

Drought conditions and management strategies in Tunisia

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The geographical position of Tunisia puts it in contact with two opposite climate type: wet temperate and arid tropical. The North of the country is in contact with the Mediterranean and the south with the Sahara. The effects of this geographical position results in a large variability in all climate time scales (inter-annual, seasonal, monthly and synoptic). The north is more influenced by the perturbed process of the temperate zone and Mediterranean Sea. The south is more open to Saharan influences. As part of this variability, Tunisia is experiencing with drought and heavy events, even very heavy rain (flood).

During the 20th century, Tunisia has experienced several severe droughts. These droughts have not affected the different decades with the same frequency. For example the years 1950 and 1970 are distinguished by the appearance of low dry years. In the years 1920, 1940, 1960 and 1980 multi-years droughts was recorded with a large spatial extension and a high rainfall deficit (Hénia L., 2001). The drought of 1940 is the most severe of the century and some regions have had 6-8 successive dry years. The end of the decade 1980-1989 and the beginning of the decade 2000-2009 were marked by an intense drought with a high rainfall deficit.

The minimum of regional annual rainfall recorded during the 20th Century (Map 2) varies from 11 mm in the south to 359 mm in the north. Map 2 shows some extreme dry years recorded in the country.

Map 1. Tunisian Climate (Source: DGRE)



- Annual rainfall: 250 mm (100 -1500 mm)
- Runoff is only **12 %** of the rainfall (0 -700 mm)
- Potential Evapotranspiration (1000-3000 mm)
- The North of Tunisian Dorsal: a Mediterranean climate
- The Centre and the Golf of Gabes: a semi-arid climate
- The rest of the country: a dry desert climate.

Map 2. Minimum regional rainfall during the 20th Century (Source: DGRE)



Many studies elaborated in Tunisia shows that the frequency of one year dry is high for all the country, Frequency of two consecutive dry years and more is relatively low in the North, moderate in the Centre and more frequent in the South. Drought periods could affect one or several regions or could be generalized, their duration could be from one month or season to one year or more.

Classified by many international organizations as a freshwater scarcity country (map 3, Table 1) the water resources of Tunisia are over exploited (map 4)

Map 3 : Freshwater availability (source UNEP/GRID-Arendal (2008))

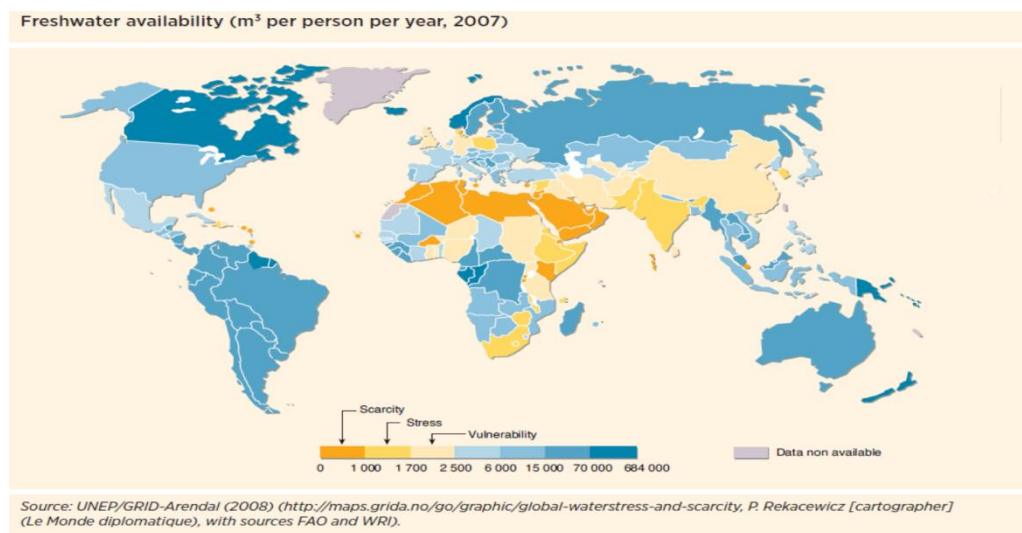


Table 1: Water availability

Country	Water availability m³ / capita / year							
	1955 ^a	1990 ^b	2000 ^c	2003 ^c	2010 ^c	2015 ^c	2025 ^c	2050 ^d
Algeria	1,770	689					332	300
Bahrain	672	179	170	153	139	120	89	
Egypt	2,561	1,123	800	770	750	600	550	510
Iraq	18,441	6,029	3,100	2,800	2,400	2,100	1,700	
Jordan	906	327	<500	150	<500	130	121	100
Kuwait				<100	<100	<100	<100	
Lebanon	3,088	1,818	900	900	800	800	867	800
Libya	4,105	1,017					359	250
Morocco	2,763	1,117					590	600
Oman	4,240	1,266	500	500	450	450	410	
Qatar	1,427	117	<100	<100	<100	<100	68	
Saudi Arabia	1,266	306	<500	400	320	250	113	
Syria	6,500	2,087	1,250	1,250	900	850	732	600
Tunisia	1,127	540					324	400
United Arab Emirates	6,195	308	<500	<400	<300	<200	176	
West Bank and Gaza	1,229	461	<500		<500		264	
Yemen	1,098	445	<500	300	250	200	152	

Sources:

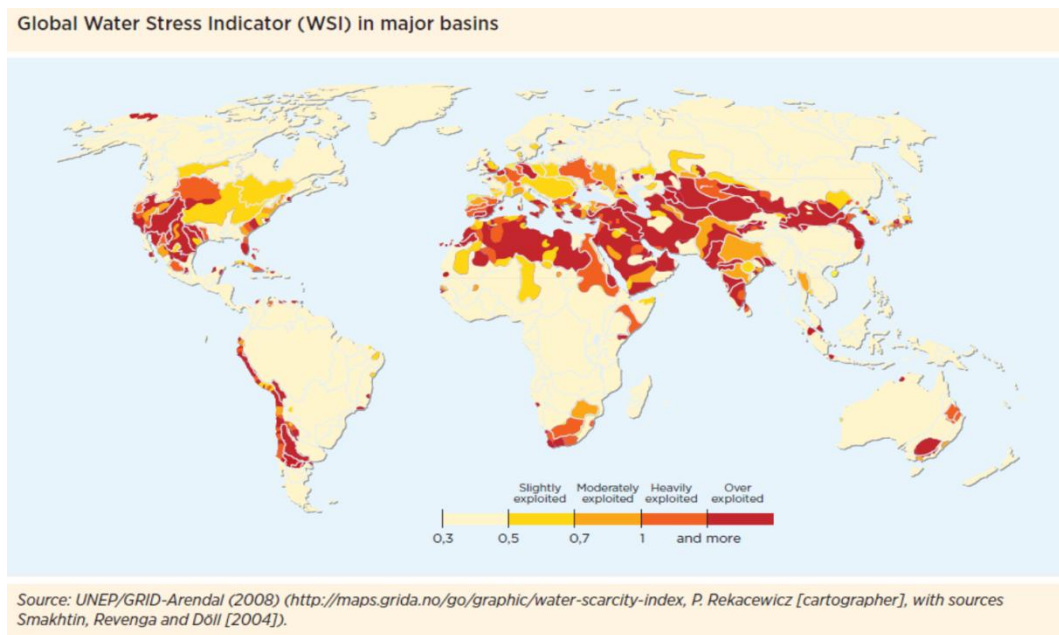
a- Policies and institutions for coping with environmental aspects of water scarcity in western Asia, by Hosni Khordagui Ph.D., Lebanon <http://www.unwater.org/downloads/wwwKhordagui.pdf>

b- ITT industries guidebook to global water issues http://itt.com/waterbook/per_cap_country.asp

c- Economic and Social commission for Western Asia, UN, 2003 - <http://www.escwa.org.lb/information/publications/edit/upload/sdpd-03-13.pdf>

d- Water demand management in the Mediterranean, Hamdy A., http://www.idrc.org.sg/en/ev-42818-201-1-DO_TOPIC.html

Map 4. Global Water Stress (WSI)

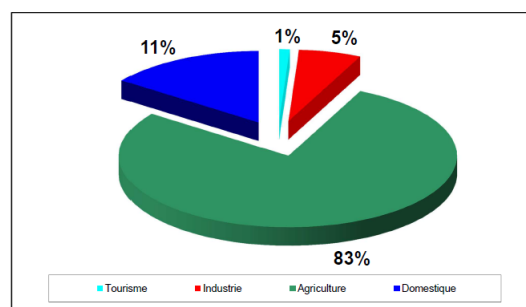


In Tunisia more than 80% of water is used by agricultural sector (irrigation) (Table 2, Figure 1). When occurs drought affect at first agricultural sector. During dry years 1987-1988, 1993-1994 and 1996-1997, deficits in cereal production compared to the average was 77% in the North and 93% in the Centre.

Table 2. Water demand in Tunisia. Source: Ministry of Agriculture and Water Resources (DGRE)

Water Use	%
Irrigation	82
Domestic and Municipal	13
Industry	4
Touristy	1
Total	100

Figure 1. Water uses. Source: Ministry of Agriculture and Water Resources (DGRE)

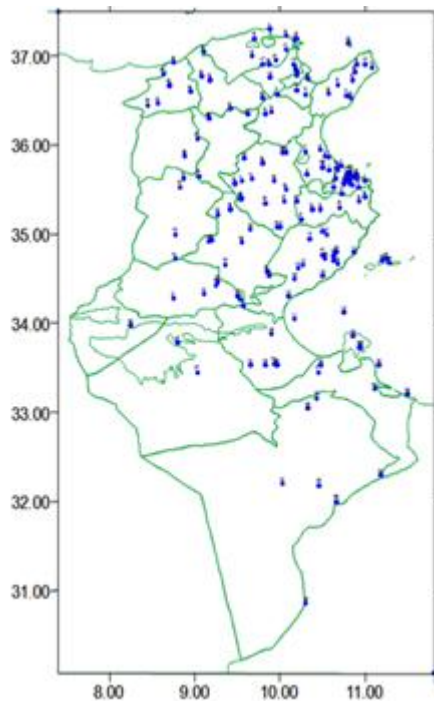


Water dotation : 461 m³/cap/year (2009)
315 m³/cap/year (2030)

In Tunisia many activities, studies and projects were conducted and elaborated in order to reduce drought affects.

The National Institute of Meteorology and The General Direction of water resources (Agricultural Ministry) maintains measurement networks (rainfall, temperature, flow of rivers, groundwater level ...) to monitor weather conditions and water resources. Various information (Index) related to rainfall and water resources are elaborated and disseminated for stakeholders.

Map 5. Rain measurement network (INM)



Map 6. Flow measurement network(DGRE)

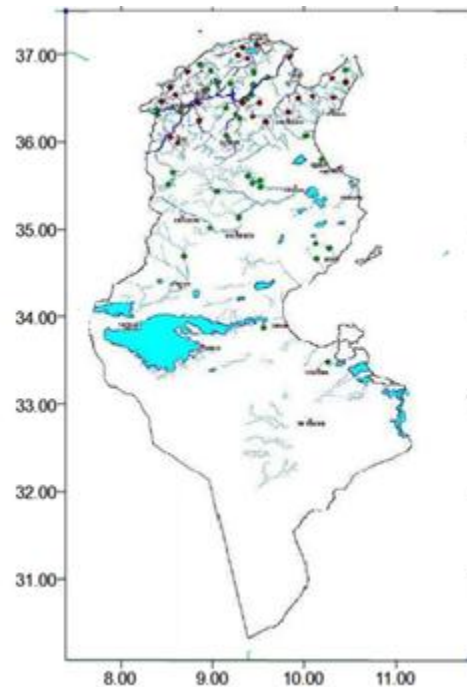


Table 3. water resources distribution and quality. Source: Ministry of Agriculture and Water Resources/DGRE

Element	North Region	Center Region	South Region	Total Tunisia
Area of the region (%)	17	32	51	100
Rainfall (%)	41	29	30	100
Surface water (Million m ³)	2,190	320	190	2,700
Surface water (%)	78	38	19	58
Shallow aquifers (Million m ³)	395	222	103	720
Shallow aquifers (%)	14	26	10	15
Deep aquifers (Million m ³)	216	306	728	1,250
Deep aquifers (%)	8	36	71	27
Total water resources (Million m ³)	2,801	848	1,020	4,670
Total water resources (%)	60	18	22	100
Resources with salinity < 1.5 g/l (Million m ³)	1796	153	6	1955
Resources with salinity < 1.5 g/l (%)	82	48	3	72
Resources with salinity > 3 g/l (%)	37	49	86	
Sallow aquifers with salinity < 1.5 g/l (%)				3
Deep aquifers with salinity < 1.5 g/l (%)				22
Sallow aquifers with salinity 1.5-3.0 g/l (%)				11
Deep aquifers with salinity 1.5-3.0 g/l (%)				57

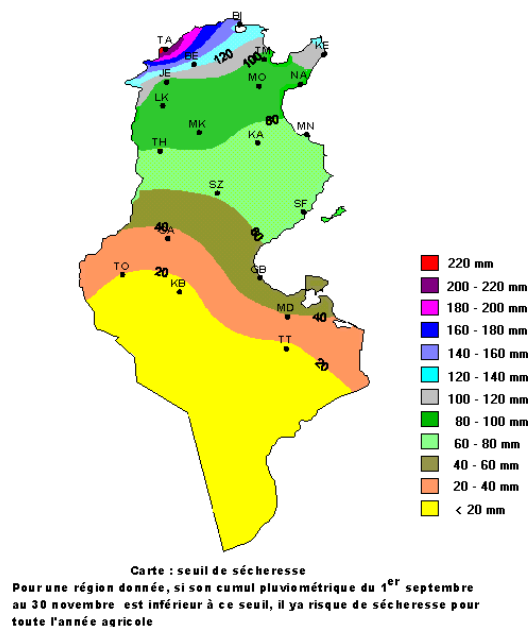
A study completed by the National Institute of Meteorology (Labben et al 2002) was requested by the Agricultural Ministry (National Center for Agricultural Studies) and lies within the framework of a strategy to warn and mitigate the effects of the drought in the sector of the Livestock. The persons in charge of the livestock sector need information about drought to prepare in advance (transfer/importation of animals food, water provision etc...). The objective of this study was to release from climatic data an estimated index of drought prediction. A characterization of the various years of drought observed (appointed, following a compilation of the official documents of the Ministry for Agriculture) was elaborate. From this characterization, a definition of a dry year was made.

On the basis of this definition a detailed analysis of the distribution of the years and dry episodes which touched the country during the last sixty ten years was carried out. Finally of this part, an indicator (the rain of the autumn) likely to be used in a preventive approach of the effects of the drought was proposed.

From the obtained results a map of drought risk was carried out (Map 7).

This map includes rainfall thresholds and the user can, by comparison between the amount of autumn rain recorded in an area and the threshold indicated on the map, have

Map 7. (Drought risk)



Between the years 2006 and 2009 a regional projected titled “Maghrebin system for drought warning” (SMAS) financed by European commission was conducted by the Sahara and Sahel Observatory (OSS). The Global objective is the prevention of the environmental degradation caused by drought thanks to the development of strategies of adaptation in order to reduce its impact by using an early warning system allowing the regular follow-up of the environmental changes in Tunisia, Algeria and Morocco.

Grouping different partners from Tunisia (CNT, INM and IRA), Algeria and Morocco
This project aims to prevention of the environmental degradation caused by drought thanks to the development of strategies of adaptation in order to reduce its impact by using an early warning system.

This warning is focused on the production and the diffusion of indicators of vulnerability of the natural resources. The development of the indicators was based, on climatic, biophysics, socio-economic data as well as satellites images.

The principal activities conducted by the meteorological institute from the three countries are Climatic zoning and Validation of a climatic index (Standard precipitation index (SPI)).

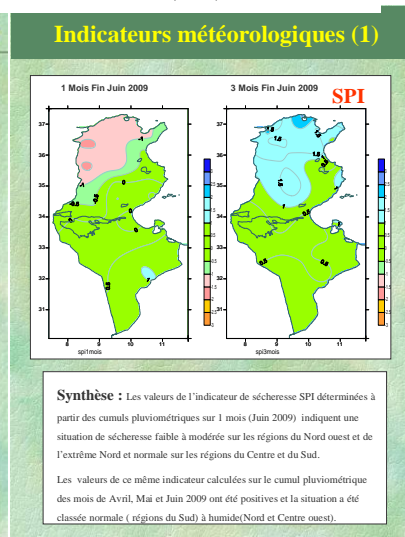
Others zoning (Ecological) and index (vegetation, socio economical) were elaborated by the others participants.

The indexes produced are synthesized in a Drought Bulletin (figure 2, figure 3).

Figure 2. Drought Bulletin (SMAS)



Figure 3. Climatic Index (SPI)



In order to reduce the resultant effects of the drought in Tunisia, a related management system was developed and adopted for the drought events which 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). 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 three major successive steps (Figure 4):

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 Agricultural 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.

Figure 4. Drought management plan in Tunisia

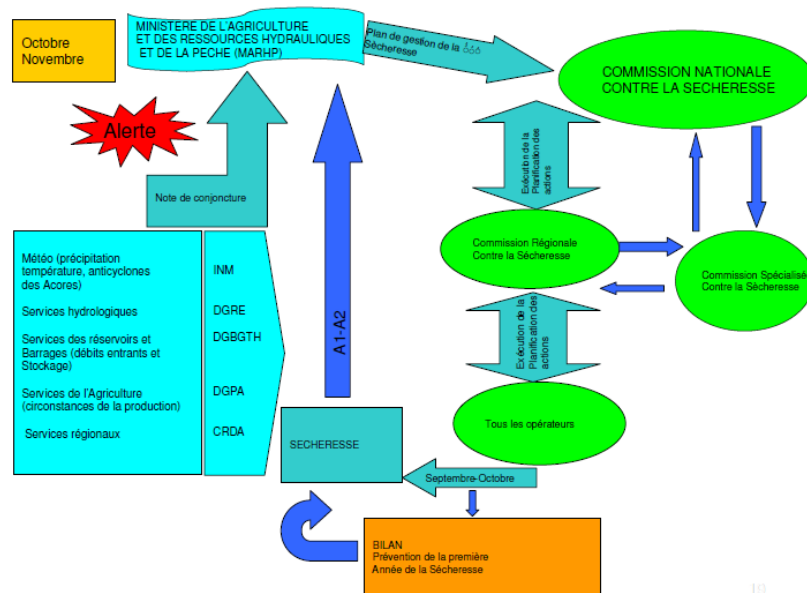


Table 4. Institutions involved in water resources management and/or drought mitigation in Tunisia

Ministry	Institution	Water Management	Drought Mitigation Phases	Ministry	Institution	Water Management	Drought Mitigation Phases
MARH	BPEH (Cabinet)	X	(1-2-3)	MPH	DHMP	X	(2-3)
MARH	DGBGTH	X	(1-2-3)	MARH	DGPA	–	(1-2-3)
MARH	DGRE	X	(1-2-3)	MARH	DGSV	–	(1-2-3)
MARH	DGGREE	X	(1-2-3)	MARH	DGPCOPA	–	(1-2-3)
MARH	DGACTA	X	(1)	MARH (Budget)	DGEDA	X	(2-3)
MARH	CRDA (Water Departments)	X	(1-2-3)	MARH (Budget, Finance)	DGFOP	X	(2-3)
MARH	CRDA (Vegetal and Animal Departments)	X	(1-2-3)	MARH	DGF	–	(1-2)
MARH	BIRH (DGRE)	X	(1)	MARH	OC	–	(2-3)
MARH	SONEDE	X	(1-2)	MARH	OEP	–	(2-3)
MARH	SECANDENORD	X	(1-2)	MARH	AVFA	–	(2-3)
MARH	IRESA	X	(1-2-3)	Prime Ministry	Media	–	(2-3)
MARH and other Ministries	CNE	X	(1-2-3)	NGO	UTAP	–	(2-3)
Advised by MARH	NGO association	X	(1-2-3)	Ministry of Finance	Ministry	–	(1-2-3)
MESD (Environment and Sustainable Development)	DGEQV	X	–	Ministry of Economic Development	Ministry	–	(1-2-3)
MESD (Environment)	ONAS	X	–	Ministry of Public Health	Ministry	–	(1-2-3)
MESD (Environment)	ANPE	X	–	Ministry of Interior	Ministry	–	(1-2-3)
MESD (Environment)	CITET	X	–	Ministry of Commerce	Ministry	–	(1-2-3)
MTCT (Meteorology)	INM	X	(1-2)	Ministry of Communication Technologies and Transport	Ministry	–	(1-2-3)

Although the drought management system has not been analyzed deeply until now in Tunisia, the strengths and weaknesses of the system are identified as stated below:

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 and is not related only to drought.

Weaknesses

- 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 “Système d’Information National des Ressources en eau (SINEAU)” in the near future.

The need for knowledge and skills on drought management is to develop institutional capacity for national drought policy and planning to improve actual drought management system by development of:

- Reliable forecasts and indicators.
- Comprehensive early warning systems.
- Preparedness plans at all government levels.
- Mitigation policies and programs that reduce drought impacts.
- A coordinated emergency response program that ensures timely and targeted relief during drought emergencies.

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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 INTRANSITIONING-SETTINGS COUNTRIES IN WEST ASIA/NORTH AFRICA. 2013. Department of Economic and Social Affairs (DESA). Economic and Social Commission for Western Asia (ESCWA). Expert Group and Inception Meeting on Strengthening National Capacities to Manage Water Scarcity and Drought in West Asia and North Africa. 24-25 June 2013. Beirut, Lebanon