water availability in Iran has decreased from 7000 m^3/year 50 years ago (when the population was 19 million) to 1910 m^3/year today with 68 million inhabitants. Given the population growth rate, further reduction is projected and the per capita water availability is expected to be approximately 1400 m^3/year by 2025 (FAO, 2006). This reduction in available water resources reduces the buffer necessary to sustain activities during times of drought.

Especially severe drought from 1999 to 2001 also revealed the vulnerability of the country to drought, including estimated damages to agriculture and livestock of USD$4.2 billion from 2000 to 2001 (FAO, 2006). Drought forced Iran to import 7 million tons of wheat in 2000, making it the world's largest importer (De Pauw, 2005). The extreme drought conditions also led to widespread migration and contributed to disease occurrence throughout the country (Agrawala et al., 2001).

Recent analyses indicate important weaknesses of Iran's drought management system (Ameziane, 2006). Identified deficiencies included a lack of operational drought early warning and monitoring; non-integration of appropriate tools of drought risk and impact assessment; lack of drought vulnerability mapping; and, above all, a lack of institutional coordination of drought activities. It was found that the lack of strategic drought planning and delays in decision making, with the associated effect on management costs, have led to more costly drought response actions.

The realization of drought management problems, along with the frequent occurrence of drought and its severe impact on the economy and natural resources, have triggered actions to formulate a strategy and action plan for drought management in Iran. The strategy is targeted toward the agricultural sector, which is especially vulnerable to drought and an important economic sector in Iran.

4.1 Overview of the Iran National Strategy and Action Plan on Drought Preparedness, Management, and Mitigation in the Agricultural Sector

The Iran National Strategy and Action Plan on Drought Preparedness, Management, and Mitigation in the Agricultural Sector was developed with support and assistance from the Food and Agriculture Organization of the United Nations Near East Regional Office in Cairo, Egypt, from 2004 to 2006 (see FAO, 2006).

The main objectives of the project were to help the government of Iran (1) formulate a comprehensive and integrated national strategy and action plan on drought management and mitigation for the agricultural sector, (2) review coordination mechanisms for drought response by various stakeholders and formulate proposals to strengthen them, and (3) strengthen institutional capacity in drought early warning, preparedness, and response to affected areas and people, especially for the more vulnerable and food-insecure households.

During the project, collaborators and consultants produced:

- assessments of drought impacts and existing drought management capacity,
- analyses of international experience and mechanisms for drought management,
- a national drought preparedness strategy in the agricultural sector outlining government objectives in the event of drought, and a plan of action defining the strategies required to prepare for, mitigate, and manage the negative effects of drought,
- research on the potential for and limitations of developing an early warning system, and
- guidelines to create a national drought management center, which could eventually evolve into a regional center.

Overall, the main components of the proposed framework for establishing the national drought preparedness strategy are to create a national drought management center; adopt policies to support drought resilience and reduce vulnerability; enhance institutional coordination mechanisms for drought management; and develop national capacity for drought planning, mitigation, and response.

As of the writing of this manual, the national drought preparedness strategy was in the process of being introduced to the parliament for official approval. When approved, the policy calls for the development of a National Drought Management Centre that would serve as the drought mitigation hub of Iran. Eventually, it is envisioned that the Centre could also serve as the regional hub for the ECO region (a regional division of about ten countries).

4.2 Steps in the development of the Iran National Strategy and Action Plan on Drought Management and Mitigation

Step 1. Creating Political Momentum and Authority

Drought conditions in Iran from 1999 to 2001 demonstrated the significant environmental, social, and economic effects of drought within the country. Similar effects experienced across the Near East Region provided the impetus for national meetings and regional conferences to better understand and develop strategies to reduce the risk of similar drought events in the future. As a result of these events, awareness increased about the need for a more comprehensive and proactive strategy for mitigating and responding to drought events in Iran.

Box 13. Steps Taken in the Development of the Iranian National Strategy and Action Plan on Drought Preparedness, Management, and Mitigation in the Agricultural Sector

Step 1. Creating political momentum and authority

Step 2. Strategic planning and coordination

Step 3. Fostering involvement and developing common understandings

Step 4. Investigating drought monitoring, risk, and management options

Step 5. Writing the national drought strategy and action plan

Step 6. Implementing the national drought strategy and action plan

The drought event created the "policy window" and, in this case, international agencies (such as FAO) played a critical role in placing drought on the international agenda within the Near East Region. FAO discussed the need for proactive drought planning at several regional conferences from 2000 to 2004, and adopted "drought mitigation" as a priority area for interdisciplinary action (PAIA).

Similarly, Iranian government representatives recognized the need for additional drought planning and requested that FAO provide technical and financial assistance to establish a national drought strategy. This assistance was provided by FAO under a Technical Cooperation Programme (TCP) project. The project, "A National Strategy and Action Plan on Drought Preparedness Management and Mitigation in the Agricultural Sector", was initiated in December 2004.

Overall, a combination of internal and external pressures and opportunities provided enough impetus to carry the project from the agenda setting to the implementation phase.

Step 2. Strategic planning and coordination

The drought planning project was officially executed by the Ministry of Jihad-e-Agriculture (Department of Agronomy), in collaboration with the Ministry of Interior (Bureau of Research and Coordination of Safety and Rehabilitation Activities – BRCSRA) and the Ministry of Road and Transportation (Islamic Republic of Iran Meteorological Organization – IRIMO). To help organize the project, a National Project Coordinator from the Iranian Department of Agronomy was appointed to work with an FAO consultant in leading the planning project. Eventually, a Project National Steering Committee was also established. Members of the committee are organizations dealing with drought management at the national, provincial, and district levels.

To help carry out the project, FAO provided technical advisory and supervisory services, and funding for an international drought mitigation consultant and 15 national drought management consultants. In addition to providing technical support, the FAO TCP project was instrumental in providing an incentive for the coordination of drought-related stakeholders and programs in the country.

The project team members also provided the leadership necessary to keep the project moving forward. For example, to initiate the project, FAO's drought management consultant met with representatives of the Iranian agencies who would be responsible for implementing the drought planning process to outline specific activities to be undertaken, including:

- outreach activities to help the project team better understand drought and its impacts in the country and to develop a drought risk reduction mentality among stakeholders
- drought research and discussions with stakeholders to better understand drought management roles and issues in Iran
- discussions among stakeholders to gain a better understanding of issues that should be included in a draft national drought preparedness strategy and action plan
- collaboration with stakeholders to write a final national drought preparedness strategy and action plan

These strategic planning sessions among the team leaders helped solidify the project goals and objectives and their respective roles and obligations during the project.

Step 3. Fostering Involvement and Developing Common Understandings

Several activities were undertaken to help the project team better understand drought and its impacts in the country, foster a drought risk reduction mentality among stakeholders, and raise support for the project.

Field visits were made to drought-affected provinces to assess the extent of impacts, learn stakeholders' perceptions of current drought management strategies, and hold training seminars to explain the project objectives and expectations and the necessity of moving toward proactive drought risk reduction strategies.

Visits were also made to many universities and research centers that play a role in drought management throughout the country. The interactions provided an opportunity for two-way information flow about the project and drought management issues, which helped clarify the objectives of the drought planning project and build support for the initiative.

Step 4. Investigating Drought Monitoring, Risk, and Management Options

With the project framework developed and key partners and issues identified, more in-depth research was undertaken to better understand drought and drought risk management in Iran. To help carry out this task, national and international consultants were hired to produce reports on a wide range of related topics, including

(i) information on the bio-physical, socio-economic, and environmental characteristics of the area exposed to droughts in Iran

(ii) a review of existing tools to monitor drought and methodologies to evaluate its impacts;

(iii) a review of plans and programs of activities to mitigate the effects of drought, by considering case studies;

(iv) an institutional analysis of the existing coordination mechanism of drought management in Iran; and

(v) a review of international experience on the subject in order to identify lessons learned and considered for drought management in Iran.

The findings from the reports were presented and discussed during two regional workshops. The first workshop (in Karaj) brought together the rainfed provinces, and the second workshop (in Birjand) was organized for the drier southern provinces, where water scarcity is already an important issue.

These efforts led to a better understanding of drought occurrence, impacts, and management options that could be included in a national drought strategy for agriculture.

Step 5. Writing the national drought strategy and action plan

With a more clear understanding of drought and drought risk management in Iran, the project team developed a draft National Strategy for Drought Management in the Agricultural Sector in Iran.

The proposed strategy had four main components: 1) creation of a national drought management center; 2) adoption of policies to support drought resilience and reduce vulnerability; 3) establishment of institutional coordination on drought-related matters; and 4) development of national capacity for drought planning, mitigation, and response.

In terms of the first component, it was proposed to establish a National Drought Management Centre (NDMC) within the Ministry of Jehad-e-Agriculture, composed of three specialized operational working groups for drought management: the Drought Early Warning and Monitoring Group, which would be coordinated by the national meteorological organization (IRIMO); the Drought Risk and Impact Assessment Group, to be coordinated by the Ministry of Jehad-e-Agriculture (MoJA); and the Drought Planning, Mitigation and Response Group, to be coordinated by the Ministry of Energy (MoE). The primary function of the Centre would be to ensure working linkages between the Ministry of Jehad-e-Agriculture and stakeholders concerned with drought at the national and provincial/district levels.

The second component proposes policies to reduce drought vulnerability by fostering (i) integrated water and drought management in agriculture, including increasing water use efficiency and water productivity; (ii) drought management policies for irrigated agriculture, rainfed agriculture, and livestock; (iii) stakeholders' participation and support to develop a drought plan, and (iv) drought information, public education, and awareness.

The third component focuses on creating a coherent drought management system with clear coordination mechanisms and information flow between users to facilitate national and local capacities for drought planning, mitigation, and response.

Finally, the fourth component is aimed at developing the national capacity for drought planning, mitigation, and response by outlining a plan for (1) monitoring drought and the processes involved in identifying the severity of drought conditions in different provinces of the country, (2) identifying the stages of drought and expected responses and activities, (3) identifying the implementation roles of government agencies/institutions, (4) developing a drought information and communications system, and (5) developing a process for updating the plan on an annual basis.

To help provide a first review of the national drought strategy and action plan, a national workshop was held to discuss and propose changes to the draft. A wide range of national and international organizations and agencies were represented at the meeting and provided essential insight on the strategy.

Following this workshop and subsequent team meetings, necessary modifications were made to the drought planning document, and the final draft was developed during a wrap-up workshop.

Step 6. Implementing the national drought strategy and action plan

The national drought preparedness strategy is in the process of being introduced to the parliament for official approval.

Meanwhile, an external study tour to FAO Rome for a group of three professional experts of the National Disaster Task Force was organized in 2006. The study tour to FAO/Global Information and Early Warning Service (GIEWS) and the visit to the Technical Divisions in Rome also contributed to improving the national capacity-building in database management and drought information delivery; and in drought early warning, monitoring, mitigation, and response.

These types of activities continue to enhance national drought risk reduction capacities and are required to fully implement the task identified in the national drought preparedness strategy, whether or not it is passed by the Iranian parliament.

5. Drought Planning and Risk Management Resources

5.1 United Nations System

United Nations Children's Fund (UNICEF)
UNICEF is mandated by the United Nations General Assembly to advocate for the protection of children's rights, to help meet their basic needs and to expand their opportunities to reach their full potential. UNICEF works in 191 countries through country programs and National Committees.
http://www.unicef.org/

United Nations Convention to Combat Desertification (UNCCD)
The "United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa" was adopted in Paris on 17 June 1994 and opened for signature there on 14-15 October 1994. It entered into force on 26 December 1996, 90 days after the fiftieth ratification was received. Over 179 countries were Parties as of March 2002.
http://www.unccd.int

United Nations Office for the Coordination of Humanitarian Affairs (OCHA)
OCHA is led by the Under-Secretary-General for Humanitarian Affairs/Emergency Relief Coordinator and located in New York and Geneva. OCHA aims to alleviate human suffering by facilitating international coordination for the effective and efficient delivery of assistance to victims of disasters and complex emergencies. OCHA-Geneva has recently created the Emergency Preparedness Section to promote and strengthen disaster preparedness at all levels, among other activities. OCHA also assists in the operation of the HEWS, under the framework of the **Inter-Agency Standing Committee (IASC)**, that serves as a common platform for humanitarian early warnings for natural hazards and socio-political developments worldwide.
http://ochaonline.un.org

United Nations Country Team (UNCT)
The Secretary-General's reform process initiated in 1997 stressed the need to achieve a greater unity of purpose and coherence in country-level operations of the UN system, highlighting the need to strengthen the UN Country Team (UNCT) System and promoting a more united UN presence at the country level. The UNCT system encompasses all organizations of the United Nations system dealing with operational activities for development and relief, regardless of their formal presence in the country. The UNCT system aims to bring together the different UN agencies to improve the efficiency and effectiveness of operational activities at the country level.

United Nations Development Fund for Women (UNIFEM)
UNIFEM is the women's fund at the United Nations. It provides financial and technical assistance to innovative programs and strategies to foster women's empowerment and gender equality.
http://www.unifem.org/

United Nations Development Group (UNDG)
Chaired by the UNDP Administrator, based in New York, the UNDG provides a framework for greater coherence and cooperation in UN development operations. As most of the UNDG members carry out activities related to disaster reduction, this group represents an opportunity to integrate disaster reduction into sustainable development.
http://www.undg.org

United Nations Development Programme (UNDP) http://www.undp.org
UNDP is the UN's global development network, an organization advocating for change and connecting countries to knowledge, experience, and resources to help people build a better life. The Bureau is on the ground in 166 countries, working with them on their own solutions to global and national development challenges. As they develop local capacity, they draw on the people of UNDP and our wide range of partners. UNDP has two specialized divisions which deal with disaster risks reduction: **Bureau for Crisis Prevention and Recovery (BCPR)** http://www.undp.org/bcpr and the **Drylands Development Centre (DDC)** http://www.undp.org/drylands.

The United Nations Economic and Social Council (ECOSOC)
ECOSOC serves as the central forum for discussing international economic and social issues, and for formulating policy recommendations addressed to Member States and the United Nations system. It is responsible for promoting higher standards of living, full employment, and economic and social progress; identifying solutions to international economic, social, and health problems; facilitating international cultural and educational cooperation; and encouraging universal respect for human rights and fundamental freedoms. It has the power to make or initiate studies and reports on these issues. It also has the power to assist the preparations and organization of major international conferences in the economic and social and related fields and to facilitate a coordinated follow-up to these conferences. With its broad mandate the Council's purview extends to over 70 percent of the human and financial resources of the entire UN system. The ECOSOC was established under the UN Charter as the principal organ to coordinate economic, social, and related work of the 14 UN specialized agencies, 10 functional commissions and five regional commissions. The Council also receives reports from 11 UN Funds and Programmes.
http://www.un.org/docs/ecosoc

The **Economic Commission for Africa** (ECA) and Economic and **Social Commission for Western Asia** (ESCWA) are regional commissions of ECOSOC.
http://www.uneca.org
http://www.unescw.un.org

United Nations Educational, Scientific and Cultural Organization (UNESCO)
UNESCO's main objective is to contribute to peace and security in the world by promoting collaboration among nations through education, science, culture, and communication in order to further universal respect for justice, the rule of law, human rights, and fundamental freedoms.
http://www.unesco.org

United Nations Environment Programme (UNEP)
UNEP is the voice for the environment in the United Nations system. It is an advocate, educator, catalyst, and facilitator promoting the wise use of the planet's natural assets for sustainable development.
http://www.unep.org

UN Environmental and Sustainable Development Division (ESCAP)
Established in 1947, ESCAP seeks to overcome some of the region's greatest challenges. It carries out work in three main thematic areas: poverty reduction, managing globalization, and tackling emerging social issues.
http://www.unescap.org/; http://www.unescap.org/esd/environment

Food and Agriculture Organization of the United Nations (FAO)
FAO leads international efforts to defeat hunger. Serving both developed and developing countries, FAO acts as a neutral forum where all nations meet as equals to negotiate agreements and debate policy. FAO is also a source of knowledge and information. FAO helps developing countries and countries in transition modernize and improve agriculture, forestry, and fisheries practices and ensure good nutrition for all. Since its founding in 1945, its has focused special attention on developing rural areas, home to 70 percent of the world's poor and hungry people.
http://www.fao.org

FOA maintains the **AQUASTAT database**, to provide users with comprehensive information related to water resources and agricultural water management across the world, with emphasis on countries in Africa, Asia, Latin America and the Caribbean. (http://www.fao.org/nr/aquastat)

FAO also coordinates the **Global Information Early Warning System**, whose mission is to continuously review the world food supply/demand situation and provide early warnings of impending food crises in individual countries.
http://www.fao.org/GIEWS

The FAO Regional Office for the Near East in Cairo, Egypt, has been especially active in assisting countries in the region with drought planning in recent years by providing financial and technical assistance.
http://www.fao.org/world/regional/rne/index_en.htm

United Nations Framework Convention on Climate Change (UNFCCC)
Adopted in 1992, the UNFCCC sets out a framework for action aimed at stabilizing atmospheric concentrations of greenhouse gases at a level that would prevent human-induced actions from leading to "dangerous interference" with the climate system. The UNFCCC entered into force on 21 March 1994. It now has 186 Parties. Seven meetings of the Conference of Parties (COP) have taken place, as well as numerous workshops and meetings of the COP's subsidiary bodies.
http://unfccc.int

The Office of the High Commissioner for Human Rights (OHCHR)
OHCHR, a department of the United Nations Secretariat, is mandated to promote and protect the enjoyment and full realization, by all people, of all rights established in the Charter of the United Nations and in international human rights laws and treaties. The mandate includes preventing human rights violations, securing respect for all human rights, promoting international cooperation to protect human rights, coordinating related activities throughout the United Nations, and strengthening and streamlining the United Nations system in the field of human rights. In addition to its mandated responsibilities, the Office leads efforts to integrate a human rights approach within all work carried out by United Nations agencies. OHCHR's priorities are set out in its Strategic Management Plan 2006-2007 and follow the Vienna Declaration and Programme of Action of the 1993 World Conference on Human Rights, and the Charter of the United Nations.
http://www.ohchr.org/

The Office of the United Nations High Commissioner for Refugees (UNHCR)
UNHCR was established on December 14, 1950, by the United Nations General Assembly. The agency is mandated to lead and co-ordinate international action to protect refugees and resolve refugee problems worldwide. Its primary purpose is to safeguard the rights and well-being of refugees. It strives to ensure that everyone can exercise the right to seek asylum and find safe refuge in another State, with the option to return home voluntarily, integrate locally or to resettle in a third country. In more than five decades, the agency has helped an estimated 50 million people restart their lives. Today, a staff of around 6,689 people in 116 countries continues to help 20.8 million persons.
http://www.unhcr.ch/

The United Nations Human Settlements Programme (HABITAT)
The United Nations Human Settlements Programme, UN-HABITAT, is the United Nations agency for human settlements. It is mandated by the UN General Assembly to promote socially and environmentally sustainable towns and cities with the goal of providing adequate shelter for all.
http://www.unhabitat.org/

International Fund for Agricultural Development (IFAD)
IFAD's goal is to empower poor rural women and men in developing countries to achieve higher incomes and improved food security. IFAD will ensure that poor rural people have better access to resources, and the skills and organization they need to take advantage of natural resources, improved agricultural technologies, a broad range of financial services, transparent and competitive markets for agricultural inputs and produce, opportunities for rural off-farm employment and enterprise development, and local and national policy and programming processes.
http://www.ifad.org

The United Nations International Strategy on Disaster Reduction (ISDR)
ISDR is the focal point in the UN System to promote links and synergies between, and the coordination of, disaster reduction activities in the socio-economic, humanitarian, and development fields, as well as to support policy integration. It serves as an international information clearinghouse on disaster reduction, developing awareness campaigns and producing articles, journals, and other publications and promotional materials related to disaster reduction. It promotes the implementation of the Hyogo Framework of Action through global, regional, national and local disaster risk reduction partnerships.
http://www.unisdr.org/

A **UN/ISDR Regional Office for West Asia and North Africa** was established in 2007 to better serve the specific needs of the region.
http://www.unisdr-wana.org/

United Nations University (UNU)
The mission of the UNU is to contribute, through research and capacity building, to efforts to resolve the pressing global problems that are the concern of the United Nations and its Member States. The UNU aims to fulfill its mission by performing four key roles that are based on the mandate given to the University by its Charter: to be an international community of scholars; to form a bridge between the United Nations and the international academic community; to serve as a think-tank for the United Nations system; and to contribute to capacity building, particularly in developing countries.
http://www.unu.edu/

United Nations Volunteers (UNV)
United Nations Volunteers is the United Nations focal point for promoting and harnessing volunteerism for effective development. UNV is a strategic source of knowledge and advice about the role and contribution of volunteerism and the benefits of civic engagement in development programs. UNV is dedicated to using Volunteerism for Development (V4D) to make distinctive contributions to the effectiveness of development.
http://www.unv.org/

The World Bank Group
The World Bank is one of the world's largest sources of development assistance. The group consists of five closely associated institutions, owned by 185 member countries that carry ultimate decision-making power: the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), International Finance Corporation, Multilateral Investment Guarantee Agency and International Centre for Settlement of Investment Disputes. Each institution plays a distinct role towards the Bank's overarching vision of global poverty reduction and the improvement of living standards.
http://www.worldbank.org

The Bank has recently launched the **Global Facility for Disaster Reduction and Recovery (GFDRR)** with the ISDR to support drought risk reduction globally. http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTURBANDEVELOPMENT/EXTDISMGMT/0,,contentMDK:21021166%7EpagePK:210058%7EpiPK:210062%7EtheSitePK:341015,00.html

The World Bank has also participated in a **drought management and mitigation project** in Central Asia and the Caucasus, sponsored by the Canadian International Development Agency (CIDA).
http://go.worldbank.org/8J56VSUEZ0

World Food Programme of the United Nations (WFP) http://www.wfp.org/english
WFP is the United Nations' frontline agency in the fight against global hunger. Operations aim to save lives in refugee crises and other emergencies, improve nutrition and quality of life of the world's most vulnerable people at critical times in their lives, and enable development by (a) helping people build assets that benefit them directly; (b) promoting the self-reliance of poor people and communities. The WFP specializes in food aid and humanitarian assistance. One of WFP's key initiatives related to Disaster Risk Reduction is the **Vulnerability Analysis and Mapping (VAM)**. http://vam.wfp.org/

World Health Organization (WHO)
The World Health Organization is the United Nations specialized agency for health. WHO's objective is the attainment by all peoples of the highest possible level of health, which is defined as a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.
http://www.who.org

World Meteorological Organization (WMO)
The World Meteorological Organization is a Specialized Agency of the United Nations. It is the UN system's authoritative voice on the state and behavior of the Earth's atmosphere, its interaction with the oceans, the climate it produces, and the resulting distribution of water resources.
http://www.wmo.ch

5.2 International Networks and Centers

Center for Research on the Epidemiology of Disasters, Brussels
CRED promotes research, training, and information dissemination on disasters, with a special focus on public health, epidemiology, and structural and socio-economic aspects. It aims to enhance the effectiveness of developing countries' disaster management capabilities as well as fostering policy-oriented research.
http://www.cred.be

Consultative Group on International Agricultural Research (CGIAR)
The Consultative Group on International Agricultural Research (CGIAR) is a strategic alliance of countries, international and regional organizations, and private foundations supporting 15 international agricultural Centers that work with national agricultural research systems and civil society organizations including the private sector. The alliance mobilizes agricultural science to reduce poverty, foster human well being, promote agricultural growth and protect the environment. The CGIAR generates global public goods that are available to all.
http://www.cgiar.org (includes links to many partner and allied institutions)

Global Water News Watch
Global Water News Watch covers water news from 188 countries. The website is produced by Sustainability of Semi-Arid Hydrology and Riparian Areas (SAHRA), a National Science Foundation Science and Technology Center at the University of Arizona.
http://www.sahra.arizona.edu/newswatch

International Federation of Red Cross and Red Crescent Societies (IFRC)
Readiness to reduce the impact of disasters is central to the work of the International Federation and its member Red Cross and Red Crescent Societies around the world. This is carried out alongside work to help National Societies respond to the consequences of disasters at local, national and international levels.
http://www.ifrc.org

Intergovernmental Panel on Climate Change (IPCC)
The IPCC was established to provide the decision-makers and others interested in climate change with an objective source of information about climate change. The IPCC does not conduct any research nor does it monitor climate related data or parameters. Its role is to assess on a comprehensive, objective, open and transparent basis the latest scientific, technical and socio-economic literature produced worldwide relevant to the understanding of the risk of human-induced climate change, its observed and projected impacts and options for adaptation and mitigation.
http://www.ipcc.ch/

ProVention Consortium (Disaster Management Facility, World Bank)
Its mission is "to help developing countries build sustainable and successful economies and to reduce the human suffering that too often results from natural and technological catastrophes". The ProVention Consortium is a global coalition of governments, international organizations, academic institutions, the private sector, and civil society organizations aimed at reducing disaster impacts in developing countries. The Consortium functions as a network to share knowledge and to connect and leverage resources to reduce disaster risk.
http://www.proventionconsortium.org

NOTE: A number of bilateral agencies and international NGOs work together with partners of developing countries to contribute to their sustainable development and poverty reduction programs, including the implementation of practical projects to reduce drought risk.

5.3 Regional Networks and Organizations

African Development Bank Group (AfDB)
The ADB is a multilateral development bank whose shareholders include 53 African countries (regional member countries—RMCs) and 24 non-African countries from the Americas, Asia, and Europe (non-regional member countries—non-RMCs). It was established in 1964, with its headquarters in Abidjan, Côte d'Ivoire, and officially began operations in 1967.
http://www.afdb.org

African Centre of Meteorological Application for Development (ACMAD), Niger
ACMAD is the Weather and Climate Centre with African continental competence. ACMAD has been operational in Niamey since 1992. ACMAD is composed of 53 Member States, the 53 countries of the "Africa" continent.
http://www.acmad.ne

The Centre Regional de Formation et d'Application en Agrométéorologie et Hydrologie Opérationne Institute (AGRHYMET Regional Centre), Niamey, Niger
Created in 1974, AGRHYMET is a specialized hydrometeorological institute of the Permanent Interstate Committee for Drought Control in the Sahel (CILSS).
http://www.agrhymet.ne

Asian Development Bank (ADB)
ADB's vision is a region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their citizens. ADB's main instruments for providing help to its developing member countries are: policy dialogue, loans, technical assistance, grants, guarantees, and equity investments.
http://www.adb.org

International Center for Agricultural Research in the Dry Areas (ICARDA)
Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is one of the 15 centers strategically located all over the world and supported by the Consultative Group on International Agricultural Research (CGIAR). With its main research station and offices based in Aleppo, Syria, ICARDA works through a network of partnerships with national, regional and international institutions, universities, non-governmental organizations and ministries in the developing world; and with advanced research institutes in industrialized countries.
http://www.icarda.org

IGAD Climate Prediction and Applications Centre (ICPAC), Nairobi, Kenya
ICPAC's mission is to improve the technical capacity of producers and users of climatic information; develop an improved, proactive, timely, broad-based system of information and product dissemination and feedback; and expand the knowledge base within the sub-region in order to facilitate informed decision making.
http://www.icpac.net

International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM)
CIHEAM's ambition is threefold: to propagate a common scientific culture for the food and agriculture sector, to work in cooperative networks with national agricultural education and research institutions, to provide a Mediterranean forum where governments can discuss prospects for food and agriculture. CIHEAM seeks to be an instrument for Mediterranean cooperation, a pivotal center and support base for initiatives linking Europe and the Mediterranean. Through its analyses, it endeavors to hold up a mirror to the modern Mediterranean region and proclaim its specific identity.
http://www.ciheam.org/uk/index.html

International Water Management Institute (IWMI), Sri Lanka
IWMI is a non-profit scientific organization funded by the Consultative Group on International Agricultural Research (CGIAR). IWMI's research agenda is organized around four priority themes covering key issues relating to land, water, livelihoods, health, and environment. The Institute concentrates on water and related land management challenges faced by poor rural communities. It also maintains the IWMI Drought Network and Information Center.
http://www.iwmi.cgiar.org
http://www.iwmi.cgiar.org/drw/info/default.asp?PG=HOME

MEDROPLAN Mediterranean Drought Preparedness and Mitigation Planning
The objectives of MEDROPLAN are to develop Guidelines for drought preparedness plans and to set up a Network for drought preparedness in Mediterranean countries.
http://www.iamz.ciheam.org/medroplan

Comité Permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel (CILSS), Ouagadougou, Burkina Faso (Permanent Interstate Committee for Drought Control in the Sahel)
Its mission is to be involved in the research of food security and to combat the effects of drought and desertification for better ecological stability.
http://www.cilssnet.org

5.4 Country-Based Organizations

Canadian International Development Agency (CIDA)
CIDA was established in 1968 to administer the bulk of Canada's official development assistance (ODA) program. The measure of its success lies in its contribution to the achievement of the Millennium Development Goals (MDGs) and Canada's broader international policy objectives. CIDA's aim is to reduce poverty, promote human rights, and support sustainable development.
http://www.acdi-cida.gc.ca

International Development Research Centre (IDRC), Canada
The International Development Research Centre (IDRC) is a public corporation created by the Parliament of Canada in 1970 to help developing countries use science and technology to find practical, long-term solutions to the social, economic, and environmental problems they face. Support is directed toward developing an indigenous research capacity to sustain policies and technologies that developing countries need to build healthier, more equitable, and more prosperous societies.
http://www.idrc.ca

International Research Institute for Climate and Society, New York, USA
The mission of the IRI is to enhance society's capability to understand, anticipate, and manage the impacts of seasonal climate fluctuations, in order to improve human welfare and the environment, especially in developing countries.
http://iri.columbia.edu

Southern Alliance for Indigenous Resources (SAFIRE), Zimbabwe
The Southern Alliance for Indigenous Resources (SAFIRE) is a Zimbabwean non-governmental organization (NGO) which has been operational since 1994. It sponsors the Southern Africa Drought Technology Network (SADNET) between Zimbabwe, Zambia, Malawi, and Mozambique.
http://www.safireweb.org

Turkana Drought Contingency Planning Unit (TDCPU), Kenya
The Early Warning System of Turkana was set up in 1987. It operates at the sub-national level, for the district of Turkana in the northern part of Kenya. It is run by local government, by the TDCPU. It provides information on how early warning data can be translated and communicated to decision makers.

U.S. Agency for International Development (USAID)
USAID has been the principal U.S. agency to extend assistance to countries recovering from disaster, trying to escape poverty, and engaging in democratic reforms. It is an independent federal government agency that receives overall foreign policy guidance from the Secretary of State. Their work supports long-term and equitable economic growth and advances U.S. foreign policy objectives by supporting economic growth, agriculture and trade; global health; and democracy, conflict prevention and humanitarian assistance. http://www.usaid.gov

USAID also maintains an **Asia and Near East Regional Program** (http://www.usaid.gov/locations/asia_near_east/) and the **Famine Early Warning System** (http://www.fews.net).

The U.S. National Climatic Data Center (NCDC)
The NCDC is the world's largest archive of weather data. They develop both national and global datasets that have been used by both government and the private sector to maximize the resources provided by our climate and minimize the risks of climate variability and weather extremes.
http://www.ncdc.noaa.gov/oa/about/ncdcwelcome.html

The U.S. National Oceanic and Atmospheric Administration - Cooperative Institute for Research in Environmental Sciences Climate Diagnostics Center (CDC)
CDC identifies the nature and causes of climate variations on time scales ranging from a month to centuries, thus enabling prediction of climate variations on these time scales. The CDC provides several resources.
http://www.cdc.noaa.gov

The U.S. National Oceanic and Atmospheric Administration's (NOAA) Drought Information Center
The Drought Information Center is a compilation of various NOAA websites and information on drought and climate conditions. It provides breaking news, including current drought assessments of various kinds, monthly roundups, and considerable background information; and links to websites with information about drought.
http://www.drought.noaa.gov

6. References

Agrawala, S., M. Barlow, and H. Cullen (2001) The Drought and Humanitarian Crisis in Central and Southwest Asia: A Climate Perspective. IRI Special Report 01-11, 24 pp.

Alley, W.M. (1984). The Palmer Drought Severity Index. Limitations and assumptions. *Journal of Climate and Applied Meteorology*, 23: 1100-1109.

Ameziane, T. (2006) The Islamic Republic of Iran: National Strategy and Action Plan on Drought Preparedness, Management, and Mitigation in the Agricultural Sector, Volume 1, Main Report, Prepared within the framework of Assistance from the Food and Agriculture Organization of the United Nations through the TCP Project No. 3003 /IRA, Regional Office for the Near East, Cairo, Egypt.

Bazza, M. (2002) Water Resources Planning and Management for Drought Mitigation, Regional Workshop on Capacity Building on Drought Mitigation in the Near East, Rabat, Morocco, November.

Bazza, M. (2006) Back-to-Office Report, TCP/JOR/3001 (A), Food and Agriculture Organization of the United Nations, Near East Regional Office, Cairo, Egypt.

Below, R., E. Grover-Kopec, and M. Dilley (2007) Documenting drought-related disaster: A global reassessment. *The Journal of Environment and Development,* 19(3): 328-344.

Blaikie, P., T. Cannon, I. Davis, and B. Wisner (1994) *At Risk: Natural Hazards, People's Vulnerability, and Disasters.* London, Routledge Publishers.

Boko, M., I. Niang, A. Nyong, C. Vogel, A. Githeko, M. Medany, B. Osman-Elasha, R. Tabo, and P. Yanda (2007) Africa. Climate Change2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, eds., Cambridge University Press, Cambridge UK, 433-467.

Cruz, R.V., H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li, and N. Huu Ninh (2007) Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, eds., Cambridge University Press, Cambridge, UK, 469-506.

Cutter, S. (1996) Vulnerability to environmental hazards. *Progress in Human Geography*, 20(4), 529-539.

Davies, S. (2000) Effective drought mitigation: Linking micro and macro levels. In, D.A. Wilhite (ed.) (2000) Drought: A Global Assessment. New York and London: Routledge Publishers, 1:3-16.

De Pauw, E. (2005) Chapter 16: Monitoring Agricultural Drought in the Near East, In: V.K. Boken, A. P. Cracknell, and R.L. Heathcote, eds., *Monitoring and Predicting Agricultural Drought*, Oxford University Press: New York.

De Pauw, E. (2000) Drought Early Warning Systems in West Asia and North Africa. D.A. Wilhite, M.V.K. Sivakumar, and D.A. Wood (eds.). *Early Warning Systems for Drought Preparedness and Drought Management.* Proceedings of an Expert Group Meeting held in Lisbon, Portugal, September. World Meteorological Organization, Geneva, Switzerland.

Emergency Management Database (EM-DAT) (2008) The OFDA/CRED International Database, Universite Catholique de Louvain, Brussels, Belgium (www.emdat.be)

Economic and Social Commission for Western Asia (ESCWA) (2005) *ESCWA Water Development Report 1: Vulnerability of the Region to Socio-Economic Drought*, United Nations: New York.

FAO/NDMC (2008) A Review of Drought Occurrence and Monitoring and Planning Activities in the Near East Region, Food and Agriculture Organization of the United Nations and National Drought Mitigation Center (USA): Cairo, Egypt. 47 pp

Food and Agriculture Organization (FAO) of the United Nations (2007) AQUASTAT Main Country Database (http://www.fao.org/nr/water/aquastat/dbase/index.stm)

Food and Agriculture Organization (FAO) of the United Nations (2007a) High Level Conferences on World Food Security and the Challenges of Climate Change and Bioenergy, Thirty-Fourth Session, Food and Agriculture Organization of the United Nations, Rome, Italy, November.

Food and Agriculture Organization (FAO) of the United Nations (2007b) Capacity Building for a Drought Early Warning System in the Syrian Rangelands, TCP/SYR/3002 Terminal Statement, Near East Regional Office, Cairo, Egypt.

Food and Agriculture Organization (FAO) of the United Nations (2007c) National Drought Mitigation Strategy: Jordan. Terminal Statement Prepared for the Government of Jordan by the Food and Agriculture Organization of the United Nations. Cairo, Egypt.

Food and Agriculture Organization (FAO) of the United Nations (2006) National Strategy and Action Plan on Drought Preparedness, Management and Mitigation in the Agricultural Sector: IRAN. Terminal Statement prepared for the Government of the Islamic Republic of Iran by The Food and Agriculture Organization of the United Nations. Cairo, Egypt, P/JOR/3001.

Food and Agriculture Organization (FAO) of the United Nations (2004) Syrian Arab Republic: Capacity Building in Drought Early Warning System for the Syrian Rangelands. Syrian Project Document, TCP/SYR/3002 (T), May.

Food and Agriculture Organization (FAO) of the United Nations (2003) The state of food insecurity in the world: monitoring progress towards the World Food Summit and Millennium Development Goals.

Freiwan, M., and I. Al-Nsour (2007) National Study on Evidence and Impacts of Climate Change with a focus on Water Resources Management in Jordan. Draft Report. FAO Regional Office for the Near East, Cairo, Egypt

Gibbs, W.J. and Maher, J.V. (1967). Rainfall deciles as drought indicators. Bureau of Meteorology Bulletin no. 48. Commonwealth of Australia, Melbourne.

Guttman, N.B. (1998) Comparing the Palmer Drought Index and the Standardized Precipitation Index. Journal of the American Water Resources Association, 34(1): 113-121.

Hayes, M.J. (2008). Drought Indices, National Drought Mitigation Center, Nebraska, USA. (http://drought.unl.edu/whatis/indices.htm)

Hayes, M., M. Svoboda, D. Wilhite, and O. Vanyarkho (1999) Monitoring the 1996 drought using the SPI. Bulletin of the American Meteorological Society, 80:429-438.

Hayes, M.J., O.V. Wilhelmi, and C.L. Knutson (2004) Reducing drought risk: Bridging theory and practice. Natural Hazards *Review*, 2(106), May, 106-113.

Iglesias, A., A Cancelliere, D. Gabina, A. Lopez-Francos, M. Moneo, G. Rossi (eds.) (2007) Drought Management Guidelines, European Commission - EuropeAid Co-operation Office Euro-Mediterranean Regional Programme for Local Water Management (MEDA Water) Mediterranean Drought Preparedness and Mitigation Planning (MEDROPLAN), pp. 78.

Knutson, C., M. Hayes, and T. Phillips (1998) How to Reduce Drought Risk. Preparedness and Mitigation Working Group of the Western Drought Coordination Council, Lincoln, Nebraska (http://drought.unl.edu/handbook/risk.pdf).

Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel (2006) World Map of Koppen-Geiger Climate Classification, *Metoerol. Z.,* 15, 259-263.

McKee, T.B.; N.J. Doesken; and J. Kleist. 1995. Drought monitoring with multiple time scales. Preprints, 9th Conference on Applied Climatology, pp. 233–236. January 15–20, Dallas, Texas.

McKee, T.B.; N.J. Doesken; and J. Kleist. 1993. The relationship of drought frequency and duration to time scales. Preprints, 8th Conference on Applied Climatology, pp. 179–184. January 17–22, Anaheim, California.

Multihazard Mitigation Council (MMC) (2005) Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities, a council of the National Institute of Building Sciences: Washington, D.C. USA (http://www.nibs.org/MMC/mmcactiv5.html)

Nasr, M., (1999) Assessing Desertification and Water Harvesting in the Middle East and North Africa: Policy Implications, ZEF – Discussion Papers on Development Policy, No. 10, Center for Development Research, Bonn, July, pp. 59

National Drought Mitigation Center (2008) Understanding Your Risk and Impacts: Impacts of Drought (http://www.drought.unl.edu/risk/impacts.htm).

National Drought Mitigation Center (2008a) What is Drought. (http://drought.unl.edu/whatis/what.htm)

Oweis, T. (2002) International network to help countries cope with drought. *ICARDA Caravan*, 17, December.

Palmer, W.C. (1965). *Meteorological drought*. Research Paper No. 45. U.S. Weather Bureau, Washington, DC.

Pulwarty, R., and W. Riebsame (1997) The political ecology of vulnerability to hurricane-related hazards. In H.F. Diaz and R.S. Pulwarty (eds.), *Hurricanes: Climate and Socioeconomic Impacts*. New York, Springer, 185-214.

Ribot, J.C. (1996) Climate variability, climate change, and vulnerability: Moving forward by looking back. *Climate Variability, climate change, and social vulnerability in the semi-arid tropics*, J.C. Ribot, A.R. Magalhaes, and S.S. Panagides (eds.), Cambridge University Press, United Kingdom, 1-10.

Safarov, M.T., A.K. Kayumov, and A.Sh. Khomidov (2006) National Drought Management and Mitigation Plan for Tajikistan, State Hydrometeorology Agency – State Nature and Forestry Protection Committee (http://siteresources.worldbank.org/ EXTECAREGTOPRURDEV/Resources/573581-1164120557290/ TajikistanDroughtPlan-English.pdf)

Shafer, B.A. and Dezman, L.E. (1982). Development of a Surface Water Supply Index (SWSI) to assess the severity of drought conditions in snowpack runoff areas. In: *Proceedings of the Western Snow Conference*, Reno, NV, 19-23, April 1982, pp. 164-175. Colorado State University, Fort Collins, Colorado.

Shetty, S. (2006) Water, Food Security and Agricultural Policy in the Middle East and North Africa Region, Working Paper Series No. 47, Office of the Chief Economist, World Bank (http://siteresources.worldbank.org/INTMENA/Resources/ WP_47REPORT.pdf).

Tsakiris, G. A. Loukas, D. Pangalou, H.Vangelis, D. Tigkas, G. Rossi, and A. Cancelliere (2005) Chapter 7: Drought Characterization, Options Méditerranéennes, Series B, No. 58, pp. 85-102.

Tsakiris, G. (2004). *Meteorological Drought Assessment*. Report for the European Research Project MEDROPLAN (Mediterranean Drought Preparedness and Mitigation Planning), Zaragoza, Spain.

United Nations Convention to Combat Desertification (UNCCD) (1994) Text of the United Nations Convention to Combat Desertification (http://www.unccd.int/convention/text/convention.php).

United Nations Framework Convention on Climate Change (1992) United Nations Framework Convention on Climate Change [http://unfccc.int/resource/docs/convkp/conveng.pdf]

United Nations International Strategy for Disaster Reduction (UN/ISDR) (2007) Drought Risk Reduction Framework and Practices: Contributing to the Implementation of the Hyogo Framework for Action. United Nations secretariat of the International Strategy for Disaster Reduction, Geneva, Switzerland, 98+vi pp.

Wilhite, D.A. (2007) A Framework for a National Strategy and Action Plan for Drought Management - Hashemite Kingdom of Jordan. Submitted to Food and Agriculture Organization of the United Nations Near East Regional Office, Cairo, Egypt, April 15.

Wilhite, D.A. (2005) Mission Report to the Food and Agriculture Organization of the United Nations Near East Regional Office, TCP/JOR/3001 (T) on Strategy for Drought Management, Cairo, Egypt.

Wilhite, D.A. (2003) Drought policy and preparedness: The Australian experience in an international context, In: Beyond Drought: People, Policy and Perspectives, L. Botterill and M. Fisher, eds., CSIRO Publishing: Collingwood, Victoria, Australia

Wilhite, D. A. and M. H. Glantz. 1985. Understanding the drought phenomenon: The role of definitions. *Water International* 10:111-120.

Wilhite, D.A., M.J. Hayes, and C.L. Knutson (2005) Chapter 5: Drought Preparedness Planning: Building Institutional Capacity, In: *Drought and Water Crises: Science, Technology and Management Issues*, D. A. Wilhite, ed., Taylor and Francis, New York.

World Bank (2005) Drought: Management and Mitigation Assessment for Central Asia and the Caucasus, World Bank Europe and Central Asia Region, Environmentally and Socially Sustainable Development Department (http://go.worldbank.org/8J56VSUEZ0).

World Bank (2006) Drought: Management and Mitigation Assessment for Central Asia and the Caucasus, Regional and Country Profiles and Strategies, World Bank Europe and Central Asia Region, Environmentally and Socially Sustainable Development Department (http://go.worldbank.org/8J56VSUEZ0).

World Food Program (WFP) (2008) Where we work – Overview (http://www.wfp.org/country_brief/indexcountry.asp?country=400)
World Meteorological Organization (WMO) (2006) Drought Monitoring and Early Warning: Concepts, Progress and Future Challenges. WMO-No. 1006.