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Annex 6: Tunisia

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Introduction

This national report (national evaluation) aims to assist in the preparation of the 2013 Horizon 2020 (H2020) regional report.

The objective of the present H2020 regional report is to evaluate progress in depolluting the Mediterranean Sea, with a focus on three principal areas (waste, water, and industrial emissions). These three sources of pollution account for around 80 % of overall pollution in the Mediterranean.

This national report will provide an overview of Tunisia's endeavours in the environmental field, and the present evaluation is based on sustainable development indicators that enable Tunisia to concentrate initially on three priority issues:

- urban waste
- water
- industrial emissions.

This national evaluation will also provide a platform for communication on other subjects of interest for partner countries.

The report is divided into three sections:

- Tunisia's diversity
- H2020 priority issues
- flexibility.

Tunisia's diversity

Geography

Tunisia lies in north-east continental Africa; along with Sicily, it represents the natural conjunction between the eastern and western Mediterranean basins.

Tunisia has one border (965 km) with Algeria in the west and another (459 km) with Libya in the south-east, and a Mediterranean coastline (1 148 km) to the north and east; it lies in the more easterly part of the Maghreb.

Tunisia's surface area is 162 155 km².

Tunisia is situated between latitudes 31° and 37°N, and longitudes 8° and 11°E.

Climate

Tunisia's climate varies depending on the region: a Mediterranean-type climate prevails in the north and along the coasts, becoming semi-arid in the interior of the country and arid to the south.

Tunisia's climate is temperate in the north, with mild rainy winters and hot dry summers; the south of the country is desert.

Average temperatures range between 11.4 °C (December) and 29.3 °C (July).

Rainfall is irregular and concentrated in the cold season (three quarters of the annual total): 800 mm in the north, and between 50 mm and 150 mm in the south.

Politics

President Ben Ali stepped down on 14 January 2011 in the wake of the Tunisian Revolution. This was followed by the abolition of the then constitution. A government of national unity was formed to prepare for the election of a National Constituent Assembly (NCA).

Map A6.1 Geographical map of Tunisia

Source: OTEDD.

On 23 October 2011, the NCA, elected by Tunisian voters, was mandated to draft the text of a new constitution, form a provisional government and elect an interim president of the republic to oversee day-to-day state business and monitor the elections to be held in the final, permanent phase of the revolution.

Administrative organisation

The country is subdivided into 24 governorates. A governorate is the largest administrative unit and is subdivided into delegations which are further subdivided into sectors (*imada*), representing the smallest administrative entity. On average, there are

eight sectors per delegation. Governors, delegates and *omdas*, respectively the governorate, delegation and sector regional heads, are state-appointed officials.

The country contains 264 delegations, subdivided into 2 073 sectors.

There is, moreover, a further territorial subdivision that divides the country into municipal and non-municipal zones. Municipal zones are considered to be urban areas that are not necessarily subject to the administrative structure described above.

A municipal zone is defined in Tunisia as all municipalities designated as such by decree of the Ministry of the Interior, and consequently are subject to municipal law. Non-municipal zones are all sectors outside municipal boundaries — built-up areas not designated as municipalities, and covering large tracts of land of dispersed settlement. In Tunisia, there is no precise definition of a rural area as such, and therefore this type of zone is classified as non-municipal.

Population

Tunisia's population on 1 July 2011 was estimated to be 10 673 800, i.e. a population density of 68.8 inhabitants per square kilometre.

Over the last 20 years, the Tunisian population has experienced an average annual growth rate of the order of 1.2 %, which is one of the lowest along the southern Mediterranean shore.

Life expectancy at birth increased by 4.3 years between 1991 and 2011, from 70.6 years to 74.9 years.

Tunisia's population is 66.1 % urban (2011) as compared with 59.8 % in 1991.

In 2011, 7 563 100 inhabitants were living in governorates with a coastline, compared to 6 012 900 in 1993.

In 2011, almost three quarters of the population of governorates with a coastline were living in urban areas.

The challenges of sustainable development

A reading and analysis of the principal plans and programmes for development in Tunisia in all socio-economic development sectors, and discussions with the main partners involved preceded the Ministry of the Environment's summary of the primary sustainability challenges. These are the major future objectives that must be achieved if promotion of sustainability at national level and its implementation are to proceed unhindered.

These challenges, currently at discussion stage, are the following:

- encouraging sustainable consumption and production (e.g. green economy);
- promoting a high-performance economy, enhancing social equity and combating regional disparities;
- sustainably managing natural resources;
- promoting regional development that is more balanced, based on high-performance, sustainable transportation;
- promoting an enhanced quality of life for citizens;
- developing energy efficiency and promoting renewable energy sources;

Table A6.1 Population indicators

	1991	1993	2011
National population (in thousands of inhabitants)	8 318 200	8 572 200	10 673 800
Urban areas	59.8 %	60.8 %	66.1 %
Life expectancy at birth (in years)	70.6	70.8	74.9
Population of governorates with a coastline (in millions) (*)		6 012 900	7 563 100
Urban areas			74 %

Note: (*) Manouba Governorate, formerly part of the Ariana Governorate, was created in 2000.

Source: INS, 2012.

- strengthening the capacity to adapt to climate change;
- promoting a knowledge society;
- adapting governance in order better to promote sustainable development.

The general objectives adopted as part of the Strategic Action Programme (SAP) are:

- by 2025, industrial facility waste released from localised sources and emissions released into the atmosphere, within the protocol zone, must comply with protocol provisions and with other agreed national and international provisions;
- within 10 years, there must be a 50 % reduction in waste, emissions and releases of persistent toxic substances from industrial facilities, that can accumulate in the biosphere;
- within 10 years, there must be a 50% reduction in waste, emissions and releases of pollutants from industrial facilities at 'hot spots' and in problematic zones.

The SAP has also identified more specific, intermediate supplementary objectives. The principal milestones in implementation of the National Action Plans (NAPs) are:

- 2003: launch year for the establishment of a baseline report for each SAP objective;
- 2010: start of the period for a 50 % reduction in waste;
- 2025: the year as of which all waste and emissions should comply with the provisions of the Protocol Concerning Pollution From Land-Based Sources and Activities (1999).

Economy

During the period from 2000 to 2010, Tunisia experienced sustained economic growth averaging 4.2 %, although there was 1.9 % regression in 2011 in the wake of the civil disorder in the lead-up to the revolution.

The gross domestic product (GDP) (2010 market price) was TND 63 540.2 million, i.e. equivalent to TND 6 024.4 per inhabitant.

The principal sectors that contribute to the Tunisian economy are as follows.

Farming and fisheries

Productive arable land, pasture and woodland resources cover 9 million ha. The farming sector has a strategic role to play in the nation's development, accounting for 8 % of the GDP (in 2010, at current prices and at constant prices) and 17.7 % of the national labour force. Farmland occupancy accounts for 5 million ha.

Industry

Industry's contribution to the GDP is 31.1 % (2010), including non-manufacturing industry, i.e. mining, energy (including electricity and gas), water, construction and civil engineering. The manufacturing industry alone represents 18.4 % of GDP (at 2010 current prices), illustrating its important role in the country's economy.

Industry accounts for 33 % of employment nationally.

Transportation

Transportation accounts for 9 % of GDP (in 2010, at current prices). Transport facilities grew considerably in terms of capacity. Tunisia has 9 airports, 7 commercial ports and an oil terminal, a road network of 20 000 km, 370 km of motorway and 2 256 km of railways. Travel by public transport is increasing apace, particularly in the three largest cities (Tunis, Sousse and Sfax), where private transport accounts for around 60 % to 70 %. Public transport of passengers between population centres has dropped from 27 % (1985) to 16 % (2007).

Tourism

This sector plays a major role in the Tunisian economy, representing 7 % of GDP and covering 51 % of the trade deficit for 2008. Tunisia is one of the southern Mediterranean's premier tourist destinations, and this sector has grown, particularly along the coast. Tourism is one of the economy's most dynamic sectors, but it is currently in a period of regression owing to the difficult circumstances Tunisia is experiencing.

Priority H2020 topics

The aim of this section is to address common topics already identified as priorities by H2020 and the countries involved, namely urban waste, water and industrial emissions.

Urban waste

Population growth, improvement of living conditions and urban expansion have led to an increase in solid-waste–management problems, particularly collection and removal. Tunisia's 66 landfill sites are, in the main, uncontrolled. Solid household waste amounted to 2.2 million t in 2007.

Given the annual population growth of 1.1 %, annual production of household waste could be as much as 4.4 million t in 2020.

Per capita production varies, depending on the environment: ranging from between 0.10 kg/d/h and 0.25 kg/d/h (rural), to between 0.65 kg/d/h and 0.85 kg/d/h (urban). Tunisia has achieved good levels of performance in terms of household-waste management by setting up a controlled landfill-site generalisation policy (PRONAGDES, 1993) and a rehabilitation and closure action in the case of 400 uncontrolled rubbish dumps, more than 130 of which are now rehabilitated. Waste capacity at controlled landfill sites is 1 765 000 t/year, which represents 78 % of total household-waste production. An additional capacity will soon be on-stream, accounting for 110 000 t/year. All solid waste produced in Tunis, Mejez ElBab, Siliana, Beja and Jendouba is buried.

Table A6.2 Production of household waste in 2007

	2007
Production of household waste	2.2 million t

Source: http://www.anged.nat.tn.

Map A6.2 Controlled landfill site construction programme

Source: OTEDD, 2012.

However, appropriate sanitation measures, e.g. covering with earth and treatment of leachate, are lacking, even at controlled landfill sites, which means that such sites are sources of pollution. Currently, 10 controlled landfill sites are operational, 10 are planned and 4 are under construction. There are 44 transfer centres.

Waste is collected from production sources and transported to a transfer centre by municipalities

and the latter's subcontractors, covering, on average, 85 % of urban areas; however, coverage in rural areas is very patchy.

The amount of waste deposited at controlled landfill sites increased from 1.5 million t in 2009 to 1.69 million t in 2010, then dropped to 1 million t in 2011. The 2011 reduction is attributed to the widespread social disorder in Tunisia after 14 January 2011.

Other household waste is disposed of at uncontrolled rubbish dumps, and industrial and medical waste (an estimated 18 000 t/year) are often disposed of together with municipal waste. Opposition to the construction of rubbish dumps close to urban centres obstructs the process for managing and recycling waste: uncontrolled landfill sites have multiplied, particularly in the wake of the revolution.

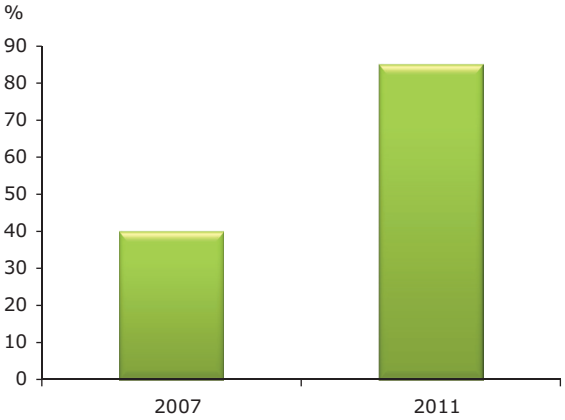
Of the four controlled landfill sites currently under construction, the development of one is at a standstill, owing to resistance from the local population since the revolution. The main weakness in terms of managing household waste is the low level of sorting at source, salvage and recycling (despite the potential for profit), and extending the lifetime of rubbish bins. Composting amounts to no more than 0.5 %, despite waste comprising 65 % organic material.

Methanisation of organic waste to produce electricity is impractical, and the waste-battery sector is still lagging behind, in terms of the way in which it functions. A system for the collection of used packaging material and plastic wastes (ECOLEF) was set up in 1998, but, as with other sectors (e.g. tyre and metal recycling), collection is disorganised, and it evades control and systematic monitoring by the public authorities.

Sorting centres are scheduled for Tunis and Sousse, with a view to upgrading solid-waste management in those cities. Waste collection is a crucial problem for municipalities, as it accounts for almost 30 % of their budget (SWEEP-Net, 2010). Even the levying of local taxes — which is currently difficult — does not generate enough income for municipalities to cover the costs of waste management, and private-sector involvement is half-hearted, ranging from a service to meet the needs of structured, well-equipped enterprises to problems of quality and service compliance.

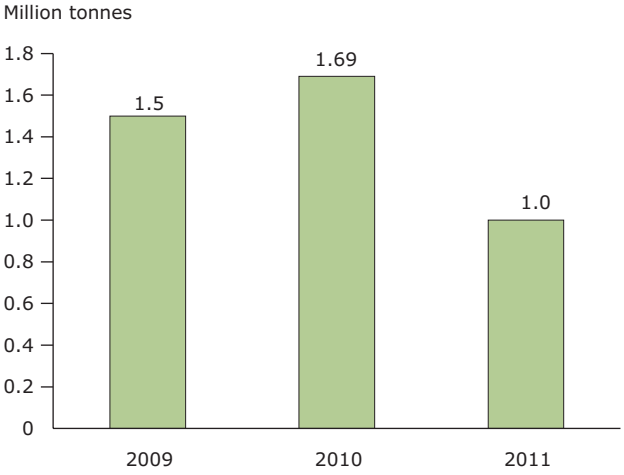
Support for municipalities, to contribute to better waste management, is a priority concern within

Figure A6.1 Household-waste collection rates between 2007 and 2011



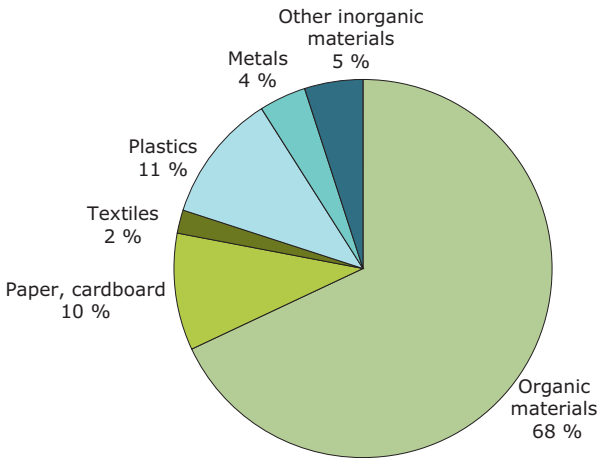
Source: OTEDD, 2012.

Figure A6.2 Amount of waste deposited at controlled landfill sites



Source: OTEDD, 2012.

Figure A6.3 Composition of household and similar waste in 2007



Source: http://www.anged.nat.tn.

the current strategic plan (PRONGIDD 2007–2016), and the commissioning of the pilot scheme for the municipal waste-management plan (PCGD) is a significant future step.

National reports on the state of the environment provide wide-ranging information on the solid-waste sector, and varied, interesting data on the various actions in progress. However, what needs to be addressed is the lack of a set of indicators showing the coverage rates achieved by the various waste-management methods.

According to the most recent statistics available within the context of preparing the NAP in 2004, in coastal towns, the quantity of household waste taken to municipal landfill sites is estimated at 1.6 million t per year, but that does not take into account hospital waste and waste from abattoirs and industrial units, and other construction and garden waste materials.

In coastal governorates, the proportions of the amounts of waste processed at landfill sites as compared with the amounts produced are shown in Table A6.3.

This table shows that only 40 % of household waste is buried at controlled landfill sites. The remaining 60 % is dumped at uncontrolled sites.

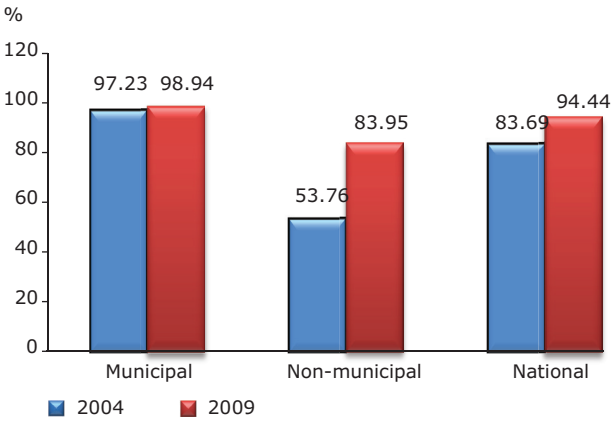
Some solid waste is dumped in sensitive environments, such as water courses, or *sebkhas*, disused quarries with friable soil, or farmland.

Water

Development policy in the case of drinking-water and sanitation infrastructures has enabled Tunisia to achieve the highest level of access to water provision/sanitation of all countries in North Africa and the Middle East. Improvement of wastewater treatment and the provision of clean water has long been the priority of national economic and social development plans.

The authorities in the sector, in particular the Tunisian Water Exploitation and Distribution Company (SONEDE), National Sanitation Office

Figure A6.4 Access to improved sanitation by percentage of dwellings (2004 and 2009)



Source: http://www.ins.nat.tn.

Table A6.3 Amount of waste managed in towns on the coast

Governorate	Amount of waste produced per governorate	Amount of waste processed at landfill sites	%
Jendouba	77 000	14 000	18.18
Béja	57 000	30 000	52.63
Bizerte	100 000	0	0
Grand Tunis	700 000	700 000	100
Nabeul	150 000	0	0
Sousse	180 000	0	0
Monastir	150 000	0	0
Mahdia	45 000	0	0
Sfax	100 000	0	0
Gabès	70 000	0	0
Medenine	10 000	0	0

Table A6.4 Urban water supply systems in coastal towns in 2004

	Jendouba	Béja	Bizerte	Ariana	Tunis	Ben Arous	Nabeul	Sousse	Monastir	Mahdia	Sfax	Gabès	Medenine	Average/total
Level of consumer connection lines (%)	95.4	97.9	95	83.7	97.6	85.1	95.7	96.4	87.9	74.1	70.2	69.2	27.1	85.2
Network length (km)	284	311	644	724	1948	1080	1027	1027	943	220	822	444	293	9 767
Number of purification stations	5	4	2	2	2	4	10	5	8	4	3	2	8	59
Number of pumping stations	32	21	36	22	61	33	62	51	54	13	22	22	34	463
Number of customers (one thousand inhabitants)	98	115	296	304	916	378	381	396	345	81	349	152	67	3 878
Volume of water collected (million m^3)	2.7	3.3	8.8	14.4	33.2	14.7	13.2	15.4	10.5	2.9	11.0	4.3	5.5	139.9
Volume of water treated (million m^3)	2.6	3.2	8.5	14.0	32.1	14.2	12.8	14.8	10.1	2.8	10.6	4.1	5.3	135.1
Level of treated water/collected water (%)	96.3	97.0	96.6	97.2	96.7	96.6	97.0	96.1	96.2	96.6	96.4	95.3	96.4	96.6
Number of member municipalities	5	6	10	5	8	10	17	13	21	5	8	8	4	120

Source: ONAS, 2004.

(ONAS) and the Northern Water Supply and Canal Company (SECADENOR), have been able to address these priorities, with very satisfactory results.

Table A6.4 shows that four major coastal towns require an extension of the water network and an increase in the capacity of their purification stations, particularly in the region of Tunis (Ariana and Ben Arous), and in the cities of Mahdia, Sfax, Gabès and Djerba, where the average levels of consumer connection lines remain below 85 %.

The SAP objectives for urban wastewater are:

- 2010: purification station for towns with more than 100 000 inhabitants;
- 2025: treatment of all wastewater in the entire coastal zone.

For 2010, the SAP objective was for all coastal towns with more than 100 000 inhabitants to be equipped with purification stations.

This objective has already been achieved in Tunisia.

In order to prepare to achieve the 2025 objective, it is necessary to increase the increasingly insufficient treatment capacity at certain stations (including those in Sfax and Tunis), by means of extension projects and/or the installation of new stations.

The SAP objective for 2025 is to manage all wastewater in the area along the coast.

Tunisia has started work in this respect by designing and launching major projects for small towns, even in rural districts, and is implementing sanitation projects in more densely populated districts, with a view to improving the rate of consumer connections to the urban water supply network.

Today, the entire population in urban areas has access to drinking water on a continuous basis, and 92 % of the rural population is supplied with drinking water by SONEDE and the agricultural development groupings (GIC/GDA). However, average drinking-water consumption ranges between 20 l/d/inhabitant and 80 l/d/inhabitant in rural areas compared to 110 l/d/inhabitant in urban areas (the rural variation is due to the distances that the generally scattered rural population must travel for drinking water) (SONEDE and OTEDD, 2012).

Furthermore, Tunisia has a well-established wastewater-treatment network. Since its foundation in 1974, the National Sanitation Office (ONAS) has been the driving force behind remarkable progress

in the water supply sector. It has enabled more than 89 % of the urban population (not counting areas for which the ONAS is not responsible, i.e. non-intervention zones) to be connected to the system, which extends over 14 500 km (2012 data). It has also constructed 111 wastewater-purification stations (2011 data).

Areas managed by ONAS include large and small towns and built-up areas of more than 4 000 inhabitants, industrial zones and tourist areas. This amounted to 6.5 million inhabitants in areas managed by ONAS in 2012, representing 90.3 % of the urban population and 60 % of the total population (2012), given that the population was 10.8 million inhabitants that year.

As the body managing potentially polluting stations, ONAS is subject to monitoring by the National Environmental Protection Agency (ANPE), with which it has signed a partnership agreement (the two institutions are under the aegis of the Ministry of the Environment). According to official data, more than 90 % of wastewater collected by ONAS is treated, and more than 20 % of treated wastewater is recycled. ONAS has also embarked upon the rehabilitation of wastewater discharge outlets in the principal tourist areas along the coast, with a view to protecting the coastal environment.

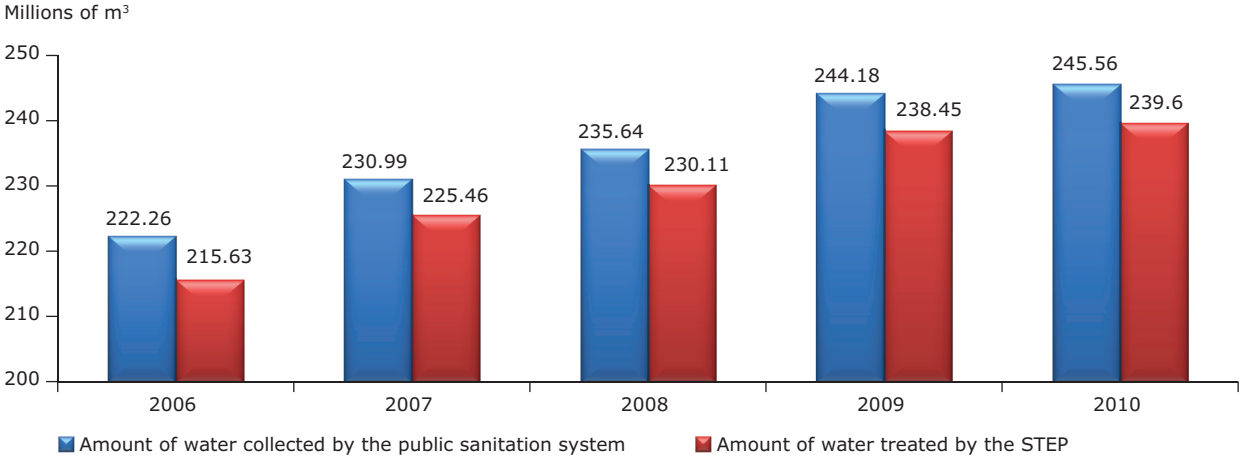
Such levels of performance, which are undoubtedly remarkable within the regional context, mask a more problematic situation:

- service-management conditions (frequent under-exploitation or over-exploitation of purification stations, insufficient staff allocated to infrastructure maintenance, inadequacy of monitoring and evaluation systems, etc.);
- invoiced prices that are too low to cover investment costs;
- absence of integration with upstream sectors (e.g. industrial wastewater) and downstream sectors (e.g. recycling treated wastewater for agricultural use).

Despite the good results achieved by ONAS in the area of collection and treatment of wastewater, challenges still exist. Owing to rapid growth of the urban population, certain purification stations are no longer capable of handling the rapidly increasing amount of effluent. The sanitation network in certain large towns and the purification stations need to be extended: Ariana and Ben Arous in the Tunis region, and Mahdia, Sfax, Gabès and Djerba, where the rate of connection to the network is under 85 %; the largest purification station in Tunis has a treatment-capacity shortfall of 60 000 m³/day.

Work is under way to extend the south Sfax purification station. Extensions of the purification stations for Choutrana and south Méliane started in 2008 and 2007, respectively. Furthermore, feasibility studies have been commissioned for the extension and rehabilitation of 19 other purification stations, and a number of projects are currently

Figure A6.5 Volume of wastewater collected and treated (million m³)



Source: http://www.onas.nat.tn.

being implemented in average-sized towns in an effort to consolidate the urban effluent-treatment system. Nevertheless, only traditional water supply systems (e.g. soakaways) exist in rural areas, and the expansion of purification stations results in an increase in dry sludge production. The lack of maintenance and levelling, and the failure to comply with treatment standards, often result in mediocre-treated water quality and its under-reutilisation, particularly in the wake of the revolution.

The pressure on water resources to satisfy demand is considerable, particularly in irrigated areas, which use almost 80 % of available resources. The requirement rose to approximately 2.7 billion m^3 in 2010, and this resource is becoming increasingly scarce. Water resources are currently being harnessed via a series of large dams, dykes, deep bore holes and surface wells. Almost 95 % of available resources are now being utilised, which leaves a small margin to cater for the increase in demand over the next few years.

Over-exploitation of groundwater is becoming an increasingly serious problem (Cap-Bon, Central Tunisia, etc.), and non-renewable water in the south is subject to intensive use. This over-exploitation has enabled the area of oases to double over 30 years, increasing from 15 000 ha to 36 000 ha of irrigated land, but this is reflected in the drying out of the water table, which is becoming a less renewable resource, with loss of pressure and volume plus saltwater intrusion (60 % of groundwater has a salt content that now exceeds 3 g/l). Moreover, water resources are at even more of a premium, in light of unpredictable climatic conditions and under-performance in the irrigation sector.

For Tunisia, water is the most precious environmental asset. Freshwater resources are increasingly rare and restricted, given the absence of possibilities to increase utilisation rates. The figure for available conventional water stands at 95 %.

Deep resources are showing signs of considerable over-exploitation in a number of regions. The next decade will likely see significantly increased demand, not only in terms of quantity but also in terms of quality, and it is expected that by 2025, the main problem will be lack of water. Rational management of water demand and of the resource itself are becoming a priority.

Highly saline groundwater resources, coastal water tables and non-renewable aquifers will diminish in size by 28 % by 2030. Surface water will see a 5 % reduction over the same period. Water quality will be affected by the increase in salinity, which is the result of increased demand for irrigation and the intrusion of seawater. Non-renewable aquifers in the south will be seriously affected owing to increased pressure resulting from lower rainfall, albeit indirectly.

Industrial emissions

There has been much industrial development and diversification in recent decades. The strategy in the years following independence involved creating industries, in particular heavy industries, in order to provide jobs. The impact of such job creation on the environment was not an issue of concern at the time. However, several years down the line, we are in a better position to assess the harmful effects of all the industrial waste released into the air and into the environment on the health, biodiversity, soil and hydrological reserves of the country.

The most polluting activities are those involving mining, phosphate processing, construction metals, textiles, agri-foodstuffs and energy production. These are generally concentrated around large urban areas (Bizerte, Tunis, Menzel Bourguiba, Sfax, Gabès, Gafsa and Kasserine) and on the coast, where the majority of the population lives. Studies have shown that the atmospheric pollution caused by the chemicals sector is responsible for the increase in cardiovascular disease and respiratory infections. Certain pollutants emitted by the chemicals industries are responsible for the appearance of new types of cancer. In Sfax, the air contains high levels of carbon monoxide (CO), carbon dioxide (CO_2), nitric oxide (NO), nitrogen dioxide (NO_2), hydrogen sulphide (H_2S), hydrocarbons and dust.

The coastline has progressively become a dumping ground for such substances. The most salient example is that of dumped phosphogypsum at Gabès and Sfax, which is extremely harmful to marine fauna and groundwater. The textiles sector annually produces several hundred thousands of cubic metres of liquid waste, some of which is released into water courses and rivers. Only 5 % of companies in the sector are equipped with pretreatment stations. Technical coastal-protection studies have been conducted over the years, but have not always been implemented, and industry is reluctant to finance the measures recommended. Another example is the tonnes of amurca generated by olive processing, which is detrimental to soils, rivers and groundwater if not pretreated.

The Tunisia MED POL programme

The National Programme for Ongoing Monitoring of the Quality of the Marine Environment forms part of the Programme for the Assessment and Control of Marine Pollution in the Mediterranean (MED POL). Launched in 1981, it involves monitoring of land-based pollution sources, pollution hot-spots (estuaries, coastal purification stations) and compliance on the part of bathing water, analysis of coastal areas, biosurveillance and the monitoring of trends and support measures.

ANPE is the coordinator for the National Programme for Ongoing Monitoring of the Quality of the Marine Environment. Institutions collaborating in the MED POL programme are:

- the National Institute for Marine Sciences and Technologies (INSTM);
- the Department of Hygiene and Environmental Protection (DHMPE).

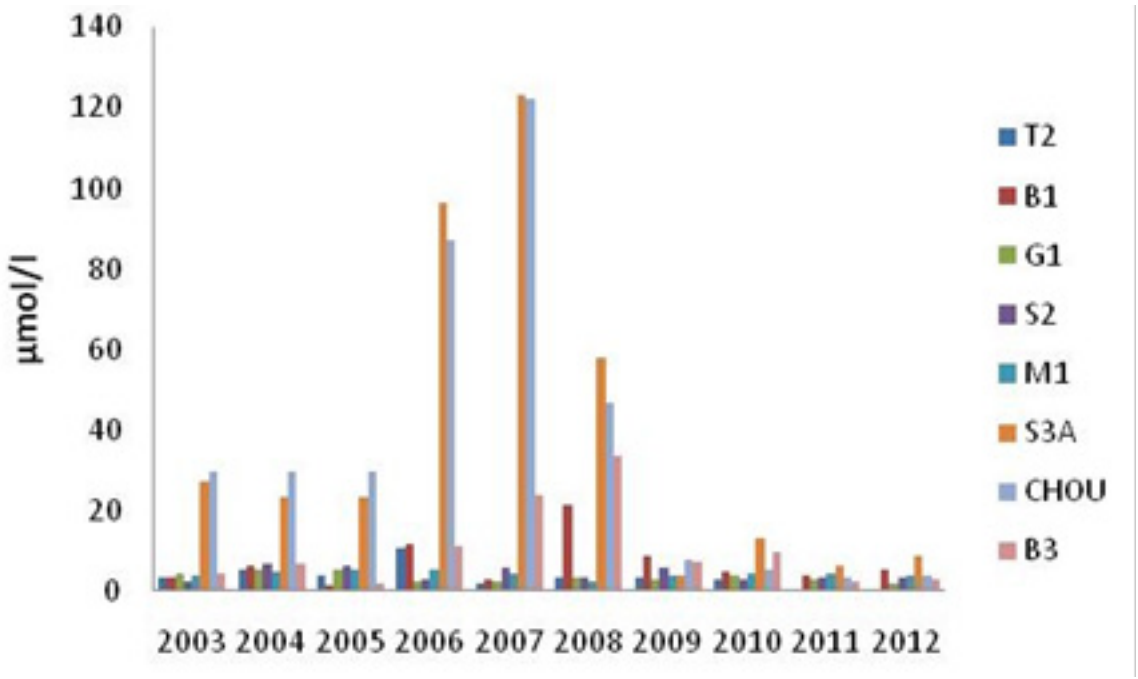
The present report includes data from:

- the INSTM, regarding monitoring of heavy metals (sediments and biota) for certain stations;
- the DHMPE, regarding monitoring of compliance on the part of bathing water;
- the ANPE/water-quality monitoring service, regarding monitoring of the quality of water in coastal environments (wadis, lagoons and *sebkhas*).

Monitoring trends and chemical contaminants in sediments and biota

The work of the INSTM under the MED POL programme involves monitoring the following in sediments and marine organisms along the coast of Tunisia:

Figure A6.6 Marine environment quality: total phosphorus (TP) (µmol/l), 2003–2012



- trace metals (cadmium (Cd), lead (Pb) and mercury (Hg))
- total hydrocarbons (THCs)
- pesticides (LIND, aldrin (ALD), Die, dichloro-diphenyl-trichloroethanes (DDTs), hexachlorocyclohexanes (HCHs), hexachlorobenzene (HCB), delta-hexachlorocyclohexane (HCHD))
- biological effects (Met, Cat, etc.)
- hydrological and oceanographic parameters of water (T, sulphur (S), dioxygen (O2), nitrogen (N), phosphorus (P) and Chlorophyll *a* (Chl *a*))

The results are of the same order of magnitude over the last three decades. The highest value, 8.605 µmol/l, is for the Wadi Méliane estuary.

The nitrogen concentration for the stations at Sfax and Bizerte remains high for 2012, as compared with 2010. However, the highest value — 39.647 µmol/l — is that of the Bizerte emissary estuary; it recorded an increase, over 2011, for this same station. In general, concentrations for 2010 to 2012 remain lower compared to previous years.

The results are of the same order of magnitude from 2007 onwards. Indeed, the Chl *a* concentration is below 6 mg/m^3 for all stations, with the Bizerte station recording the highest, at 3.012 mg/m^3.

Analysis of total hydrocarbons

At sediment level

The results for total hydrocarbons (TH) (µgram/g) at sediment level for 2007 to 2012 are set out in Table A6.5.

There is a drop in 2012 as compared with earlier years for Menzel Jemil point (B3), and a slight increase at Choutrana and Méliane as compared with 2010 values.

Within the context of a review and update of Tunisia's environmental protection standards, an order concerning sediment quality was proposed in June 2009. The draft order set two reference levels for total polycyclic aromatic hydrocarbons (PAHs) in the case of marine sediment quality: QSDM1 and QSDM2, equivalent to 1.7 mg/kg and 9.6 mg/kg of total PAH/kg of sediment, respectively.

Figure A6.7 Concentration of total nitrogen (TN) (µmol/l), 2003–2012

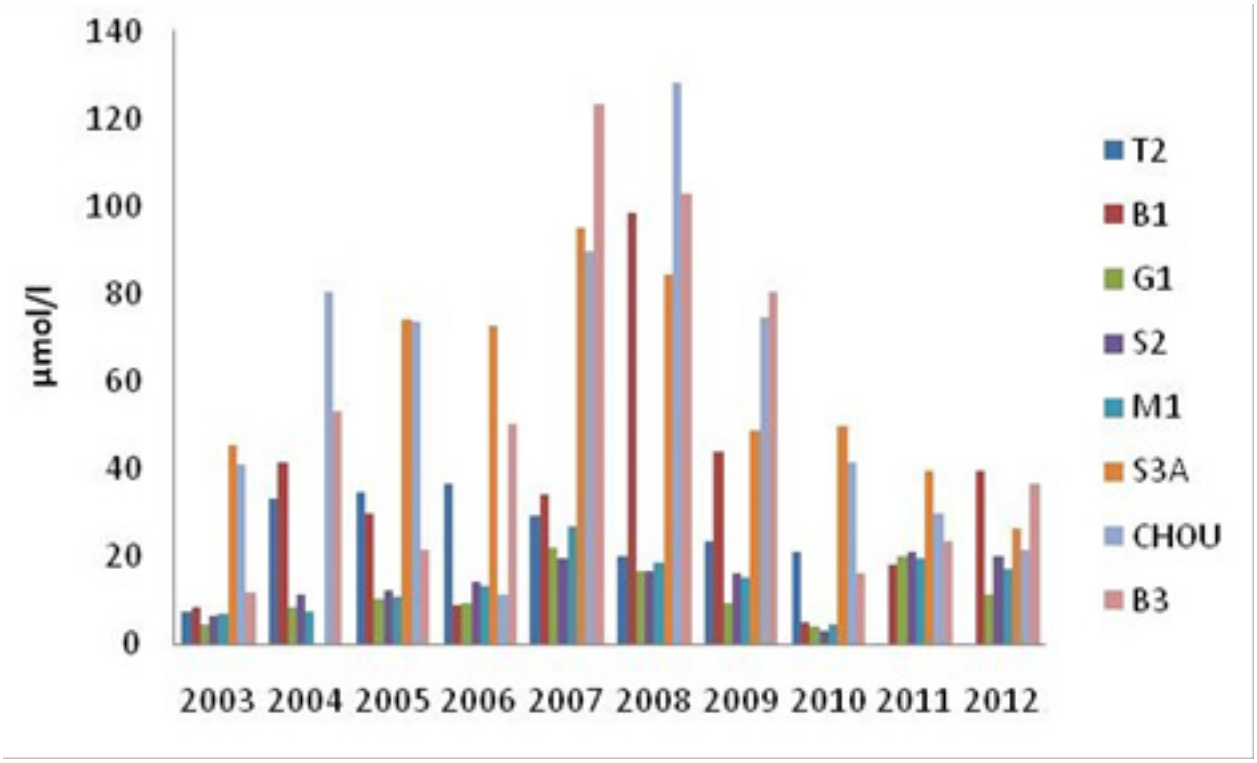


Figure A6.8 Marine environment quality: chlorophyll *a* (Chl *a)* (mg/m³), 2004–2012

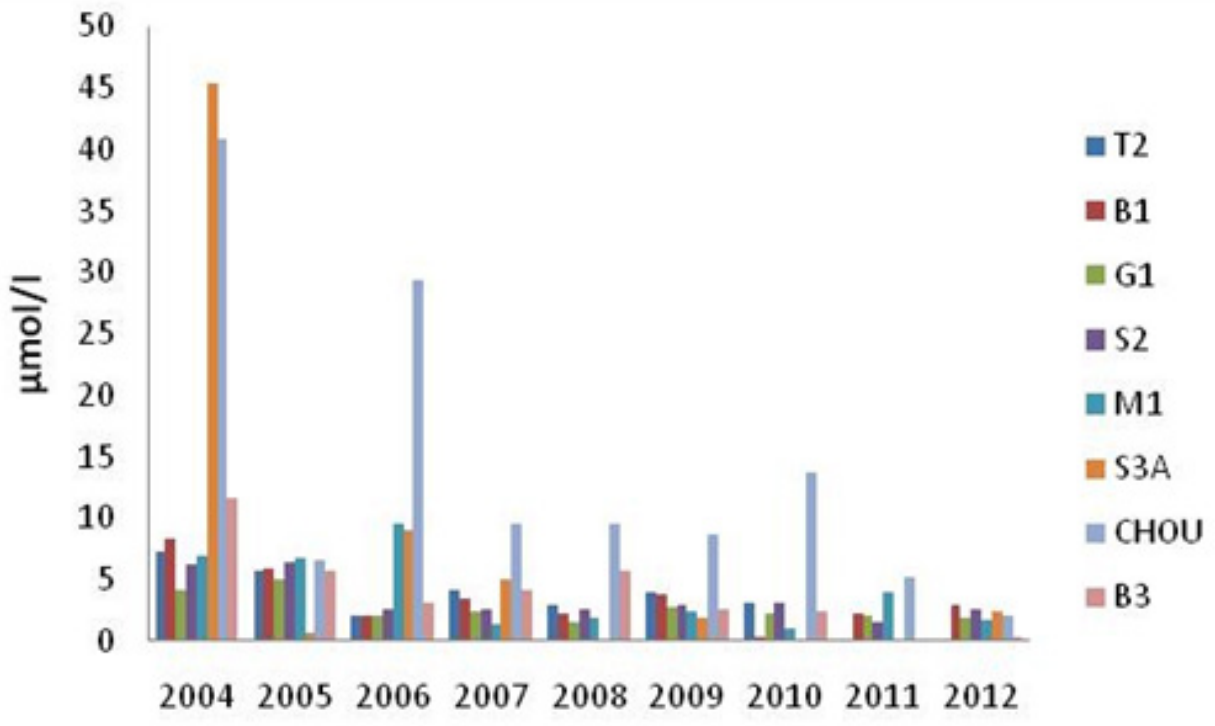


Table A6.5 Results of monitoring of total hydrocarbons (TH) in sediment (µgram/g), 2007–2012

Station	2007	2008	2009	2010	2011	2012
T2: Tunis navigation channel	0.658	-	0.005	-	-	-
S3A: Wadi Méliane estuary	1.27	0.027	0.029	0.00149	-	0.00193
CHOU: Choutrana outfall	0.685	0.064	0.017	0.00536	-	0.00703
B3: Bizerte-Menzel Jemil lagoon	0.583	0.1578	0.01	0.12179	-	0.00772
B1: Bizerte emissary lagoon	-	-	0.005	-	-	-

The total PAH concentration is less than the lower level (1.7 mg/kg). Total PAHs are a combination of six compounds: fluoranthene, benzo[*b*]fluoranthene (B[*b*]F), benzo[*k*]fluoranthene (B[*k*]F), benzo[*a*] pyrene (B[*a*]P), benzo[*ghi*]perylene and indeno[1,2,3-*cd*]pyrene (IP).

At marine organism level (whole soft tissue)

For 2012, there were no data made available relating to total hydrocarbons.

Analysis of heavy metals

At sediment level

For 2012, there were no results for stations T2 and B1. Concentrations for station B3 are the highest, but they are still below the minimum threshold (QSDM1 = 1.2 mg/kg) proposed by the draft order concerning sediment quality (mentioned above).

Figure A6.9 Cadmium in sediment, 2003–2012

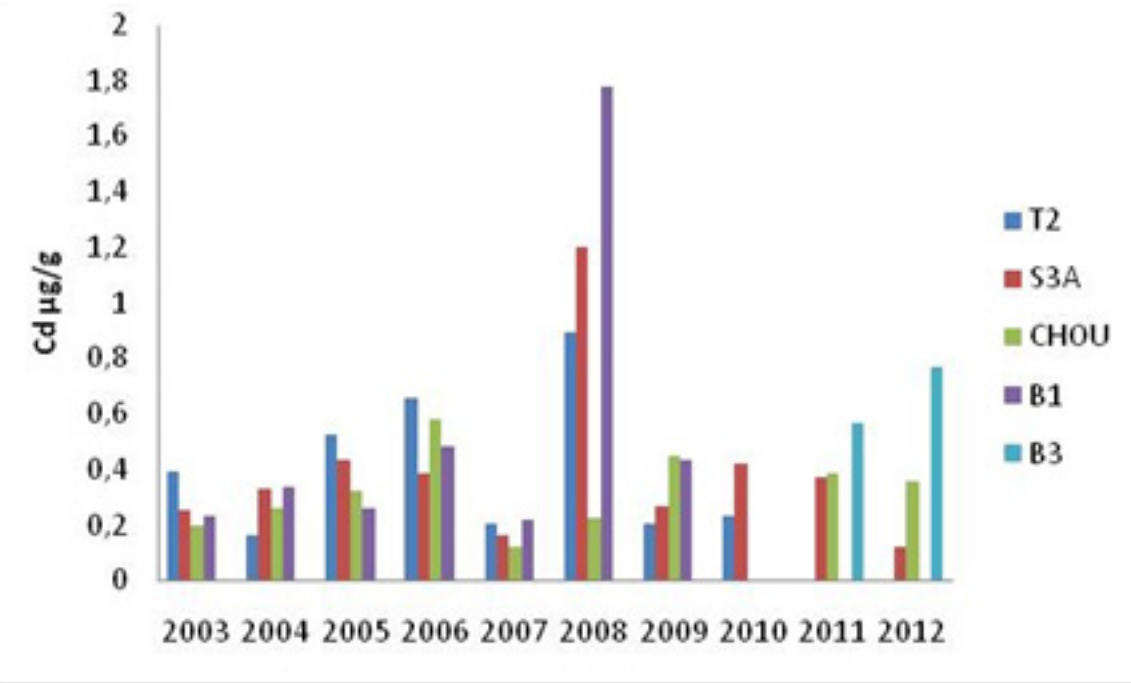
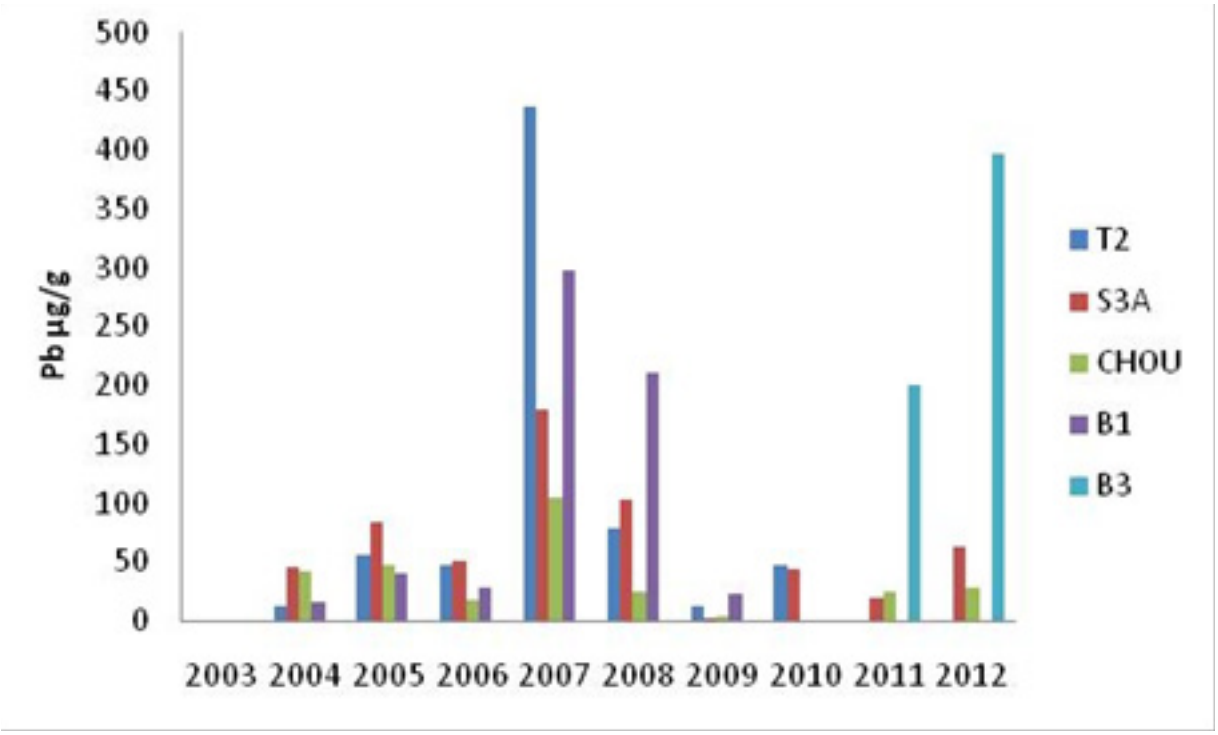


Figure A6.10 Lead in sediment, 2003–2012



The Menzel Jemil station (B3: 397.907 mg/kg) exceeds the maximum threshold (QSDM2 = 51.6 mg/kg) proposed by the draft order concerning sediment quality. For the two other stations for which data are available, sediment contamination with lead is slightly higher than the minimum threshold (QSDM1 = 20.9 mg/kg) proposed by the draft order concerning sediment quality in the case of S3A (Méliane estuary), and exceeds QSDM1 for the Choutrana outfall.

Mercury

As the mercury analyser used since 1992 was out of service, we were unable to analyse mercury levels. However, a proposal for the purchase of a replacement device has been submitted.

It is recommended that precise readings be obtained to confirm heavy metal concentrations in sediment.

Monitoring surface water quality

ANPE is responsible for performing this task. However, within the context of a review of Tunisia's environmental standards, a standard on surface-water quality has been proposed in order to make it possible to compare the results obtained.

Results

Comments related to data interpretation follow.

Wadi Medjerda

- Salinity at sample points for the main Medjerda course ranges between 0.34 g/l and 3.63 g/l; it increases slightly from upstream to downstream, influenced by certain tributaries. From that point onwards, salinity is variable, with everything being dependent on the release from the Sidi Salem dam. As regards the salinity of tributaries, there is a relatively saline inflow from the right bank, and a freshwater inflow from the left bank (Wadis Bouhertma, Béja and Kasseb).

- The COD measured for the main Medjerda course is less than 30 mg O_2/l. On the other hand, in the case of the tributaries, very high CODs are recorded for the October readings at the level of Wadi Kasseb (102 mg O_2/l) and Wadi Béja (3 680 mg O_2/l).

- The phosphorus concentration for the Medjerda drainage basin ranges from between 0.1 mg/l and 1.3 mg/l for the main watercourse, to between 0.2 mg/l and 26.6 mg/l for the tributaries, for which the highest values are at the level of Wadi Kasseb and Wadi Béja, which receive agri-foodstuff industry waste.

These results are similar to those recorded in the course of the 2011 readings for the same period, representing stabilisation in parameters, despite the flooding in this region.

Wadi Méliane

- Salinity measured at the level of Wadi Méliane exceeds 2 g/l and 4 g/l at the level of M'Hamedia point. This increase is due to the inflow of salt water through the Jbel Oust tributary, the salinity of which exceeds 10 g/l.

- An increase in the phosphorus concentration, upstream to downstream of Wadi Méliane, has been noted, reaching 4.9 mg/l at the level of the Jbel Oust area. As with nitrate, this increase is caused by the nature of waste issuing from the agri-foodstuffs industries in the Ben Arous governorate.

Wadi El Bey

- The pH in the Wadi El Bey drainage basin ranges between 7 and 8.5. The highest reading is recorded at the level of Wadi Tahouna, and is probably due to the industrial waste present, particularly from the tannery in the town of Grombalia.

- Salinity in the water of wadis in the El Bey drainage basin ranges between 1.4 g/l and 1.8 g/l for May 2012. The most saline waste includes that from the tannery in the Grombalia area.

- The water of Wadis Tahouna, El Bey and Meleh (Billi village) are characterised by a high organic load, which is connected to the hydric waste issuing into this environment, namely treated or untreated wastewater, and tannery, paper-mill and industrial-zone waste. The COD in a number of cases exceeds 1 000 mg O_2/l.

- The BOD_5 in the Wadi El Bey basin is very high, exceeding 100 mg O_2/l in a number of cases.

Bizerte Lagoon

- The pH values recorded are around 8.5. In fact, they range between 8.4 and 8.6.
- The redox potential values are stable, at around – 80 mV.
- Salinity at points located at lagoon level is high, between 35 g/l and 39 g/l. This can be explained by the nature of the environment, which is closed, thereby promoting water salinity.
- As for nitrates, recorded concentrations of orthophosphates are high at the level of the Wadi Laazib sampling points, which shows that these two environments are experiencing eutrophic pressure, with a resulting increase in nitrate and orthophosphate concentrations. Other points have low concentrations below 1 mg/l, except for the point corresponding to I.M.M. Bourguiba, where the orthophosphate concentration is around 5 mg/L.

Ghar El Melh Lagoon

- The pH values recorded in the Ghar El Melh Lagoon are fairly stable, ranging between 8.2 and 8.6.
- The redox potential values recorded show significant oscillations, ranging between – 45 and – 13. The values recorded at the level of the lagoon are fairly low, ranging between – 80 and – 130, and are illustrative of a fairly significant absence of oxygenation in the lagoon.
- Recorded conductivity is very high at the level of points on the lagoon shore, particularly point P1.
- The salinity for the points P1 to P6 is fairly high, of the order of 38 mg/l, something which can be explained by the nature of the environment.
- The values recorded at the level of the lagoon are higher than the standard, which is set at 0.5 mg/l.
- The Utique industrial zone is also subject to organic pollution, the COD measured at this point being equal to 349 mg O_2/L, and higher than the standard.

Monitoring of the microbiological quality of bathing water

Health monitoring of bathing water (e.g. the sea and swimming pools) is one of the regular, ongoing activities of the services of the Ministry of Health. The monitoring of health indicators is a subject of much attention, since water is a potential vector for the transmission of infectious diseases.

Within the context of the MED POL programme, monitoring of the microbiological quality of bathing water along the entire Tunisian coast is carried out by the laboratories of the Department of Hygiene and Environmental Protection and the Pasteur Institute in Tunis.

'Good' bathing water has decreased by around 17 %, while water 'to be monitored' has increased by around 13 %.

Based on the results provided by the institutions involved in the programme for ongoing monitoring of the quality of the marine environment, and also byANPE's mobile laboratories, the following points are observed.

- A very marked improvement for all stations (reference stations and 'hot spot' stations) was recorded for 2010, not only for total nitrogen but also for total phosphorus.
- For Chl *a*, the results are of the same order of magnitude from 2007 onwards. Indeed, the Chl *a* concentration is below 5 mg/m^3 for all stations.
- Total hydrocarbons in sediments stand at the same values as for preceding years.
- All concentrations for two trace metals (Cd and Pb) in sediments are below the lower levels set by the draft order. Concentrations for 2009 and 2010 are of practically the same order of magnitude, except for the Menzel Jmil station, which exceeded the maximum threshold.
- Trace metals in living matter (biota) were not analysed, owing to a lack of samples.
- In the case of continental water, the main conclusions are as follows.
  - In Wadi Medjerda, an improvement in results was observed concerning their compliance with the NQE project (2009) on surface water quality, particularly in relation to dissolved oxygen parameters (quality objective:

Table A6.6 Overall grading of bathing water over the last 6 years

Year	Very good	Good	Fairly good	To be monitored	Poor	Very poor
2006	40 %	16 %	6 %	24 %	7 %	7 %
			62 %	24 %		14 %
2007	44 %	13 %	7 %	26 %	6 %	4 %
			64 %	26 %		10 %
2008	50 %	11 %	6 %	23 %	7 %	3 %
			67 %	23 %		10 %
2009	47 %	11 %	4 %	24 %	11 %	3 %
			62 %	24 %		14 %
2010	48 %	10 %	3 %	27 %	8 %	4 %
			61 %	27 %		12 %
2011	68 %	18 %	1 %	10 %	1 %	2 %
			87 %	10 %		3 %
2012	57 %	11 %	2 %	23 %	4 %	3 %
			70 %	23 %		7 %

6 mg O_2/l) and COD (quality objective: 30 mg O_2/l). COD was exceeded for the point before and after the Béja STEP.

- Given its importance as main, permanent watercourse, the Medjerda is the subject of a modelling project aimed at linking the pollution sources of the drainage basin to the latter's overall status, by involving the cumulative impacts of various pollution sources. This project was launched during the second half of 2012.
- Certain monitoring points for Wadi Méliane and Wadi El Bey are characterised by a high COD, which confirms a poor result which was probably due to intensified human activity.
- For lagoons and *sebkhas*, nutrients and COD represent the major problems for these expanses of water.

- In the case of bathing water, there has been one main, highly remarkable change: 70 % of monitoring points are classified as 'very good' to 'fairly good' (2012), compared to 61 % for 2010. However, the situation must continue to be monitored.

Depollution funds

Remedial measures represent a fundamental component of state policy in terms of combating pollution in all its forms, particularly industrial pollution, given the negative, direct impact of such pollution on natural resources, quality of life and the health of various ecosystem components.

With a view to achieving a balance between environmental protection imperatives and those driving development forward, ANPE set up the Depollution Fund (FODEP) in 1992. This is an important financial mechanism designed to help industry achieve hydric and atmospheric pollution-reduction goals.

The fund also grants support to undertakings specialising in the collection and recycling of waste, as well as to industrial projects that aim to use clean technologies.

FODEP was involved, until late 2013, in the financing of 510 projects related to depollution, and the collection and recycling of waste, and also of projects based on clean technologies, which benefited from a global subsidy of the order of TND 33 230 million (i.e. 20 % of investment).

All fund interventions are distributed, according to sector and up to 30 June 2013, as shown in Table A6.7.

Table A6.7 Sectoral distribution of FODEP-grant–receiving projects, up to June 2013 (million TND)

Sector	Number of undertakings	Grant
Textiles and tanneries	47	1 242
Agri-foodstuff industries	112	4 747
Mechanical and electrical industries	34	696
Construction materials	66	4 876
Collection and recycling of waste	183	18 229
Chemical industries	62	3 332
Miscellaneous industries	06	108
Total	510	33 230

FODEP's future

With a view to breathing new life into FODEP's activities and broadening its field of intervention, not only qualitatively but also quantitatively, Decree No 2636 of 24 September 2005 amended and supplemented Decree No 2120 concerning the conditions and formalities for fund intervention. Its field of intervention was broadened to include projects in the services sector and the agricultural sector, in addition to industrial units, thereby allowing a greater number of undertakings to benefit from the advantages offered by the fund.

As part of the overall programme to update industrial undertakings, the fund will also, after expansion of its remit for intervention, work to encourage those in industry to utilise clean technologies and to adopt measures that guarantee a saving in raw materials and energy. This action will take place as part of a global vision for sustainable development, taking account of development requirements and also of the need to conserve our natural resources and to rationalise raw-material and energy consumption.

In parallel with FODEP's activities, a new credit line was set up by the French Development Agency, amounting to EUR 40 million, intended to finance depollution and energy-management projects.

This credit line is characterised by:

- involvement in the financing of environmental investment, to the extent of 85 %;
- an interest rate of approximately 4.5 %, including bank commissions;
- repayment of the loan over a period of as many as 12 years, with a 3-year grace period;
- a maximum loan amount of around EUR 5 million (approximately TND 9 million).

Two loans were granted within this context, funding two projects aimed at recycling amurca and managing controlled landfill: these amounted to around TND 8.5 million overall.

Priority environmental issues identified by the National Diagnostic Review (BDN)

The BDN proposed the initial classification of environmental issues by order of priority, taking account, for each of Tunisia's administrative regions, of the respective importance of each environmental issue in terms of food security, public health, marine and coastal resources, the health of the ecosystem and socio-economic advantages.

Contaminants and sources

For all coastal administrative regions, the following issues relating to pollutants were proposed for priority examination in the APs.

Physical changes and habitat destruction

The following issues relating to physical changes and to habitat destruction need to be examined as a matter of priority under action plans for all coastal administrative regions.

The BDN proposed an initial classification of environmental issues by order of priority, taking account, for each administrative region along the coast of Tunisia, of the respective importance of

Table A6.8 Pollutants: priority areas for further examination

Pollutants	Sources	Priority actions to be taken
Wastewater	Purification stations and industries	Precise survey of all sources and application of the 'polluter pays' principle
Rainwater	Water courses	Preparation of plans for managing rainwater in the drainage basins of watercourses flowing into the Mediterranean
Urban solid waste	Urban environment in general	Continuing to implement PRONAGDES More rigorous monitoring of industrial solid waste
Persistent organic pollutants (POPs) (12 priority OPs and others)	Industrial environment	Precise POP recording and inventory
Heavy metals and organometallic compounds	Industrial environment	Precise recording and inventory
Organohalogen compounds	Industrial environment	Precise recording and inventory
Radioactive substances	Industrial environment and services	Precise recording and inventory
Nutrients and suspended solids	Industrial environment	Precise recording and inventory
Hazardous waste (spent chemicals, lubricating oils, batteries)	Industrial environment and services	Precise recording and inventory Disposal of hazardous waste

Table A6.9 Physical changes, habitat destruction nas priority actions

Physical change	Zone/region	Priority actions
Shoreline management/ transformation	Entire coastline threatened by erosion	Implementation of the recommendations of studies relating to sensitive zones
Mineral and sediment extraction/ processing	Entire coastline threatened by erosion	Implementation of the recommendations of studies relating to sensitive zones Ongoing monitoring
Changes to wet areas and salt marsh	Entire coastline	Studies of all zones and, in particular, sebkhas
Changes in marine water and drainage basins along the coastline	Entire coastline	Monitoring and database
Biological changes (invasion by allogenic species)	Gabès Bay (Gabès and Sfax shoreline, and islands of Djerba and Kerkennah)	Monitoring and database

each environmental issue in terms of food security, public health, marine and coastal resources, the health of the ecosystem and socio-economic advantages.

The BDN suggested that consideration be given to protection requirements for sensitive zones and habitats and, more particularly, for zones to be classified as 'marine parks', such as Galitte, Zembra and Zembretta Islands, Kuriate, the Kerkennah archipelago, the coastal fringes of Cap Negro and Cap Serrat, and parts of Djerba put forward as areas designated for special protection.

The BDN highlighted the significant Tunisian efforts to combat land-based pollution, notably in the following fields:

- management of wastewater (from households, tourism and industry);
- management of solid waste (domestic waste, in particular);
- management of the shoreline by means of the preparation of management schemes for sensitive zones and ongoing monitoring of coastal occupation;
- measures to combat industrial pollution and its ongoing monitoring by a specialist body of environmental inspectors and by means of the application of legislation that penalises contraventions;
- depollution programmes for Tunis Lake, Sfax and Gabès;
- monitoring of marine pollution and measures to combat pollution by hydrocarbons;

Table A6.10 List of environmental issues by administrative region

Administrative region	Environmental issues in order of priority	Environmental issue's importance for food security	Environmental issue's importance for public health	Environmental issue's importance for marine and coastal resources	Environmental issue's importance for ecosystem health	Environmental issue's importance for socio-economic advantages
Gabès Governorate (Gabès shoreline)	Emissions into the marine environment	Very important	Important	Very important	Very important	Important
	Gaseous emanations	Important	Very important	Important	Important	Important
	Solid waste	Important	Important	Very important	Very important	Important
Sfax Governorate (Sfax shoreline)	Emissions into the marine environment	Important	Very important	Very important	Very important	Important
	Gaseous emanations	Important	Very important	Important	Important	Important
	Solid waste	Important	Very important	Very important	Very important	Important
Bizerte Governorate (Bizerte Lagoon)	Emissions into the marine environment	Very important	Very important	Very important	Very important	Very important

- measures to combat non-regulatory forms of fishing;
- adoption of an 'urban planning code' awarding special status to the coast and to its protection;
- preparation of the national study on biodiversity;
- the set-up of the Tunisian Observatory for the Environment and Sustainable Development (OTEDD), administered by ANPE;
- development of awareness-promoting and environmental-education programmes.

The BDN has stressed the need for additional efforts to combat pollution caused by activities on land and, more particularly, as concerns the following.

- Improving the situation of Gabès Bay, which remains a matter of concern with, in particular, waste from the phosphate (phosphogypsum) industry. Studies carried out in the bay and observations made on biodiversity in Gabès Bay have revealed signs that indicate a serious environmental deterioration, particularly that of *Posidonia* seagrass beds and the disappearance of species.
- Rehabilitating the shoreline at Sfax, where industrial and urban pollution have led to the ecological destabilisation of the marine environment to the benefit of pollution-resistant species.
- Improving the situation of Bizerte Lagoon, which continues to be a cause for concern, with pollution from the various industries around the lagoon.
- Preserving coastal lagoons, which are also threatened by pollution and eutrophication phenomena (as is the case for Ghar El Melh Lagoon).
- Documenting POPs (the 12 priority POPs, in particular), heavy metals and organometallic compounds, organohalogen compounds and radioactive substances, and developing a database on such contaminants.

Specific issue: depollution of Bizerte Lake

Within the context of the H2020 initiative, in 2010 the Ministry of the Environment launched a study, titled *Integrated depollution of Bizerte Lake*. The general objective of this study is to restore water quality and that of ecosystems in Bizerte Lake, with a view to promoting sustainable socio-economic development and improving quality of life for citizens.

Bizerte Lake is a coastal lagoon with a connecting channel to the Mediterranean (created artificially in 1881) and to Lake Ichkeul via Wadi Tinja. This drainage basin is a centre for socio-economic development. Indeed, this zone is characterised by very varied and highly dynamic industrial, agricultural, port and commercial activities. As a

result, Bizerte Lake is subject to pollution from a range of sources:

- waterborne waste from urban areas
- diverse industrial waste from industrial areas
- diverse solid waste from urban areas, rural areas and industrial activities
- waste from agricultural activities in the drainage basin.

The effects and consequences of pollution due to any waste in the lake, whether of domestic, urban, industrial or agricultural origin, are the following:

- a reduction in surface area and distribution volumes of flora and fauna through the formation of 'dead' enclaves of rubbish and silting up of the lake bed;
- a reduction in primary production (fishing and the rearing of shellfish) through the effect of suspended matter originating from detergents, toxic elements and pesticides;
- a direct threat in terms of the consumption of the produce, owing to their feeding method (shellfish and fish);
- silting up of the link between sea and lake, which slows down intervals between the ebb and flow of the tide and the renewal of lake water.

Despite efforts of the state, public institutions and private economic operators, human activities in these drainage basins (agricultural, industrial and urban pollution) contribute to the acute degradation of their environment, and severely affect Bizerte Lake's water and ecosystems and the coastal fringe along the Mediterranean. Furthermore, some of these activities are sources of real, ongoing contamination for local populations.

With a view to remedying the human impact of the past and safeguarding the environment against future impact, the Ministry of the Environment has conducted a very detailed study into depollution and rehabilitation of the Bizerte Lake drainage basin (2004–06). This study advocates a whole range of integrated actions linked by the same common objective of depolluting the drainage basin (DB) of Bizerte Lake and improving the quality of the lake's water and the condition of its ecosystems.

In order to achieve this objective, it is of paramount importance that all potential sources of pollution be monitored with a view to their removal or reduction, to a level deemed to be acceptable under existing standards. To omit or to underestimate even one pollution source could radically change the costs/benefits ratio of the project and compromise its efficacy.

The project that arose from the 2004 study comprises four different interventions, each with its own sponsor. Table A6.11 summarises the interventions under this project.

Table A6.11 Summary of proposed interventions

Intervention	Sponsor	Brief description	Indicative cost (TND)
Rehabilitation and recalibration of sanitation networks and extension of collective sanitation systems (STEP)	ONAS	1. Update of networks in the urban environment 2. Development of the network in the rural environment (new) 3. Extension and update of 3 STEPs (Bizerte, M. Bourghiba, Mateur)	74 000 000
Sustainable management of waste in rural environments	anged	1. The set-up of transfer centres in the rural environment 2. Closure and rehabilitation of uncontrolled landfill sites 3. The set-up of a waste disposal facility	7 500 000
Improvement and monitoring of the condition of lake ecosystems	MEDD-DGEQV/APAL	1. Management of the lake shore at Menzel Abderrahman 2. Management of the Menzel Jemil shellfish-breeding zone 3. Plan for environmental monitoring of Bizerte Lake 4. Environment awareness-raising programme for managing fertilisers and agricultural/forestry treatment products	16 000 000
Environmental upgrade of the El Fouladh plant	El Fouladh	1. Management of a solid-waste tip at El Fouladh plant (confining and storing industrial waste) 2. Depollution of the El Fouladh plant (treatment of process water, management of sanitation water, treatment of atmospheric emissions)	16 000 000

Acronyms

μmol/L	micromoles/litre
μgram/g	10^{-6} grams/gram
ANC	National Constituent Assembly
ANGED	National Waste Management Agency
ANPE	National Environmental Protection Agency
APAL	Shoreline Development Protection Agency
BDN	National Diagnostic Review
COD	Chemical oxygen demand
DB	Drainage basin
DHMPE	Department of Hygiene and Environmental Protection
ECOLEF	ecological packaging
GDP	Gross domestic product
GIC/GDA	Agricultural Development Grouping
INS	National Statistics Institute
INSTM	National Institute for Marine Sciences and Technologies
ME	Ministry of the Environment
MED POL	Programme for the Assessment and Control of Marine Pollution in the Mediterranean
NAP	National Action Plan
NCA	National Constituent Assembly
ONAS	National Sanitation Office
OTEDD	Tunisian Observatory for the Environment and Sustainable Development
PAH	Polycyclic aromatic hydrocarbon
PAN	National Action Plan

PCGD	Communal Waste Management Programme
PIB	Gross domestic product
PNE	National Water Policy
POP	Persistent organic pollutant
PRONAGDES	National Solid Waste Management Programme
PRONGIDD	National Integrated Hazardous Waste Management Programme
SAP	Strategic Action Programme
SECADENOR	Northern Canals and Water Supply Company
SONEDE	Tunisian Water Exploitation and Distribution Company

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