



NOSTRUM-DSS

Network on Governance, Science and Technology for Sustainable Water Resource



European Commission, FP6, Specific measures in support of international co-operation
Mediterranean Partner Countries (MPC), 2004-2007



NOSTRUM-DSS

NATIONAL REPORT

PART 1

STATISTICAL INFORMATION AT COUNTRY LEVEL
ASSESSMENT OF WATER MANAGEMENT PRACTICES, USE AND NEEDS

TUNISIA

Date: April - 2005

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Country Profile

Geography; Administrative division of the country and Capital

Tunisia is located in north Africa and it is bordered in the north and north-east by the Mediterranean Sea, in the south-east by Libya and in the south and west by Algeria. The total area, according to FAO, is 16.3 million hectares of which 15.5 are land area.

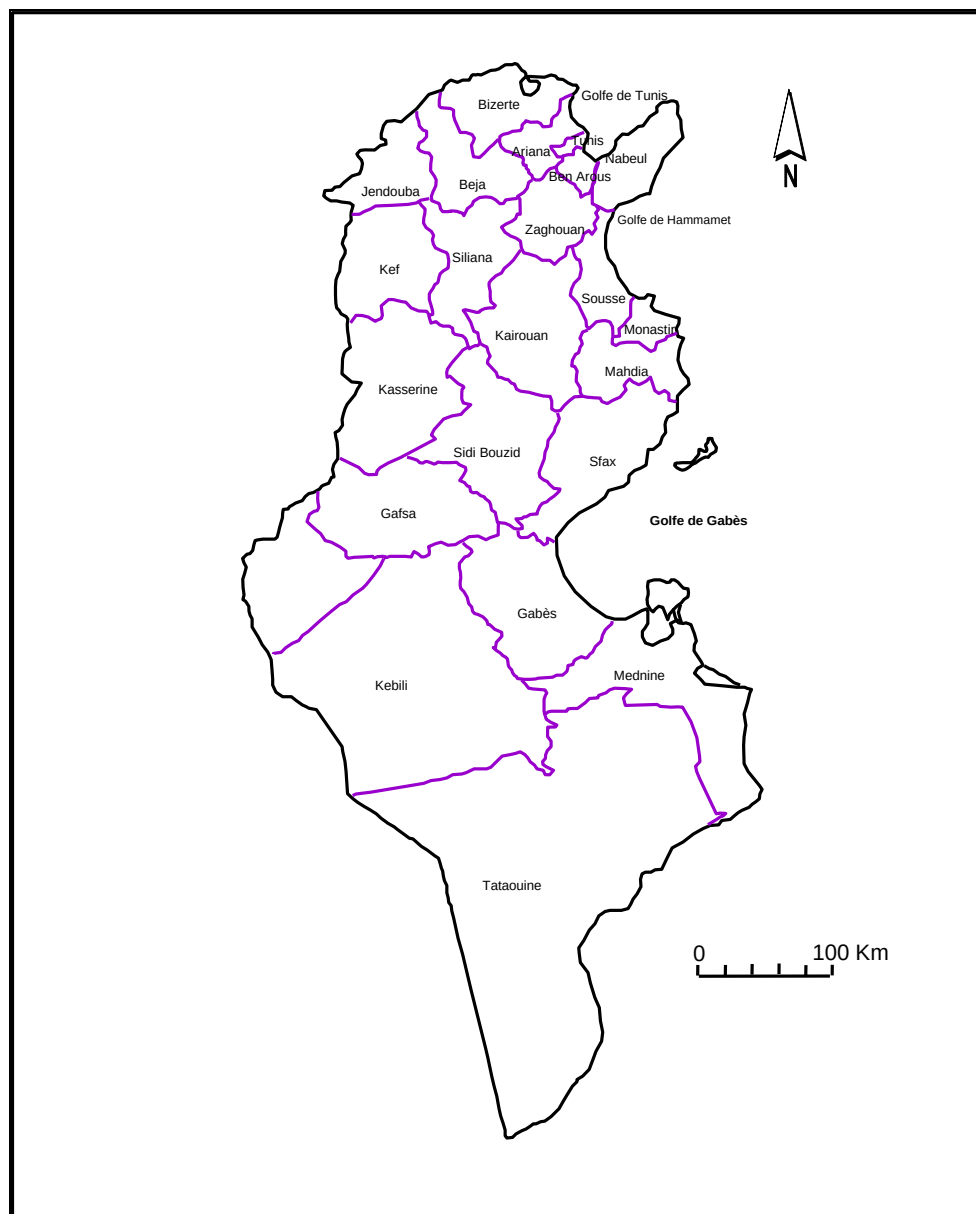


Figure 1: Administrative boundaries – SDAT (1996)



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The country is divided into 24 governorates and the main cities are Tunis, the capital, with 690,940 inhabitants, Safaqis (263,840), Al-Arianah (205,940) and Susah (149,420).

TYPE OF INFORMATION	INDICATOR	SOURCE
Geographic characterisation	Total Area (1000 ha) – 2002	16,361
	Land area (1000 ha) – 2002	15,536
	Agricultural area (Percentage of total area)	51.8
	Forest area (Percentage of total area)	5.5
	Desert area (Percentage of total area)	42.7
		SDAT 1996

Table 1: Total and Land area

Socio-demographic description

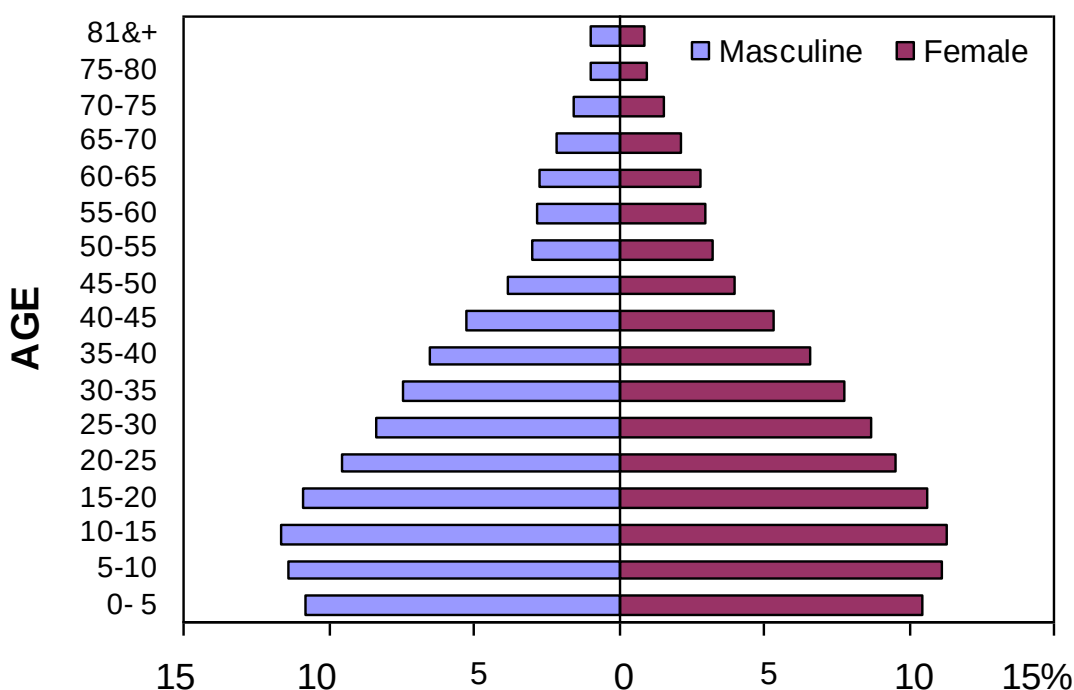


Figure 2: Demographic pyramid – INS (1995)

Tunisia has a population of nearly 10 million people while the average population density is of 60 people per km². The 37% of the overall population is rural and lives mainly in 4,500 villages. The rural population decreased over the time. In fact, 35 years ago it was about 60% of the total population. The annual demographic growth rate is less than 2%. About three-quarters of the population live in the mild, mountainous north and in the coastal regions. The rest of the population lives in the arid central plain and southern regions, which merge into the Sahara Desert. These zones constitute approximately 70 percent of the total land area.



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TYPE OF INFORMATION		INDICATOR		SOURCE
Socio-demographic Indicators	Population (Million people) – 2002	9.7		UN Department of Economic and Social Affairs, Population Division. New York. 2004
	Urban Population (% of total population) - 2002	62.8		
	Population Growth Rate (Percentage) – 1975/2002	2		
	Population Density (People/square km)- 2002	60.1		
	Life expectancy at birth (Years) - 2002	71.6		WHO 2004
	Fertility rate - (Number of children per women)	1970-1975	2000-2005	UN Department of Economic and Social Affairs, Population Division. New York. 2004
		6.2	2	

Table 2: Country profile - Population dynamics

Political description of the current form of government

Tunisia is a republic with a strong presidential system dominated by a single political party, the Constitutional Democratic Assembly (RCD). The President is elected to 5-year terms and nominates a Prime Minister and cabinet, who play a strong role in the execution of policy. The central government appoints also regional governors and local administrators, whereas largely consultative mayors and municipal councils are elected. The Chamber of Deputies is a unicameral legislative body formed by 182 seats, 20% of which are reserved for the opposition. It is an important arena for debating national policies but basically it never originates legislation and virtually always passes bills presented by the executive with only minor changes. The judiciary is nominally independent but responds to executive direction especially in political cases. The military is professional and does not play a role in politics.

The current president is Zine el-Abedine Ben Ali who is in office since the deposition of Habib Bourguiba in 1987 who was the first president after the Tunisia's independence from France in 1956.

General description of the economy of the country

After decades of heavy state direction and participation in the economy, Tunisia is now facing a process of economic reform and liberalisation. A moderate sustained growth, caused by the adoption of a prudent economic and fiscal planning, has characterised the Tunisian economy for over a decade. The economic growth was historically due to the following sectors: oil, phosphates, agriculture, and tourism. In the first years of independence, the economic policies of the government had scarce success. During the 1960s, a drive for collectivisation caused unrest, and farm production fell sharply. In the 1970s, the growth was stimulated by higher prices for phosphates and oil and growing revenues from tourism but there were some inefficiencies caused by the emphasis placed on protectionism and import substitution. In this period, the United States and European and Arab countries substantially supported the Tunisian economy, Tunisia is now one of the few developing countries in the region which moved into the "middle income" category.

In the mid-1980s the overvaluation of the dinar and the growing foreign debt provoked a foreign exchange crisis. In 1986, the government launched a structural adjustment program in order to reorient Tunisia toward a market economy. Through this program the government liberalised prices, reduced tariffs, lowered debt-service-to-exports and debt-to-GDP ratios, and extended the average maturity of its \$10 billion foreign debt. Structural adjustment brought additional lending from the World Bank and other Western creditors. This economic reform program was appreciated by international financial institutions. In 1990, Tunisia acceded to the General Agreements on Tariffs and Trade (GATT) and is a member of the World Trade Organisation (WTO).

Another important success for Tunisia was the execution of an "Association Agreement" with the European Union (EU) in 1996. This will allow the removal of EU tariff and other trade barriers on most goods by 2008. The EU is also



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providing its support to the Tunisian Government for the drafting of the “Mise A Niveau” program which should enhance the productivity of Tunisian businesses and prepare for competition in the global marketplace.

Since the privatisation program was launched in 1987, about 160 state-owned enterprises have been partially or totally privatised. This program, thought supported by the UGTT, has been carried out gradually in order to avoid mass firings. Unemployment is in fact one of the major economic problem in Tunisia, also worsened by the rapid increase in work demand. Officially, 15.6% of the Tunisian work force is unemployed, but it seems that the real numbers of jobless or underemployed are higher.

The stock exchange is under the control of the state-run Financial Market Council and lists nearly 50 companies. Substantial tax incentives are offered to encourage companies to join the exchange, but expansion is still slow. In 1992, Tunisia re-entered the private international capital market for the first time in 6 years, securing a \$10-million line of credit for balance-of-payments support. In 1993, the government adopted a unified investment code in order to attract foreign capital. In January 2003 Standard and Poor affirmed its investment grade credit ratings for Tunisia. Tunisia's currency, the dinar, is not traded outside Tunisia. However, partial convertibility exists for bonafide commercial and investment transaction. Certain restrictions still limit operations carried out by Tunisian residents.

Tunisia was ranked 34th in the Global Competitiveness Index Ratings (two places behind South Africa, the continent's leader) according to the World Economic Forum (2002-2003).

In Tunisia, more than 1,600 export-oriented joint venture firms operate because of the advantage to have rather low labour costs and for the preferential access to nearby European markets. Economic links are closest with European countries, which dominate Tunisia's trade.

TYPE OF INFORMATION		INDICATOR	SOURCE
Economy	GDP (Billion US \$ PPP) – 2002	66.2	World Bank 2004
	GDP per Capita (US \$ per Capita) – 2002	6,760	World Bank 2004
	Gini coefficient of income distribution (Index) - 2002	39.8	World Bank 2004
	GDP by Agriculture (Percentage of GDP) – 2002	12.3	World Bank 2004
	GDP by Industry (Percentage of GDP) - 2002	28.8	World Bank 2004
	GDP by Services (Percentage of GDP) - 2002	58.9	World Bank 2004

Table 3: Country profile – Economy

TYPE OF INFORMATION		INDICATOR	SOURCE
Employment	Labour force employed in Agriculture (Percentage of total Labour force) - 2002	22	International Labour Organisation
	Labour force employed in Industry (Percentage of total Labour force) - 2002	23	International Labour Organisation
	Labour force employed in Manufacturing (Percentage of total Labour force) - 2002	33.9	International Labour Organisation
	Labour force employed in Services (Percentage of total Labour force) - 2002	55	International Labour Organisation
	Labour force classified as economic activity (Percentage of total Labour force) - 1997	22	INS - 1997
	Labour force not classified as economic activity (Percentage of total Labour force) - 2002	47.1	INS - 1997
	Unemployment rate (Percentage of total active population) - 2002	14.9	IDD - 2003

Table 4: Country profile – Employment



1 Cross-sectoral issues

The importance of water for development cannot be overemphasised, as many recent reports and international efforts have shown. For instance, the Millennium Declaration, which 189 Heads of States and governments embraced following the UN Millennium Summit in 2000, resulted in the subscription to the Millennium Development Goals (MDG). Of the eight goals, two targets focus specifically on freshwater; moreover, at the 2002 World Summit on Sustainable Development, water was recognised as a fundamental component of the three pillars of sustainability – namely social, economic and environmental. In addition, the UN Secretary Kofi Annan proposed the WEHAB initiatives, which targets action in five key areas: water and sanitation, together with energy, health, agriculture and biodiversity. It is clear that integrated management of water resources has a key role to play for all key areas of the WEHAB.

Goal 1: Eradicate extreme poverty and hunger

In 2000, the proportion of population whose income is less than the poverty line (threshold) evaluated at **418 DT/year/capita** was about **4.2%**. While, in 1980, the proportion of population whose income is less than the poverty line (threshold) evaluated at **120 DT/year/capita** was about **12.8%**.

Goal 2: Achieve universal primary education of primary schooling

Since 1984, the proportion of illiterate population is in continuous decrease : it was about 46.1% and became 24.1% in 2001. The primary education is achieved to 40.4% of the population with a weak difference between communal and rural population. The primary school population is not equally distributed between boys (52.7%) and girls (47.3%).

Goal 3: Promote gender equality and empower women of education no later than 2015

In 1999, some differences in women and men education can still be observed on different levels : primary school (35.6% for women and 42.7% for men); secondary school (24% for women and 31.2% for men) and university (3.8% for women and 6.2% for men). However, this percentage are in continuous decrease since the independence.

Goal 4: Reduce child mortality

Child mortality was reduced from 34.1 ‰ in 1992 to 28.9 ‰ in 1997.

Goal 5: Improve maternal health

Goal 6: Combat HIV/AIDS, malaria and other diseases

Goal 7: Ensure environmental sustainability

In 2002, the proportion of population with access to improved water supply was 100 %, while in the rural areas the percentage reached 83.2.

Goal 8: Develop a global partnership for development

In 1990, Tunisia acceded to the General Agreements on Tariffs and Trade (GATT) and is a member of the World Trade Organisation (WTO).



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TYPE OF INFORMATION Millennium Development Goals	Goal s		INDICATOR	SOURCE
		Human Development Index (Index) - 2002	0.745	World Bank – UN - 2004
Eradicate extreme poverty and hunger	1	Population below \$1 a day (Percentage) - 2002	2.0	World Bank - 2004
Achieve universal primary education of primary schooling	2	Education Index - 2002	0.7	UNESCO 2004
Promote gender equality and empower women of education no later than 2015	3	Ratio of young literate females to males (Percentage) - 2002	93.0	UNESCO 2004
Reduce child mortality	4	Under-five mortality rate (per 1.000 births) - 2002	26	WHO 2004
Improve maternal health	5	Maternal mortality ratio (per 100.000 births) - 2002	120.0	WHO 2004
Combat HIV/AIDS, malaria and other diseases	6	HIV prevalence (% 15-49 years)	0.04	UNAIDS (Joint United Nations Programme on HIV/AIDS). 2004
Ensure environmental sustainability	7	Access to improved water supply	80	WHO 2004
Develop a global partnership for development	8	Total ODA Given as Percent of GNP - 2002	2.3	World Bank 2004

Table 5: MDG Selected Indicators – Country's performance

WSSD implementation

TYPE OF INFORMATION		INDICATOR	SOURCE
WSSD	Access to improved water sanitation (Percentage of total population)	84	WHO 2004
	Presence of an Initiated Integrate Water Resource Management Plan, as required by 2005 (Y/N)	y	Currently achieved

Table 6: WSSD implementation



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Internationally agreed development goals and selected targets relevant to water

Millennium Declaration

Goal 1: Eradicate extreme poverty and hunger

Goal 2: Achieve universal primary education of primary schooling

Goal 3: Promote gender equality and empower women of education no later than 2015

Goal 4: Reduce child mortality

Goal 5: Improve maternal health

Goal 6: Combat HIV/AIDS, malaria and other diseases

Goal 7: Ensure environmental sustainability

Goal 8: Develop a global partnership for development

Targets

Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day

Halve, between 1990 and 2015, the proportion of people who suffer from hunger

Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course

Eliminate gender disparity in primary and secondary education, preferably by 2005, and to all levels

Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate

Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio

Halt by 2015 and begin to reverse the spread of HIV/AIDS

Halt by 2015 and begin to reverse the incidence of malaria and other major diseases

Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources

Halve by 2015 the proportion of people without sustainable access to safe drinking water

Achieve by 2020 a significant improvement in the lives of at least 100 million slum dwellers

Develop further an open, rule-based, predictable, non-discriminatory trading and financial system. Includes a commitment to good governance, development, and poverty reduction – both nationally and internationally

Address the special needs of the least developed countries, landlocked countries and Small Island Developing States (SIDS)

In cooperation with the private sector, make available the benefits of new technologies

Source: UN (2000a). UN Millennium Development Goals (MDG). New York, United Nations, <http://www.un.org/millenniumgoals/>

WSSD Plan of Implementation

Halve, by the year 2015, the proportion of people who are unable to reach or to afford safe drinking water (as outlined in the Millennium Declaration) and the proportion of people who do not have access to basic sanitation.

Develop integrated water resources management and water efficiency plans by 2005

Source:

UN (2002). WSSD Plan of Implementation. Johannesburg, United Nations

Table 7 – Millennium Development Goals and World Summit on Sustainable Development Implementation Plan

1.1 Environment and the water cycle

1.1.1 General context

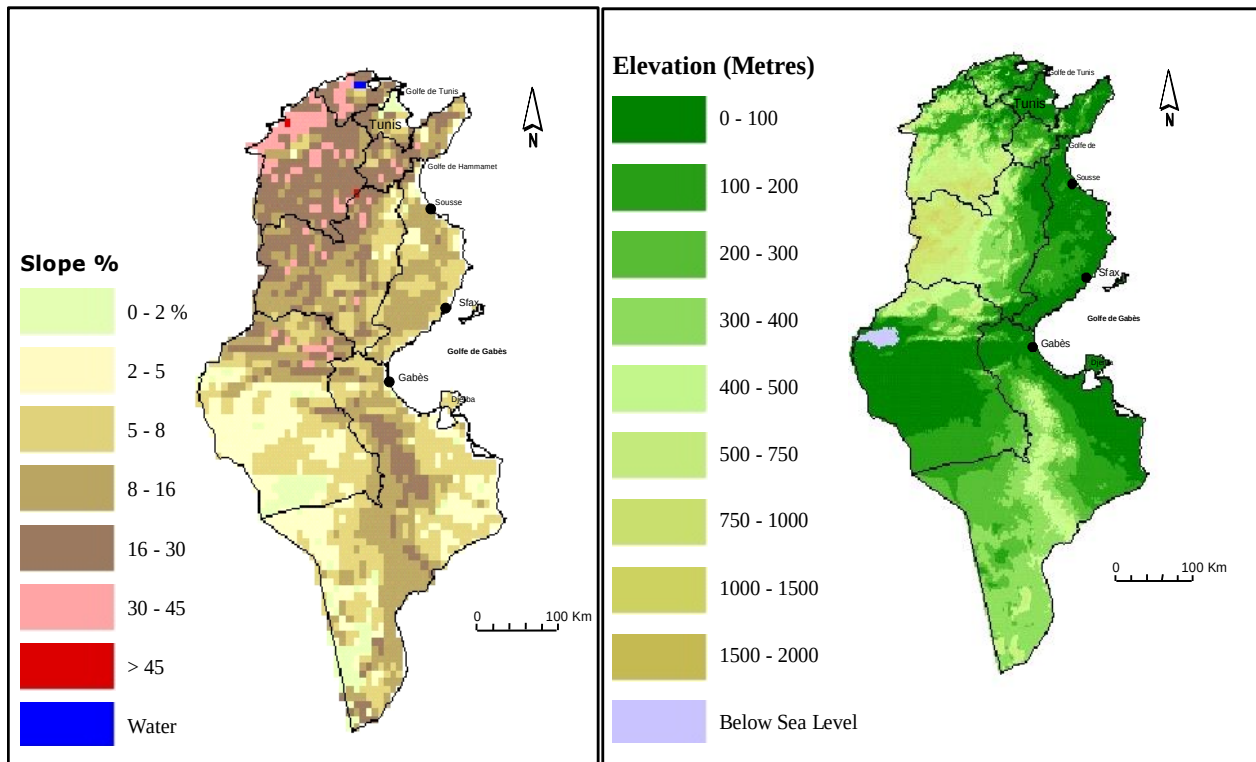


Figure 3: Elevation and Slope – FAO-CROPWAT

Tunisia is characterised by four physiographic regions :

- The North-western Mountains are located at the eastern end of the two mountain ranges, the Atlas El-Talli and the Desert Atlas. These mountain chains extend from Morocco through Algeria and reach a peak at 1,500 metres in Tunisia. This area is crossed by permanent rivers;
- The Southern Mountains slope towards the east to the Coastal Plains and towards the west to the Desert Plains. This area is covered by sand dunes;
- The Coastal Plains which run close to the Mediterranean Sea as wide plains;
- The Desert Plain forms the northern boundary of the Great Desert (Sahara). A number of chotts exist in this plain, the largest one being the Chott El-Jarid with an area of 5 000 km² at a minimum elevation of 15 metres below sea level.

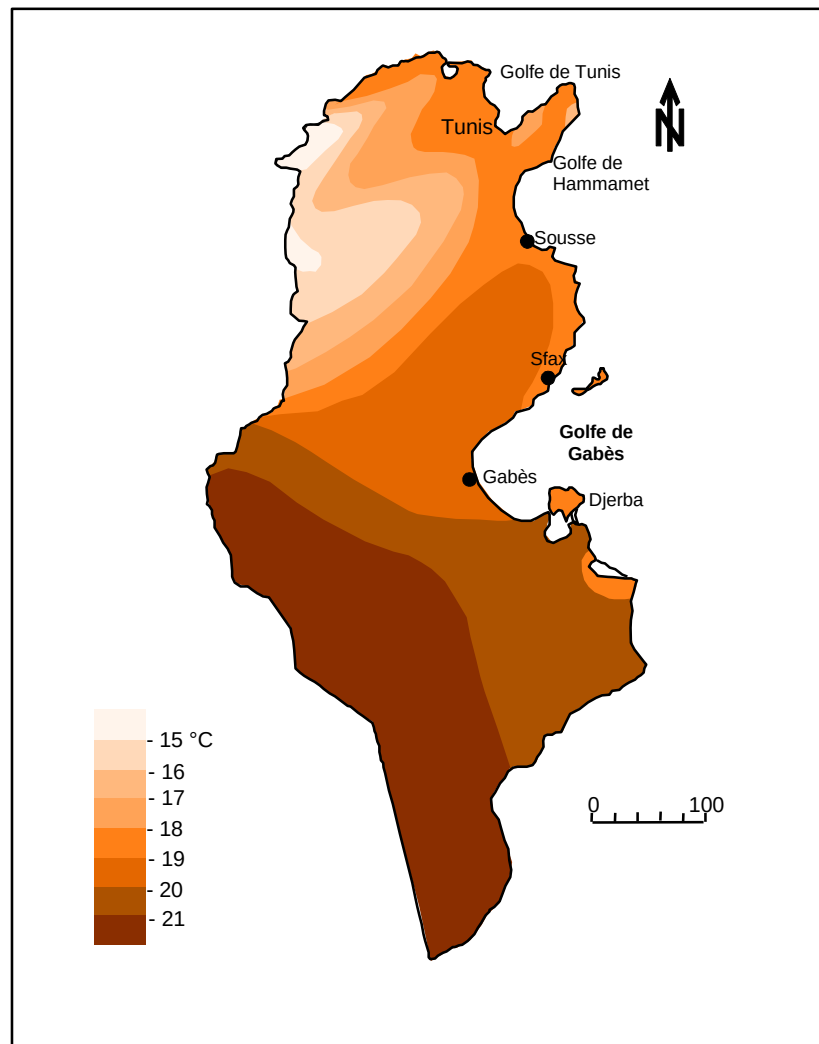


Figure 4: Temperature – Zouari and Gaâloul (2004)

The Tunisian has a typically Mediterranean climate, characterised by hot dry summers and cool moist winters that limit the growing period; precipitation is very irregular and the rainfall varies considerably from the North to South. According to rainfall, temperature and winter, there are five bioclimatic zones in going from the most arid to the most humid, as defined by Emberger (1960). Temperature is determined by altitude and by the degree of continentality; inland stations have relatively hotter summers and colder winter than areas which benefit from the buffering effects of the sea.

1.1.2 Water resources

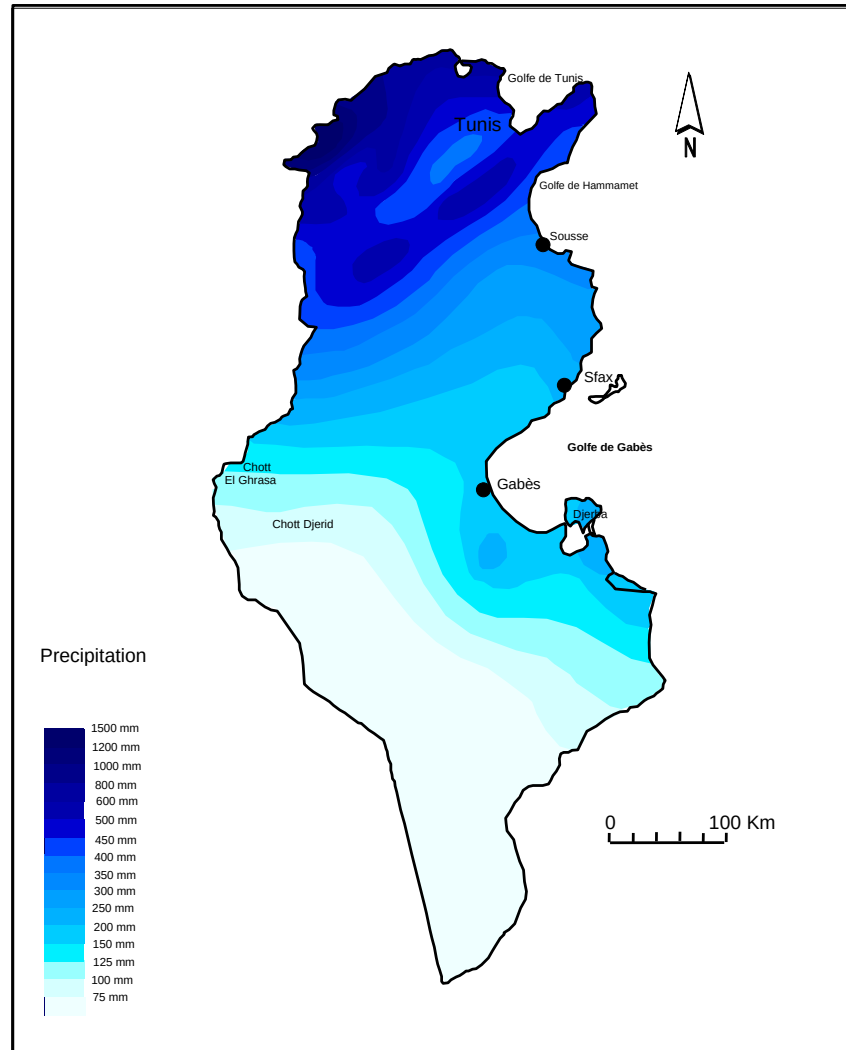


Figure 5: Precipitation – Zouari and Gaâloul (2004)

Due to the variability of both Mediterranean climate in the north and arid climate in the south, the availability of water resources is uncertain and not equally distributed in space and time. The average precipitation rainfall is 245 mm/year, which represents 37 km³ per year. This volume varies between 11 km³ per year in drought years and 90 km³ per year during particularly rainy years. The annual rainfall is 594 mm in the north, 289 mm in the centre and less than 50 mm/y in the south.

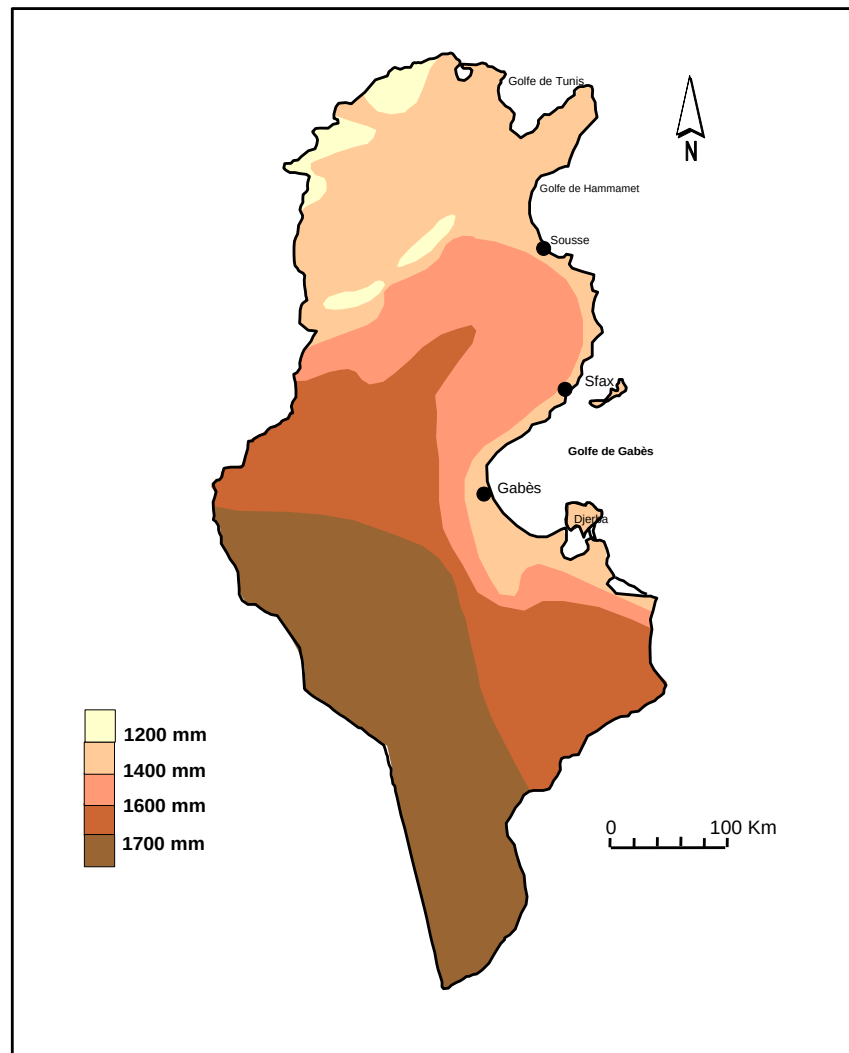


Figure 6: Potential Evaporation rate – Henia (1993)

The current estimated evaporation rate is about 80 %, on the whole country.

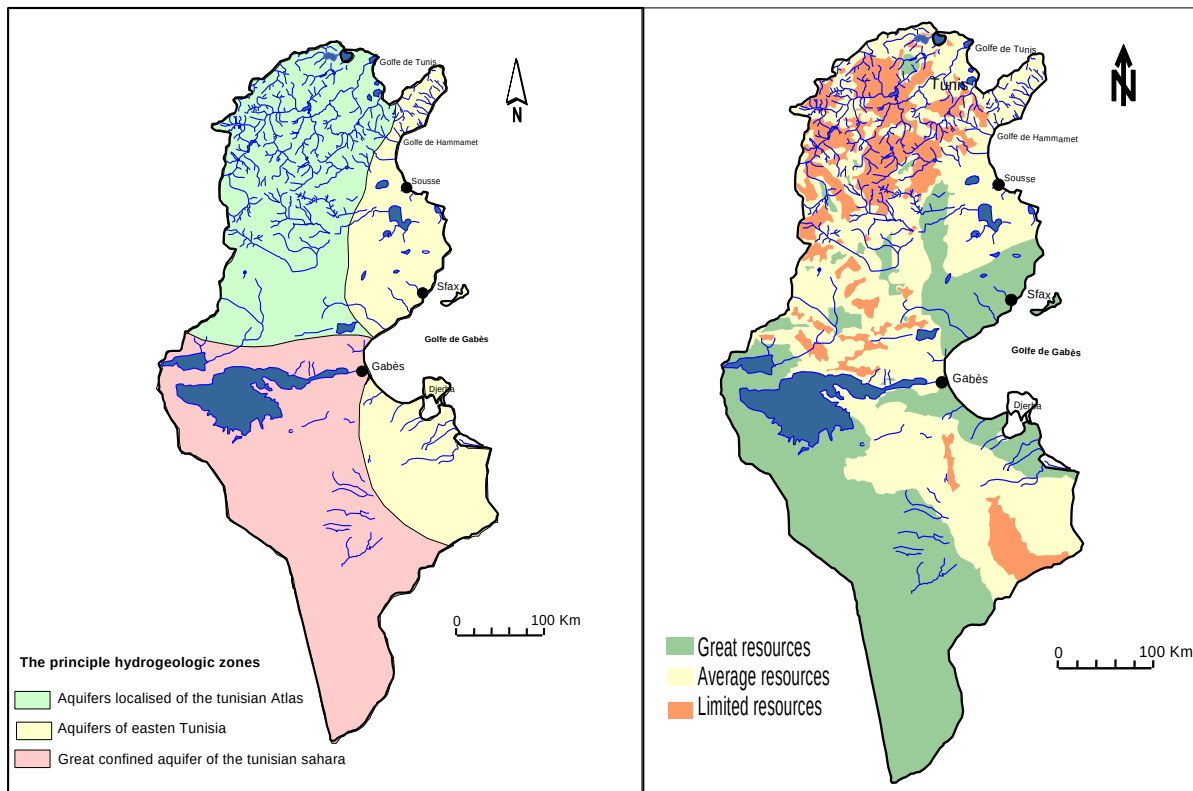


Figure 7: Main surface and ground water systems; hydrological basins – Zouari and Gaâloul (2004)

Surface water resources produced internally each year have been estimated at 2.7 km³.

In 202, there were 27 large dams and 182 hillside dams. About 2.04 km³/year are exploitable at present through reservoirs (2002).

Total groundwater resources have been estimated at 2,145 million m³, not equally distributed within the country: north owns 55 % of the phreatic groundwater and only 18 % of the deeper systems; centre has a proportion of respectively 30 and 24 % while south reaches only 15 % of the phreatic groundwater but owns 58 % of the deepest water systems. In Tunisia, 212 phreatic groundwater resources have been identified with a potential of 745 million m³/year. Total potential groundwater resources had been estimated at 1,400 million m³/year, of which 605 is fossil water. Internal renewable groundwater resources have been estimated at 1.5 km³/year. In 1997 there were, 83,000 open wells and 1,830 tubewells.

In the last 20 years, the reuse of treated wastewater occurred. In 1993, 96 million m³ was treated, of which 20 million m³ was reused. In 1997, it was planned to boost the wastewater treatment to 200 million m³/year by the year 2000. According to the ONAS, in 2002, the wastewater treatment in 2002 concerned 150 million m³ of which 36 million m³ was reused.

The amount of water withdrawn in 2000 was estimated at about 2.7 km³/year, of which 84 % was used for agricultural purposes (11 % is withdrawn for domestic use and 4% for industrial use). Usually, this amount depends to a large extent on the quantity and the distribution of the precipitation. More specifically, the amount of water withdrawn for agriculture depends on the rainfall and on the area actually irrigated by means of the public irrigation network.

In Tunisia, during the 1990s a strategy for facing better the future demand of water was adopted. This strategy aimed at building the construction of 21 dams, 235 hillside dams and 610 deep tube-wells in order to develop 90% of



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surface water resources and 100% of groundwater resources by the year 2010. This improvement in the control of water resources is associated with the agricultural development of the irrigation schemes. At the moment, main aims of Tunisia are to encourage the adoption of water saving techniques, to favour the reuse of treated wastewater for irrigation, to expand the irrigated areas and to set up the related activities necessary for agricultural development and for a better use of irrigation schemes.

TYPE OF INFORMATION		INDICATOR	SOURCE
General description of the climatic and morphological systems, hydrological basins	Precipitation (mm/year) – 1961/1990	245	FAO – Aquastat 2003
	Number of main river basins	8	SDAT – 1996
	Volume in groundwater systems (km ³) – 2003	2.145	Deutsches Institut Für Entwicklungspolitik 2003
Renewable Water Resources	Surface water: produced internally (cubic km/year) – 2000	2.7	FAO Aquastat 2003
	Groundwater: produced internally (cubic km/year) – 2000	1.5	FAO Aquastat 2003
	Desalinated, Reused treated wastewater (Million cubic m/year) - 2003	51	IDD - 2003
Non renewable water resources	Non renewable groundwater system (Million cubic meters) - 2004	0.745	Annuaire d'exploitation des ressources en eau DGRE
Sharing Water	Number of transboundary basins	1	International Journal of Water Resources Development, Vol. 15 No. 4, December 1999.
	Dependency ratio (Percentage) – 2000	9.0	FAO Aquastat 2003
Water withdrawals	Total withdrawals (cubic km/year) – 2000	2.7	FAO Aquastat 2003
	Groundwater withdrawals (cubic km/year) – 2000	1.6	FAO Aquastat 2003
	Surface withdrawals (cubic km/year) – 2000	1.1	FAO Aquastat 2003
Water storage	Dam Storage and reservoirs (cubic km) – 2000	2.1	Deutsches Institut Für Entwicklungspolitik 2003

Table 8: Key water statistics

1.1.3 Development pressures on environment and ecosystem

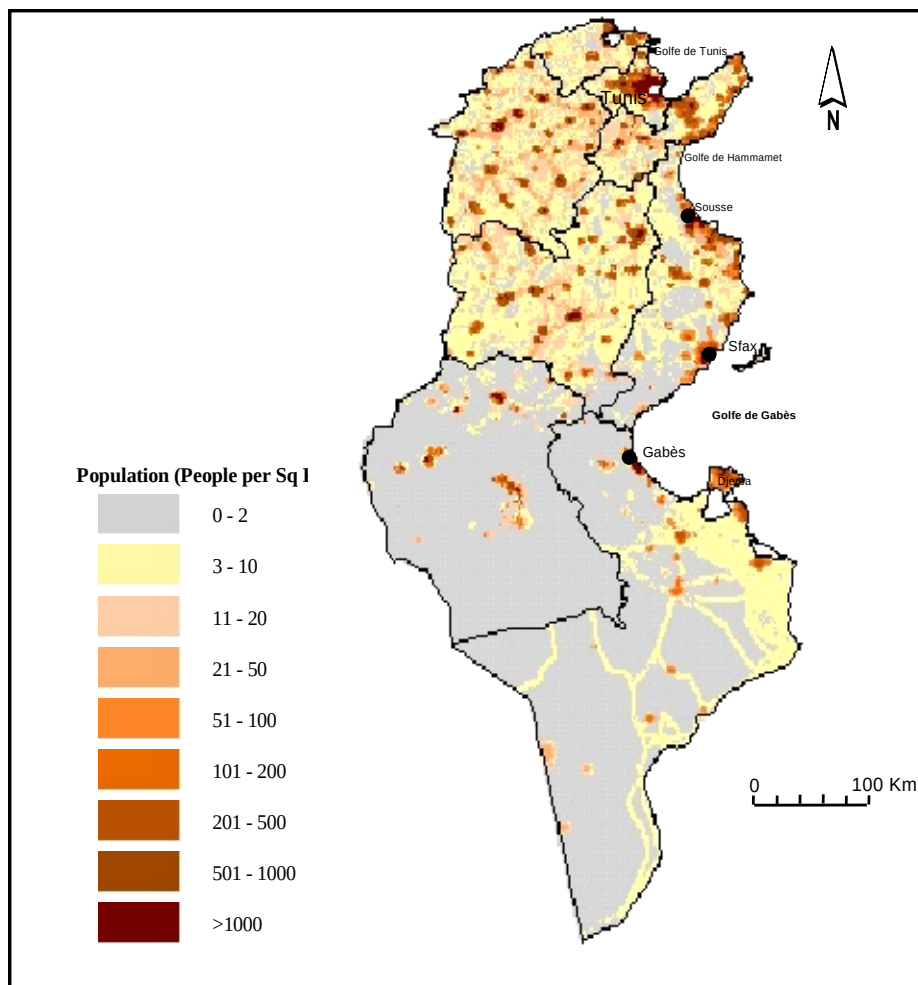


Figure 8: Map of Population density – FAO (2004)

One of the effect of the demographic development is the mobilisation of water. In fact, in Tunisia the major part of water resources is concentrated in the north of the country, while the main demand centres are on the east side. This distribution implies an expensive transfers of water from one region to another.

According to the Tunisian standards good quality water is the one with a salinity rate lower than 1.5 g/l. Therefore on the basis of this classification, the percentage of good quality water in the whole country is 72 % for the surface water , 8 % for the phreatic groundwater and 20 % for the deepest groundwater. Considering a salinity rate of 3 g/l, suitable for drinking and irrigation purposes, only 36 % of the Tunisian groundwater reaches such a quality.

Population dynamics	1975	2002 projection	2015 Projection	UN (United Nations) Department of Economic and Social Affairs, Population Division. New York. 2004
Urban population (%total population)	49.9	63.4	68.1	
Rural population (%total population)	50.1	36.6	31.9	

Table 9: Population dynamics – Percentage of urban and rural population



In Tunisia, according to ONAS (Office National de l'Assainissement) the consumption of potable water is of 79 litres per day per person. In fact, according do SONEDE (Société Nationale de l'Exploitation et de Distribution des eaux), the consumption of potable water is of 85 litres per day per person in communal zones and of 23 litres per day per person in rural zones.

TYPE OF INFORMATION	INDICATOR	SOURCE
Total - Water consumption per capita (litres per day per capita) – 2000	124.3	AQUASTAT FAO 2004
BOD Emissions (Kg/day) – 2004	46,051.7	World Bank

Table 10: Development pressures on environment

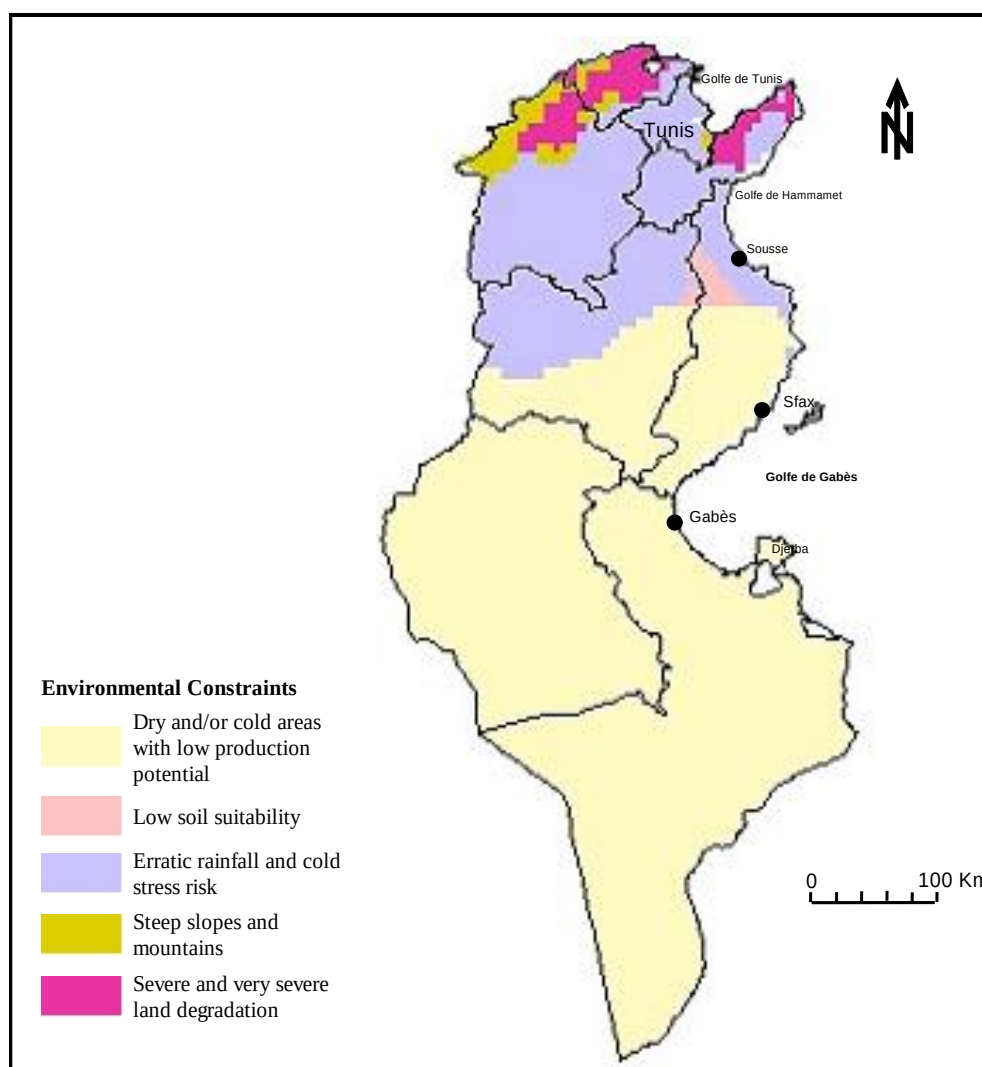


Figure 9: Hazard map - FAO (2004)



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TYPE OF INFORMATION	INDICATOR	SOURCE
Non sustainable Water production index – year	10	Blue Plan: MARGAT (J.), VALLEE (D.) – Water Resources and uses in the Mediterranean countries: figures and facts, 2000. Plan Bleu
Rate of change of the occurrence of flood phenomena	N.A.	
Index of River fragmentation	N.A.	
Area of wetland drained	0.08	IDD - 2003
Cholera and epidemic by dysentery (number/year)	0	World Health Organization
Malaria (Number for 1000 persons/ year)	1	World Health Organization

Table 11: Environmental health impacts on development

The Tunisian soils are particularly favourable to degradation phenomena because of their physical, geomorphologic and socio-economical conditions. The erosion problem is widely spread in the country and it provokes decrease in soil fertility and productivity. The erosion process together with other factors such as saltiness, urbanisation and desertification brought about the loss of nearly 23,000 ha of agricultural land. Desertification is highly present in the south and central regions (8,000 ha per year). In the Dorsal and the Tell many factors are at the origin of desertification such as overexploitation of water resources heavy rain, slope land. In this area, the increase of edaphique aridity allows dry farming only, particularly annual cultures. The central part of Tunisia is divided into two socio-agro-ecological zones: the high steppe and the low steppe. The former one is characterised by high relief and it is covered by more or less damaged forests, while the latter is marked by a smooth relief, large alluvial plains and salty depressions where the main water resources of the Dorsale and High Steppe flow.

In the Meridional area of Tunisia there are different types of desertification according to topographic and morpho-pedological landscape impacts. The Atlasic zone, is characterised by strongly eroded soils relief and the soil degradation had been increased by over exploitation of the Alfa, while the Meridional Stepped zone presents three different landscape (1 Oriental Erg, 2 Dahar and Matmata, 3 Chotts) where desertification appears variable intensities.

The Ministry of Environment and Territory Planning drafted the “Yellow Hand” Program which is specific to combat desertification according to the UN international convention. (United Nations Convention to Combat Desertification)

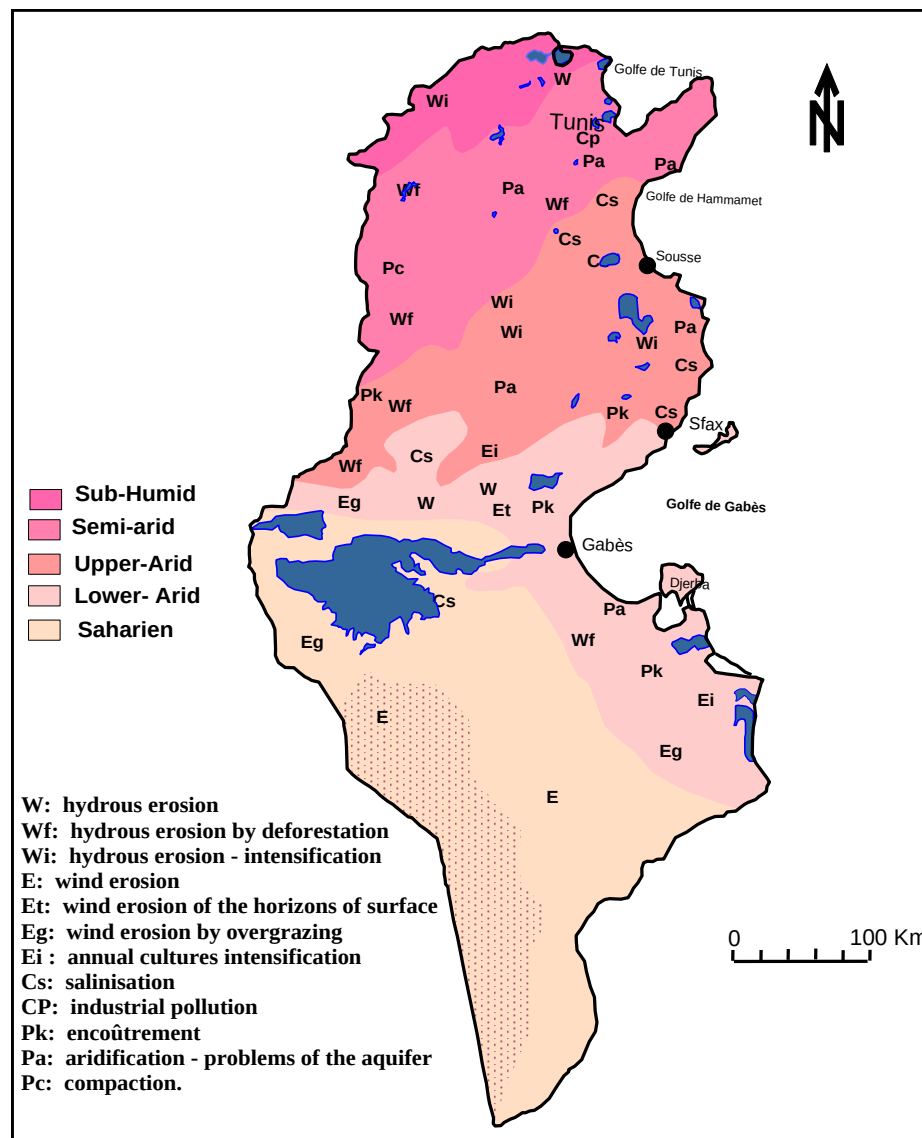


Figure 10: Soil problem map – ANPE (1996)

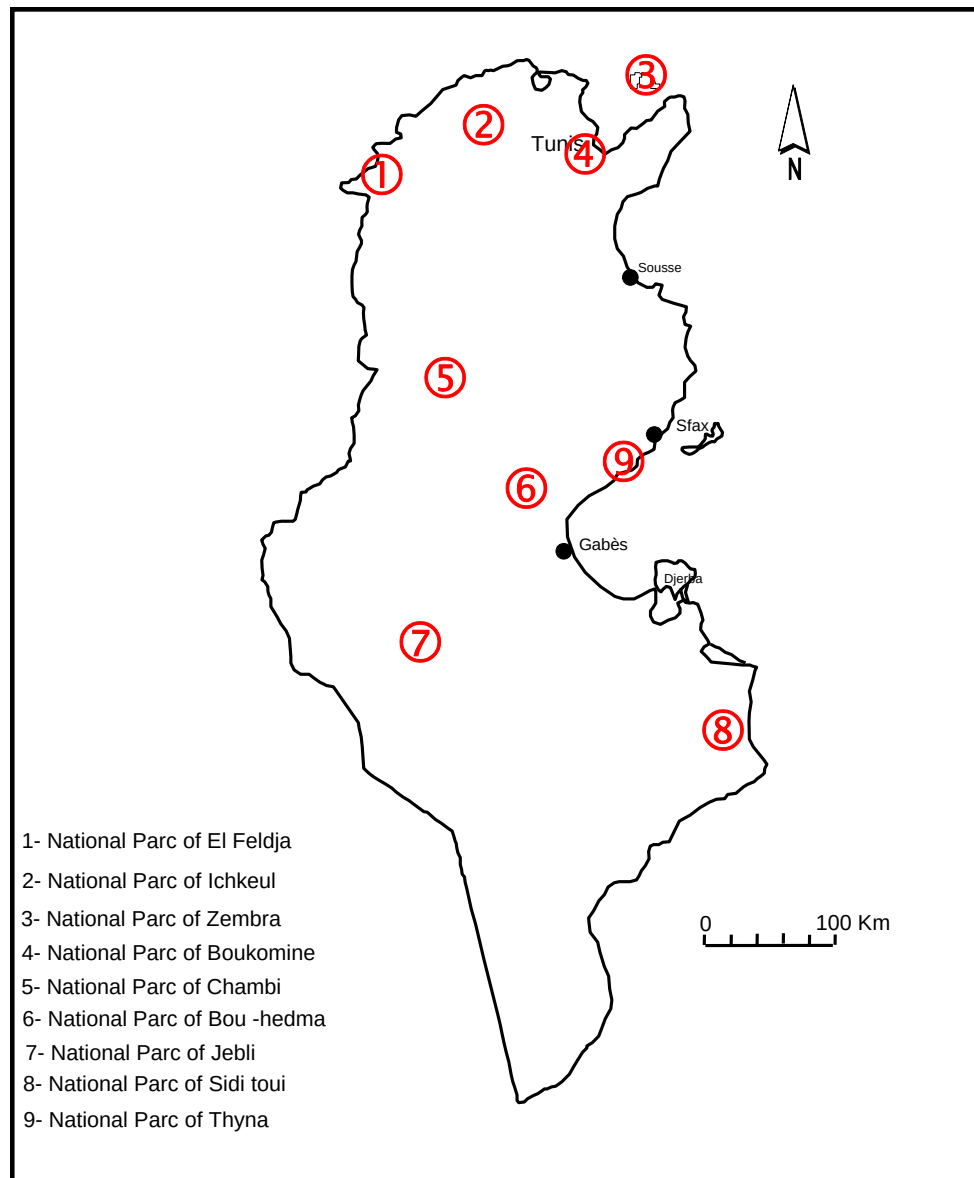
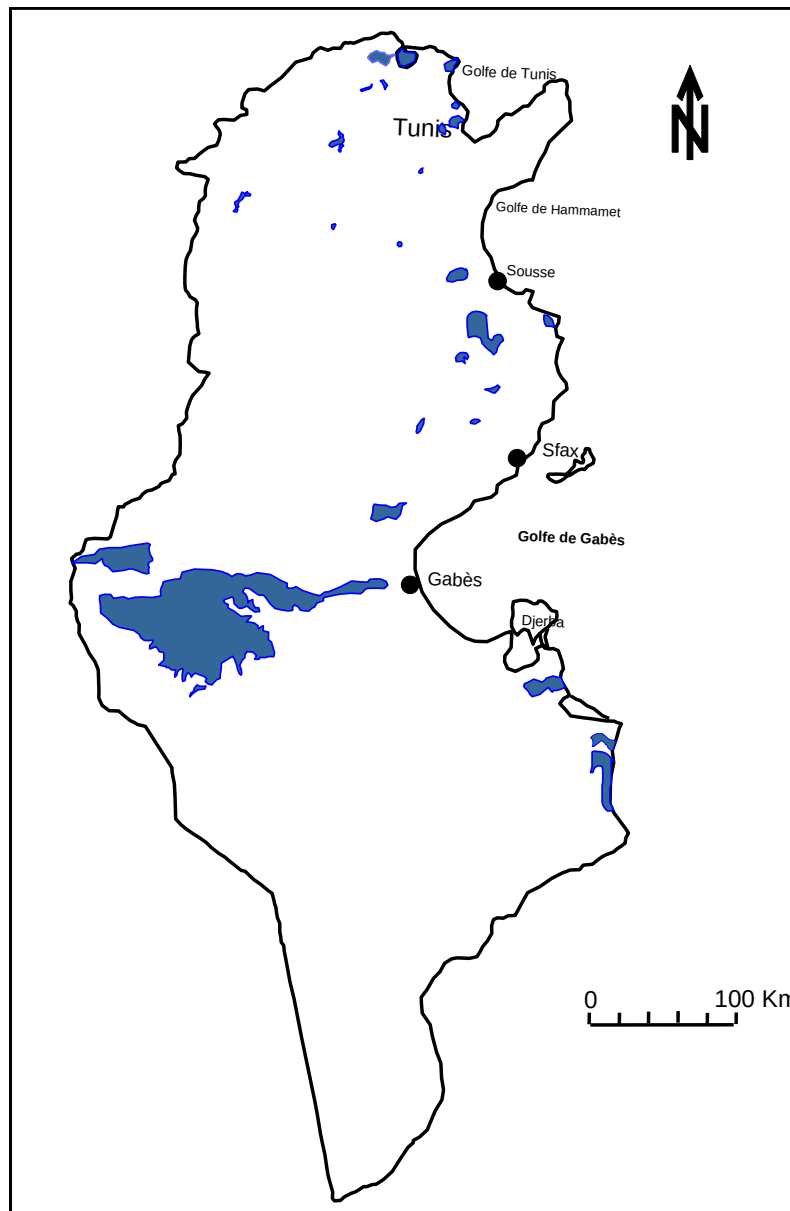


Figure 11: Protected Areas: IUCN Categories I-VI – ANPE (1996)

The main measures undertaken by the government in order to preserve the biodiversity are the following: fight against genetic erosion; protection of ecosystems in the face of aridity and the increasing needs of the population; proper management of the ecosystems; integrating biodiversity in strategic sector-based options (water, soil conservation, forest); set up of a proper institutional and legal framework; training, information, development of the production and use of knowledge matter of biodiversity.



Source: Map of hydrographic network of Tunisia (1/500000)

Figure 12: Wetlands

Although the dominant aridity of the climate, Tunisia has over 130 wet zones representing 3% of its non desert space. These zones include the waterways, the hydrographical network and the outcroppings of groundwater tables and are located between Europe and Africa, hence they are a wintering sites for many migrating birds.



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TYPE OF INFORMATION	INDICATOR	SOURCE
MDG – Protected Areas: IUCN Categories I-VI, Percentage of Total Area	0.2	United Nations Environment Programme - World Conservation Monitoring Centre (UNEP-WCMC)
Ramsar sites (ha)	12,600	Ramsar Convention
Amphibians and aquatic species at risk	50	Rapport National “L’état de l’environnement”- 2002

Table 12: Protected areas, wetlands and endangered species

1.2 Economics of the Water Cycle

1.2.1 General context

The interventions in the water sector are regulated by the water code which was promulgated in 1975.

The main institution involved in the water sector is the Ministry of Agriculture which has four main General Directorates dealing with water resources: 1) the General Directorate of Water Resources (DGRE or Direction Générale des Ressources en Eau) which carries out monitoring and evaluation activities in the field of water resources; 2) the General Directorate of Large Hydraulic Works (DGGTH or Direction Générale des Grands Travaux Hydrauliques), which is responsible for the dams construction; 3) the General Directorate of Hydraulic Studies and Works (DGETH or Direction Générale des études et Travaux Hydrauliques), which develops activities related to general hydraulics studies, construction of hillside dams, development of large-scale schemes and management of the dams, 4) the General Directorate of Rural Engineering (DGGR or Direction Générale du génie rural), which is in charge of irrigation, rural equipment and it also responsible for drinking water supply to the rural population.

Moreover, at regional level there are some institutions linked to the Ministry of Agriculture: the regional agricultural development offices (CDRA or Commissariat régional de Développement Agricole). These institutions are in charge of developing the public irrigation schemes at regional level. These schemes are managed by both the CDRA and the water users association (AIC-Associations d'Intérêt Collectif). More specifically, large-scale public irrigation schemes are managed by the state while medium-scale public irrigation schemes are managed by AIC. The services of the state or AIC are responsible for the operation and maintenance of the irrigation network as well as of the distribution of water to the farmers.

As already mentioned, during the 1990s a national strategy to satisfy the increasing demand coming from domestic, industrial and tourist sector was established. Thanks to a series of investments in public works, such as construction of dams, wells and other infrastructures, Tunisia mobilised 67 % of the country water resources. The final objective of the planned strategy was to reach a 95 % exploitation capacity.

Recently, the strategy for maximising the water use has changed. In fact, at present time water management is more focused on the application of financial (e.g. tariffs) and legislative instruments rather than on mobilisation of resources. This change has been provoked by the increasing scarcity of water resources which made necessary the adoption of water saving policies. Therefore, some objectives for saving water in each sector were fixed according to the following percentages: 30 % for agriculture, 20 % for industry and 27 % for potable water. These objectives shall be achieved by 2010.

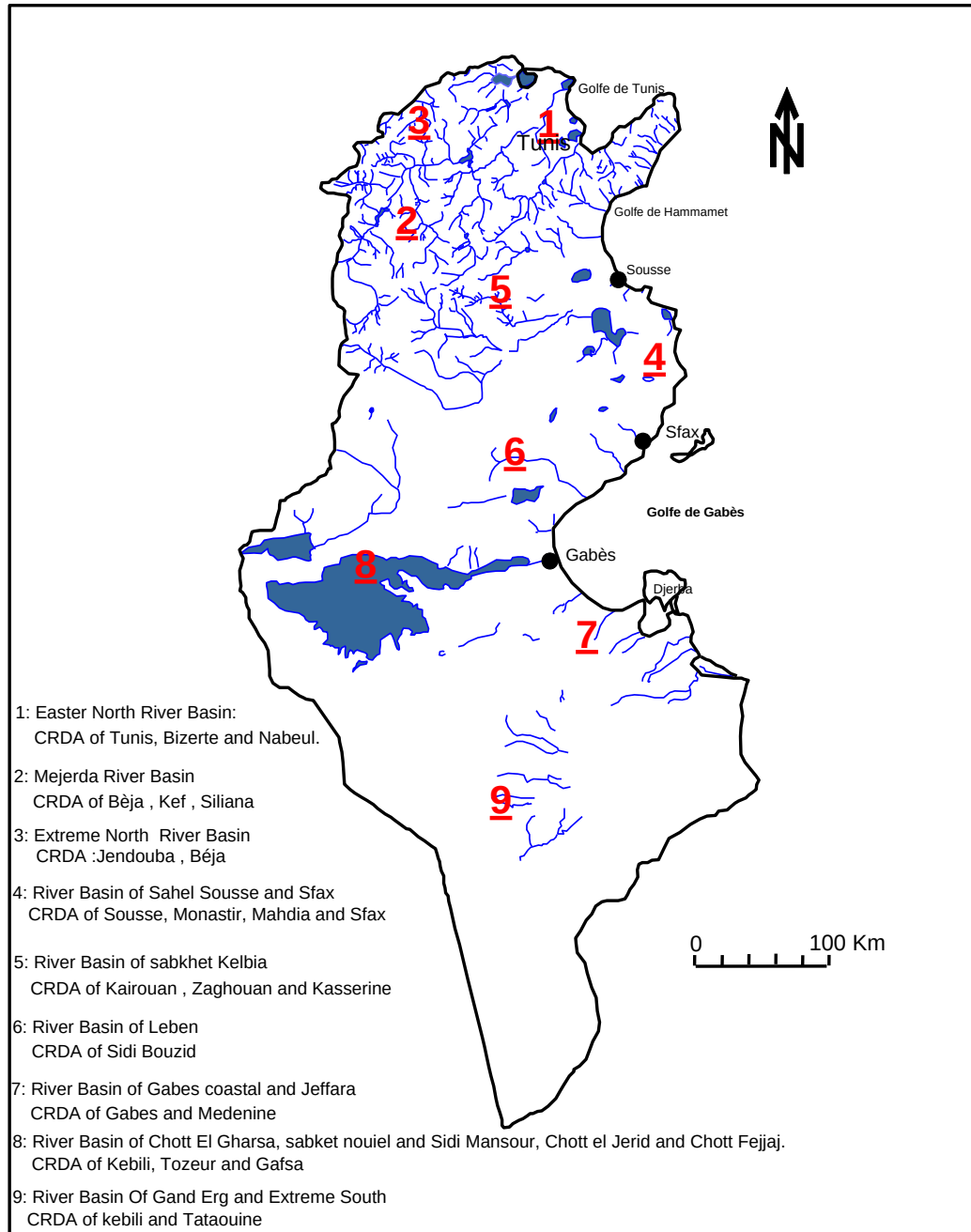


1.2.2 Valuing water

TYPE OF INFORMATION		INDICATOR	SOURCE
Water use	Water use for Agriculture (Percentage)	84	IDD - 2003
	Water use for Industry (Percentage)	4	IDD - 2003
	Water use for Domestic (Percentage)	11	IDD - 2003
	Water use for Recreational uses (Percentage)	1	IDD - 2003
	Dependency ratio (Percentage)	9.0	FAO – Aquastat 2003
Water market	Volume of water market	100000 m ³ /year	SONEDE
	Volume of groundwater market (where relevant)	100000 m ³ /year	SONEDE
Water productivity	Water use productivity for Industry (US \$ PPP Billions/cubic km)	284.5	FAO - World Bank
	Water use productivity for Agriculture (US \$ PPP Billions/cubic km)	3.7	FAO - World Bank
	Total Water use productivity (US \$ PPP Billions/cubic km)	24.3	FAO - World Bank
Water infrastructure	Investment needs in infrastructure	2000 millions dinars	Eau 21 - 1998
	Share of public investment	100%	Eau 21 - 1998
	Share of private investment	0	Eau 21 - 1998
Share of permit allocation in the supply system	Water permitted (as % of total water available)	65,46	Protection des ressources en eau
	Water permitted (as % of groundwater water available)	85.43	Protection des ressources en eau
	Water permitted (as % of surface water available)	51.85	Protection des ressources en eau

Table 13: Water demand and supply management – key indicators

1.2.3 Water supply sector (water supply enhancement)



Source: Map of hydrographic network of Tunisia (1/500000)

Figure 13: River basin and river basin management authority



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TYPE OF INFORMATION	INDICATORS		
River basin management authority characteristics	Population - Million people (1997)	Water input (cubic km/year)	Water output (cubic km/year) (groundwater 2001)
Basin 1 : Easter North river basin	3.0638	0,6	0.07727
Basin 2 : Mejerda river basin	0.5276	1	0.02463
Basin 3 : Extreme North river basin	0.7279	0,585	0.01739
Basin 4 : Sahel Sousse and Sfax Basin	1.9711	0,07	0.03921
Basin 5 : Sabkhet Kelbia	0.6999	0,2	0.09269
Basin 6 : River basin of Leben	0.8015	0,02	0.11279
Basin 7 : Gabès Coastal and Djeffara	0.729	0,06	0.16057
Basin 8 : River basin of Chott El Gharsa and Chott Jerid	0.4138	0,135	0.21684
Basin 9 : Grand Erg and Extreme South	0.2807	0,03	0.37717

Table 14: River Basin Management Areas – Key statistics

1.2.4 Policies for water demand management

The price of water depends on the volume of water consumption. It is of 827 millimes per cubic meters for tourism and between 135 and 837 millimes for other uses according to consumption. The water cost is evaluated by SONEDE to 432 millimes per cubic meters.

The water charge in agriculture is applied according to volume. The cost of irrigation development for the public schemes depends on the size of the scheme, generally it varies between \$US 6 000 and 7 000/ha. The annual operation and maintenance costs are about \$US 130/ha. The State offers subsidies to the farmers for irrigation water (for up to 20-30% of its real exploitation cost) and it also offers incentives (60 % of the needed investment : 40 % by loan and 20 % by subvention) for the use of modern irrigation techniques. The water supply to different sector is mainly ensured by SONEDE.

TYPE OF INFORMATION	Water supply	INDICATORS	
		Mean Cost (DT/m ³)	% of real cost
Whole sale pricing	Domestic	0.320	72
	Collectivities	0.706	158
	Industry	0.796	178
	Others	0.785	176
	Tourism	0.827	185

Source : SONEDE

Table 15: Water supply: suppliers' cost and consumers' price

In 1974, the National Office for Sanitation (ONAS) was established in Tunisia. The law n°94-31 of April 19th 1993, reformulated ONAS competencies. Currently, it is responsible for combating pollution in certain zones, for managing several structures for cities sanitation, for promoting and selling the treated water and sub products.

In 2001, ONAS managed 61 stations for sanitation treating a total water volume of 169 million m³; 12 other stations were under construction for an added capacity of 35,115 m³. ONAS is responsible for 55 % of the Tunisian communes, reaching 86 % of the urban housing units and 51 % of the total population of the country. Currently, a privatisation process is under way and 10 % of ONAS sanitation activity will be assigned to the private sector.

The water tariffs have a progressive structure, they are calculated according to the kind of use and to the quantity used: for domestic and tourism, the price is based on the volume of water used; for the industry, price is fixed both on the volume of water used and on the quality of the wasted water. Since 1998, ONAS fixed 5 tariff steps for domestic sanitation,



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from a consumption below 20 m³ to those of more than 150 m³; for the tourism sector the monthly fixed charge is 7,880 DT while another 0.926 DT is charged for each m³ consumed. The current tariff structure does not allow to recover the full costs afforded by ONAS, which recovers only 70 % for domestic uses, 85 % for industrial purposes and 90 % for tourism sector.

TYPE OF INFORMATION	Water treatment	INDICATORS		
		Rate (% of total wastewater)	Cost (US\$(PPP)/m ³)	Charges (%)
Whole sale pricing	Agriculture	25	N.A.	N.A.
	Industry	N.A.	N.A.	0.396 to 0.626 DT/m ³
	Domestic	100	N.A.	0.006 to 0.290 DT/m ³
	Tourism	0	N.A.	0.545 DT/m ³

Source : SDAT - 1996

Table 16: Waste water treatment: suppliers' cost and consumers' charge

TYPE OF INFORMATION		INDICATOR	SOURCE
Whole sale pricing	Private investment in water supply and sanitation (US\$(PPP)/m ³)	0	SONEDE

Table 17: Private investment in Supply and Sanitation

1.2.5 Structure of the Water Supply and Sanitation Sector: Economic measures of water demand management

TYPE OF INFORMATION	Owner of the service	INDICATORS			SOURCE
			Price of water to customer (US\$(PPP)/m ³)		
		Percentage of water utilities	Minimum	Maximum	
Privatisation of water utilities	Public	100	0.205	1.05	SONEDE
	Partly privatised	0	0	0	
	Fully privatised	0	0	0	

Table 18: Ownership type of water supply and sanitation companies

2 Sectoral Issues

2.1 Water use in Agriculture

2.1.1 General context

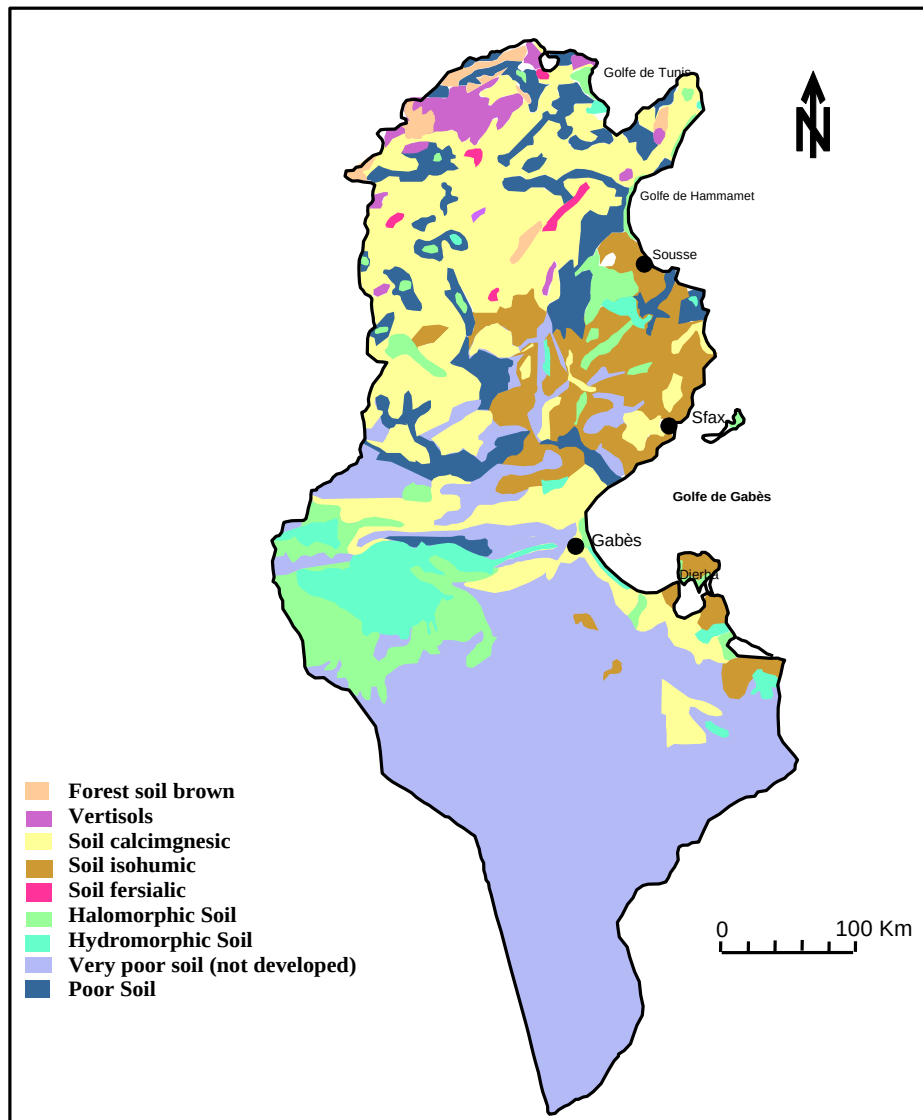


Figure 14: Soil type map – Zouari and Gaàloul (2004)

In Tunisia, the soil typology varies according to the different physiographic zones.

The North of the country can be divided in two regions, the North-East and the North-West. In the North-East, there are numerous hills and plains. The soils are fertile and intensive and extensive agriculture are practised thanks to the presence of important underground water resources. The North-West area instead, characterised by hills and valleys, is



lacking of underground water resources. The southern part (the Tell) of this area is formed by "calci-magnesian" soils and vertisols on limestone and marls, while its northern sector, called "Mogods-Kroumirie", has mainly brown-dark soils developed on sandstone and on non-calcareous clays. In this area, the soil was and results showed that soils are very acidic (pH KCL = 4 – 4.3) and low in nitrogen (0.06 - 0.07 percent), with a very low phosphorus content (1 mg / 100 g) and a marginal humus concentration (1.5 - 1.9 percent) and therefore they have a low agricultural potential.

The Tell is a fertile region with alluvial plains with deep soils, although it is dominated by marly slopes. Different soil types are typical of this region: alluvial soils with a relatively high organic matter content (2%) in the superficial horizon, which decreases gradually with depth; young or recent alluvial soils; vertisols which have a high content of clay and calci-magnesian, rendzinas and brown limestone soils.

The Dorsale has hilly relief and plains where are typical fragile soils. Large mountains separated by plains dominate the east part of the Dorsale. The mountains are covered with forests and *Stipa tenacissima* (alfa or esparto), and at their basis there are calci-magnesian soils, which are crusted, limestone brown and degraded on hardpan. These soils formed under more arid climatic conditions, are low in organic matter, stony and often eroded. The alluvial plains, in which are placed irrigation schemes, have soils which suit many crops.

The central part of the country is arid. The eastern zone of this area lacking of relief, has deep and light soils and it is marked by a flat space broken by many saline depressions called "sebkhas" which collect the flowing water, while the western part instead is mountainous and it is connected to alluvial plains rich of water resources.

In the southern Tunisia there are mainly four areas:

- Mountainous areas (Matmatas): in which there are limestone and calcic-marly soils on which are developed lithosols characterised by a very shallow surface horizon (10 to 15 cm) with the rock breaking the surface here and there. In the major river valleys and in alluvial fans below escarpment slopes there are also fluvisols which are usually fertile, receiving regular silt from flooding.
- Coastal plains (called the Jeffara): in this arid areas soils undergo a low soil genesis. The scouring and sedimentation under the action of the water and the wind are the most visible processes. Therefore, it is possible to observe crusted glaciis where the soil is formed in one horizon with light texture (calcic paleorthid). In the low Jeffara, soils are more or less crusted, but with the appearance of the crystalline basement rocks consisting of gypsum at the surroundings of the "sebkhas" and the large depressions that are formed of salty soils (salorthids). These crusted soils (paleorthids, calciorthids, cypsiorthids) serve as a water reservoir and constitute the most fertile soils of the region for irrigated cropping (oases and irrigated areas) when they are well protected from the wind erosion.
- Large Depressions or "Chotts": in this area the soils are influenced by the presence of salty materials and they are very susceptible to wind erosion of their sandy surface horizon from the soils surrounding the oases. The underground waters in this area are the origin of some oases. There is prevalence of two types of soils: on the one hand the sandy soils of the Southern Chott Jerid where the surface is a succession of micro dunes on which there is a vegetation called "nebkas"; and on the other hand the very salty soils of Chotts where the surface is covered with salt lying over sediments engorged with salty water. The latter is the true desert where any type of vegetation can not grow.
- The Desert zone, the "Erg": in which there are dunes of sand separated by small sandy depressions where a very sparse vegetation grows.

The Tunisian economy is strongly dependent of the agricultural sector. The State continues to grant a particular attention to this sector seen its role in the economic and social development and in the realization of the food security of the country. The agricultural strategy is based on three principles :



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- to assure food security by a combination of national production and imports;
- to maintain a flexibility of the production to answer world markets evolution;
- to improve the income of the sector.

TYPE OF INFORMATION		INDICATORS						SOURCE
Short description of the relative socio-economic importance of agricultural sector in the national economy	Year	1970	1980	1990	2000	2002	2003	
	People employed (% of total labour force)	49.2	38.9	28.1	24.6	23.9	22	FAO 2004
	GDP of agricultural sector (% of total GDP)	17.0	14.1	15.7	12.4	10.3	13.9	World Bank 2004
	GDP from agriculture, except livestock and aquaculture (as % of GDP)	N.A.	N.A.	N.A.	N.A.	12	12	World Bank 2004
	GDP from aquaculture (as % of GDP)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
	GDP from livestock (as % of GDP)	N.A.	N.A.	N.A.	N.A.	36	N.A.	World Bank 2004
	Government subsidies to Agricultural sector ((US\$(PPP)/year) (as % of GDP)	N.A.	N.A.	6-7	N.A.	N.A.	N.A.	FMI - 2003

TYPE OF INFORMATION		2003	Source
Short description of the relative socio-economic importance of agricultural sector in the national economy	People employed (% of total labour force)	22	FAO 2004
	GDP of agricultural sector (% of total GDP)	13.9	World Bank 2004
	GDP from agriculture, except livestock and aquaculture (as % of GDP)	12	World Bank 2004
	GDP from aquaculture (as % of GDP)	N.A.	
	GDP from livestock (as % of GDP)	N.A.	World Bank 2004
	Government subsidies to Agricultural sector (as % of GDP)	N.A.	FMI - 2003
	FDI to agricultural sector (as % of total FDI)	0.9	FIPA – 2003
	FDI to agricultural sector (in Millions dinars)	4	FIPA – 2003
	Firms in Agricultural FDI	67/2616	FIPA – 2003
	Food security	34%	FAO 2004
	Index of agriculture production (PIN99-01)	92.3	FAO 2004
	Agriculture contribution to import (as % of total import)	3.4	FAO 2004
	Agriculture contribution to export (as % of total export)	9	FAO 2004
	National investment in agriculture (as % of total investments)	11.82	ONAGRI
	National investment in agriculture (millions dinars)	9th Plan (1997-2001) 10th Plan (2002-2006)	4241 4850 ONAGRI

Table 19: Contribution of agriculture to the national economy

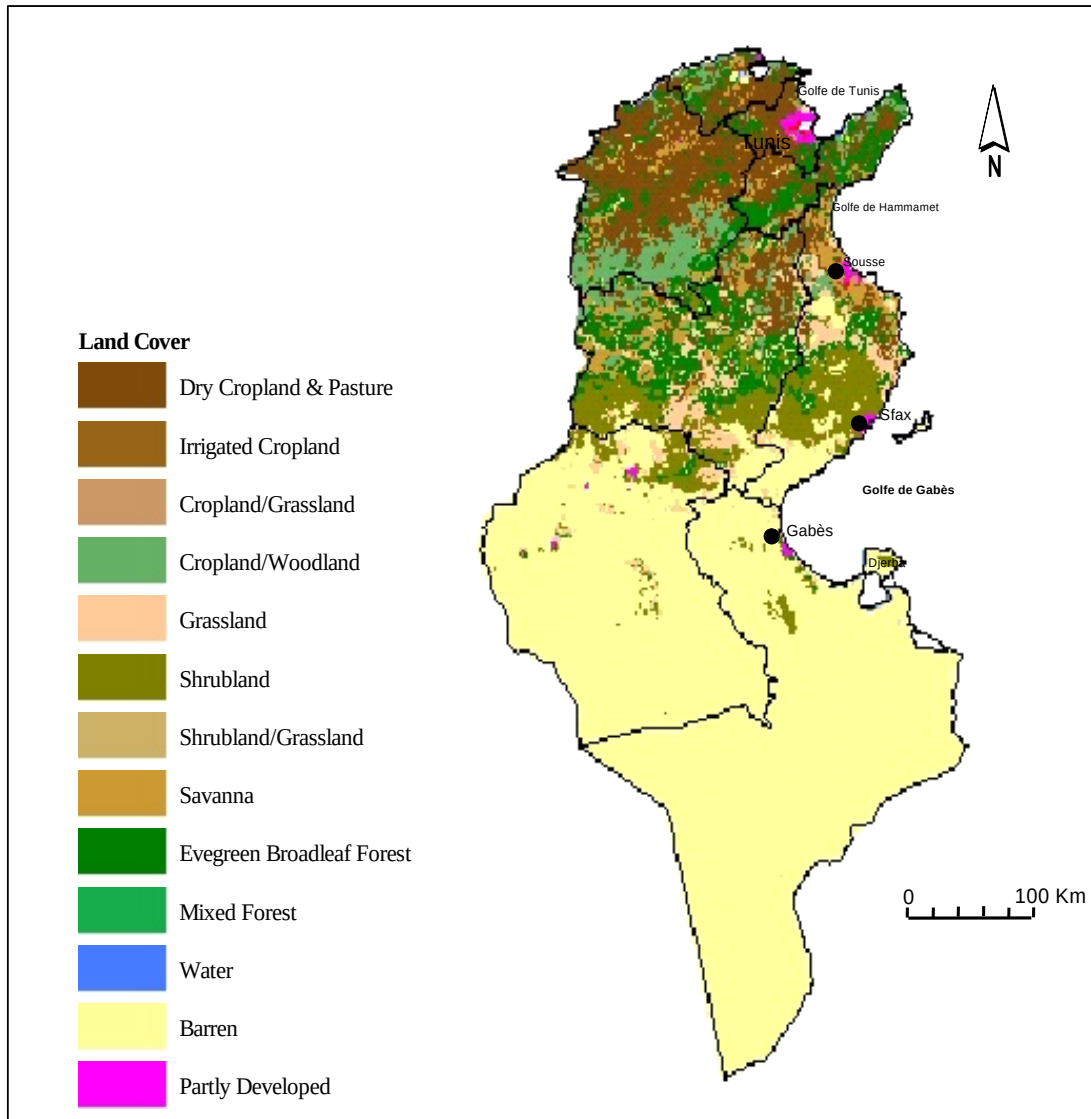


Figure 15: Land cover map - FAO

In Tunisia, cereals and olive dominate the traditional agriculture, however livestock has an important share of agricultural production, and it contributes approximately 40 percent of the total agricultural product. Recently, the government encouraged to increase national self-sufficiency in animal products (meat and milk).

Since 1975, Tunisia has imported more than 100,000 pregnant dairy heifers. Pure breed cattle rose rapidly from 83,000 in 1986 (they represented only 24 percent of all cattle) to 185,000 cows at present. In the past decade, the State encouraged the evolution of the dairy sector, granting advantageous loans and subsidies and through the privatisation of the milk collection. In fact, the milk centres were transferred from the public sector to private and co-operative organisations. Tunisia has recently (1999) reached self-sufficiency in milk (78 kg/capita/year). Dairying has been traditionally concentrated in the north where climatic conditions are favourable. However, in recent years dairying is appearing in new regions, in the Sahel, which had no such tradition and that, according to the last statistics, contribute half of the collected milk nationally.



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Between 1986 and 1999, ruminant meat production has also increased considerably, from 70 000 to 110 000 tons. The total national production is constituted by meat from cattle, sheep and goats for 95 percent, while 5 percent is from camels and horses. The total meat consumption is 30 kg per capita per year: poultry (15), beef (7) and sheep and goat (8). Tunisia is almost self-sufficient with national ruminant meat production which covers 95 percent of total consumption. Ruminant production systems depend on the variety of feed resources which decrease with aridity. Farm income in most of the subhumid and semi-arid areas is based on cereals, vineyards, orchards and livestock, whereas small ruminants are the basic source of income in arid areas.

TYPE OF INFORMATION		Production in **Mt	Water demand (km ³ /year)	SOURCE
Agricultural production by type in Mt	Cereals, Total	1,503,000	4.5	FAO 2004
	Citrus Fruit, Total	313,000	7	
	Coarse Grain, Total	353,000	NA	
	Fibre Crops Primary	2,000	NA	
	Fruit excl Melons, Total	1,008,660	NA	
	Jute & Jute-like Fibres	NA	NA	
	Oilcrops Equivalent	9,671	NA	
	Oil-crops Primary	116,855	2	
	Pulses, Total	61,304	NA	
	Roots and Tubers, Total	345,000	5	
	Tree-nuts, Total	19,350	NA	
	Vegetables & Melons, Total	2,092,130	5	

Table 20: Agricultural production by type

Tunisia has about 380,000 farms, of which 65 percent keep livestock, mainly smallholders, with an average agricultural area under 20 ha which represent 80 percent of the livestock statistics for 1998.

The sector of agriculture and the fishing keeps a major place in the Tunisian economy. Indeed, it participated in 13.9% of the GDP in 2003 of which 12% are provided by agriculture with except fishing and aquaculture. It ensures the essential of the food of the country, 34%, and occupy 22% of labour force (2002). The involvement of the agricultural sector in the prosperity of the Tunisian economy proves to be considerable. It participated for 9% of total exportation mainly olive oil (114.3 millions dinars), dates (95.2 millions dinars), citrus fruit (11.9 millions dinars) and fishing products (144.7 millions dinars).

The adoption of a new agricultural agreement, 3rd of January 2001, with the European Union, opened new horizons for the exports. It is about, notably, the widening of the access to the European market for some farm products as olive oil, and of the authorization of the out-flow of new products.

On the other hand, the agricultural imports concern mainly cereals, oil and sugar as 3.4% of the total imports of Tunisia. Thus, the agricultural sector acquires a more and more important place in the Tunisian economy and require considerable amounts of investments. The interior investments for the sector represent an important part of the total investments (11.82% in 2002).

Thus, the total amount of the investments achieved in the agricultural sector during the 9th plan (1997-2001) is valued to 4241 Million Dinars of which 2146 has been achieved by private operators, planned investments during the 10th plan (2002-2006) are evaluated to 4850 Million Dinars of which 2650 will be achieved by private operators.

As for the foreign direct investments, the sector of agriculture benefits from 4 billions of dinars what represents 0.9% of the total IDE. We can notice the weak part of the IDE in the agricultural sector with 67 foreign enterprises on a total of 2616 in 2003.



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TYPE OF INFORMATION	INDICATORS	SOURCE
Short description of the relative socio-economic importance of agricultural sector in the national economy	Total import of agricultural sector (as % of total import) -1997	3.4 FAO 2004
	Total export of agricultural sector (as % of total export) - 1997	0.7 FAO 2004
	Food security (Percentage)	34.0 FAO 2004
	Main agricultural production by crop (tons-2002)	ONAGRI - 2003
	Cereal growing	
	Arboriculture	
	Vegetable Culture	
	Livestock	
	Others culture	
	Aquaculture	
	Agricultural production index (PIN 99-01)	92.3 FAO 2004
	Average farm dimension (ha)	20 FAO 1997

Table 21: Socio-economic importance of the agriculture sector

2.1.2 Land use and land cover change

The colonisation process influenced the Tunisian agriculture, determining the structure and at some extent the types of production. Of a total area of 16,361 km² some 63 % are considered as agricultural land, 17.8 % are arable, 31.3 % are pastures while forests lands represent 5.5 % of the country area.

Although Tunisia is arid and semi-arid climate country, its economy is essentially based on agriculture, notably for the past generations. The problem that arises then resides in the fact that this sector requires enormous quantities of water resources. Seen the aridity of the climate, the only solution consists in resorting to the irrigation to fill the insufficiency of the precipitations.

TYPE OF INFORMATION	INDICATORS	SOURCE
Land use and land use change	Total Area (1000 ha)	16,361 FAO AQUASTAT 2003
	Land area (Percentage of total area)	15,536 FAO AQUASTAT 2003
	Agricultural Area (Percentage of total area)	62.8 FAO AQUASTAT 2003
	Arable Land (Percentage of total area)	17.8 FAO AQUASTAT 2003
	Permanent Crops (Percentage of total area)	13.8 FAO AQUASTAT 2003
	Permanent Pasture (Percentage of total area)	31.3 FAO AQUASTAT 2003
	Desert areas (Percentage of total area)	42.7 SDAT 1996
	Forest area (Percentage of total area)	5.5 SDAT 1996
	Arable land change (Percentage) - 1996	92 FAO 2004
	Human-induced land degradation due to agricultural activities (Percentage) – 2000	31.0 FAO 2004

Table 22: Land use and land use change

2.1.3 Water for agriculture

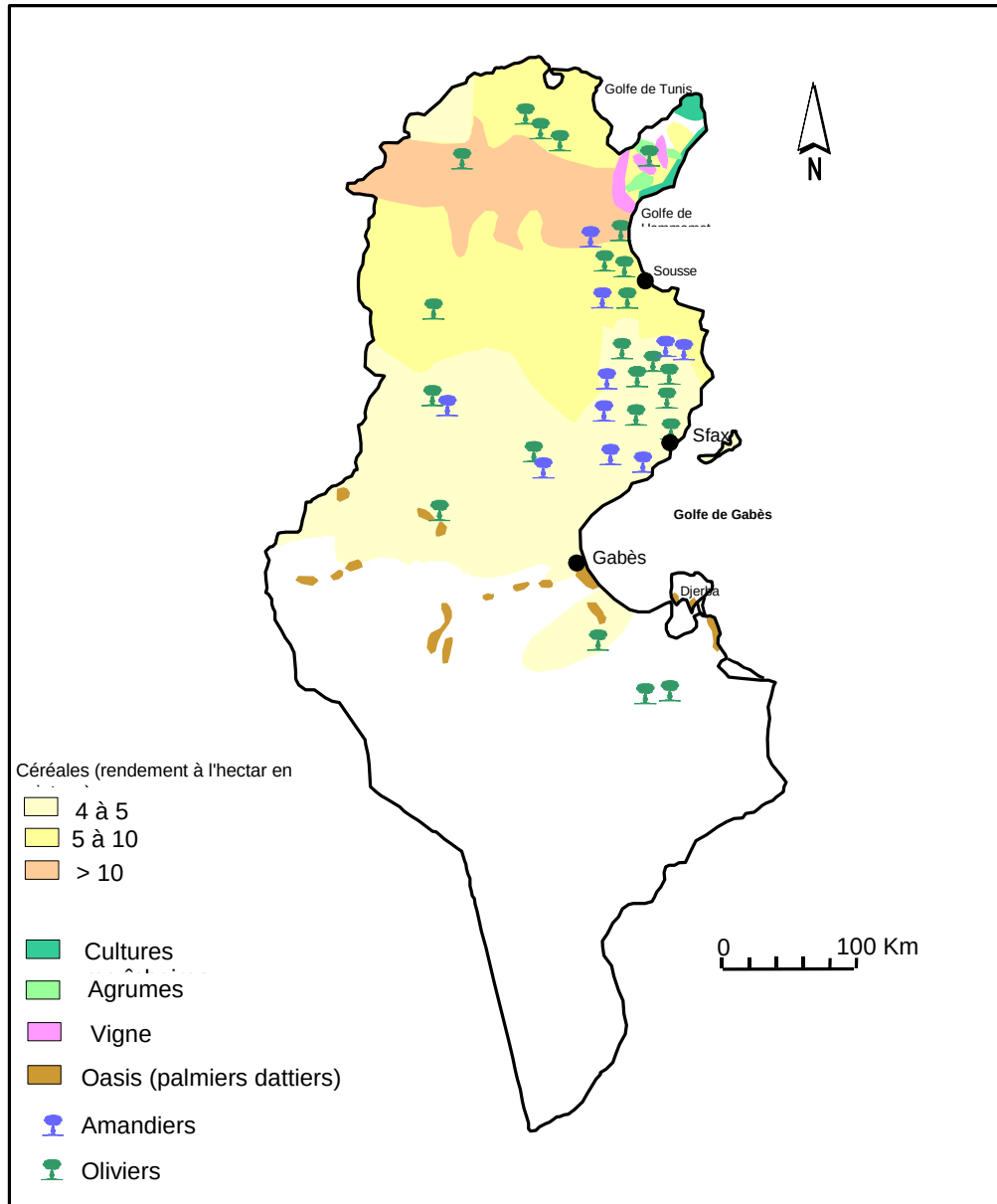


Figure 16: Agriculture map – Zouari and Gaâloul (2004)

On the total water managed area, a large percentage (about 70%) of the full or partial control schemes actually irrigated is dominated by fruit trees (dates, oranges, grapes, etc.) and vegetables (tomatoes, melons, water melons, potatoes, etc.). However, recently an increase in the irrigation of cereals and fodder crops was provoked by the tendency of the government to promote the development of dairy livestock.

The irrigation schemes use mainly surface irrigation techniques and in some cases (e.g. on cereals in case of a severe rainfall deficit and on fruit trees during the early years of their development) also sprinkler irrigation is practised.



The intensive irrigation schemes are divided into: 140,000 ha of small schemes developed individually by the farmers (70 000 households) and irrigated by open wells or by pumping of water in the wadis; 163,000 ha of schemes with a communal irrigation network, irrigated by tubewells in the case of medium schemes (60 000 ha; 47,000 households) and by dams in the case of large schemes (103,000 ha; 24,000 households).

At present time the water used for irrigation is quite saline (1.5-4.0 g/l), however there is not a serious problems of salinisation of the irrigated soils because of the low intensive irrigation practices. Moreover, for the areas with a high risk of salinisation a monitoring system has been fixed. Subsurface drainage is not very spread (162,000 ha) and it is used only with soils with a high water table (located especially in the north).

The irrigable agricultural surfaces are constituted of public perimeters and private perimeters. The perimeters whose planning has been achieved by the state (irrigated by dams or hillside lakes, by boring or waters purified) are qualified of public perimeters even though they belong to private. Those whose network is achieved by the private (irrigation by well or by capture from wadis) are considered private perimeter. The public perimeters are those in which the networks of irrigation have been executed on the credits of the state on lands belonging to private and/or to the state. They are managed by para-governmental institutions that want to say the offices. The part irrigated from the dams is concentrated in the north, it is divided on big perimeters. The perimeters irrigated from the boring are distributed in the center and the south on small surfaces of a few hundreds of hectares. Otherwise, the private perimeters are equipped and are exploited by the agriculturists themselves. The public powers privilege the north, whereas the private agriculturists prefer the center and the south.

In the north region, the exploitation of water resources in water require important financial and human means that only the state can unite.

Outside of the zones where the irrigation is a centennial tradition as the Cape-Bon, the farmers don't want and/or cannot assume the investments necessary to the irrigation. The public intervention would allow, then, the extension of the irrigation.

To the inverse, the aridity of the climate of the center and the south always pushed the farmers to exploited groundwater to provide the water needs of the region.

The importance of the irrigation in terms of irrigated surfaces reached 385 000 hectares in 2003 (120 000 hectares in 1972 and it is foreseen that they will cover 450 000 hectares in 2025). The volume of used water reached 2.2 Km³ in 2000 and represented 54% of the total volume used in agriculture.

Water used in the irrigation comes from different sources: surface water, with a percentage of 33.6 of irrigated surface, groundwater, of which 19.4% of irrigated surface are irrigated by deep groundwater and 40.5% by phreatic groundwater, spring and wadis also participate in the irrigation but with a weak quantity, only 4.2% of the surface. Treated waters are only exploited for a small surface that represents 2% of the irrigated total surface.

The irrigation proves to be the most adequate solution for the agricultural sector in the countries where water resources are limited and of which economy are essentially based on agriculture. Indeed, it allows to fill the scarcity of water caused by irregularity and insufficiency of precipitations.

Nevertheless, as it has positive effects, the irrigation of the agricultural surfaces also has negative effects as wastewater and soil pollution.



Network on Governance, Science and Technology for Sustainable Water Resource



European Commission, FP6, Specific measures in support of international co-operation
Mediterranean Partner Countries (MPC), 2004-2007

TYPE OF INFORMATION	INDICATORS	SOURCE
Main indicator of water needs and efficiency in agriculture-livestock and aquaculture productions	Water use in agriculture (cubic km/year)	2.2
	Water managed area (ha)	385,000
	Water intensity (cubic meters/ha)	444.8
	Water productivity (US \$ Billions/cubic km)	3.7
	Specific water demand (by crop production)	N.A.
		FAO AQUASTAT 2003
		FAO AQUASTAT 2003
		FAO 2003
		FAO AQUASTAT 2003 – World Bank
		FAO- CROPWAT

Table 23: Water efficiency in agriculture

2.1.4 Pollution from agriculture

Irrigation, like all other phenomenon, has some impacts on the environment. One of the positive impact is that the irrigation leads small surface to high productivity which often allows to replace the use of extended surface on a country where arable land area only represents 18%. On the other hand, irrigation is also know by wastewaters: water is wasted to nearly all stages of the cycle, by the channels used to the transport of irrigation water, on the non cultivated lands that receive important volumes of water and to the level of cultures for which water passes their needs.

Besides, irrigation waters are often contaminated by salts, pesticides and herbicides. For insecticides and herbicides, 10 liters by hectare and by year are used, while bactericides are used with less quantity (3 liters by hectare). These products have negative effects on the land and on groundwater as well as on the quality and the sanitary of farm products.

In arid regions, irrigation can also wash natural toxic elements present in soils, like selenium, and reject them in groundwater and surface water. Moreover, chemical products used for the irrigated agriculture often contaminate the out-flow of surface water and groundwater. Potassium and nitrogen contained in manures can be driven in groundwater and/or surface water causing proliferation of algae and eutrophisation.

The capture of surface water for irrigation from rivers and lakes can put however in danger aquatic ecosystems and wetlands by threatening their productivity and their biologic diversity.

The recourse to the irrigation is an absolute necessity in Tunisia to guarantee agricultural production notably for the strategic cultures that have an important role in the commercial balance of the country. To this effect, the availability of water resources of sufficient quality and quantity to ensure the sustainability of food production in the country, is one of the priorities of national policies.

TYPE OF INFORMATION	INDICATORS	SOURCE
Indication on Potential pollution in water cycle from agricultural sector and soil conservation techniques	Average Nitrogenous fertilisers use (t/ha) 1997	5.7
	Average phosphogenous fertilisers use (t/ha) 1997	4.2
	Average Herbicides use (t/ha) 1997	10 l/year /ha
	Average Fungicides & Bactericides use (t/ha) 1997	10 l/year /ha
	Average Insecticides use (t/ha) 1997	3 l/year /ha
		FAO 2004
		FAO 2004
		Minister of agriculture
		Minister of agriculture
		Minister of agriculture

Table 24: Chemical inputs in agriculture



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TYPE OF INFORMATION	INDICATORS	SOURCE
Cropland under organic management (Ha) – 2000	18,255	FAO 2004
Area with soil conservation techniques	99962 ha	DGTA

Table 25: Environmental-friendly agricultural practices

2.1.5 Assessment of technologies used

At the moment, surface irrigation is the most common irrigation technique employed in Tunisia. In general, this kind of irrigation is performed by means of prefabricated canals or low pressure pipes, while sprinkler irrigation uses high pressure pipes.

Currently, about 6,000 ha are irrigated by treated wastewater, the remaining part by surface water (dams, pumping in wadis) and by groundwater (open wells, tube-wells). In 2000, the water managed area was estimated at 385 000 ha, including 355,000 ha of full or partial control irrigation schemes and 30,000 ha of spate irrigation.

According to estimates the Tunisian irrigation potential, which has been calculated on land and on water resources availability, has been fixed at is about 563,000 hectares. This area is divided in to 402,000 hectares with possibilities for full or partial control irrigation development and 161,000 hectares of spate irrigation. The area where full or partial control irrigation can be practised is divided into 52,000 ha of complementary irrigation and 303,000 ha of intensive irrigation. The average annual growth of irrigation development is about 2 %, which means that at this rate full potential will have been achieved by the year 2010.

In order to encourage water saving, several measures were adopted such as the improvement of the efficiency of the water distribution networks, the spread of modern irrigation techniques, the definition of a tariff system with higher volumetric prices for higher consumption, the involvement of the Collective Interest Association (AIC) in the management of the irrigated areas.

The estimated investments for the water sector under the 10th Plan (2002-2006) are about 1,856 million DT.

TYPE OF INFORMATION	INDICATORS	SOURCE
Types of irrigation	Total irrigation (ha)	385,000
	Full/partial control irrigation (ha)	355,000
	Spate irrigation (ha)	30,000
	Equipped wetland (ha)	0
	Others (specify) (ha)	0
		FAO AQUASTAT - 2003

Table 26: Irrigation and technologies used

TYPE OF INFORMATION	INDICATORS	SOURCE
Innovation in agriculture with respect to technological innovation and water efficiency	Irrigation efficiency Ratio	50 – 80 %
	Investment in R&D Percentage	1.2 %
		Plan de développement économique et social

Table 27: Technology efficiency



2.2 Industrial water use

2.2.1 General context

The Tunisian economy strongly depends on industrial sector that procures an important contribution to economic and social indicators.

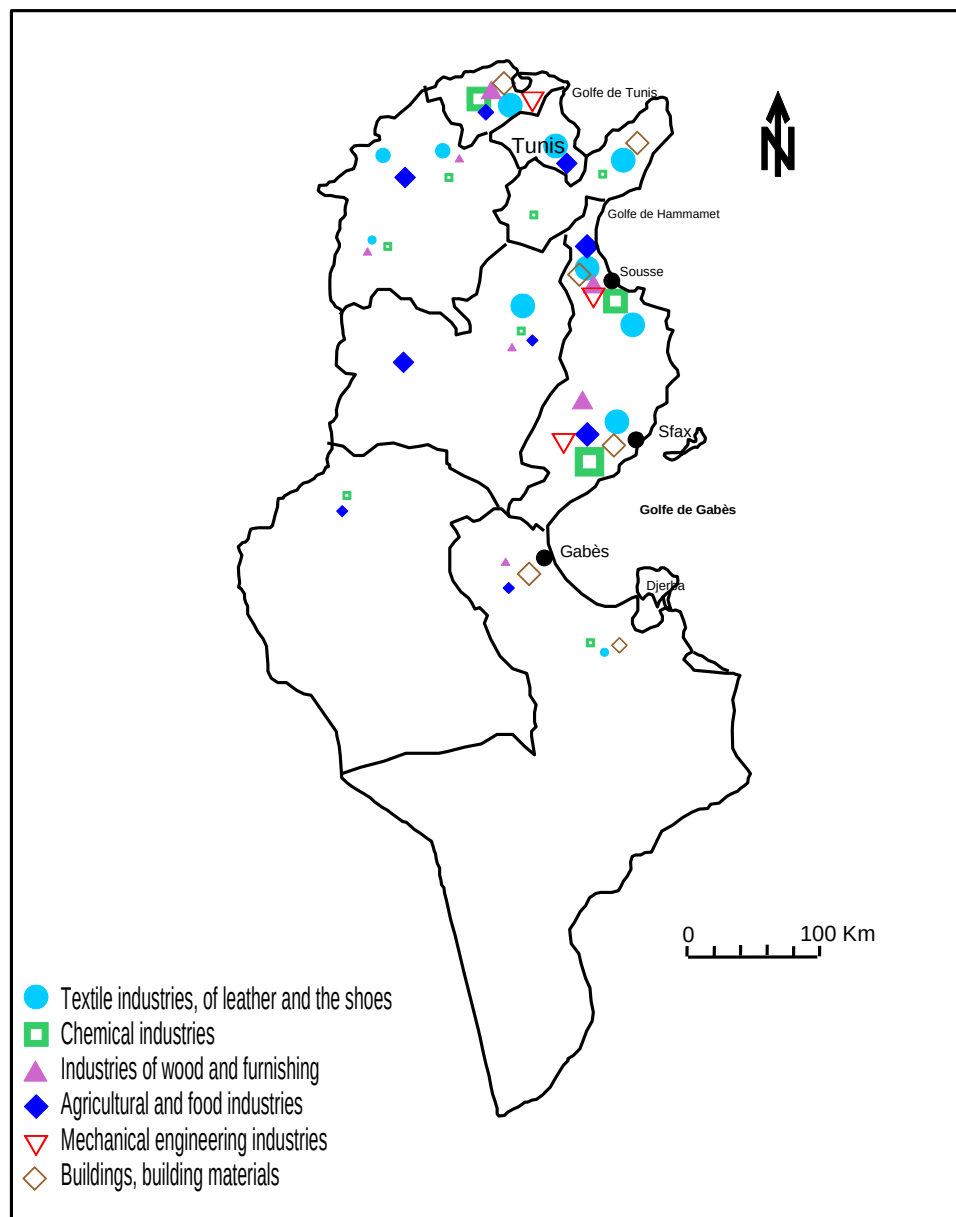


Figure 17: Location of main industrial districts (UNIDO classification) – Zouari and Gaâloul (2004)



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TYPE OF INFORMATION		INDICATOR	SOURCE
Social and economics analysis	People employed	Percentage of active population	International Labour organization - 2002
		Percentage of total population	IDD-2003
	Part of the industry in the GDP - 2002		28.8
	GDP from various sub-sector of industry		32.2%
	GDP from energy sub-sector of industry		32.2%
	GDP from processing sub-sector of industry		NA
	GDP from transport sub-sector of industry		5.8%
	Product of manufacturing Industry - Billions of dinars - 2001		21.2
	Investment - Million of dinars - 2001		1064
	Value of the exports - Billions of dinars - 2001		8,5

Table 28: Contribution of industry to the national economy

During the last three decades, manufacturing industries were the most dynamic component of productive sector. Their contribution to GDP evolved of 6% during the years 1961-1963 to close to 28,8% in 2002. The production value manufacturing industries reached, in 2001, 21,2 billions of dinars. The added value represented, in 2001, 31% of this value. These evolutions of the indicators of industrial sector development important amount of investment. Indeed, these investments evolved from 513 Million Dinars in 1992 to 1064 Million Dinars in 2001.

The importance of the industry in the promotion of the exports was about 3 billions of dinars in 1992 and reaches 8,5 billions of dinars in 2001, with an increasing rate of 13%. In 2001, the contribution of manufacturing industries was 89% of total exports of goods. On the social plan, the industry is employing 23% of labour force.

2.2.2 Water for industry

Water forms an essential requirement and input to the manufacturing process, regardless of the industrial sector. Industry would not be able to function without water to serve cooling and processing purposes and to act as a catalyst and to convey waste materials. The availability of water supplies in sufficient quantity and quality is one of several important considerations in the locations of most industrial establishments. Therefore, it comes as no surprise that the overwhelming majority of manufacturing establishments in every part of the world are located adjacent to large sources of water.

In Tunisia, the industry sector is a big consumer of water resources. It uses less water than agriculture (0,07 cubic km³ in 2000) but its need in water increases as the number of enterprises increases. Numbers of industrial subscribers increases every year. It was of 11543 in 2002 (INS) and it passed to 11762 subscribers in 2003, it evolves to an increasing rate of 1,9%. The subscribers of industrial sector represent 0,7% of the total of the subscribers.

Most industrial processes use water as an input for various purposes. In some cases, water is a classic input and form a part of the output, as the industry of drinks. In other industries, water is used to drive the product from a stage of production to another as for the paper industry. In the pharmaceutical and chemical industries, water is rather an agent of treatment. In a general manner, it is necessary to note that small and mid-size firms often use water with good quality (drinking water of the public network) because it satisfies to all practices. On the other hand, the size and the situation of big industries drive them to use less expensive water resources, even seawater. The increasing importance of the quantitative needs proves to be very various from an industrial activity to other, but also within a same activity according to the input technologies.



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In documenting industrial water use, five basic parameters (indicators) are of interest: water intake, recirculation (recycling), gross water use, water consumption, and wastewater discharge¹. The latter is relevant for establishing the risk of water pollution.

TYPE OF INFORMATION		INDICATORS	SOURCE
Annual water abstraction by source and by sector (mio3/year)	Total gross abstraction		Eurostat
	Abstraction by manufacturing industry (total)		
	Abstraction by manufacturing industry, for cooling purposes		
	Abstraction by production of electricity, for cooling purposes		

Table 29: Water use in industry

2.2.3 Water pollution caused by industry

Tunisian industry knew an important prosperity because it achieved a growth in the GDP and in the added value. However, this fast development exercises some pressures on the environment. As in all over the world today, it appears as the main responsible of the pollution of water, air and soil and be characterized constantly by an excessive consumption of energy and a increasing production of garbage. Actually, most processes generate polluted wastewaters that contain all by-products and raw losses materials that cannot be recovered or recycled. The nature and the composition of these wastewater are very various from an industry to another. According to an investigation done in 1996 by the ONAS, on 10 000 enterprises, 3333 have been identified as polluting enterprises in different sectors.

Sectors	Number of enterprises	% of total number
Agro-Food	1188	11.88%
Leather and textile	249	2.49%
Mechanical, metallurgy and electricity	604	6.04%
Chemistry	272	2.72%
Construction supplies, ceramic, glass	93	0.93%
Other industries	927	9.27%
Total	3333	33.33 %

Source : ONAS 1996

Table 29: Most polluting industries – ONAS (1996)

We can notice the importance of industries identified as polluting, 33% of the total number of investigated enterprises and we also notice that most of them are exporters enterprises that have important contribution to the GDP.

In the same way, we notice that among these industries there are those that are greatly consumers of water resources, as the industry of leather, chemistry and especially agro-food industries that represent the most important number (1188 enterprises). The agro-alimentary industries has a meaningful contribution to industrial water pollution in Tunisia estimated to close to 47% in terms of oxygen biologic demand of oxygen (DBO) with a weight of 5555,8 tons. Its part in suspended materials is less important and is close to 2,19%. The industry of woods, furniture and paper comes in second

¹ Two identities can be used to quantify industrial water use.

(1) On the intake side, $I + R = G$ Where: I = the quantity of water intake R = the quantity of recirculated water G = the quantity of gross water use

(2) On the discharge side, $I - C = D$ Where: I = the quantity of water intake C = the quantity of water consumed D = the quantity of water discharged



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place with a part in the pollution of 39,45% of oxygen biologic demand and 22,33% of suspended materials. The most important contribution to suspended materials is rejected by metallic and metallurgic industries, it represents more that the fifty: 52,33%.

Designation	BOD (1)		TSS (2)	
	tons/year	%	tons/year	%
Agro-alimentary industries	5 555,8	46,59	1 560,8	2,19
Textiles and clothing	173,9	1,46	274,7	0,38
Leather and shoes	155,4	1,30	252,1	0,35
Construction supplies, ceramic and glasses	17,9	0,15	2 774,8	3,89
Chemical industries	1 053,4	8,83	12 477,7	17,48
Oils and oil products	137,6	1,15	632,4	0,89
Metallic and metallurgic industries	119,4	1,00	37 363,3	52,33
Mechanical machineries	0,3	0,00	104,7	0,15
Electric and electronic products	7,4	0,06	11,4	0,02
Material of transportation	0,2	0,00	1,2	0,00
Wood, furniture, and various paper	4 704,1	39,45	15 942,5	22,33
Total	11 925,4	100,00	71 395,8	100,00

1) DBO: Biochemical Oxygen Demand; (2) TSS: Total Suspended Solids

Table 30: Industrial water pollution (1)

SECTOR	POLLUTANTS	INDICATORS		SOURCE
Iron and steel	Organic residues, oil, metals, acids, phenols and cyanide	Organic residues : 400 mg/l		ONAS
Textiles and leather	Organic residues, suspended solids, sulphates and chromium	Sulphates :370 mg/l		ONAS
Pulp and paper	Organic residues, solids, chlorinated organic compounds	n. d		ONAS
Petrochemicals and refineries	Organic residues, mineral oils, and refineries phenols and chromium	heavy metals	As = 0.1 µg/l Pb = 0.612 mg/l Zn = 0.007 mg/l Hg = 0.266 µg/l Al = 0.1 mg/l	ONAS
Chemicals	Chemicals Organic chemicals, heavy metals, suspended solids and cyanide	N.A.		ONAS
Non-ferrous metals	Fluorine, suspended solids	N.A.		ONAS
Micro-electronics	Organic residues, organic chemicals	N.A.		ONAS
Mining	Suspended solids, metals, heavy metals, acids, salts	7.2 < pH < 7.6 salts < 1.5g/l (+ 80%)		ONAS

Table 31 : Industrial water pollution (2)



2.2.4 Assessment of technology used

Types of data required:

TYPE OF INFORMATION		INDICATORS	SOURCE
Recycled water	Percentage of water re-used	25%	IDD – 2003
	Percentage of companies with wastewater treatment plants	90%	
	Percentage of companies with water saving technologies	Max 20%	
	Share of industrial wastewater treated.	<3%	

Table 32 : Water saving friendly technologies in industry

2.3 Domestic water use, and the engineering of the water cycle

2.3.1 General context

The pressure on water resources for domestic uses became more pronounced following a fast demographic growth and an accelerated urbanization. Indeed, the Tunisian population who was of 3,7 millions of inhabitants in 1956 adjoins today the 10 millions (9 945,6 in 2003) that divides in 6 322,3 in the urban zone and 3 623,3 in rural zone. This demographic evolution is reflected on water resources as an intensification of the demand. This demand starts with being qualitative to turn into a quantitative demand, since the intensive mobilization of water resources is likely to alter their natural quality.

TYPE OF INFORMATION			INDICATOR	SOURCE
General information on the urban water supply and sanitation situation	Population (thousands)	Urban	6 322,3	INS - 2003
		Rural	3 623,3	
		Total	9 945,6	
	Rate of servicing (% of total population)	Urban	100	INS - 2003
		Rural	43.5	
		Total	79.4	
	Rate of households supplying (% of total housolds)	Urban	98.4	INS - 2003
		Rural	36	
		Total	77.2	
	Water available per capita (cubic meters/ day)		1.32	
	Total - Water consumption per capita (litres per day per capita) – 2000		124.3	AQUASTAT FAO 2004
	Rural - Water consumption per capita (litres per day per capita)		<50l/day	World Resources Institute
	Urban - Water consumption per capita (litres per day per capita)		80l/day/hab	

Table 33: Domestic water consumption

TYPE OF INFORMATION		INDICATORS				SOURCE
General information on the urban water supply and sanitation situation	As % of total reference population	Improved Water Supply - 2000	Improved sanitation			UNICEF 2001
			1990-96	2000	2002	
	Urban access to	94	96	90	90	
	Rural access to	60	52	62	62	
	Total access to	80	80	84	80	

Table 34: Access to water and sanitation services



2.3.2 Domestic water demand and sanitation

The rate of urbanization was of 33% in 1956 and reached today 65%. In spite of the bending of the birthrate, result of a domestic scheduling politics, the demographic projections foresee a population of 13 millions in 2025. The comparison between needs and resources have a situation of "water stress" appeared already. In the next decades, available water per capita will continue to decrease.

However, in spite of this problem of non-adequacy between water resources and the number of consumers, the Tunisian authorities don't stop trying to put at the disposal of the citizens water resources of which they have need. Thus, the rate of servicing reached 100% in the urban environment and 43,5% in the farming environment.

Following the statistical analyses made by the institute of the world resources (world resources institute), the quantity of available water per person in Tunisia is of 1,32 m3 per day in 2003.

The problem of increasing unsuitability between resources and needs worsen because of the improvement of the living standard of a big part of the population. Indeed, if one compares our life of today and the one of our forebears, one distinguishes a big difference enters, on the one hand, their needs in waters and our needs, and, on the other hand, the manners of water consumption. These changes are explained by the increase of the requirements for sanitation : the rate of access to sanitation is of 90% in the urban zone and 62% in the rural zone in 2000.

In Tunisia, as some other countries, some citizens are plugged directly to the water distribution network provided by the domestic corporation of exploitation and distribution of water (SONEDE) and some others are not plugged.

Water demand for connected subscribers

District	Number of subscribers	% of subscribers	Volume (millions m3)	Volume %	Specific consumption L/day/capita
North	401 848	22,6 %	42 029	20,2 %	66
Center	401 208	22,7 %	44 479	21,3 %	96
South	471 688	26,7 %	54 751	26,3 %	71
Tunisia except capital district	1 274 744	72,1 %	141 259	67,7 %	70
The capital district	503 164	27,9 %	67 305	32,3 %	88
Tunisia	1 777 908	100 %	208 563	100 %	75

Table 35: Quantity of water supply – SONEDE (2004)

During the period 1981-2003, the number of subscribers in Tunisia knew an important evolution. Indeed, it passed of 467 272 in 1981 to 1 777 908 subscribers in 2003, it is nearly multiplied by four. Therefore, the water consumption evolved during this same period to 132,453 millions of m³, it was of 76,2 millions of m³ in 1981. As for the specific consumption of the connected domestic class, it knew a light increase. It passed of 72 liters/day per connected inhabitant in 1981, to 75 litres/jour. The most elevated volume of consumption was observed in 1987 (86 liters/day). However, these evolutions of water resources consumption for the connected class of people are due to those of the different districts. In our analysis, the capital district is considered a part next to the district of the inside of Tunisia.

The number of subscribers most elevated is in the capital district; it is of 503 164 subscribers and represent 27,9% of the total. This last knew a remarkable evolution during the period 1981 -2003. Indeed, it was of 136 068 subscribers in 1981, it nearly tripled. This is explained by the fact that the capital is characterized by a most important urbanization rate, what results is a more important water demand. Indeed, water consumption in the capital district is greater for the other districts. It reached 67 305 millions of m³ in 2003, as 32.3% of the whole consumed volume.

For the other districts (North, Center and South), the number of subscribers occupied a part of 72,1% divided on the three regions in near parts varying between 22,6% for the north and 26,7% for the south. This number of subscribers



evolved in time; it was of 331 204 subscribers in 1981 and reach 1274744 subscribers in 2003. These regions consummated the most elevated volume of water as a part of 67,7% distributed between the three regions in slightly different parts that are 20,2% in the north with a volume of 42 029 millions of m³, 26,3% in the center with a volume of 44 479 millions of m³ and 21,3% in the south with a volume of 54 751 millions of m³ in 2003.

Water demand for others users

It is the class of the households that uses the water of the boundary-marks fountains.

District	Volume in millions m ³	Volume in %	Specific consumption L/day/inhabitant
North	1 303	34,6 %	107
Center	703	18,7 %	83
South	1 533	40,8 %	32
Tunisia except capital district	3 538	94,1 %	47
The capital district	222	5,9 %	20
Tunisia	3 760	100 %	43

Table 36: Quantity of water supply – SONEDE (2004)

The consumption of water for the non-connected persons is quite weak in the total consumption in comparison with the volume consumed by connected people. The volume consumed by this type of people for the whole country is of 3 760 millions of m³ that only represents 1.77% of the total consumed volume consumed that are of 212 323 millions of m³. In spite of its weak involvement, this volume knew an evolution since 2002 with a rate of variation of 7,8%, it was of 3486 millions of m³ in 2002. The specific consumption of the whole country for the non-connected domestic class knew a considerable increase while passing from 8 liter/day per non-connected inhabitant in 1981 to 43 litres/jour.

The less important volume of consumption for non-connected people is observed in the capital district, it is of 222 millions of m³, and represent 5,9% of the total. It also knew an increase of 28 millions of m³ since 2002, with a rate of variation of 14,1%. In the same way, the specific consumption represents the weakest part in the capital district. It is of 20 liters/day per non-connected capita. It knew a decrease from 1981 until the year 2002 of 20 liters to 15 liters to increase in 2003 and to reach the same volume that of 1981 that is of 20 liters by non connected day per capita.

For the other district (North, Center and South), consumed water volume represents 94,1% distributed between the three regions in fairly scattered parts that are 34,6% in the north with a volume of 1303 millions of m³, 18,7% in the center with a volume of 703 millions of m³ and the most important part is in the south with a volume of 1533 millions of m³ and representative 40,8%. For the specific consumption, the most elevated volume is in the north region of the country with an amount of 107 liters per day. The volume that comes in second place is consumed by the non connected of the Tunisian Center. This volume is of 83 liters per day. Whereas the non connected inhabitant of the south consume 32 liters/day. This consumption evolved for these three regions during the period between 1981 and 2003, it increased by nearly 7, while passing 7 litres in 1981 to 47 liters in 2003. It was of 4 liters for the south, 12 liters for the center and 6 liters for the north.

The quality of water supply is not available as an average of hours suspension of the service because the water supply is not deliberately but only if there is some reparation to make on the supplying network. The SONEDE evaluated this indicator by the LIR (Linear Index of Reparation) calculated as the number of damage and leakage reported to the length of the network. This index is equal to 2.5 reparations by km of network and is constant since 1997 although the length of network has increased.



TYPE OF INFORMATION		INDICATORS				
		1970	1980	1990	2000	2002
Urban water demand and sanitation	Water for domestic use (m ³ /year/subscriber)	305	169	137	129	126
	Water treated (Million m ³)	NA	NA	NA	195.5	203.3
	Hyper chlorination of drinking water (?)	NA	NA	NA	0	NA
	Quality of water supply (Average hours of suspension of the service per year)	NR	NR	NR	NR	NR

Table 37: Quality of water supply – SONEDE (2004)

TYPE OF INFORMATION	Housing units with piped water (As Percentage of reference housing units)	INDICATORS	SOURCE
Urban water demand and sanitation	Total	75.2	SONEDE - 2000
	Urban	100	SONEDE - 2000
	Rural	36.5	SONEDE - 2000

Table 38: Domestic connections to water supply

TYPE OF INFORMATION	Housing units with toilet (As Percentage of reference housing units)	INDICATORS	SOURCE
Urban water demand and sanitation	Total	75.4	UN - HABITAT
	Urban	94.9	UN - HABITAT
	Rural	45	UN - HABITAT

Table 39: Domestic connections to sanitation services

2.3.3 Water demand for collectivities

Collective uses include three main types of use that are : trade, administration and municipal.

designation	Number of subscribers		Volume of water consumed	Specific consumption
Trade	40890	52%	8810 thousands of m3	3 l/day
Administration	26624	34%	25646 thousands of m3	9 l/day
Municipal	11200	14%	6052 thousands of m3	2 l/day
Collective total	78714	100 %	40508 thousands of m3	14 l/day

Table 40 : Water consumption for collective uses – SONEDE (2004)

The trade use includes the most important part of the total subscribers for the whole country, it represents more than the half with a part of 52%. This is also the case for the capital district with 55% of total subscribers and for the other regions (55%). However, the volume of water used by trade sector remains limited due to the restricted specific consumption 3 l/day per capita).

The administration use consumes more important quantities. The number of subscribers is lower than for the trade, it is only of 26624 and represent 34% of the total for the whole country. In spite of this limited number of subscribers, the administration consumes 3 times more than the quantity consumed by the trade with a volume of 25 646 thousands of m3 in 2003, increasing according to the previous year, where it was of 25 509 thousands of m3. Unsuitability between the number of subscribers and the consumption is due to the importance of the specific consumption of the administration that is of 9 liters per day per capita.

Municipalities are the weakest consumers of water. It only represents 14% of the total number of subscribers with 11200 subscribers and consume 6052 thousands of water m3. Besides, this volume of water knew a decrease since 2002 where it was of 6250 thousands of m3. The specific consumption of the municipal is only of 2 liters per day what explains the weak demand in water by this type of use.



2.3.4 Implications of tourism for water management

TYPE OF INFORMATION		INDICATOR	SOURCE
Role of the tourism industry in the local economy	Tourism receipts (Million dinars) – 2002	2,021	SESRTCIC
	2003	1,903	
	GDP of tourist sector (Percentage)	8	SESRTCIC
	Public expenditure on tourism development (million dinars/year)	332.8	SESRTCIC
	People employed in tourism sector (Percentage)	12	SESRTCIC
	Number of bed-places (Number) - 2003	183 377	World Tourism Organization
	Number of hotels (Number) - 2003	790	World Tourism Organization
	Volume of water	Millions of cubic meters	World Tourism Organization
		Liter/day/bed	
	Tourists arrivals (Number) – 2002	5,064	World Tourism Organization
	Tourist Pressure on WSS infrastructure Ratio	N.A.	World Tourism Organization

Table 40: Contribution of tourism to the national economy

Tourist industry is one of the sectors on which is based the Tunisian economy. Indeed, in spite of its fragility and its strong sensitivity to the national and world events, its participation to the development of the national economy is not negligible. The economic importance of the tourism sector is expressed by its contribution of 8% in the GDP and its contribution in terms of returns that is of 1903 Millions Dinars in 2003. In spite of a light decrease (2021 millions dinars in 2002), they remain important and represent a non negligible source of income for the country and permit to compress the current deficit. Indeed, the tourism stimulates the industries and permits to vary the economy. It contribute to the creation of employment and permits to decrease unemployment. Thus, in Tunisia, the tourism permits to use 12% of the population.

The tourist sector also entails in place an improvement of the infrastructures: the adduction of water, electricity, the treatment of the garbage, better roads, better communication system,...The state directly support the cost of these infrastructures. The public expenditure attributed to the development of the tourism are of 332,8 Millions Dinars that permits to bring some returns allowing the country to adjust its outside debt.

The tourist sector is known by its strong use and even the unchecked use of resources in waters. It provokes as a consequence disastrous effects on the natural habitat, especially when natural resources are insufficient. Showers, swimming pools and watering of the lawns constitute a real destructive of the aquatic reserves, what accentuates the shortage of water for the country.

Indeed, following statistical analyses, the volume of water consumed by this sector is of 15 867 millions of m³ in 2003. This volume knew a strong evolution since 1984 : it was of 7918 millions of m³ in 1984 ; it currently doubled. The problem of unchecked consumption of resources in water becomes more pronounced as the number of the hotels increases and the number of beds exploited also increases. Indeed, the number of beds exploited went from 68893 beds in 1984 to 183377 beds in 2003. This increase is negatively transmitted to the volume of water that is of 237 liters per day by exploited bed.



2.3.5 Infrastructure development

TYPE OF INFORMATION		INDICATORS	SOURCE
Infrastructure and water engineering development	Exploitation index natural water resources (percentage)	57	Plan Bleu
	Energy generated by hydropower (% of total energy produced in the country)	0.54	IDD-2003
	Energy generated by hydropower (% of total energy consumed in the country)	0.67	STEG - 200
	Planned investment in new technologies and new infrastructures	1045669 DT	Economie d'Eau 2000

Table 41: Hydropower generation and water infrastructure

TYPE OF INFORMATION		INDICATORS			SOURCE
Water saving for domestic use		Actual	Planned	Total potential	
	Reservoirs and Dams (cubic km)	1.342	N.A.	2.17	Deutsches Institut Für Entwicklungs-politik 2003
	Irrigation network (km)	N.A.	N.A.	N.A.	
	Water from reused sources and desalinated/treated plant (million m ³ /year)	51	65	150	IDD - 2003
	Others (specify)	N.R.	N.R.	N.R.	

Table 42: Domestic infrastructures



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