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Strengthening National Capacities to Manage Water Scarcity and Drought in West Asia and North Africa
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WORKING DRAFT BACKGROUND PAPER ON THE ANALYSIS, MAPPING AND IDENTIFICATION OF CRITICAL GAPS IN PRE-IMPACT AND PREPAREDNESS DROUGHT MANAGEMENT PLANNING IN WATER-SCARCE AND IN-TRANSITIONING-SETTINGS COUNTRIES IN WEST AISA/NORTH AFRICA

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Abbreviations

CDD	Consecutive Dry Days
CDs	Compact Discs
CIHEAM	International de Hautes Etudes Argonomiques Mediterraneennes
DIS	Desertification Information System (DIS)
DMCSEE	Drought Management Center for South-Eastern Europe
EDO	European Drought Observatory
EM-DAT	Emergency Events Database
EPA	Environmental Protection Authority
EROS	Earth Resources Observation and Science
FAO	Food and Agriculture Organization
FAPAR	Fraction of Absorbed Photosynthetically Active Radiation
FEWS NET	Famine Early Warning Systems Network
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information System
GWP	Global Water Partnership
HMNDP	High-Level Meeting on National Drought Policy
IAMZ	Mediterranean Agronomic Institute of Zaragoza
ICARDA	International Center for Agricultural Research in Dry Areas
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resource Management
MARH	Ministère de l'Agriculture, de l'Environnement et des Ressources Hydrauliques/Ministry of Agriculture, Environment and Water Resources.
MEDROPLAN	Mediterranean Drought Preparedness and Mitigation Planning
MOU	Memoranda of Understanding
NAP	National Action Plan
NAPA	National Adaptation Program for Action

NDMC	National Drought Mitigation Center
NDO	National Drought Observatory
NDVI	Normalized Difference Vegetation Index
NEMEDCA	Network on Drought Management for the Near East, Mediterranean and Central Asia
NGO's	Non-Governmental Organizations
NOAA	National Oceanic and Atmospheric Administration
NPC	National Project Coordinator
PDSI	Palmer Drought Severity Index
RJGC	Royal Jordanian Geographical Center
SA	Standard Approaches
SMAS	Maghreb Early Warning System to Drought
SPI	Standardized Precipitation Index
SWI	Standardized Water Indexes
SWSI	Surface Water Supply Index
TNA	Training Needs Assessments
TOT	Training of Trainers
UN	Untied Nations
UN/ISDR	United Nations International Strategy for Disaster Reduction
UNCCD	United Nations Convention to Combat Desertification
UN-DESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UN-ESCWA	United Nations Economic and Social Commission for Western Asia
USA	United States of America
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WMO	World Meteorological Organization

Figures and Tables

1.1-Introduction

Drought has become a more frequent and a major threat to human security in most of the Arab countries in transition located in arid and semi-arid areas of North Africa and Western Asia, as shown in Figure 1. Rainfall in this region is scarce and its distribution is very variable. This was especially seen during the last three decades within the region. The responses to severe drought in the region's countries are mainly ex-post (reactive) and tend to emphasize emergency relief, take effect after or during drought events and do not incorporate methods that support water conflict prevention. In response, the United Nations Department of Economic and Social Affairs (UN-DESA), in cooperation with the United Nations Economic and Social Commission for Western Asia (UN-ESCWA) and other United Nations cooperating agencies are implementing a regional capacity development project entitled "Strengthening National Capacities to Manage Water Scarcity and Drought in West Asia and North Africa". The project also answers a call for urgent action from the Rio + 20 Conference on Sustainable Development and the Outcome Document, The Future We Want, to take effective measures in dealing with drought and water scarcity as well as developing disaster risk reduction and community resilience. The project's timing coincides with the big effort from the UN-System, in particular WMO, the UNCCD and the FAO, in organizing the High-Level Meeting on National Drought Policy (HMNDP) during 11-15 March 2013 and the Final Declaration that encourage countries to develop and implement National Drought Management Policies. The declaration also urges related UN agencies and programmes to assist governments, especially the developing countries, in the development of National Drought Management Policies and their implementation.

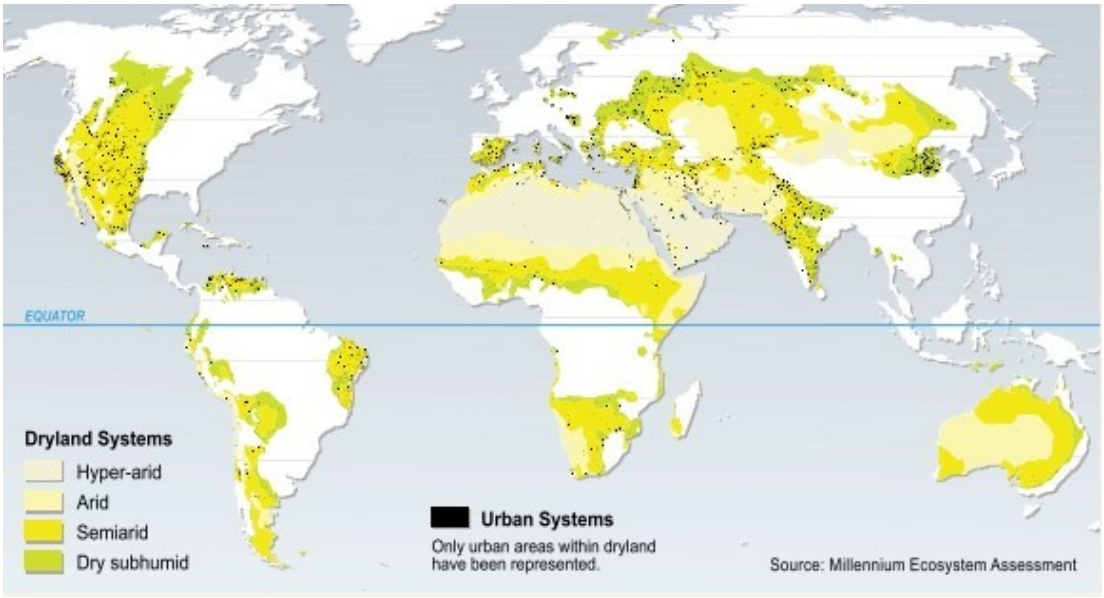


Figure 1- Countries Dry land Classification

1.2-Purpose and Objectives

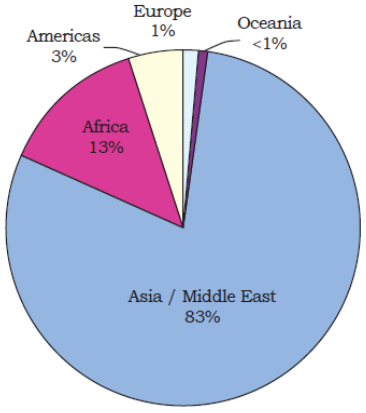
This project will lead to an increased awareness and knowledge of tools and methodologies for national planners, policymakers, institutions and stakeholders in countries experiencing transition in order to develop proactive drought management plans.

The study focuses on the following:

1. The existing resources and capacities of climate information and dissemination systems in the region;
2. The existing resources and capacities of drought monitoring and early warning systems in the region;
3. Experience with drought risk reduction programs including micro-finance and index-based insurance in the region;
4. Other pre-impact and preparedness measures and programs, including the application of drought resistant agriculture, and water resources conservation and management plans;
5. Current capacity of national planners and policy makers in West Asian and North African countries to prevent conflicts associated with water scarcity and drought.

1.3-Need of National Action and Drought Mitigation Strategy

The Centre for Research on the Epidemiology of Disasters has an emergency events database (EM-DAT)[1] , which includes statistics of the number of people killed or affected by natural disasters around the world. According to the published figures, 2 and 3, the distribution of the population affected by drought alone is 51% compared to 49% of all other disasters combined. This fact illustrates the severity of the issue of drought. It is also clear that the Middle East and Asia region is the most affected region in the world, being that 83% of the population in this area is affected by drought.



igure 2 Distribution of population affected by drought between 1990 to 2004 (Below, rt al 2007) [2]

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

2 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.

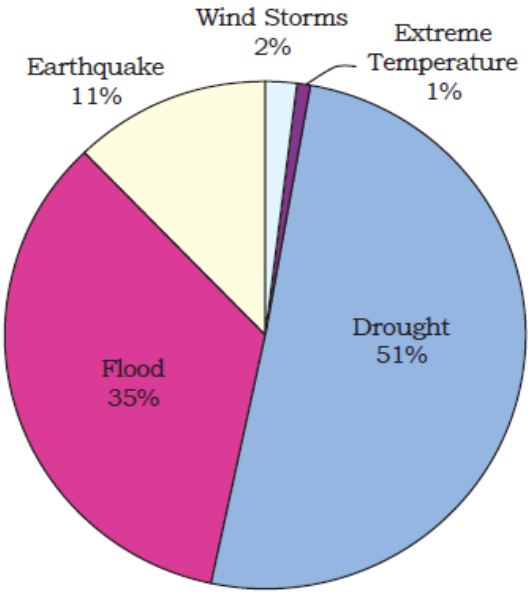


Figure 3 Distribution of population affected by natural disaster compared to drought between 1978 to 2004

In addition, the database reported that, in 1983, especially severe drought in Sudan killed an estimated 150,000 people and affected another 8.4 million people over the next several years. 8.6 million people were again affected in Sudan when they were struck by drought in 1991. More recently, the 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.

Drought management strategy is needed because it directly impacts a great number of humans and animals and a significant portion the environment. Drought often results in a shortage in water resources, crop failures, loss in livestock, an increase in diseases, reduction in hydropower, increased soil erosion, fire occurrences and an increase in social stress. All this leads to human losses, mass migration, reduced security, and potential wars. Therefore, there is a great need to develop and implement drought management strategies and action plans in the countries affected by drought in order to increase societal and environmental resiliency and enhance drought response and recovery capabilities. Clear examples of the effects of drought various countries in the Middle East are listed below.

Table 1: Examples on Effects of the 1998-2001 Drought in some of the North Africa and West Asia countries

Region	Country	
West Asia	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
	Lebanon	
	Syria	47,000 nomadic households forced to liquidate their livestock assets Urban water shortages and hydropower reductions
	Yemen	
North Africa	Egypt	
	Sudan	Sudan was struck by several droughts which resulted in famine across many parts and millions of people were affected.
	Libya	
	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)
	Algeria	
	Morocco	1 million hectares of cropland affected, resulting in 5 million tons of wheat imports in 2001 (US$500 million in total cereal imports)

Drought action plans can help decision makers to identify sectors that are vulnerable to drought, investigate management options before a crisis and increase readiness for the implementation of the most appropriate and cost-effective strategies available. This will foster a more informed decision-making process and the development of efficient drought management program. In addition, drought management strategies and action plans 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.

1.4-Existing Resources and Capacities and Dissemination Systems in the Region.

Most countries formed a national committee or commission to be responsible for drought management, action plans and dissemination systems. The committees include members from ministries, universities, NGO's and research centers. International organizations, mainly FAO, ESCWA, ICARDA and UNDP helped countries in North Africa and West Asia to develop their own drought management plans and provided them with expertise. Unfortunately, many of these countries lack the resources to implement the recommended action plans. According to the published studies, the existing resources and dissemination systems in the region (North Africa and West Asia) can be summarized as below:

Region	Country	Responsible Organization	Status of Drought Management Plan	Capacity Building and Dissemination systems
West Asia	Jordan	Ministry of Environment leading the National Steering Committee from ministries, NGO's, and Universities.	Drought strategy and action plan Exist since 2006, it will be updated in nearest future	Needed Capacity Building In the following areas ❖ Drought monitoring and early warning systems ❖ Preparedness and mitigation actions ❖ Standard approaches to vulnerability and impact assessment ❖ Emergency response and recovery measures ❖ UNDP, and GEF funded a project to identify priority research topics in combating desertification, study is ready in 2013[3].
	Lebanon	Ministry of Agriculture	To be checked	
	Syria	Ministry of Agriculture Agrarian Reform leads Drought Steering Committee	To be checked	FAO helped in developing early warning system ❖ Monthly drought bulletins have been produced regularly since 2005 in both English and Arabic; ❖ The technical capacity to operate a drought warning system in Syria was successfully developed.

3 Policy Oriented National Priority Research Topics in Climate Change, Biodiversity, and Combating Desertification, UNDP, gef (2013-2020)

				Needed Capacity Building In the following areas ❖ Drought monitoring and early warning systems ❖ Preparedness and mitigation actions ❖ Standard approaches to vulnerability and impact assessment ❖ Emergency response and recovery measures
	Yemen	Ministry of Water and Environment	There are strategies for Biodiversity and for Climate Change but no Strategy for Combating desertification.	Needed Capacity Building In the following areas ❖ Drought monitoring and early warning systems ❖ Preparedness and mitigation actions ❖ Standard approaches to vulnerability and impact assessment ❖ Emergency response and recovery measures
North Africa	Egypt	Ministry of Environment and Ministry of Agriculture	To be checked	
	Sudan	Ministry of Agriculture	To be checked	
	Libya	Ministry of Agriculture	To be checked	
	Tunisia	Ministry of Environment and Ministry of Agriculture leading the National Commission from ministries , NGO's, and Universities,	Drought strategy, and action plan exist since 1987	There is drought Management System, which include database, and dissemination system Needed Capacity development in the following areas

		Also there are Regional commissions in all 24 governorates.		❖ Drought monitoring and early warning systems ❖ Preparedness and mitigation actions ❖ Standard approaches to vulnerability and impact assessment ❖ Emergency response and recovery measures
	Algeria	Ministry of Agriculture	To be checked	
	Morocco	National Drought Observatory (NDO)	Drought Strategy and Action Plan Exist	There is drought information and dissemination system

1.5-Assessment of Drought Management Knowledge and Practices and Identify Critical Gaps

The response to drought, drought management and practices vary between countries. Some countries they are well advanced by having drought management system while others still lack drought management strategy or policy. Below is an assessment of the drought management knowledge and practices in some of the countries under this study.

1- Jordan

Jordan is one of the more vulnerable countries to drought. This is due to reliance of the country on groundwater and generated runoff from rainfall as the main sources for water supply. Some of the drought indicators in Jordan include:

- Water supply shortages in the summer
- Dried springs (decreased discharges in 850 springs)
- Decrease of groundwater levels by 1 m/year on average over the last 30 years.
- Decrease in the amount runoff
- Change in agricultural patterns in the Jordan Valley and highlands due to drop in rainfall
- Increase of imported fruits and vegetables, from Syria, Lebanon, and Egypt
- Jordan's southern highlands represent the countries poorest – mainly farmers and women where communities are severely affected by cumulative impacts from extensive weather related disasters, such as flash flood and drought (Jordan Rural Poverty Fact Sheet - International Fund for Agricultural Development, 2010 [4]

The government of Jordan requested FAO's 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. A National Project Coordinator (NPC) from the Ministry of Agriculture was first appointed to lead the project and assist in recruiting committee members. 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 members of the National Steering Committee included:

- 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

4 Jordan Rural Poverty Fact Sheet - International Fund for Agricultural Development, 2010

The Ministry of Environment then took the lead and created policies in cooperation with the United Nations Development Programme (UNDP) and the Global Environment Facility, a financial mechanism for United Nations (UN) conventions on environment. The policies also suggest amendments to Jordan's environmental protection laws to strengthen its compliance with three UN conventions on biodiversity, climate change and desertification.

The ministry of environment formed a new committee to be responsible for the development of a national strategy for drought. The committee was led by the ministry of environment and reported to the minster of environment. This committee is comprised of 20 members from governmental ministries and institutions, universities, NGO's. The full list of members is listed in Annex 1. The committee meets every three months to discuss a work agenda developed by the ministry of environment.

The consultant met with some of the members from the national committee (listed in the index) as well as UNDP and FAO, and IUCN organizations to evaluate their programs on drought management in Jordan..

The ministry of environment is working on implementation of the three Rio conventions:

- National Strategy and Action Plan to Compact Desertification , 2006- under update [5]
- National Policy on Climate Change, 2013 [6]
- National Strategy on Biodiversity

Under the desertification component, the immediate obligation from the United Nations Convention to Combat Desertification (UNCCD) is to prepare a national action plan to combat desertification. With support from UNDP, The ministry of environment developed a national strategy and action plan to combat desertification in 2006. The ministry is planning to update this strategy in the nearest future.

The NAP includes six major programmes that are mainly “project-based”. However, these programs and the proposed projects provide a framework for an action plan to combat desertification. Each program has several projects with justification, activity, implementing agencies and initial budget. The proposed programs are:

1. Desertification information system (DIS),
2. Drought prediction and Desertification control,
3. Capacity building and institutional development,
4. Restoration of degraded ecosystems of rangelands and forests,
5. Watershed management, and
6. Human, social and economic development initiatives.

The Ministry of Agriculture in cooperation with Food and Agricultural Organization of the United Nations (FAO) implemented a project entitled “The drought mitigation strategy in Jordan.” This project ended in mid 2007[7] . A national strategy and action plan for drought management was prepared and final recommendations and conclusions were discussed in a national workshop. Recommendations included:

5 National Strategy and Action Plan to Combat Desertification, Ministry of Environment/UNDP, 2006
6 Jordan's Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), UNDP, gef, 2009.
The National Climate Change Policy of the Hashemite Kingdome of Jordan, UNDP, gef, 2013-2020.

7 National Strategy and Action Plan to Combat Desertification, UNDP, 2006.

1. Establishing a high committee headed by the Prime Minister and membership of several ministries and institutions such as Royal Jordanian Geographical Center (RJGC), Meteorological Department, Research Centers, Governmental and non-governmental organizations (NGOs).

2. Formulation of the following sub-committees: technical, follow-up and evaluation of risk committees with membership of the mentioned institutions to supervise whatever effects drought occurrence, establishing standards for declaring drought and writing reports for the high committee.

3. Training programs on drought issues is vital for the sustainability of the work. It is also important to have an independent budget and train local communities so that they can be involved in decision-making and drought mitigation.

4. Signing of MOU's within different institutions in order to clarify duties and responsibilities of each party.

5. Training of Trainers (TOT) in order to clarify the concepts and the vision of drought issues

The following gaps were identified in Jordan drought management system:

- No independent body or unit responsible for drought management
- No standard management approach
- No regional sharing of drought information
- No drought projection
- No drought management system. There is only a strategy and the ministries are not obliged to include its recommendations in their plans.
- The Drought National Action Plan (NAP) is still a new document that requires an effective awareness program and a resource mobilization strategy. It can be considered as a framework for action at the country level. A precise reference was made to it in the National Agenda.
- The link between desertification and poverty is missing.
- No database for drought data collection on national scale.
- No early warning or monitoring systems.
- No Mitigation plan.
- No link between desertification, and migration and conflicts.
- The Steering committee meets every 3 months. Members are absent frequently and the meeting's agenda items are not met within a timely fashion.
- The involved ministries and organizations do not include the actions stated in the NAP in their plans or projects. In each ministry, there is no unit specialized and responsible for drought issues, rather the responsibilities are scattered between various sections.
- The ministry of environment's role is limited to calling meetings and updating strategies and policies concerning drought. There is a need to expand this role in order to establish coordinate between various ministries so that the drought action plans are included in the ministries plans and projects.
- The members in the steering committee changes frequently, which affects the follow up and understanding of the agreed upon issues.
- The Metrological department is not a member of the steering committee.

2- Tunisia

In Tunisia, the ministry of agriculture and environment are the ones responsible on drought issues. There has been a drought management system to reduce the effects of the drought since 1987. The system was adopted when drought events occurred during 1987-1989, 1993-1995 and 2000-2002. During 1999, Tunisia published the first guideline on drought management entitled "Guide Pratique de la Gestion de la

Sécheresse en Tunisie" (Louati et al., 1999) [8]. The guideline was elaborated by referring to the drought management system and by analyzing the data and information recorded during the drought periods of 1987-1989 and 1993-1995. This guideline consists of methodological approaches, identification of principal drought indices, description of drought preparedness and management processes, and maps of intervening parties. The drought management system in Tunisia has 3 major successive steps:

1. Drought Announcement: Referring to meteorological, hydrological and agricultural indicators as observed in the different regions affected by drought and transmitted by the agricultural, economic, and hydrologic districts relevant to Ministère de l' Agriculture, de l' Environment et des Resources Hydrauliques/Ministry of Agriculture, Environment and Water Resources (MARH). A drought announcement is established by means of a circumstance memorandum.
2. Warning: This announcement, qualified as warning note, is transmitted to the MARH Minister, who proposes a scheduled operations plan to the National Commission (committee), which is composed by decision makers and beneficiaries.
3. Action implementation: The National Commission is in charge of supervision of the execution of all the operation actions, in strong collaboration with the regional and specialized committees. The National Commission also supervises all operations when the drought is over.

According to the published studies and information on Tunisia drought management system, the strengths and weaknesses of Tunisia drought management system can be summarised as follows:

Strengths

- A high Presidential interest and support is devoted to the drought mitigation system in Tunisia.
- The approach based on three drought management phases (before, during and after drought process), is a very important strategy and relevant to the basic elements of drought management theory.
- Capital productive sharing and preservation.
- Sustainability of farmers' incomes.
- Integrated and optimized water resources management in Tunisia, especially during drought depending on its intensity and duration.
- Water saving is a national policy

Weaknesses

- No independent body or unit responsible on drought management
- No standard management approach
- No regional sharing on drought information
- No drought projection
- The financial incidences are supported by the State budget because of the absence of insurance systems linked to drought and private sector contribution is limited.
- Updating the drought mitigation plan is based until 2003 on simple note-taking and observation findings, without any wide-spreading evaluation study. The latter would be realized by an in-process study "The climatic changes and their impacts on the agricultural sector and the ecosystems".
- The deficiency in the relations between the different institutions that provide information and data about water, which should be resolved by the establishment of the Unified Water Resources National Information System in the near future.

8 Louati, M.H., Khanfir, R., Alouini, A., El Echi, M.L., Frigui, H.L. and Marzouk, A. (1999). Guide pratique de gestion de la sécheresse en Tunisie: Approche méthodologique. Ministère de l'Agriculture de Tunisie, 94 pp.

3- Morocco

Morocco suffered from several droughts that sharply affected the production of basic crops such as cereal. For example, as a result of drought in 2001, approximately 1 million ha of cropland was affected, which caused the country to import approximately 5 million tons of wheat and allocate more than $500 million for their cereal imports (FAO, 2004) [9]. In addition, drought conditions in Morocco can lead to food shortages and rural malnutrition, herds perishing or being slaughtered for lack of forage, farmers temporarily abandoning their land and flocking to the cities, and increased wind erosion and desertification (Swearingen and Bencherifa, 2000.) [10]

At the national level, the government of Morocco established a National Drought Observatory (NDO) in 2001 with the goal of collecting, analyzing, and delivering drought-related information, which 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.

The NDO was placed within the Institute Agronomique et Veterinaire Hassan II, an academic institution, to facilitate interdisciplinary collaboration and give the centre a degree of neutrality in regard to policy decisions. Over time, the mandate of the NDO has broadened into playing a central role in drought planning activities in the country.

The main gaps in Morocco drought systems can be summarised as follows:

- No independent body or unit responsible on drought management
- No standard management approach
- No regional sharing on drought information
- No drought projection
- Weak coordination between various ministries and organizations
- In each ministry, there is no unit specialized and responsible on drought issues, rather the responsibilities are scattered between various sections.
- Mitigation plans are mainly for emergency and not updated regularly
- No early warning system
- No monitoring system
- No standard management approach

4- Syria

Syria is a semi arid country that has suffered from several drought events. The 1999-2001 drought was the worst in four decades, seriously affecting crop and livestock production in the Syrian Arab Republic, which, in turn, had serious repercussions on the food security of a large segment of the population as incomes fell sharply, particularly among the rural small farmers and herders (FAO, 2004a[11]; ESCWA, 2005[12]). For example, in 1999, drought played a role in forcing approximately 47,000 nomadic households

9 Description of drought management actions [Part 1. Components of drought planning. 1.3. Methodological component] CIHEAM, 2007

10 Swearingen, W.D., and A. Bencherifa (2000) Chapter 21: An Assessment of the Drought Hazard in Morocco, In D. A. Wilhite, ed., Drought: Volume I A Global Assessment, Routledge: New York.

11Food and Agriculture Organization (FAO) of the United Nations (2004a) Syrian Arab Republic: Capacity Building in Drought Early Warning System for the Syrian Rangelands. Syrian Project Document, TCP/SYR/3002 (T), May.

12Economic 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.

(329,000 people) to liquidate their livestock assets, which was a primary source of long-term income (De Pauw, 2005)[13]. Therefore, many families in the rangelands eventually required food aid during the drought years (FAO, 2004a)[14]. In addition, according to ESCWA (2005)[15], urban populations, particularly in the southern part of the Syria, suffer from water shortages due to decreases in the Euphrates River. This resulted in dry of irrigation canals and drop in hydro-powered generation.

Eventually, the economic growth was affected as agricultural production fell sharply, reducing the contribution of agricultural income to GDP. Although the government made extensive efforts to reduce the effects of the drought, especially on herders, by providing extra resources, feed rations, water and veterinary supplies, they were inadequate given the drought's scale and severity and the country's limited resources.

Between 2004 and 2006, FAO worked with the government of Syria to develop an effective early warning system for drought in the Syrian rangelands (FAO, 2007a)[16]. The project had the objectives of: training national staff in the collection, analysis, interpretation, and implementation of data in the Syrian Ministry of Agriculture and Agrarian Reform, and strengthening institutional capacity in drought early warning with particular emphasis on pastoralists and agro-pastoralists of the Syrian Steppe and its margins. The Syrian project was completed in 2006. As a result, an early warning system office and a steering committee were organized; a series of drought indicators were identified.

The early warning 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.

The main gaps in Syrian drought systems can be summarised as follows:

- No independent body or unit responsible on drought management
- No standard management approach
- No regional sharing on drought information
- Weak coordination between various ministries and organizations
- In each ministry, there is no unit specialized and responsible on drought issues, rather the responsibilities are scattered between various sections.
- Mitigation plans are mainly for emergency and not updated regularly
- No early warning system
- No monitoring system
- No standard management approach

13De 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

14Food and Agriculture Organization (FAO) of the United Nations (2004a) Syrian Arab Republic: Capacity Building in Drought Early Warning System for the Syrian Rangelands. Syrian Project Document, TCP/SYR/3002 (T), May.

15Economic 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.

16Food and Agriculture Organization (FAO) of the United Nations (2007a) Capacity Building for a Drought Early Warning System in the Syrian Rangelands. Terminal Statement prepared for the Government of Syria by The Food and Agriculture Organization of the United Nations. Cairo, Egypt, TCP/SYR/3002

5- Yemen

Yemen is highly vulnerable to drought impacts. This is a serious concerns as Yemen's economy largely depends on its rural natural resources. According to the Yemen Environment Authority, moreover, more than 75% of the population is rural-based and engaged in farming and pastoralism, and hence highly reliant on favourable climatic conditions for their livelihoods. Recently, Yemen suffered from increased drought frequency, increased temperatures, and changes in precipitation patterns leading to degradation of agricultural lands, soils and terraces.

For example, the 1990-1991 drought had a great impact on the Yemeni economy and population. As agricultural production fell sharply, economic growth was affected by the reduction of agricultural income's contribution to GDP. The agricultural sector registered significant yield losses, resulting in widespread farm losses and increased poverty in rural areas. The drought highlighted the vital role that adequate rainfall and water resources play in keeping Yemen's economy profitable and sustainable, as Yemen has no perennial rivers, and depends on rainfall from water run-off and groundwater recharge. The drought had serious repercussions on the food security of a large segment of the population. According to the World Bank, a sizeable portion of the population remains economically vulnerable to falling into poverty due to drought, as the Yemeni agricultural sector provides employment for 58 per cent of the population.

The responsibility of drought and climate change issues in Yemen belongs to the Ministry of Water and Environment and Environment Protection Authority (EPA). Some of the international organizations such as UNDP, GEF, and IUCN helped Yemen in developing strategy on climate change and biodiversity. However still there are no sustainable land management strategies to combat desertification and land degradation. The primary goal of the Yemen National Adaption Program of Action (NAPA)[17] is to identify priority measures to adapt to drought variability, and translate them into project based activities that can address Yemen's urgent needs for adapting to the adverse impacts of drought. Some of the key elements of the process include adequate stakeholder representation in all phases of the process. The main weaknesses in Yemen related to Drought Management System are as follows:

- No independent body or unit responsible on drought management
- No standard management approach
- No regional sharing on drought information
- No drought projection
- Weak institutional structures and environmental legislations
- Lack of explicit policies to facilitate the implementation of Yemen Plans
- Lack of appropriate data collection
- Lack of adequate monitoring,
- Difficulties experienced in accessing databases,
- Lack of technical capacity to analyze and manipulate drought data
- Lack of quality assurance)
- Inadequate institutional, technical and financial capacity to develop, modify, or interpret existing models and methodologies,
- Lack of financial sources to implement the adaptation measures
- Weak coordination between various ministries and organizations
- In each ministry, there is no unit specialized and responsible on drought issues, rather the responsibilities are scattered between various sections.
- Mitigation plans are mainly for emergency and not updated regularly
- No early warning system

17 Yemen National Adaptation Program of Action, Republic of Yemen Environment Protection Authority, 2009

❖ No monitoring system

2. Review Standard Approaches in Drought Management

Specific definitions of drought may vary across sectors and regions. Drought generally originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector (Knutson et al., 1998)[18]. More specifically, Wilhite and Glantz (1985)[19] describe three types of droughts:

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 a 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.

The following main indicators reflect impacts from the three types of drought. Figure 4 shows the relation between various indicators; Table 3 Indicators Relationship

Table 3: List of Drought Main Indicators

Shortage in Water Resources
Increase in Diseases
Agricultural Losses
Livestock Losses
Drop in Hydropower
Soil Erosion
Drop in income
Stress on governments budgets
Society Instability

18Knutson, 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).

19Wilhite, D. A. and M. H. Glantz. 1985. Understanding the drought phenomenon: The role of definitions. Water International 10:111-120.

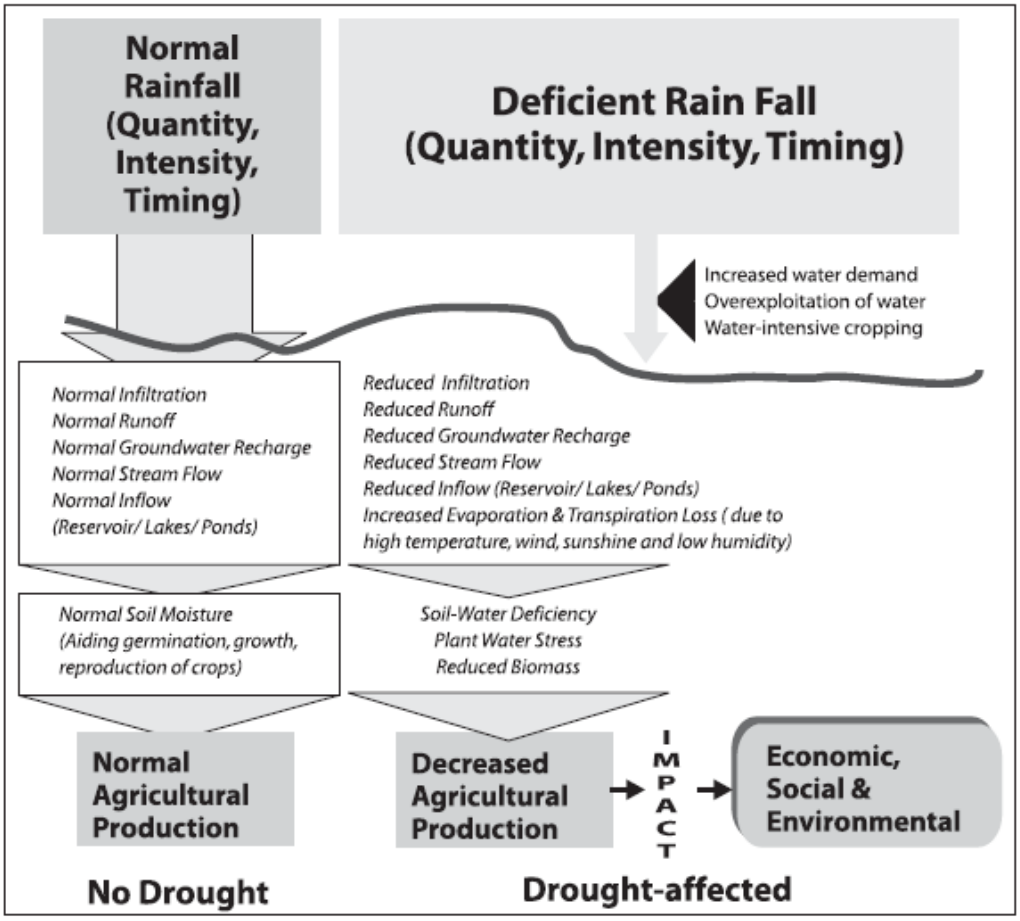


Figure 4- Relation between various Indicators

2.1 Standard Approaches Vulnerability and Application

The standard approaches in drought management include two main approaches:

- Reactive Approach
- Proactive Approach

Reactive Approach:
This approach is based on the implementation of measures and actions after a drought event has started and is perceived. This approach is taken in emergency situations and often results in inefficient technical and economic solutions. This is because actions are taken with little time to evaluate optimal actions and stakeholder participation is very limited.

Proactive Approach:
This approach includes all the measures designed in advance, with appropriate planning tools and stakeholder participation. The proactive approach is based both on short term and long term measures and includes monitoring systems for a timely warning of drought conditions. It can be considered an approach to "manage risk". A proactive approach consists of planning the necessary measures to prevent or minimize drought impacts in advance. Such an approach includes preparedness of planning tools which

enable the consequences of a possible water emergency to be avoided or reduced, as well as the implementation of such plans when a drought occurs.

The proactive approach foresees a continuous monitoring of hydrometeorological variables and of the status of water reserves in order to identify possible water crisis situations and to apply the necessary measures before a real water emergency occurs. Nevertheless, if it is not possible to avoid a water crisis that appears as natural public calamity (after a government declaration), the Drought Contingency Plan is implemented until the establishment of normal conditions. It is evident that a proactive approach, even if more complex, is more efficient than the traditional approach, since it allows drought mitigation measures (both long term and short term) to be defined in advance, improving the quality of the interventions.

Table 4: Standard Approaches

Approach	Characteristics	Limitations
Reactive	Based on the implementation of actions after a drought event has occurred and is perceived. Taken in emergency situations but not based on a contingency plan	Often results in inefficient technical and economic solutions since actions are taken with little time for evaluating optimal actions. Limited stakeholder participation
Proactive	Actions designed in advance, with appropriate planning tools. Includes stakeholder participation. Provides both short and long term measures and includes early warning systems. Includes a contingency plan for emergency situations.	The ineffective coordination and cooperation between institutions and the lack of policy to support and revise the proactive plan may lead to an inadequate planning.

The implementation of a proactive approach implies drafting plans in which the mitigation measures are clearly defined together with the instructions for their implementation. The proactive approach is recommended for drought management and will reduce the drought impacts and risks. This implies the following standard steps below:

- Establish a specialized unit or section which is responsible for drought management. It can be within one of the key ministries such as Ministry of Agriculture or Environment or Water.
- Establish Steering Committee from relevant ministries, NGO's, Universities, Research institutes, Farmers associations, and private sector. The committee needs to have competences at different levels of implementation of policy and expert analysis. It might be helpful to have two committees: Policy committee and Technical committee.
- Classify and characterize the geographical area into drought zones according to vulnerability (High, Medium, Low). Drought characterization should also include a previous diagnosis of the sources, scales and reliability of the data used in the analysis. The correct drought characterization provides decision makers with a measurement of the abnormality of historical weather variability and its effects on a region. methodological component is essential for stakeholders.
- Develop GIS based database to house maps and drought information
- Collect metrological, hydrological, biological and socio economic data within the geographic zones.

- Collect and share transboundary and regional metrological data through direct regional cooperation programs or WMO joint programs or database
- Project potential future droughts based on collected metrological data using climate change projection models
- Analyze the hydrological data and identify the impact of changes in rainfall and temperature on the each zone based on the drought projection.
- Develop monitoring system a regular monitoring at fixed stations in each zone will continue. Drought monitoring has the objectives to warn about a possible incoming drought, providing adequate information for an objective drought declaration and for avoiding severe water shortages, therefore this
- Update and modify the drought management plan based on new information on regular basis.
- Develop early warning system that incorporate the drought projections in the classified zones and alert the various stockholders on regular basis. The warning system can be categorized into 4 mains stages; alert, alarm, emergency, and recovery.
- Measure the impact of droughts in each zone and estimate the losses in each of the above listed indicators

Drought management depends on indices to detect drought conditions, and thresholds to activate drought responses. Indices and thresholds are important to detect the onset of drought conditions, to monitor and measure drought events, and to quantify the hazard. The appropriate drought index is selected according to the type of drought. Indices may be considered as general or specific depending on the utility for which they have been devised. It is understood that this distinction is difficult. Some of the indices, however, are more appropriate for monitoring and some for the analysis of historical drought events.

The most commonly applied drought indices include the Standardized Precipitation Index (SPI), the Palmer (Drought Severity Index PDSI) and Deciles due to their simplicity. It was concluded that the easiest index to use for monitoring purposes is the SPI, which is based on a single meteorological parameter (precipitation) and the RDI that also includes evapotranspiration. Recent advances in remote sensing provide products that have a large potential as drought indices. The NDVI is widely used for monitoring and forecasting crop production world-wide and by agricultural insurance companies.

2.2 Impact of Standard Approaches on Drought Management Effectiveness

The adoption of standard approaches (SA) in drought management will minimize drought risk and impacts and will facilitate the decision making process. This can be seen in several areas:

- Standard approaches facilitate the step-by-step execution of drought management plans, which minimizes the risk of missing any part in the management process.
- Standard approaches minimize errors and make the projections more efficient
- Standard approaches help to improve the quality of data and analysis procedures which reflects on the projections and actions to be implemented.
- Standard approaches increase readiness to face drought in a short period of time, which will reduce drought impacts.
- The standard approach fosters implementation of standardized categories of alerts for different types of events. It also identifies the situations in which alerts should be sent, which prepares stakeholders for action.
- The SA provides guidelines in a comprehensive manner. It provides a standard method for receiving reports and information about drought situations from the concerned Ministries/ Departments/Agencies and State Governments and thereafter issuing alert messages to all concerned.

This will help in the case that there is a change of staff or committee members so all will follow the same procedures.

- ❖ The SA also standardizes the information requirements for various event categories. This will facilitate the communication between various ministries.
- ❖ The SA establishes protocols for alerting decision makers and the Cabinet Secretariat. It also outlines procedures for receiving and analyzing reports and issuing alerts through various modes to the concerned authorities .
- ❖ The SA is designed to specify actions that are required to be taken for reporting on drought events .
- ❖ The SA specifies duties and responsibilities for the personnel working on drought management.

Using standard approaches in developed countries like Europe and the United States showed that the impact and risk from such events were much less than the countries that did not use standard approaches. This is clear in all disaster events in general and droughts in particular.

3. Effective Drought Monitoring and Early Warning Systems in the Region

3.1 The Importance of and Need for Early Warning Systems

Early warning is the provision of timely and effective information, through identified institutions, that allow individuals at risk of a disaster to take action to avoid or reduce their risk and prepare for effective response.

As mentioned before, most countries in North Africa and West Asia suffered and will suffer from the impacts of drought on human life, livestock, agriculture, water resources, and environment. Furthermore, published results from climate change models indicate that this region will continue to face serious droughts in the future.

The IPCC Fourth Assessment Report (2007)[20] synthesized the simulation results from 21 models. Results indicated that West Asia and North Africa are likely to see a 3.5-7 centigrade temperature increase in the last 20 years of this century compared to the temperature of the last 20 years of the 20th century (Fig. 2, top row). In terms of precipitation, most of this region probably has had less rain (up to 50% less) in the last 20 years of this century compared to that of the precipitation in 1980-1999.

IPCC (2012)[21] also depicts the global drought scenarios for 2046-2065 and 2081-2100. Standard deviation is used for the comparison, and it is likely that there will be more Consecutive Dry Days (CDD) and higher negative soil moisture anomalies (i.e. soil moisture deficit) in West Asia and North Africa in the latter half of the 21st century.

According to the Food and Agriculture Organization (FAO, 2007),[22] future drought leads to the following:

20Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). CambridgeUniversity Press, Cambridge, United Kingdom and New York, NY, USA.

21 Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (Eds.). CambridgeUniversity Press, The EdinburghBuilding, Shaftesbury Road, CambridgeCB2 8RUENGLAND, 582 pp.

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

- A decrease in water availability of up to 40 mm per year by 2080-99
- An increase in the number of dry days in most portions of the region
- A decrease in the number of frost days and an increase in heat waves in more continental areas.
- A decrease in growing seasons
- A 3ºC 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.

In light of the above projections and considering the current trend and future projections for drought situation in West Asia and North Africa, drought early warning systems in global, regional and national levels are necessary because these systems provide the timely and reliable information necessary to make decisions regarding the management of water and other natural resources. Preparedness and early warning are the key factors for later operational management and help to reduce social vulnerability to drought by:

• Establishing a drought plan
• Identifying alert mechanisms
• Establishing the links between drought, water and development policies

Scientific advances in seasonal to inter-annual climate forecasts and monitoring systems create the possibility to implement early warning systems in many regions, especially where the data and information systems are in place.

3.2 Drought Early Warning Systems in Developed Countries

Effective drought monitoring and early warning systems are an integral part of efforts worldwide to improve drought preparedness. Timely and reliable data and information is the cornerstone of effective and proactive drought planning. However, the UN/ISDR (2006)[23] recently completed a global survey and found that early warning systems for drought are more complex than those for other hydro-meteorological hazards and are, consequently, less developed globally. Monitoring drought presents some unique challenges because of drought's distinctive characteristics (i.e., low onset, non-structural impacts, and large spatial extent). Therefore, choosing the appropriate indicators of drought and formulating those measurements into an effective early warning system can be challenging.

The drought early warning and monitor system developed by the Drought Management Centre for South-eastern Europe (DMCSEE) and the European Drought Observatory (EDO) by European Commission Joint Research Centre uses a combined drought indicator, which is based on SPI, soil moisture and FAPAR. A map of droughts in Europe for the 2nd ten-day period of March 2013 is presented in Figure 5. The color scales represent different drought scenarios: *Watch* means a relevant precipitation shortage is observed; *Warning* means this precipitation translates into a soil moisture anomaly; and *Alert* signifies when these two conditions are accompanied by an anomaly in the vegetation condition.

23United Nations International Strategy for Disaster Reduction (UN/ISDR) (2006) Global Survey of Early Warning Systems: A Report Prepared at the Request of the Secretary General of the United Nations (http://www.unisdr.org/ppew/info-resources/ewc3/Global-Survey-ofEarly-Warning-Systems.pdf).

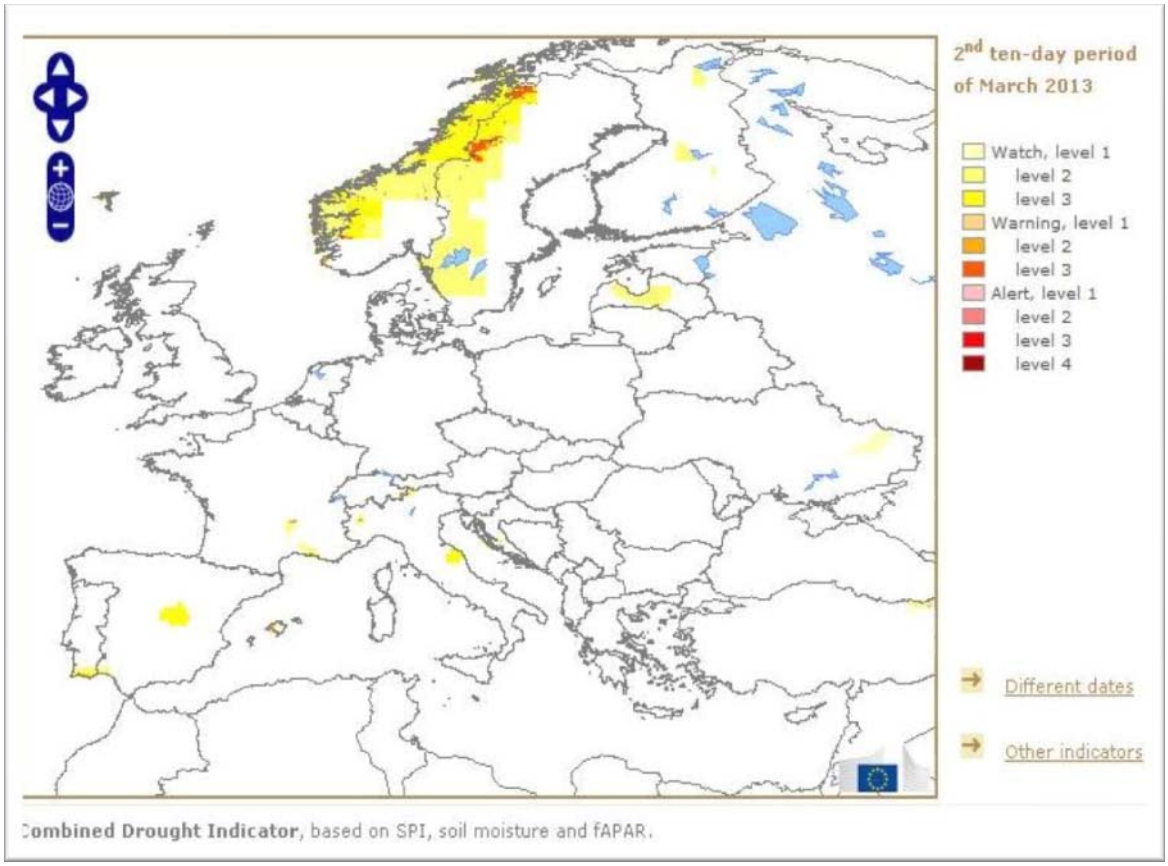


Figure 5 - The European drought monitoring map.

In the US, a partnership emerged in 1999 between the National Oceanic and Atmospheric Administration (NOAA), the U.S. Department of Agriculture (USDA), and the National Drought Mitigation Center (NDMC) at the University of Nebraska-Lincoln with the goal of improving the coordination and development of new drought monitoring tools. The U.S. Drought Monitor (USDM) became an operational product on August 18, 1999. The USDM is maintained on the website of the NDMC (http://droughtmonitor.unl.edu/). This website has evolved into a web-based portal for drought and water supply monitoring. Figure 6 shows a drought monitoring map for the US released on Mar 28, 2013.

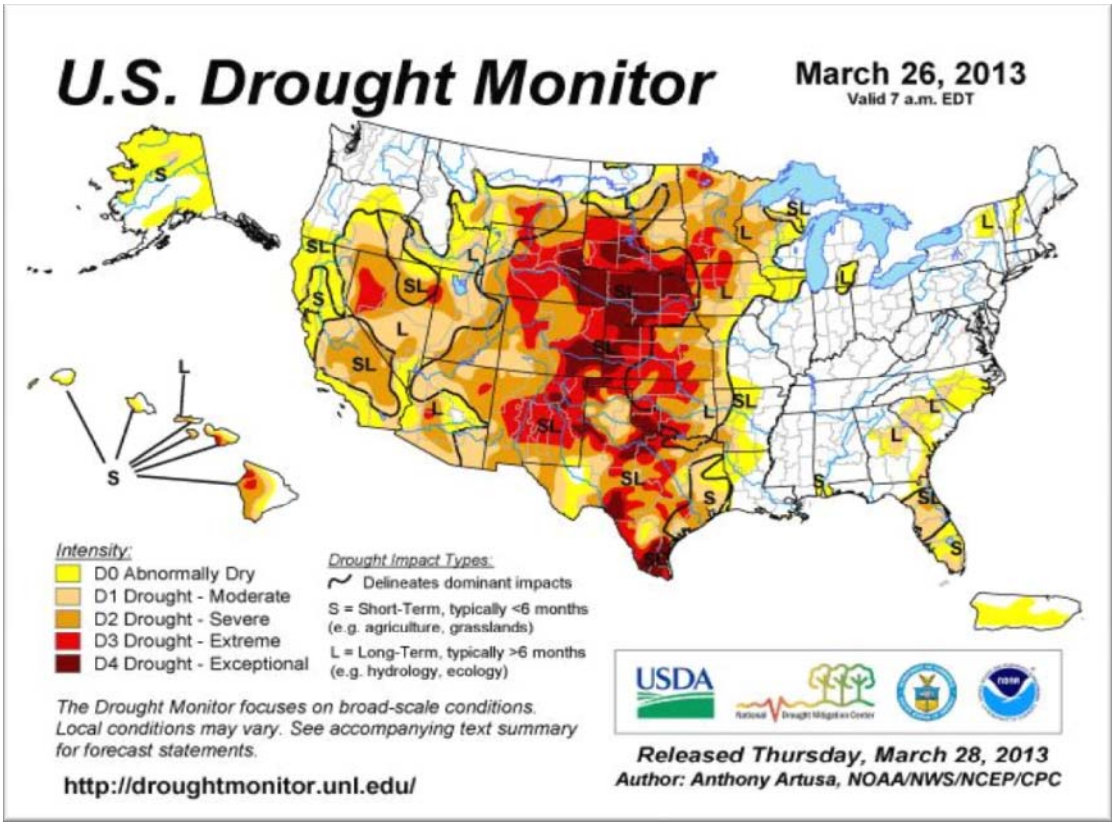


Figure 6- The U.S. Drought Monitoring map

In China, the National Climate Center is in charge of the monitoring, diagnosing and predicting the timing of the droughts. Figure 7 shows a map on the website, which depicts the precipitation anomalies percentage national map on Apr 2nd, 2013. For the widely used indicators, such as SPI and PDSI, there is no related information found on the website.

Another example is the Africa drought monitoring system shown in Figure 8. It shows changes in rainfall and temperature on regular basis and in short durations. As we know, a single variable is not enough for monitoring drought. It is suggested that drought indicators should be introduced for better monitoring.

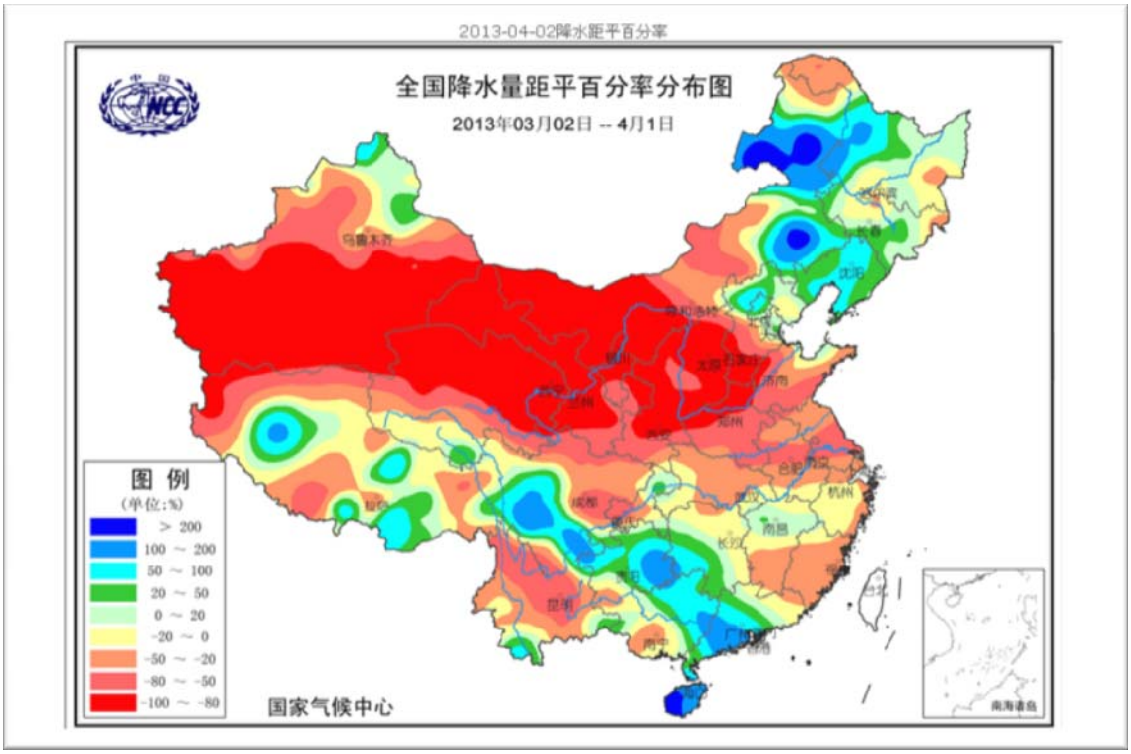


Figure 7- China's drought monitoring map.

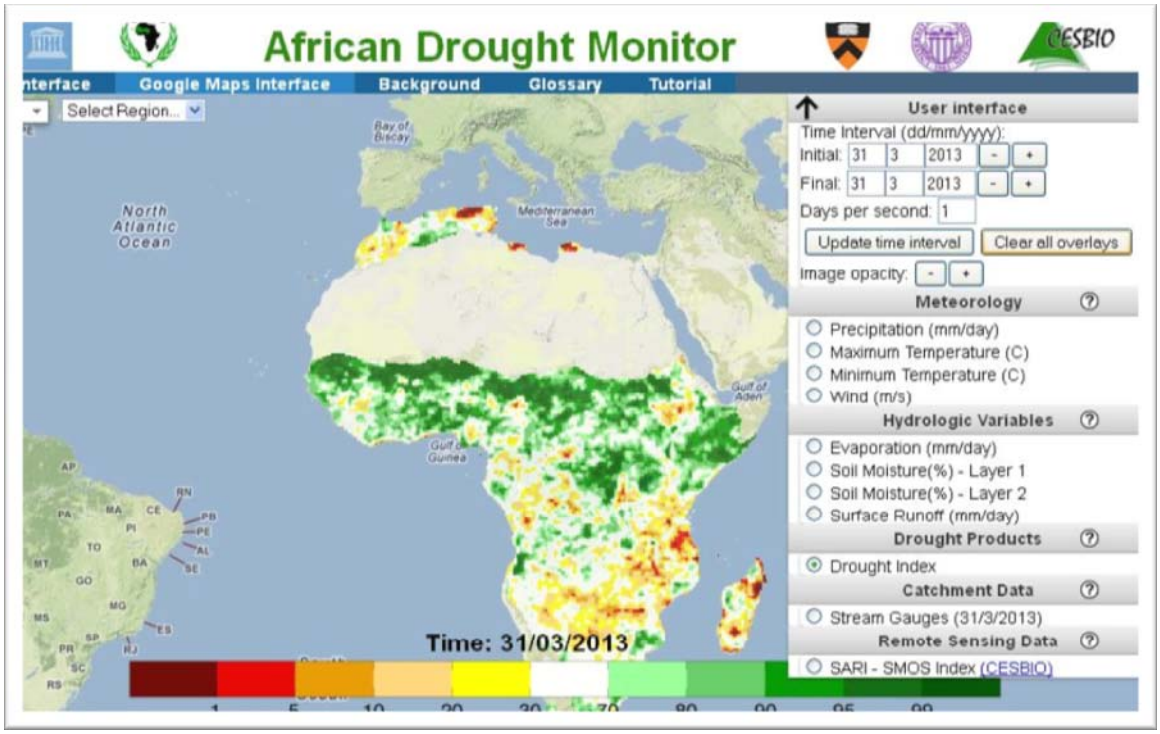


Figure 8- Africa drought monitoring map.

3.2 Impact of Application of Early Warning Systems in the Selected Countries

The impact of early warning systems is highly significant in saving people, livestock, crops and environment. In Europe, it is estimated that hydro-meteorological information and early warning systems saved several hundreds of lives per year, between 460 million and 2.7 billion Euros of disaster asset losses per year, and creates 3.4-34 billion additional benefits per year through the optimization of economic production in weather-sensitive sectors (agriculture, energy etc.).

In North Africa and West Asia, the published surveys and studies on drought, indicated that most countries in the region do not have well-functioning drought monitoring systems that would allow them to take timely action to mitigate the effects of drought. Even though the meteorological networks in most countries are adequate and well-equipped, they are poorly prepared to function effectively as a drought early warning system because of inadequate analytical tools required for drought monitoring, unsuitable information products, and insufficient data sharing.

However, there is an example from North Africa in Morocco where they established a National Drought Observatory (NDO) in 2001 with the goal of collecting, analyzing, and delivering drought-related information in a timely manner (De Pauw, 2005),[24] which includes assessing the frequency severity of drought. Even though even great strides have been made in these efforts in North Africa and West Asia, in general, there are still many challenges to overcome in developing effective drought monitoring. Some of the most pressing challenges 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;
- Providing support to create and maintain systems.

3.3 Assessment of Required Resources and Capacity for Drought Monitoring

The required resources for drought monitoring include national resources and international support. On the national level drought monitoring requires, firstly, a functional observation network. The spatial and temporal variability of rainfall is very high in the semi-arid and arid areas prone to drought. It is recommended to establish an observational network as follows:

- Automatic weather station;
- Automatic rain-gauge;
- Ground water table observations;
- Surface water flow measurements;
- Regular updated Satellite data

[24] 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

The rainfall data not only needs to be accurately measured but it is required to be measured and transmitted on real time basis. Telemetric rain gauges are useful in recording real time rainfall data which enables near time analysis. The availability of real/near real time rainfall/weather data makes it possible to develop early warning systems. The digital data obtained from telemetric rain gauges enables not only efficient database management but also enables development of operational early warning systems. Automatic weather stations and rain gauges need to be distributed at appropriate places to enable micro level analysis and forecasting.

The observation network can be established from the existing stations which belong to various ministries or metrological departments in each country. In order to get proper monitoring, the observational network would require a reasonably dense observational network. It also requires a skilled and operational maintenance staff to run the network.

Drought monitoring indicators based on climate data and remote sensing products are at present the best available tools to monitor drought over large regions and time periods (Vicente-Serrano et al., 2012) [25]. The two most widely used indicators are the Standardized Precipitation Index (SPI) and the Palmer Drought Severity Index (PDSI). In addition, the surface water supply index (SWSI), the standardized water indexes (SWI), the field monitoring and remote sensing systems and the socio-economic indicators. These indicators should be used in an integrative way to have a better idea of drought severity. Below is a list of the basic indicators and the measurement means.

Monitoring Indicators	Monitoring Means
Rainfall	Rainfall Gauging Stations
Water supplies (domestic, livestock)	Household Survey
Vegetation Cover	Satellite imagery (NDVI)
Livestock	Livestock's Survey

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

Drought Stage	Indicators
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

[25] Vicente-Serrano S. M. et al. 2012: Challenges for drought mitigation in Africa : The potential use of geospatial data and drought information systems. Applied Geography, 34, 471-486.

On the international level, there are several centres with advanced technology that can support and help the countries in drought monitoring by providing them with Seattleite images and climate conditions projections. Some of these resources include:

- The Experimental African Drought Monitor operated by the Land Surface Hydrology Group at Princeton University with support from the UNESCO International Hydrology Program;
- The Global Drought Monitor, developed by the Department of Space and Climate Physics of the University College London;
- The US Geological Survey (USGS) Famine Early Warning Systems Network (FEWS NET) Data Portal, which is probably the most comprehensive drought monitoring system available. This portal is provided by the USGS FEWS NET Project, part of the Early Warning and Environmental Monitoring Program at the USGS Earth Resources Observation and Science (EROS) Center. It provides access to geo-spatial data, satellite image products, and derived data products in support of FEWS NET monitoring needs throughout the world. 20 indices including SPI, Daily 10-day Moisture Index, etc. are mapped and easily accessed.

The second important requirement is the GIS database to house the data from the observation network and international centres. This requires professional staff to operate the database mainly in the analysis part where the metrological data will be linked with hydrological, and socio economic data.

The third requirement is the transfer of the monitoring results into action plans at all levels. This needs to have a drought management unit/committee with technical expertise to communicate monitoring outcomes with all stakeholders.

4. Drought risk reduction programs

4.1Review of International Drought Management Programs (WMO, FAO, UNCCD, etc)

The international organizations are heavily involved in drought management programs in the region. The most active organizations are FAO, UNDP, ICARDA, WMO, UNCCD and ESCWA. Below is a brief description on the international organizations drought management programs;

FAO has contributed to agricultural improvement and rural development in arid, semi-arid and dry sub-humid zones ravaged by drought and desertification, primarily in the form of technical assistance projects requested by member nations or within programs that group together projects with common priorities (e.g., soil conservation, pasture and livestock improvement, irrigation, etc.).

FAO adopted “drought mitigation" as a Priority Area for Interdisciplinary Action, and agreed to help initiate a Network on Drought management for the Near East, Mediterranean and Central Asia (NEMEDCA drought network), along with ICARDA and the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM). Furthermore, in 2004 and 2005, FAO approved three technical cooperation projects to assist in drought monitoring and mitigation planning in Syria, Iran and Jordan.

UNDP has worked in Asian and African countries to reduce drought risk by promoting sustainable development and poverty eradication through programs that support: policy development, capacity building, financial and technical support for program development and implementation, advocacy, and

outreach and awareness raising (UNDP, 2006)[26]. These actions are carried out by providing technical and financial resources through country offices, regional centres like the UNDP Dry lands Development Centre in Kenya and funding programs like the Global Environmental Facility. These programs support a wide range of projects, including assistance in developing national action plan for the UN Convention to Combat Desertification (UNDP, 2005)[27].

ESCWA sponsored studies to better understand drought impacts, vulnerabilities, and mitigation options in West Asia. It has undertaken recent research to better understand the vulnerability of the region to drought (ESCWA 2005)[28]. 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 International Centre of Agriculture Research in the Dry Areas (ICARDA) engages in drought management and mitigation of its effects through the development of technologies. ICARDA mitigation measures have centred on improvements in production and management of crops, land and water resources through various techniques (e.g. the development of crop varieties and breeds that tolerate drought, adapted livestock management, deficit and supplemental irrigation, water harvesting and no-till or minimum tillage systems). Through these means, ICARDA has supported national programmers and agricultural research systems in the region to promote better natural resource management to increase agricultural productivity and resilience to drought.

With the omnipresent threat of drought in the region because of climate change, the urgency to integrate drought management into long-term development is fundamental. ICARDA, as part of its efforts, hosts the Network on Drought Management for the Near East, Mediterranean and Central Asia (NEMEDECA), which was created in 2002 with ICARDA, the Food and Agriculture Organization of the United Nations (FAO) and the Centre International de Hautes Etudes Agronomiques Méditerranéennes (CIHEAM). The Network serves to enhance technical cooperation among concerned national, regional and international organizations in the region. The Network's objectives include promoting risk, vulnerability and impact assessments of drought, preparing and creating drought-preparedness and mitigation plans and promoting cooperation in planning and implementing drought-mitigation programmes at national and regional levels. The NEMEDECA network involves nations in the Arabian Peninsula; Central Asia; the Mediterranean European region; North Africa, the Nile Valley and the Red Sea; and West Asia.

[26]United Nations Development Programme (UNDP) (2006) Partnerships to fight Poverty through Sustainable Land Management. Report of the United Nations Development Programme to the fifth session of the Committee for the Review of the Convention (CRIC 5) (http://www.unccd.int/).

[27]United Nations Development Programme (UNDP) (2005) Partnerships to fight Poverty in the Drylands, Report of the United Nations Development Program to the third session of the Committee for the Review of the Convention (CRIC 3), 2-11 May, Bonn, Germany (http://www.unccd.int/).

28Economic and Social Commission for Western Asia (ESCWA) (2005) ESCWA WaterDevelopment Report 1: Vulnerability of the Region to Socio-Economic Drought, United Nations: New York.

NEMEDECA is a partner in the European Union-supported project on Mediterranean Drought Preparedness and Mitigation Planning (MEDROPLAN), which, under the coordination of the Mediterranean Agronomic Institute of Zaragoza (IAMZ), has recently developed guidelines for managing drought risk using preparedness plans and early warning systems. The MEDROPLAN guidelines provide a framework to move from a reactive to a proactive approach in fighting drought through a wide range of methodologies of drought analysis and management involving various stakeholders. In January 2008, ICARDA hosted a workshop about the applicability of these guidelines in Egypt, Gaza and the West Bank, Jordan, Lebanon, Libya, Syria and Turkey. ICARDA is actively involved in developing integrated approaches to enhancing drought and risk management measures and policies with partners and various stakeholders.

For the Maghreb region, a network for the development of drought early warning systems (SMAS) which was established between Morocco, Algeria and Tunisia and it is coordinated by OSS. The plan of action was launched and some activities have started.

4.2 State and community level conflict prevention by implementing drought management

Based on information from the United Nations Interagency Team for Preventive Action, the main sources of conflict over water include degradation of water quality due to pollution, development and infrastructure projects that reduce water supply, environmental factors changing the availability of water, competition between livelihood groups and different water sectors, unclear water use rights, poor transboundary water management, and changes in the pricing structure of water. These issues are further compounded and may lead to violence when adding factors such as political unrest, ethnic polarization, poverty and poor governing systems. Even though the causes of violence and conflict are multifaceted and cannot be attributed to one source, it is significant to address problems of natural resource availability as a way to promote conflict prevention.

The drivers of conflict for renewable resources interact with and reinforce each other. The section below describes the main drivers of conflict for renewable resources and offers strategies to prevent natural resource related conflicts based on the information from The United Nations Interagency Team for Preventive Action's report entitled "Toolkit and Guidance for Preventing and Managing Land and Natural Resources Conflict." Although these guidelines apply to all natural resources, they provide a thorough framework to approach preventing water-specific conflicts. Water is a unique natural resource, however, in that there can be no direct substitute for it. For this reason, water-specific conflict prevention strategies are also included in this section.

Drivers of Conflict:

Driver 1 - Competition over increasingly scarce renewable resources. This occurs when water resources are not sufficient to supply for the demand. In water scarce situations, competition between user groups occur when there are not enough resources to sustain the livelihoods of individuals, families, and cattle. People can respond to the lack of natural resources in a number of ways including: technological innovation, migration out of the community experiencing the scarcity, cooperation, or violent conflict.

Types of Scarcity:
There are three main types of scarcity: 1.) Demand induced scarcity, 2.) Supply-induced scarcity, and 3.) structural scarcity.

Demand-Induced scarcity refers to times in which the demand for a specific limited resource it too large for the existing supply. The per capita availability of water can become limited when population increases, there is development of new technology, or consumption rates of water increase.

Supply-Induced scarcity occurs when there is a problem with the source of the supply, such as land degradation, pollution, or an issue with the delivery infrastructure limits the availability of the supply of water. During supply induced scarcity, competition between livelihood groups may ensue because this type of scarcity limits options for citizens to pursue productive livelihood strategies.

Structural Scarcity happens when there is unequal access to water resources between various social groups. Structural scarcity can occur in both poorly developed and well developed governance systems. Landuse decisions, cultural practices, gender roles, societal and economic factors may all influence to occurrence of structural scarcity.

Driver 2 – Poor governance over water resources and other natural resources can also lead to conflict. Regulations concerning the allocation, access, use, and management of water, as well as the policies and institutions involved with water resources at a community level are all significant drivers of conflict. Poor governance also refers to the political and social exclusion and corruption which often result in structural scarcity (defined above). On the other hand, with a strong governing system, conflicts that arise from water scarcity and drought can be mitigated if not solved by the implementation of a strong governing system. It is important to understand the governing systems at the local and national level so it is easier to identify why conflicts over water are occurring and how they can be addressed most effectively.

Below are the four main causes of poor resource governance:

1) *Water rights and laws are unclear, are contradictory and overlap*. One reason for this is that renewable resources are often governed under religious and informal regulations, or have statutory or customary based rules and policies. Furthermore, there is often a lack of capacity and authority in regards to enforcement of natural resource laws and policies. Tensions are also heightened when the state does not consider the customary laws of the communities at local scales.

2) *Laws and policies are in place that marginalize specific groups and influence discrimination.* At times one group will have complete control over natural resources, which often causes an unfair advantage for other groups. If livelihoods are affected the result is often violence, conflict, or retaliation of some sort. This is another cause of structural scarcity.

3) *Development projects that do not benefit groups equally or cause more of a burden to some groups than others.* Implementation of infrastructure, large-scale extraction of natural resources, and industrial sites can contribute to beneficial development in some communities, but can also tremendously damage, burden, and marginalize others.

4) *Decision making processes that are not comprehensive or transparent and that exclude public participation.* Often the state and private sectors are the main actors in the decision making process while stakeholders and public community members, who are likely to oppose some decisions concerning natural resources, are not included in the process. Some of the negative outcomes that may occur from exclusion of the public from decision making processes include a sudden increase in prices of resources, eviction, and lack of access to water.

Driver 3 - Transboundary water dynamics are also drivers of conflict. Transboundary conflicts can occur beyond national levels. This becomes particularly a problem when dealing with such issues as pollution, water waste, climate change, and natural disasters because how one nation uses their water can greatly affect other nations. Combating transboundary water issues requires cooperation and management between neighbouring countries.

The main challenges with transboundary water resources are listed below.

1) Unequal allocation or consumption of water resources across boundaries.

2) Water and other renewable resources that are negatively affected by the industrial development and change in land use practices of neighbouring nations. Such issues as pollution, deforestation, and soil erosion can cross boarders and create significant human health and ecological problems in other nations.

3) Wildlife and traditional livelihood groups that migrate to other nations in search for natural resources can shift economic opportunities from one country to another.

4) Illegal exploitation of water and other natural resources across borders and the development of global and transboundary criminal networks.

It is also important to note that while Climate change is not a direct driver of conflict, it does lead to the availability of fewer water resources.

Strategies for Natural Resource Conflict Prevention

In order to prevent conflict, the first step is to build trust so that there can be a way for communities and nations to peacefully co-manage natural resources and determine ways in which each party will benefit equally. Pre-existing political and socioeconomic tensions must be addressed in order for conflict prevention to ensue.

The table below addresses the four main objectives for natural resource conflict prevention and describes how these objectives can be met:

Objective 1: Ensure that livelihood groups are not competing over scarce water resources	**Objective 2: Improve the governance system in regards to water resources, and increase capacity to resolve conflict**	**Objective 3: Develop an improved system for transboundary water resources**	**Objective 4: Employ measures for cost cutting across all programs**
❖ Reduce vulnerability in livelihood groups by increasing the availability of water. This can be done through better infrastructure, efficiency, and water resource protection ❖ Support Sustainable livelihoods ❖ Implement supply-side interventions	❖ Changing governance so that there is equitable access to water amongst users ❖ Reduce corruption in the governance system by making the decision making process transparent to all stakeholders ❖ Increase public participation in formation of policies/rules/laws	❖ Strengthen transboundary resource information ❖ Implement resource-sharing agreements across local and national borders ❖ Harmonize laws and make sure rules and regulations do not overlap	❖ Utilize early warning technology, risk assessments, and scenario analyses to determine when and where conflicts are likely to occur based environmental and social factors and trends ❖ Implement and design conflict prevention programs

by improving access to water and limiting environmental degradation and pollution.	❖ Build capacity of stakeholders and citizens in society ❖ Establish and enforce rights and rules concerning water resources		❖ Ensure that stakeholders are aware of when their interventions may cause conflicts

Water-Specific Conflict Prevention:

1. Implement Integrated Water Resource Management (IWRM). IWRM involves managing and developing water with a coordinated effort across state institutions and government instead of managing water sector by sector.

2. Acquire and share accurate and scientific information on water quality and quantity when there are potentially water scarce situations. Joint data collection and the exchange of water data between parties will not only help to build trust, but will equip parties with sound hydrological data from which they may base their management decisions.

3. Adopt benefit sharing principles instead of simply sharing water resources. This encourages positive-sum outcomes instead of zero-sum outcomes that come about when dividing water.

4. Clearly define and secure water rights at the local level. If there is a raised awareness of water rights then it may lead to an increase in water productivity and improve rural livelihoods, which is needed for equitable water use and conflict prevention.

5. Implement full cost accounting in water pricing. Make sure that water pricing reflects financial costs, environmental costs, and resource costs. This type of cost accounting should be done in a gradual fashion in order to reduce or prevent conflicts.

6. Build stakeholder capacity, even marginalized groups in order to engage them in the decision-making process and provide them with access to water policies, services and infrastructure. If stakeholders know what to expect from their water policies and governance system then it is less likely that conflict will arise.

7. Implement proper and up-to-date technology on a broad scale. Appropriate water technologies will help to increase water efficiency and thus reduce water scarcity. Potential technologies to implement include improved irrigation systems, rainwater catchment and harvesting systems, waste management and pollution control.

8. Protect riparian ecosystems and forested water catchments as forests are key in good quality water. Protecting forests also benefits conservation, economical and social efforts as well as mitigates flooding in communities.

9. Conduct Environmental Impact Assessments (EIAs) for infrastructure, irrigation systems, and development. Conducting EIAs will help to determine how development and water systems are impacting water resources. EIAs are a priority and should be implemented at the onset of a project.

10. Create a code of conduct and increase capacity on a local and national scale so that public-private partnerships will be governed effectively. Agreements between public and private sectors should be clearly outlined and transparent.

11. Ensure that river basin commissions and joint riparian agreements are being fully supported. It is important to implement joint monitoring programs, standardize approaches to evaluate water-sharing principles agreements, and determine how water will be allocated equitably.

12. Determine and monitor national and international indicators that help to identify conflict. Key indicators include the per capita availability of water, the degree to which the state of social livelihood groups are changing, shifts in power relationships in transboundary and sectoral water-sharing parties, ecosystem requirements and the impact of dams and other infrastructure projects.[29]

4.2 Drought Risk due to Transboundary Water Issues

Drought conditions are mainly linked to drop in rainfall and increase in temperature. However, there are cases where drought resulted from transboundary water issues. In most of the Arab countries the rivers originated from outside the Arab region, Tiger and Euphrates originated in Turkey, The Nile originated from Ethiopia. The changes in rainfall or temperature in the upstream countries will affect the rivers flow to downstream countries. His resulted in conflicts between riparian countries. Iraq suffered from drop of Tigers and Euphrates flow which the quality of water, agricultural activities along the rivers. According to Ministry of agriculture in Iraq the agricultural activities decreased due to drop in water flow into the rivers and due to drop in the water quality.
In Jordan, the Jordan valley was affected by the diversion of the water downstream of Tiberius Lake to the national carrier inside Israel which leads to dry of Jordan River and drop in the Dead Sea water table. Egypt also to certain extent suffered from drop of Nile flow in recent years.

Drought risk reduction efforts need to be implemented at all levels national, regional and international. Such efforts are generally aimed at developing enhanced drought monitoring and early warning systems, understanding how populations and countries are vulnerable to the effects of drought, and implementing or enacting effective drought mitigation and response actions, plans, and policies. These activities are generally being implemented either in a piecemeal approach or as part of larger drought planning processes.

In order to reduce the drought risk from transboundary water issues, it is recommended to encourage and strengthen the joint dialogue between riparian countries on all levels, political and technical. This will provide a common reference and planning framework, and will increase information exchange and coordination between riparian countries; however work is still needed in several fields, such as:

[29] Toolkit and guidance for preventing and managing land and natural resource conflict, (2012), The United Nations Interagency Framework Team for Preventive Action, with funding and support from the European Union

- Develop common systems for monitoring and data management.
- Exchange and share information related to drought
- Establish joint management plans
- Resolve the disputes according to international laws and regulations

To address these challenges, an interdisciplinary approach is needed, responding to the need of managing river basins as social-ecological systems. Such an approach is crucial to understand the diverse and intertwined layers (hydrological, ecological, institute economic, social) that constitute the water system, as a framework to address the relationship between natural water resources and social water demands. Therefore, drought risk needs to be assessed using data and methodologies of all scientific fields and economic sectors involved.

In addition to the above measures, drought risk can be reduced through networking by participation in several networks that offer opportunities for enhanced collaboration and information sharing in the region. One of the suggested networks is the Network on Drought Management for the Near East, Mediterranean and Central Asia (NEMEDCA Drought Network) coordinated by ICARDA, FAO-RNE, IAM (CIHEAM) Zaragoza[30]. This Network is based on the tools and guidelines developed through the MEDROPLAN project. NEMEDCA Drought Network is divided into 3 Sub-networks;

-Mediterranean Sub-network: Albania, Algeria, Cyprus, Egypt, France, Greece, Italy, Jordan, Lebanon, Libya,
Malta, Mauritania, Morocco, Palestine, Portugal, Spain, Syria, Tunisia and Turkey;
-The Nile valley, Red Sea and Arabian Peninsula Sub-network: Djibouti, Eritrea, Ethiopia, Somalia and Sudan,
Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates;
- Central and West Asia Sub-network: Iraq, Iran, Kazakhstan, Pakistan, Tajikistan, Turkmenistan and Uzbekistan.

The overall objective of the NEMEDCA is to enhance technical cooperation among concerned national regional and international organizations in the region, particularly the exchange of information, and experiences among the member countries. The specific objectives are:

- Promoting risk, vulnerability and impact assessment of the effects of drought considering ecological, agricultural and socio-economic dimensions at national and regional levels;
- Contributing to the creation, development and coordination of drought preparedness and mitigation plans, including harmonization of methodologies and approaches used in member countries. In that context, the MEDROPLAN Drought Management Guidelines should constitute a reference;
- Facilitating the development of national, sub-regional and regional project proposals to address drought priority areas;
- Streamlining exchange of information on monitoring tools and data on early warning among members;
- Promoting the exchange of information on mitigation practices and coping mechanisms to support the decision making process in member countries;
- Strengthening and developing human and institutional capabilities at the national level;

[30] 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)

- Promoting cooperation in planning and implementing drought mitigation programs at national and regional levels;
- Disseminating information among concerned organizations / institutions on pertinent drought issues and promoting professional contacts, study tours, expert meetings, training courses, etc.;
- Coordinating activities with other relevant regional and international networks.

In summary, to minimize the drought risk the following issues need to be addressed;

- 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?

4.2 Experience in Including Micro-finance and Index based Insurance in the Region

The farmers are the most affected group due to drought risk. In developing countries most farmers/farming companies have their own insurance system to compensate them in drought cases. However, in developing countries in general and countries in North Africa and West Asia they lack such system. In some of these countries the government give partial compensation due to drought while others they do not provide and kind of compensation to farmers or affected groups by drought. On the international level, some of the international organizations provide certain types of compensation in the form of technical assistants, tools, free seeds, fertilizers.

The compensation schemes are considered as part of wider term Micro-finance. Micro-finance refers to small savings, credit and insurance services extended to socially and economically disadvantaged segments of society. At present, a large part of micro finance activity is mostly confined to credit. However, there are many cases in Africa and Asia and Europe where the micro finance targets drought insurance.

In Kenyan farmers increasingly fearing massive weather-related losses, UAP Insurance, Syngenta Foundation and mobile operator Safaricom announced a major expansion of Kilimo Salama, an innovative and affordable crop insurance program that will now cover the expected value of farm harvests, more crops and many more farmers against drought and flooding, while also protecting against livestock losses.[31] The new program, called Kilimo Salama Plus, builds on the original Kilimo Salama—Kiswahili for “safe farming”—which was launched last year. It uses a low-cost mobile phone payment and data system that is linked to solar-powered weather stations to issue an insurance policy and rapidly compensate farmers for investments in seeds, fertilizer, and other inputs that are lost to either insufficient or excessive rains. Agricultural insurance is particularly important in Kenya and elsewhere in Africa today as the extreme weather patterns generated by climate change are introducing greater volatility to food production and food prices. According to Syngenta Foundation, there are 12,000 farmers in Kenya take advantage of the original Kilimo Salama and their target to reach 50,000 farmers with Kilimo Salama Plus this year and provide far more insurance options.

One of the Arab countries that adopted successfully the insurance approach in cereal production is Morocco. This approach is based on the difference between average and potential yields.

[31] UAP Insurance, Syngenta Foundation and mobile operator Safaricom, Kilimo Salama micro insurance program, 2011.

4.3 Capacity Needs Assessment of National Policy Makers in the Region

Human resource development, training, education and capacity building are essential components of the strategy for effective drought mitigation and management. The objective of capacity building is to put in place a systematic functional mechanism with trained human resources. It has to be understood with a broad perspective to include knowledge, skill, attitude and resources in an integrated manner. A realistic national training and capacity building program for drought management needs to be formulated and implemented. A program of resource enhancement encompassing all institutions/ organizations/ individuals also needs be developed. Capacity development/training programs requires the following:

- Identification of the target group

Training is the most important, essential and central activity of all capacity development programs. Training needs have to be identified and appropriate training programs are to be designed and conducted at all levels and involve the entire spectrum of stakeholders (from government/NGOs and community) to fully address the needs of sensitization, knowledge/information management and skills. The target groups identified for training and capacity development will focus on government officials including policy makers, NGO's, Academic institutions who are part of the steering committee.

- Training needs assessment

Training Needs Assessment (TNA) of drought management is needed to be carried out first and properly to identify the training areas to be covered based on strengths and weaknesses of trainees.

Special focus will be given to water resources, policy, socio-economic, legal, water, soil, environment and ecology related issues.

Training can take different forms such as:

- Organizing special training session for policy makers or other groups
- Meetings, conferences and workshops
- Self learning Media, CD's,
- Manuals and standard procedures

Below is summary table which shows the target group, training topics or areas, and training approach for drought management related fields. This table will be filled at later stage after direct meetings with selected countries to be covered under this project.

Table 5: Target Group

Region	Country	Target Group	Training Areas	Training Approach
West Asia	Jordan			
	Lebanon			
	Syria			
	Yemen			
North Africa	Egypt			
	Sudan			

	Libya			
	Tunisia			
	Algeria			
	Morocco			

5. Drought Management National Policy and Response

5.1 Review of Drought Management Policies in the Region

As stated in section 1.4 there are variation between countries on drought management polices and response to droughts. In general most countries (Jordan, Syria, Lebanon, Yemen, Egypt, Sudan, Tunisia, Morocco, Algeria and Libya). Recently, many Arab countries have become more concerned with the problem of drought and some
progress in dealing with this natural disaster has been achieved. Among the actions taken are the establishment of national committees or units where different ministries are represented to coordinate efforts and actions to reduce the effects of drought on the populations, crops and livestock and hence to improve the livelihood of the poor. Local committees have also been constituted to implement drought relief measures set up by the national committee.

With the assistance from international organizations, the Arab countries have focused on drought relief measures. In fact, as a response to recent reoccurring droughts, most of the Arab countries have established a drought unit where different concerned ministries are represented to coordinate efforts to deal with the drought crisis and its impacts. This is a positive initiative and it has solved some of the conflicts and the lack of coordination among different administrations and agencies concerned with water and drought issues. A national contingency plan and drought emergency program to monitor (Through inter-governmental National Committee) and alleviate drought impacts on people, crops, livestock and agro-pastoral systems is launched. The National committee is usually headed by a high political authority such as the Minister of Agriculture or even the prime minister (case of Morocco). Provincial or local committees are also formed to implement drought relief measures adopted by the national committee. Among the coping measures adopted in the region are, the provision of supplementary feeds to safeguard livestock with the predominant investments

Although Governmental plans are mainly based on crisis management of drought, they also recognize the urgent need to develop long term risk management strategies based on drought preparedness and mitigation. This is due to the effort of international organizations to enhance the awareness of the seriousness of drought especially to decision makers. In fact, it is recognized now that the Arab countries have become more involved in regional and international workshops, networks and research programs aiming at the development of strategies for long term drought management.

5.2 Developing national strategies and action plans for drought preparedness

Steps taken to develop drought management action plan for Iran:

1. *Creating political momentum and authority*

- Frequent droughts in the Middle East region led to a series of national and regional conferences that focused on developing strategies to mitigate drought;

- As a result of these conferences, international agencies such as FAO came together to make the drought conditions in the Middle East a priority area for interdisciplinary action (PAIA);
- Per request, FAO provided the Iranian government with technical and financial assistance under a Technical Cooperation Program (TCP) project entitled, "A National Strategy and Action Plan on Drought Preparedness Management and Mitigation in the Agricultural Sector".

2. Strategic Planning and Coordination

- Together the Ministry of Jihad-e-Agriculture (Department of Agronomy), Ministry of the Interior, and the Ministry of Road and Transportation worked together to execute the TCP project;
- A National Project Coordinator from the Iranian Department of Agronomy and a consultant from FAO led the planning of the project and a Project National Steering Committee was established;
- FAO played a key role in coordinating drought related stakeholders with their efforts and for providing technical advisory and supervisory services;
- FAO appointed Iranian agencies to be in charge of a planning process that included outreach to raise awareness of the threat of drought in the country, drought research and discussion for better understanding of drought management roles in Iran, discussion among stakeholders concerning national drought preparedness, and collaboration with stakeholders for a final strategy on drought preparedness.

3. Fostering Involvement and Developing Common Understandings

- Field visits were made in the drought effected provinces of Iran so that current drought management strategies and stakeholder perceptions could be assessed;
- Training seminars were held in order to explain the drought mitigation project and develop proactive drought risk reduction strategies;
- Visits were also made to universities to learn about drought management throughout the country and to encourage the exchange of information concerning drought;

4. Investigating Drought Monitoring, Risk, and Management Options

- Consultants were hired to produce reports on subjects such as
  - information on environmental characteristics of the areas exposed to drought in Iran, as well as information on bio-physical and socio-economic factors;
  - existing drought monitoring tools and methods;
  - case studies that offered plans to mitigate the effects of drought;
  - coordinating mechanisms of drought management;
  - and an international review on drought to determine lessons learned;
- Information from these reports were discussed during two regional workshops in Iran.

5. Writing the national drought strategy and action plan

- The team used all of the information that they gathered during these previous steps to draft a report on the National Strategy for Drought Management in the Agricultural Sector in Iran;
- The components of the action plan and strategy include:
  - The development of a national drought management center;
  - Implementation of policies that will reduce drought related vulnerabilities and encourage drought resilience;
  - Involve institutions in coordinating efforts concerning drought related matters;
  - Strengthen and build national capacity for drought planning, mitigation, and response;

6. Implementing the national drought strategy action plan

- The national drought preparedness strategy will need to be introduced to and approved by parliament;
- Experts from the National Disaster Task Force attended a study tour to FAO/Global Information and Early Warning Service (GIEWS) in order to build national capacity in drought related issues[32].

Brief Overview of CIHEAM Guidelines:

The purpose of CIHEAM's proposed guidelines is to provide a methodological framework for a drought management plan. CIHEAM's guidelines include five major components: 1) The planning Framework, 2) The Organizational Component, 3) the Methodological Component, 4) The Operational Component, and 5) the Public Review Component.

The Planning Framework
The planning framework involves defining the planning purpose and process for developing drought planning at the local, regional and national scales. The planning framework is an important step in the development of a common language among stakeholders, which will be integral throughout the entirety of the planning process.

The Organizational Component
This component helps the user to understand the legal and institutional frameworks involved in the drought management planning process. It also helps to identify which drought mitigation tools and methodologies are most suitable for a specific the specific geographic location. Coordination with various institutions, compilation of societal responses to drought, and the provision of public information are also involved in this component.

The Methodological Component
The Methodological Component Involves developing the indicators of risk to drought and the compilation of scientific and technical approached to drought; defining methods to combat drought in the Mediterranean region; determining indicators of social vulnerability to drought based on academic methods; and developing technical studies in order to strengthen the use of indices when defining drought.

The Operational Component
The Operational Component includes early warning systems and preparedness measures; prioritizing efforts during drought and water scarce situations; determining social and physical thresholds as defined by drought indices; and defining and evaluating implementation of actions.

The Public Review Component
The purpose of the Public Review Component is to review and revise the four other components as necessary. This involves stakeholder dialogue, workshops, interviews, and questionnaires in order to receive feedback and update drought plans so that they will be most effective.[33]

[32] The Near East Drought Planning Manual: Guidelines for drought mitigation and preparedness planning, (2008). Food and Agriculture Organization of the United Nations Regional Office for the Near East, Cairo, Egypt, University of Nebraska Lincoln, National Drought Mitigation Center

[33] 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)

Comparison of University of Nebraska/FAO strategy and action plan framework and CIHEAM's Drought Management Guidelines:

Both the University of Nebraska/FAO strategy and action plan framework and CIHEAM's Drought Management Guidelines provide a thorough framework for how the development of drought management plans should be approached. The similarities in the plans further emphasize the importance of that specific component while the differences propose new ideas that should be considered and possibly implemented into other plans.

Commonalities between the University of Nebraska/FAO guidelines and CIHEAM guidelines:

1. Defining the problem of drought and assessing its impacts (social, political, environmental and financial)
2. Key involvement of stakeholders and public throughout the drought planning process
3. Creation of committees involving experts in various fields in order to foster an integrated approach to drought management planning
4. Involvement with institutions, academic and otherwise, to exchange ideas and information concerning technology and effective methods of drought management
5. Use of drought and early warning system technology for preparedness measures
6. Assessment of societal vulnerabilities to drought by using indicators and threshold values
7. Development of a mitigation framework
8. Frequent and review and modification of drought plans to increase their effectiveness

5.2 Interaction between Current Drought Management Polices and IWRM Plans

One of the main shortcomings in drought management in Arabic countries is the lack of integration between drought management strategy or policy and ministries plans. Given this context, there is an urgent need for action in order to integrate drought management strategy with the integrated water management plans at the national level. The integration will enhance the water sensitivity and promote water considerations within cross-sectoral policies, and mainstream climate change adaptation into IWRM planning. This necessitates developing appropriate tools, building capacity, raising public awareness and promoting water-sensitive environmental education, as well as setting up water partnerships at regional and national levels. The Global Water Partnership (GWP) is one of the leading organizations in the Mediterranean region which promoting integration between drought management strategies and IWRM planning.

The following areas are the key areas in the IWRM to be linked with drought management strategies:

- Impact of drought projection and strategy actions measures on surface and groundwater availability:

Any potential future drought need to be identified and linked with surface and groundwater availability for all users; domestic, irrigation or industry. This will be reflected in adopting certain water conservation measures to control the water demand for all users due to potential drop in water availability. Accordingly, the various users will be prepared to face the new situation through other alternatives for their livings or investments and will help the government in providing suitable services to the users;

- Impact of drought projection and strategy actions on water quality;

- Similarly, future droughts will affect water quality; the change in the water quality requires proper planning for future investments in water treatment to maintain good quality for water supply to all users. The integration of drought strategy actions with IWRM will help the governments to be ready for such situation and will the help decision makers in securing the necessary funds for implementing future projects on water quality;

- Impact of drought projection and strategy actions on Monitoring:

The monitoring is an important part of the IWRM, and also in the drought management strategy. It is necessary to establish the link between IWRM and drought management action where more stations (hydrological and metrological) may need to be added, frequency of monitoring may be modified.

5.3 Emergency Response that Reinforce National Drought Management Policy Goals

The emergency response is the dominant case in most countries; however the emergency response can be used as the basis for a long term national policy in response to drought. Usually drought management policy goals focus on early warning and monitoring systems to plan the suitable response for projected future droughts. While emergency response focus on:

- Conservation of water supply in drought period;
- Maintenance of supply to domestic and hygiene, and fire protection purposes;
- Public health protection;
- Minimization of adverse impact of water supply for irrigation and other purposes;
- Minimization of adverse impact on environment;

The above emergency actions can be integrated in the drought management policy. The emergency measures have to be comprehensive and represent the services provided by all stakeholders such as:

- Ministries (Agriculture, Environment, Water, Interior, Planning, Tourism);
- Farmers or Farmers Associations;
- Water Utilities/Companies;
- Chamber of Industry;
- Local Authorities (Governorates);

Annex:

A1. Potential Drought Mitigation Approaches in the West Asia/North Africa Region

Region	Challenges in the Middle East/North African Region	Potential Agricultural Water Saving Methods	Potential Domestic/Residential Water Savings Methods	Potential Industrial and Commercial Water Saving Methods
North Africa and Middle East Region	❖ Water scarcity ❖ Frequent drought ❖ Increase in population causes growing demand for water but decreasing supply ❖ Transboundary water conflicts ❖ Water quality issues ❖ Land degradation from unsustainable water resource practices ❖ Need for capacity building for water resource issues ❖ Need for funding to implement water resource systems (such as proper irrigation systems) ❖ Frequent water leaks in residential, industrial, commercial and agricultural water systems	*As suggested by the Egypt Water Use Project (EWUP):* ❖ Irrigation scheduling ❖ Precision land levelling ❖ Implementation of modern irrigation systems such as drip irrigation and sprinklers ❖ Cleaning and maintaining furrows ❖ Maintaining canal lining ❖ Utilization of dikes in order to combat surface drainage ❖ Improved crop management and low water consumption crop varieties ❖ Fixing water leaks in irrigation systems and dams ***The Egypt Irrigation Improvement project saw a 15% increase in water efficiency after adopting land levelling interventions** *Based on success from Mozambique drought management:* ❖ Implementation of water harvesting and catchment structures built next to schools and communities most affected by drought ❖ Rooftop water harvesting systems ❖ Implementation of conservation agriculture and drought resistant crops like cassava and sorghum ❖ Early warning technology	❖ Improvement on the maintenance of the water supply network ❖ Utilization of new water saving devices ❖ Use of high-efficiency washing machines (saves approximately 37% of water) ❖ Use of landscape water conservation devices- includes centralized computer control, moisture sensors, rain shut-off switches ❖ Implementation of metering and sub-metering for water conservation (could yield savings of between (25% - 40%) ❖ Recycling and reuse of domestic water *Examples of water-saving devices:* ❖ Low-flow showerheads (estimated savings set at 5 gallons/day/showerhead) ❖ Toilet displacement devices (estimated savings set at 4.2 gallons/day/device) ❖ Use of ultra low flush toilets (estimated savings set at 4.2 gallons/day/device) ❖ Faucet aerators (estimated savings set at 1.5 gallons/day/device)	❖ Utilization of self-closing faucets. One technology involves a spring loaded faucet lever that closes after a certain amount of time. The second involves an infrared sensor that only turns on the water once it detects that hands are underneath the sensor. ❖ Utilization of ultra low-flush toilets ❖ Use of low-flow urinals (saves approximately 33% of water per flush) ❖ Using treated waste water is expected to save a great percentage of water