

# Horizon 2020 Mediterranean report

Annex 4: Morocco

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# Introduction

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Several business sectors in the area under study have undergone significant development over the past few decades, most notably the industrial, tourism and construction sectors. This development has been accompanied by a number of major infrastructure projects in the area's ports and industrial zones, and also on its road and railway networks.

However, this development has also had an environmental impact on the area. Pressures have been placed on the area's resources and natural environment owing to improper waste management practices: this has resulted in liquids (generated by both houses and industrial facilities) being emitted into the water cycle, without having been pretreated. These improper practices are one of the main reasons for the worsening state of the area's natural heritage and the increasingly poorer health and hygiene conditions suffered by its inhabitants.

This report, which forms Morocco's contribution to the Horizon 2020 initiative, aims to analyse the country's current environmental situation and future prospects for the three priority areas covered by the initiative. It will provide an understanding of the

state of the environment and how it is changing in the area under study, and present a clear idea of the origin of the pressures generated. It will also highlight progress that has already been made, and describe the political initiatives taken in each of the areas concerned. The analysis contained in this report is based on available data collated in the context of this project or of other projects carried out at regional or national scale.

This paper is based on the analysis of a set of indicators identified as part of the Shared Environmental Information System (SEIS) project. They describe, as far as possible, the impact that socio-economic activities have on resources and the natural environment. They are based on the Driving forces, Pressures, State, Impacts and Responses (DPSIR) framework, which makes it possible to analyse the cause-effect relationships that exist between the various factors that impact the environment.

This document is the culmination of a group effort: every member of the steering committee of the national SEIS project has contributed, in close collaboration with representatives of the various local parties involved.

# Overview of the area under study

The area under study in this assessment covers regions located in the Mediterranean river basin as follow:

- The basin of the Moulouya River, covering 8 % of the entire country (74 000 km<sup>2</sup>) and spanning 4 economic regions <sup>(1)</sup> and 9 provinces and prefectures <sup>(2)</sup>. In the 2004 General Population and Housing Census (GPHC), the basin's population stood at around 2.5 million, with 54 % living in towns and cities. The Moulouya rises in the High Atlas and Middle Atlas ranges and the High Plateaus. Its course stretches over more than 600 km, with highly fluctuating water levels.
- The Tangier and Mediterranean coastal basins, which have a total, combined surface area of 9 000 km<sup>2</sup> and together cover 6 prefectures and provinces <sup>(3)</sup>. This area is drained by many rivers and streams that form very narrow valleys at their mouths. These valleys have created a highly undulating relief, with a series of hills lying to the west, and high mountains lying to the east. In the 2004 census, the area's population stood at 2.2 million people, with 1.5 million (54 %) living in towns and cities, and 1.3 million (46 %) in rural areas.

This territory has a wide variety of landscapes, including a coastal zone (512 km long and with 39 beaches), plains (Moulouya), arid plateaus (Guercif) and mountainous regions (Rif and Middle Atlas). It has an abundance of natural resources and

contains 41 sites of biological and ecological interest (SBEIs), as well as several national parks, most notably those at Talassemtane and Al Hoceima.

The prefectures and provinces shown in Table A4.1 are either wholly or partially covered by this assessment.

The combined total population of these prefectures and provinces increased from **4.16 million in 2004 to almost 4.53 million in 2011**. This population accounts for 16 % of the national gross domestic product (GDP).

The 41 towns and cities that fall entirely within the area under study had a population of around 10 000 in 2004 (the lower limit set for the project — see Annex A4.1), their combined total population increased from **2.22 million in 2004 to around 2.62 million in 2011**. They account for 58 % of the area's population.

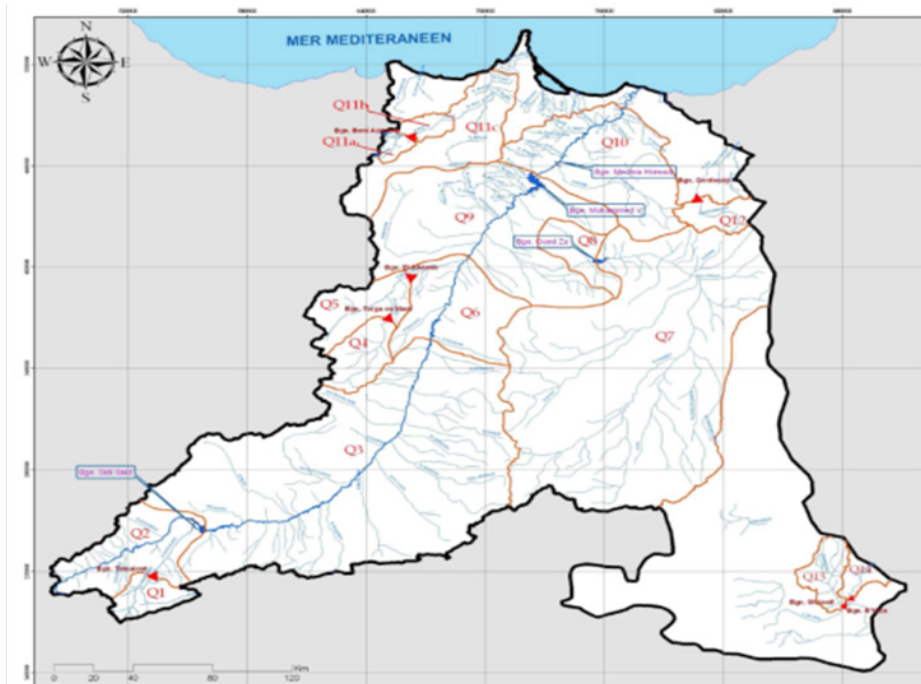
The assessment of the municipal waste and wastewater priority areas, as defined under the H2020 initiative, will be based on data and information gathered for the towns and cities located in the prefectures and provinces listed below. The assessment of the industrial emissions priority area will be based on data obtained from the network for monitoring the levels of telluric pollution conveyed to the Mediterranean Sea, which were collected as part of the Programme for the Assessment and Control of Marine Pollution in the Mediterranean (MED POL) programme.

<sup>(1)</sup> Four in their entirety (Tangier, Fahs Anjra, Tetouan and M'diq-Fnideq) and two partially (Chefchaouen (65 %) and Al Hoceima (90 %)).

<sup>(2)</sup> Five in their entirety (Oujda, Berkane, Nador, Jerada and Taourirt) and four partially (Figuig, Taza, Boulemane and Guercif).

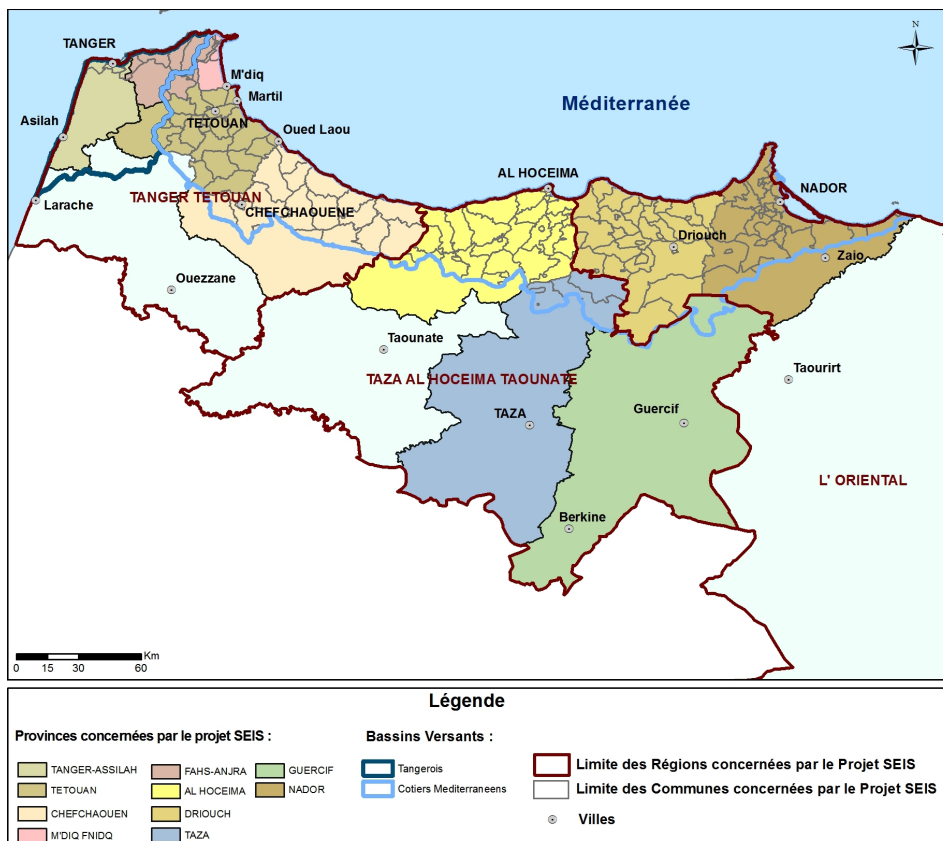
<sup>(3)</sup> Four in their entirety (Tangier, Fahs Anjra, Tetouan and M'diq-Fnideq) and two partially (Chefchaouen (65 %) and Al Hoceima (90 %)).

Map A4.1 The Moulouya Basin



Source: ONEM.

Map A4.2 The Mediterranean basin



Source: ONEM.

**Table A4.1 Population of the area under study**

Provinces and prefectures	Percentage (*)	Total population		Population covered by the SEIS project	
		2004 GPHC	2011	2004	2011
<b>Moulouya Basin</b>					
1. Oujda	100	476 021	508 026	406 695	462 281
2. Taourirt	100	206 009	219 225	118 373	146 933
3. Nador	100	505 022	518 822	277 464	306 284
4. Berkane	100	270 012	277 185	114 508	125 823
5. Jerada	74.2	78 636	77 586	57 306	59 780
6. Driouch	100	223 010	241 817	47 192	53 355
7. Boulemane	85.1	157 352	169 206	32 473	37 648
8. Taza	24.7	137 964	143 105	3 983	4 432
9. Midelt	61.9	159 203	170 167	44 429	50 152
10. Guercif	100	184 602	199 196	64 657	82 559
<b>Tangier and Mediterranean coastal basins</b>					
11. Chefchaouen	79.6	336 546	376 781	35 797	43 760
12. Tangier-Assilah	55	442 308	520 713	439 308	516 606
13. Fahs Anjra	98.5	66 015	104 421	10 354	16 382
14. Tetouan	97.8	464 440	504 354	325 035	411 179
15. M'diq-Fnideq	100	140 006	174 735	133 073	171 865
16. Al Hoceima	79.1	312 819	329 346	110 992	126 608
<b>Total</b>		<b>4 159 965</b>	<b>4 534 685</b>	<b>2 221 639</b>	<b>2 615 647</b>

**Note:** (\*) Percentage of the population living in the area under study.

**Source:** ONEM.

# Priority areas

## Municipal waste

### *Issues surrounding waste*

Morocco's urban population increased by 10 % between 2003 and 2011. This led to an increase in the demand for basic services, including the collection, treatment and disposal of household and solid waste.

The management of household and solid waste has certainly improved markedly over the past decade. However, there are a number of areas that have room for improvement, especially as regards financial resources and waste management qualifications at local-government level, availability of the necessary infrastructure, and access to the land needed to set up sanitary landfills.

To make matters worse, some of the waste generated is disposed of in uncontrolled landfill sites or in the vicinity of water channels, without having been pretreated.

As a result, household and solid waste is still a real problem area with significant ramifications for public health, natural resources and socio-economic activities in general.

### *State and impacts*

Household waste in Morocco is predominantly organic (50 % to 70 %) and is characterised by high humidity (65 % to 70 %) and density levels, and a low calorific value (< 1 000 kcal/kg). It occasionally consists of paper/cardboard (8 % to 10 %), plastic (6 % to 10 %), glass (1 % to 3 %) and metals (1 % to 4 %). This has the effect of accelerating its rate of fermentation, and means that it cannot be stored for sustained periods of time at production sites

without being appropriately packaged (Department for the Environment, 2004).

Between 2007 and 2010, the amount of household and solid waste produced across the entire country went up by 5.9 %, an increase of 6.3 million t/year, to 6.67 million t/year. During the same period, the collection rate of this waste shot up from 44 % to 72 %.

The average rate of production stands at 0.76 kg/res./day (0.3 kg/res./day in rural areas, and 1.2 kg/res./day in urban and suburban areas), while the average waste collection rate is estimated to be around 80 % in urban areas.

Based on the available data, the amount of household waste that was produced in 2010 in the area under study is estimated at approximately **969 000 t per year** <sup>(4)</sup>, which accounts for roughly 14.5 % of national waste production. The average rate of production stands at 0.75 kg/res./day, with figures ranging from 0.44 kg/res./day to 1.38 kg/res./day. This variation can be explained by urbanisation rates, the pressures linked to tourist-based activities, and the ways in which waste is managed in the provinces. The collection rate ranges from 80 % to 90 %, and depends on the system put in place by local authorities to provide this service to citizens.

In addition, waste production has continued to rise over the past 10 years. The graph below, which illustrates the changes recorded in several provinces in the area, clearly shows the increase in waste production since 2008, with a growth rate ranging between 1.5 % and 30 %. This increase can be explained by the escalating rates of urbanisation (currently around 6 % in coastal towns), and also by the pressures generated by tourism during the summer holidays.

(<sup>4</sup>) Data collected from partner organisations (report on the state of the local environment or SEIS project) or calculated with respect to the national rate. The total amount of waste produced corresponds to the total population of the provinces in the area under study.



**Table A4.2 Production of household and solid waste**

Provinces and prefectures	Population	Amount of waste produced (2010), in tonnes per year	Average rate of production (kg/res./day)
<b>Moulouya Basin</b>			
Oujda	454 039	118 881	0.72
Taurirt	142 757	27 457	0.53
Nador	301 995	101 048	0.92
Berkane	277 185	67 063	0.66
Jerada	59 387	12 888	0.59
Driouch	52 448	10 332	0.54
Boulemane	36 851	10 222	0.76
Taza	4 365	1 211	0.76
Midelt	258 557	67 077	0.67
Guercif	199 196	32 000	0.44
<b>Tangier and Mediterranean coastal basins</b>			
Chefchaouen	42 593	8 312.8	0.53
Tangier-Assilah	505 228	254 850	1.38
Fahs Anjra	15 518	4 305	0.76
Tetouan	399 490	167 929	1.15
M'diq-Fnideq	166 798	51 650	0.85
Al Hoceima	124 294	34 479	0.76
<b>Total</b>		<b>969 705</b>	<b>0.75</b>

**Note:** Estimation based on the national rate of production.

**Source:** ONEM, Data collected from partner organisations, Regional Report on the State of the Environment (Oriental Region).

Household waste poses a threat to public health and to the long-term sustainability of the environment. This threat tends to increase significantly when such waste is stored in uncontrolled landfills which contaminate the soil and water resources, pollute the atmosphere and scar the surrounding natural landscape.

Figure A4.1 shows the amount of waste produced by certain provinces and urban areas over the years, based on data collected from partner organisations in the context of the SEIS project.

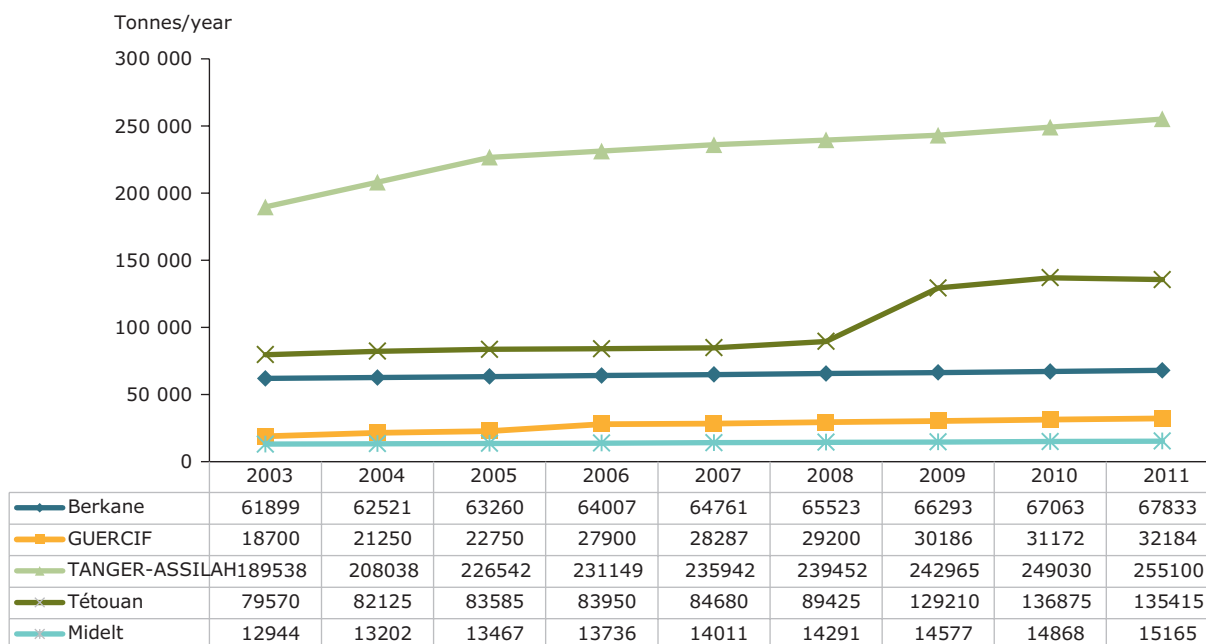
Unlike the cities of Tetouan and Tangier, the other major conurbations (Oujda, Berkane, Nador and Al Hoceima) each have sanitary landfills that together are able to receive around 292 700 t of waste per year, which accounts for 36 % of the waste produced in the area under study, and corresponds to 40 % of its population. The waste produced by other medium-sized towns (such as Chefchaouen, Taza and Midelt) and municipalities are sent to uncontrolled landfills or stored in unsightly rubbish tips lying close to these urban areas.

### *Pressures and driving forces*

Socio-economic activities, population growth, urbanisation and changes in consumer habits are the main driving forces behind pressures placed on the environment by increased waste generation.

The population of the area under study increased from 2.22 million to 2.62 million between 2004 and 2011. In addition, this area is regarded as one of the most urbanised regions in Morocco: its urbanisation rate ranges from 58 % (in the Tangier-Tetouan region) to 62 % (in the Oriental region), exceeding the overall national rate (estimated at 55.1 %).

The tourism sector, which forms one of the key sectors for driving the country's economic development, has expanded rapidly in the area under study, and in so doing, has contributed to the increased amounts of waste produced. Over the past decade, the number of tourism establishments in the Tangier-Tetouan region has almost doubled, increasing from 73 in 2000 to 122 in 2009 (up by

**Figure A4.1 Amount of waste produced from 2003 to 2011**

**Note:** Tonnes/an = Tonnes/year; Tanger = Tangier; Tétouan = Tetouan.

**Source:** ONEM, Data collected from partner organisations, Regional Report on the State of the Environment (Oriental Region).

**Table A4.3 Sanitary landfills in the area under study**

Cities with a sanitary landfill	Municipalities served by the sanitary landfill	Number of residents served	Capacity (tonnes/year)
Oujda	Bni Drar	360 000	100 000
Berkane	Sidi Slimane Echcharraa, Aklim and Zegzel	227 000	63 000
Al Hoceima	Ait Youssef Ouali, Ajdir and Bni Bouayach	112 000	31 000
Nador	Segangan, Zaio, Bni Ansar, Al Aaroui, Selouane and Ras El Ma	354 000	98 700
Total number of sanitary landfills: 4		1 053 000	292 700
Total number of towns/cities and municipalities served: 18/41		(40 %)	(36 %)

**Source:** ONEM, Data collected from partner organisations, Regional Report on the State of the Environment (Oriental Region).

65.57 %). Around 6.83 % of all the hotels in Morocco are located in this region.

Figure A4.2 shows the number of overnight stays that were recorded in the Tangier-Tetouan region between 2004 and 2011.

Waste is also a source of greenhouse gas emissions, which are responsible for global warming. In Morocco, these emissions rose from 2 419 gigagrams (Gg) CO<sub>2</sub> (equivalent in 1994) to

3 739.97 Gg CO<sub>2</sub> (equivalent in 2004), representing an increase of over 56 %.

### Responses and outlooks

The waste collection rate has improved over the past few years as a result of local authorities increasingly favouring the privatisation of the waste management sector, which has delegated waste collection services to private operators. As part of this new approach, the National Household and

**Figure A4.2 Number of overnight stays in the Tangier-Tetouan region, 2004–2011**



Source: HCP, 2014.

Solid Waste Management Programme (NHSWMP) launched in 2007 provides financial and technical support to local authorities seeking to improve the ways in which they collect, process and dispose of their waste.

By 2020, this programme aims to:

- provide for the collection and treatment of household waste in urban areas, and achieve a

collection rate of 90 % (this rate currently stands at 75 %);

- establish, for every urban area (100 %), sanitary landfills for receiving household and solid waste;
- restore all existing landfills after they have been closed (100 %);
- privatise waste management in urban areas where this management could generate a profit for private operators, but at the same time keep costs down to accommodate local authorities;
- develop the 'waste sorting/recycling/recovery' sector by implementing pilot sorting initiatives, in order to achieve a recycling rate of 20 %;
- raise public awareness about issues surrounding waste.

Under this programme, sanitary landfills will serve every town, city and urban area, uncontrolled landfills will be restored, and local authorities will benefit from improvements in their waste collection, treatment and disposal services.

The programme has seen a significant rise in the number of studies and interventions aiming to better control and rationalise the management of solid waste in the area under study. Many projects have been carried out, and others are either under way or in the pipeline (for instance, the drawing up of

**Table A4.4 Actions in progress or scheduled to take place under the NHSWMP**

Restoration of uncontrolled landfills		Establishment of sanitary landfills	
Completed or in progress	Scheduled by 2020	Completed or in progress	Scheduled by 2020
Nador	M'diq	Oujda	Tangier
Tetouan	Fnideq	Berkane	Taza
Al Hoceima	Oued Laou	Nador	Fnideq
Berkane	Aklim	Al Hoceima	Oued Laou
Tangier	Boulemane		Jerada
Tetouan	Taza		Guercif
Targuist	Bni Drar		Taurirt
	Bni Bouayach		Boulemane
	Imzouren		Chefchaouen
	Driouch		Tetouan
	Tafoughalet		Driouch
	Midelt		
	Guercif		
	Ras El Ma		

Source: ONEM, 2014.

prefectural/provincial master plans for managing household waste). Similarly, several towns and cities have opted to delegate waste management in order to improve the service provided.

Table A4.4 shows the sanitary landfills that have already been established, and the existing uncontrolled landfills that have already been restored, as well as any similar operations that are currently under way or scheduled to take place.

It highlights the following points.

- The area under study has 4 of the sanitary landfills of the 14 established in Morocco to date, which are financed by the government and the relevant local authorities. The operation of these landfills has been contracted out to private operators (Oujda: CSD/CRB; Berkane: VEOLIA; Al Hoceima: SEGEDEMA; Nador: AVERDA).
- Nine more landfills will be operational by 2020.
- Three uncontrolled landfills have been restored and a further four are currently being restored.
- The restoration of the remaining 16 uncontrolled landfills is scheduled to take place by 2020.

In addition, the legal framework governing the waste sector has been strengthened over the past few years, thanks to the adoption of several laws and regulations.

- Law No 28-00 on the management and disposal of waste seeks to curb the harmful nature of waste and reduce the amount of waste produced, and also to organise the collection, transportation, storage, treatment and disposal of waste, as well as waste recovery, in an environmentally sustainable way. A series of regulations have been adopted in order to implement this law.
- Law No 22-10 on the use of degradable or biodegradable plastic bags prohibits the production, for the local market, of bags made of non-degradable or non-biodegradable plastic, and also bans such bags from being imported, sold or stored for the purposes of being sold, or given away for free.

Furthermore, under the provisions of Law No 28-00, several prefectural and provincial master plans for managing household and solid waste have been drawn up, and others are currently being devised.

These master plans set out:

- the objectives to be reached concerning the collection and disposal rates of household and solid waste;
- the sites appropriate for constructing facilities to dispose of and store this waste, taking into account the guidelines for town-planning;
- an inventory with a 5-year and a 10-year forecast of the amounts of waste to be collected and disposed of as a function of their origin, nature and type;
- an investment programme covering the same periods, giving a calculation of the costs involved in establishing sanitary landfills and building plants for treating, recovering, storing or disposing of this waste, and also in restoring uncontrolled landfills;
- the financial and human resources needed, and the actions to be taken in order to raise awareness and provide information and advice.

As regards waste management at Morocco's coastal resorts during the holiday season, in 1999 the Mohamed VI Environmental Protection Foundation launched the 'Clean Beaches' programme in a bid to bring the country's beaches up to the requisite environmental standards – and keep them that way. The programme aims to make beaches cleaner and more hygienic, and focuses on raising awareness of the various stakeholders involved, and either putting in place or improving basic infrastructure.

The programme proved hugely successful at the beaches that were initially selected, with visitor numbers soaring and pioneering partnerships struck up between the local authorities involved and socially responsible companies. This prompted the foundation to launch the even more ambitious and proactive 'Blue Flag' programme in 2002. Backed by the Foundation for Environmental Education (FEE), this programme's objective is to see Morocco's beaches officially classified as complying with the highest international environmental standards.

The beaches on Morocco's Mediterranean coastline were inspected between May 2010 and February 2011, with 33 out of 35 being classified as 'clean beaches', three of which (the municipal beach at Saidia, and the beaches at M'diq and Fnideq) were awarded the 'Blue Flag' eco-label.

## Wastewater and sanitation

### *Issues surrounding wastewater*

Since the 1960s, one of Morocco's key priorities has been the construction of hydraulic facilities to facilitate socio-economic activities and provide safe drinking-water for the entire population. However, this development of the country's water infrastructure has not been accompanied by any serious efforts to bring its liquid sanitation and wastewater treatment infrastructure up to scratch.

Until 2005, Morocco's liquid sanitation infrastructure was considerably underdeveloped: issues surrounding wastewater management were not prioritised; what sanitation infrastructure did exist covered only a small proportion of the country; and wastewater treatment rates were low.

At national level, and more particularly in the Mediterranean region forming the subject of this assessment, the deficiencies in liquid sanitation infrastructure resulted in a steady decline in the quality of both water resources and the natural environment, which in turn posed a threat not only to the health of the population but also to the socio-economic development of the region.

In a bid to resolve this situation, the public authorities introduced a framework policy for the sector by setting up the National Liquid Sanitation and Waste Water Treatment Programme (NLSWWTP), which seeks to increase the number of properties connected to sanitation systems and reduce the amount of pollutants discharged into receiving environments.

### *State and impacts*

In both Morocco as a whole and in the area under study, the vast majority of urban areas (around 80 %, accounting for 97 % of the urban population) are served by public sanitation systems, with the remaining 20 % or so being served by independent or private sanitation systems. The most common types of sanitation systems in urban areas are combined systems.

According to the available information, the volume of wastewater collected in the area under study has almost doubled over the past decade, increasing from around 45 million m<sup>3</sup> in 2003, for a population of 2.22 million (i.e. 52.85 % of the people living in the area under study), to approximately 79 million m<sup>3</sup> in 2011, for a population of

2.62 million (57.83 % of the people living in the area under study). This volume of wastewater was recorded for towns and cities having a public sanitation system, and a population of around 10 000 in 2003.

However, over the same period, there was a significant disparity between different towns and cities in terms of properties being connected to sanitation systems. This disparity was attributed to several factors: the distance that some towns lie from major conurbations; the fact that drinking water and electricity was not accessible to all; and the sheer isolation of some urban areas and other geographical features, which complicated the expansion of the sanitation infrastructure to cover them. However, broadly speaking, the past few years have seen a marked rise in the number of connected properties in every town and city: between 15 % and 75 % of properties were connected in 2003 (depending on the town or city in question), compared to between 60 % and 97 % in 2011.

The last few years have also witnessed a general rise in terms of access to sanitation, with a number of national programmes being implemented including a wastewater sanitation and treatment programme and programmes for making drinking water and electricity accessible to all.

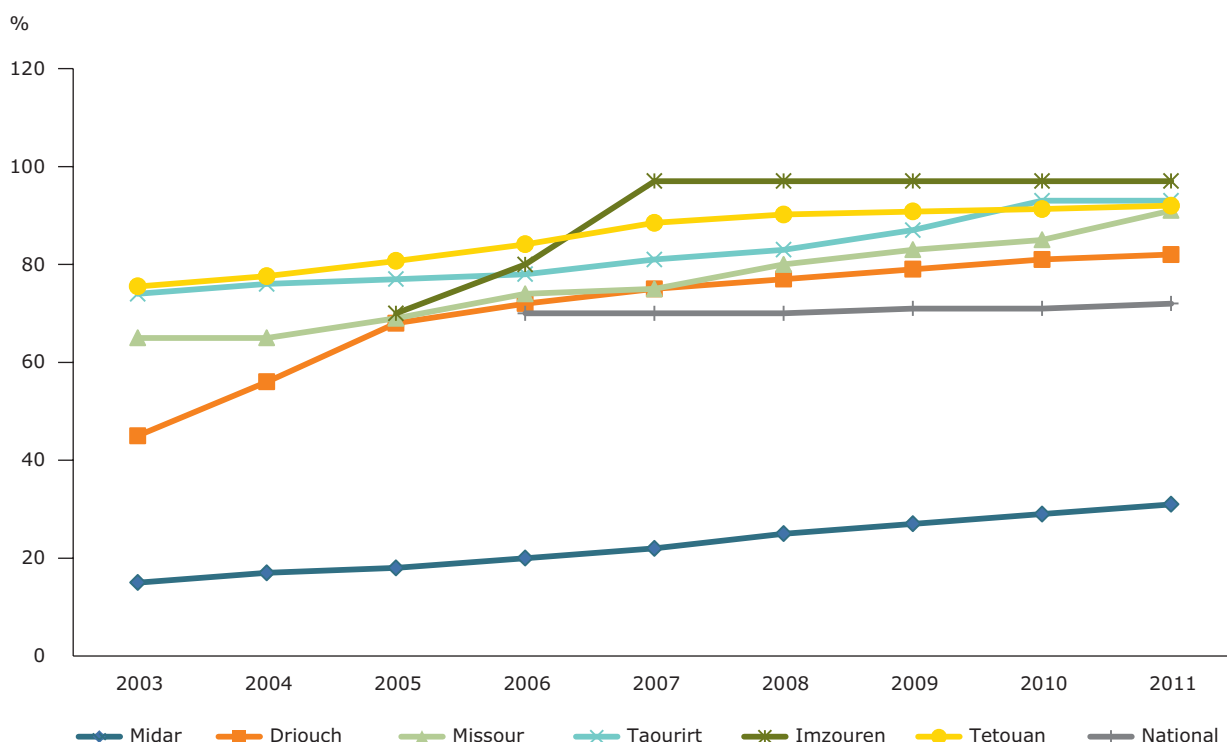
Overall, in practically every town and city falling within the area under study, the number of properties connected to sanitation systems has, since 2006, exceeded the national average, which stood at 70 %. In 2011, around 70 % of these towns and cities had a connection rate higher than the national average, which now stands at 72 %.

Figure A4.3 shows how the connection rates of certain towns and cities have evolved, in relation to the national rate.

Concerning the treatment of wastewater collected in the 41 towns and cities in the area under study:

- 22 towns and cities already had treatment plants in 2011;
- treatment plants were being constructed in a further five towns and cities;
- treatment plants were scheduled to be built between 2013 and 2017 in a further nine towns and cities;
- there were no plans to build treatment plants in the remaining five towns and cities.

**Figure A4.3 Number of properties connected to sanitation systems**



**Source:** ONEM, Data collected from partner organisations, Regional Report on the State of the Environment (Oriental Region).

The first wastewater treatment plants became operational in 2004. Since then, significant progress has been made in this field: in 2011, there were 14 treatment plants in the area under study, accounting for around 19 % of those in Morocco. According to the available data, these plants treat almost 95 % of the wastewater collected.

Table A4.5 gives a summary of the different types of wastewater treatment methods employed at the various plants located in the area under study.

According to the available information, wastewater treated in the area under study is not currently reused. However, as part of the implementation of a national water strategy that highlights water saving

and use of non-conventional water sources, projects promoting reuse of treated waste will soon be initiated in the area under study, especially in the plants where tertiary treatment is performed.

The operation of these treatment plants generates sludge, with approximately 4 184 t being produced in the area under study in 2010, accounting for almost 12 % of the country's total amount that year. This sludge production is essentially a result of wastewater treatment for the cities of Nador and Al Hoceima.

Generally, there are two ways in which this sludge is managed: it is either sent to landfills after having been pretreated (thickening and/or dehydration), or stored at the treatment plants.

In addition, trials have been carried out in an attempt to process this sludge for reuse, most notably in Nador:

- incineration trials in cement works;
- experiments to assess its fertilising power.

Conversely, in the absence of information on the sanitation networks in rural parts of the area under study, it may be considered that access to improved

**Table A4.5 Types of treatment performed at the treatment plants**

Type of treatment	Number of treatment plants
Primary treatment	2
Secondary treatment	7
Tertiary treatment	5
<b>Total</b>	<b>14</b>

**Source:** ONEM, Data collected from partner organisations, Regional Report on the State of the Environment (Oriental Region).

sanitation systems in these regions is close to that recorded at a national level (i.e. around 11 %).

When wastewater is discharged directly into receiving environments without having been pretreated, there are a variety of economic, social, environmental and health-related ramifications. There is no specific information on this subject for the area under study and no studies have been carried out there. The possible ramifications of improper wastewater management should therefore be highlighted for that area, as these may impact the following.

- **Public health:**  
wastewater is the principal transmission vector of waterborne diseases, whether through consumption, direct contact or agricultural reuse without being treated. Statistics show that these diseases are most common in the vicinity of areas in which untreated wastewater is discharged or dispersed.
- **The living conditions of the local population:**  
found chiefly in poorly drained districts, wastewater is not an only unpleasant sight and smell, but it is an ideal breeding ground for pathogens.
- **Water resources:**  
water resources contaminated by wastewater must be treated, at great cost, before they are fit for human consumption.
- **The quality of bathing water:**  
the large quantities of wastewater discharged into the sea severely reduce seawater quality along the coastline, and pose health risks in the form of contaminated fish and shellfish, or polluted swimming waters; in turn, this

has a significant impact on the development of tourism.

### *Pressures and driving forces*

Population growth, urbanisation and greater numbers of tourists during the summer holidays are the main driving forces behind the pressures placed on the environment due to increasing levels of wastewater generation.

The population of the towns and cities located in the area under study has grown incessantly over the past decade, rising from around 2 221 639 in 2004 to some 2 615 647 in 2011. What's more, the number of tourists visiting the area has also gone up dramatically. These developments have resulted in a marked increase in the volume of household liquids discharged: according to available information, roughly 46 million m<sup>3</sup> were discharged each year around the turn of the century, compared to around 80 million m<sup>3</sup> in 2011.

Table A4.6 shows how the volume of discharged household wastewater has evolved in recent years, for several of the major cities in the area under study.

Until the beginning of the 21st century, the wastewater generated placed much pressure on the environment, since properties in the area under study were being connected to sanitation systems at low to average rates, ranging from 15 % to 75 %. A significant proportion of the household wastewater generated was discharged directly into the natural surroundings, without having been pretreated. According to available information, the first wastewater treatment plants became operational in 2004. This untreated discharge caused severe damage to the receiving environment

**Table A4.6 Wastewater volumes for certain cities in the area under study**

City	2008		2009		2010		2011	
	Waste-water volume (Mm <sup>3</sup> /year)	Population (residents)	Waste-water volume (Mm <sup>3</sup> /year)	Population (residents)	Waste-water volume (Mm <sup>3</sup> /year)	Population (residents)	Waste-water volume (Mm <sup>3</sup> /year)	Population (residents)
Tangier-Assilah		855 905	20.784	874 024	32.226	892 170	33.041	910 387
Tetouan	14.965	345 547	15.564	370 739	16.218	389 308	17.079	400 700
Nador		134 246		136 462		138 747	8.194	141 067
M'diq	1.379	64 694	1.365	66 997	1.476	69 163	2.386	71 264

**Source:** ONEM, Data collected from partner organisations, Regional Report on the State of the Environment (Oriental Region).

by adversely impacting the quality of its natural resources, and especially its water resources.

There is also another source of pressure on the environment: the generation of substantial amounts of sludge, arising from the operation of treatment plants situated in the area under study, without any prudent form of environmental management being in place.

### *Responses and outlooks*

The public authorities have implemented a number of measures in recent years. Their aim is to improve the quality of life of the local population: to address the shortfalls of the sanitation and wastewater treatment infrastructure, and restore the area's water resources, bathing water and natural surroundings to their former glory — and keep them that way. Some of these measures are described below.

#### **Institutional level**

On both an institutional level and an organisational level as relates to sanitation infrastructure, the Municipal Charter has placed local municipalities in charge of managing liquid sanitation services. The charter also gives these municipalities the right to decide the form of management that is most appropriate for them: direct control, independent control or subcontracting to a specialist operator.

Other than the municipalities, the principal ministerial departments and public and private bodies and establishments involved in the sanitation sector are described below.

- The Ministry of the Interior, which, as the entity officially overseeing local municipalities, provides them with technical assistance and helps them coordinate the distribution of drinking water and sanitation services.
- The Department for the Environment, which is responsible for devising and overseeing the implementation of the country's environmental policies.
- The Department for Water, which is in charge of managing public water services, as well as assessing and organising water resources.
- The Ministry of Health, which is responsible for all health aspects related to water.

- The Ministry of General Affairs and Governance, which leads the Inter-Ministerial Pricing Commission and sets the regulations governing sanitation and drinking-water tariffs at the production and distribution stages.
- The independent bodies responsible for distribution, which, as financially autonomous local public organisations, oversee, on behalf of the municipalities, the distribution of drinking water and electricity, and also of sanitation in large conurbations.
- The National Office of Electricity and Drinking Water (Water Division), which is responsible for organising the supply of drinking water on a national scale, and for looking into, implementing and managing the production of drinking water in urban areas. It also has powers concerning the distribution of drinking water and sanitation, which it can delegate to local municipalities.
- The river basin agencies, whose management boards bring together all the parties involved in water management, and which are responsible for organising and overseeing the management of water in the river basins under their charge.
- The private sector, through subcontracted companies, which under Moroccan law have been placed in charge of drinking-water distribution, electricity distribution and liquid sanitation.
- Non-governmental organisations, which are essentially involved in providing water to rural populations.

#### **Regulatory level**

- The enactment, in 1995, of Law No 10-95 on water, which has proved to be a crucial turning point in policy on conservation, protection and integrated management of water resources, as it regulated discharges and introduced a funding instrument based on the 'polluter pays' principle. Several decrees for implementing this law have also been adopted, in particular standards governing the discharges of household wastewater and the liquid discharges emanating from certain industrial sectors (pulp, paper and cardboard industries, and the sugar industry).
- The adoption, in 2002, of the new Municipal Charter, which confirms the prerogatives of local municipalities in matters related to the



management of sanitation services, and sets out the different ways in which these services can be managed.

- The coming into force (since 1996) of contracts delegating the management of public water, sanitation and electricity services in certain towns and cities.
- The enactment, in 2001, of Law No 31-00, which places the National Drinking Water Authority (ONEP) in charge of managing liquid sanitation services in municipalities, when the management of those services had been entrusted to it.

### Financial level

Within the context of the NLSWWTP, sanitation projects are financed to the tune of between 30 % and 50 % by the state, and of between 50 % and 70 % by operators, through specific partnership agreements.

### Technical level

The NLSWWTP was devised in 2006 in order to meet the following objectives:

- have 75 % of all properties in urban areas connected to the sanitation network by 2016, with a rise to 80 % by 2020, and ultimately to 100 % by 2030;
- reduce household pollution by 50 % by 2016, 60 % by 2020 and 100 % by 2030;
- have all wastewater treated to tertiary level and be reused, by 2030.

The programme also forms part of the initiative launched by the international community for establishing the principles of sustainable development. It aims to meet Millennium Development Goal 7 (MDG7: 'ensure environmental stability'), and more specifically Target 23, which seeks to 'halve, by 2015, the proportion of the population without sustainable access to safe drinking-water and basic sanitation'.

It should be noted that the majority of the sanitation projects carried out in the area under study and relating to wastewater treatment and the restoration and extension of the network in the desert fall within the remit of the NLSWWTP.

Thanks to these projects:

- the number of properties in the area under study that are connected to the network increased from around 65 % in 2006 to almost 80 % in 2011;

- the number of treatment plants rose from 6 in 2006 to 14 in 2011.

In addition, other sanitation projects falling within the remit of the NLSWWTP are currently being carried out in the area under study or are scheduled to take place in the near future. These include:

- the construction (currently under way) of five treatment plants:
  - two secondary treatment plants (Ben Taieb and Guercif);
  - three tertiary treatment plants (Chefchaouen, Midelt and Oued Laou);
- a further nine treatment plants that are scheduled to be built:
  - five secondary treatment plants (Missour, Ras El Ma, Zaio, Debdou and Jerada);
  - four plants for which the type of treatment will be defined by technical studies (Driouch, Midar, Ajdir and Bni Drar).

Once completed, the various sanitation projects that are currently under way in the area under study, together with those pencilled in under the NLSWWTP, will help the region's sanitation sector meet the required environmental standards and will improve its wastewater management. This will significantly alleviate the economic, social, environmental and health-related impacts of wastewater discharges in the region, and also help to markedly improve the standard of life of the local population.

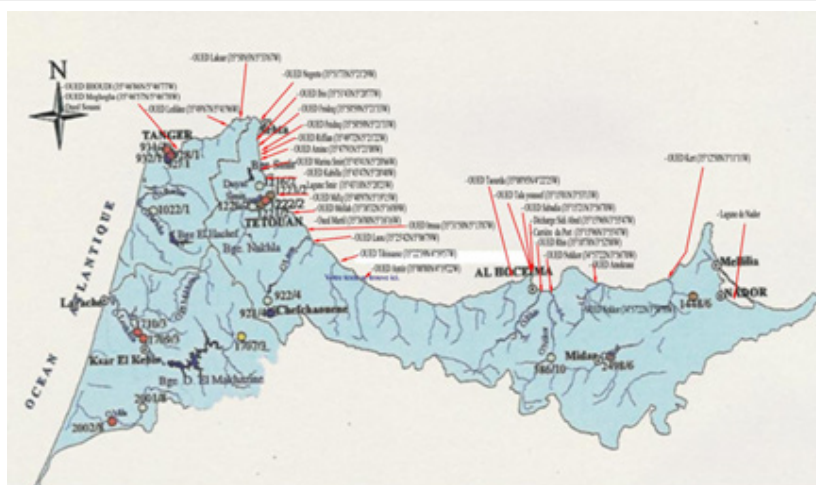
### Industrial emissions

The region in question is that spotlighted by the national MED POL programme for monitoring Morocco's Mediterranean coastline. It covers the northernmost parts of the two basins mentioned above (the Moulouya Basin, and the Tangier and Mediterranean coastal basins), with surveillance points located where discharges are made directly into the sea. This programme, which is coordinated by a national network of laboratories and partner institutions, monitors the activities of liquid-discharge monitoring stations listed and shown in Figure A4.4.

The programme aims to assess, both quantitatively and qualitatively, the household and industrial effluents generated by the major conurbations

Figure A4.4 Map and list of MED POL-Morocco monitoring stations

MOR1 Tangier	
Code	Stations
MOR1E1	Lihoud River
MOR1E2	Tangier discharge (Sidi Bouknadel Port)
MOR1E3	Souani River
MOR1E4	Moghora River
MOR1E5	Aliane River
MOR1E6	Ksar Seghir River
MOR2 Tetouan	
MOR2E1	Fnidq discharge
MOR2E2	M'diq
MOR2E3	Martil River (downstream)
MOR2E4	Laou River Martil River (upstream)
MOR3 Al Hoceima	
MOR3E1	TP inlet TP outlet
MOR4 Nador	
MOR4E1	Nador TP outlet
MOR4E2	Cabaillo River
MOR4E3	Selouane River
MOR4E4	Moulouya River
MOR4L	Nador Port Atalayoune Ras El Ma Bni Ansar Kariat Arkmane



Map: Discharge points of major towns and cities  
 Parameters measured: pH; conductivity; dissolved oxygen (O<sub>2</sub>); temperature (T°); total phosphorus (P<sub>tot</sub>); phosphate (PO<sub>4</sub>); total Kjeldahl nitrogen (TKN); ammonium (NH<sub>4</sub>); nitrate (NO<sub>3</sub>); nitrite (NO<sub>2</sub>); chemical oxygen demand (COD); biological oxygen demand (BOD); mercury (Hg); suspended matter (SM); cadmium (Cd); copper (Cu); chromium (Cr); nickel (Ni); lead (Pb); zinc (Zn); manganese (Mn); iron (Fe); mercury (Hg), etc.

Source: MEDPOL-Morocco.

located in the basins adjoining the Mediterranean. Its structure is based on potential sources of pollution.

Other measurements of the national network related to surface-water quality are also taken into consideration, in order to assess the pollution load of industrial and household emissions in the area.

**Industrial emissions issues**

There are several major issues currently needing attention in the area under study: they are predominantly linked to the discharges of industrial enterprises that are not connected to the sanitation network and have no treatment plants on site. These industrial plants are especially prevalent along the coastline, something which could generate significant pressures on the natural and physical surroundings.

**State and impacts**

In the Tangier-Tetouan region, the pollution load emitted by industrial plants was estimated to stand at around 7 000 t of oxidisable matter in 2004, with more than half being discharged directly into the natural surroundings. If no preventative measures are taken, it is estimated that this figure will reach 9 000 t by 2020, which could cause irreparable damage to the quality of the receiving environments (Regional report on the state of the environment, 2012).

More than 50 % of the organic load is discharged by the food-processing sector, most notably by the sugar-producing industry (45 %). The remainder is generated by slaughterhouses (13 %), dairies (12 %), cheese makers (9 %) and oil mills (9 %). The latter are concentrated in the Loukkos basin upstream of the El Makhazine River dam, and pose a threat to the quality of water at this dam.

Surface-water quality is generally good in the Tangier-Tetouan region, with the exception of certain river sections lying downstream of urban or industrial discharges (see Annex A4.2). The river sections considered to experience a permanent or temporary deterioration in water quality are listed below.

- The upstream section of the Martil River, which receives household and industrial discharges from the cities of Tetouan and Martil, is extremely polluted, especially when the water level is low, as the river's dilution capacity is significantly reduced. The amount of dissolved oxygen in the section of the river lying downstream from where household and industrial effluents are discharged from the city of Tetouan is very low, and is non-existent along the 16-kilometre stretch leading up to the mouth. The river has been found to contain organic pollutants originating from household discharges and food-processing plants, together with toxic substances (such as chromium and mercury) that have been discharged by chemical plants and tanneries.
- The Laou River has seen a slight deterioration in the quality of its water lying downstream of discharges from the city of Chefchaouen. Consequently, the water quality ranges from excellent to average during the wet season, and is poor at several sampling points during the dry season. Further downstream, the water purifies itself and returns to its original high quality.
- The Mghogha and Souani rivers, for their part, receive almost 7 % of the urban effluents discharged from the city of Tangier. Water quality in these two rivers continues to be rather low, due to the leachate coming from Tangier's uncontrolled landfill site (situated close to the river mouths), discharges from suburban areas that have still not been intercepted, accidental discharges from utility networks, a number of industrial discharges from industrial areas, and water being shed during the winter. As a result, an increase in conductivity has been observed: it can reach up to 6 694  $\mu\text{S}/\text{cm}$  at certain times of the year.
- The Boukhalef River receives water from the conurbation of Guzenaya, which has caused its water quality to deteriorate. It should be noted

that the activated sludge treatment plant in the industrial area of Guzenaya, which is currently at the trial phase, is intended to eventually treat these discharges.

Surface-water quality in the Moulouya Basin generally ranges from good to average. In addition, according to the most recent surface-water studies published by the Moulouya River Basin Agency (2011–2012), the overall quality of the rivers in this basin is still good to average on the whole, with the only exceptions being those stretches of river lying downstream of points where pollutants are discharged. Here, quality is poor, most notably in the stretch of the Bounaim River lying downstream from the Oujda treatment plant, and the stretches of the Cheraa River lying downstream from the treatment plants in Berkane, Missouri, Midelt, Cabailou, Selouane and Oued El Heimer (mining discharges from the smelting plant at Oued El Heimer). During studies in 2005, the water quality recorded by the stations at these points generally ranged from poor to very poor.

This deterioration in quality is due to the high levels of BOD, COD and nitrogen- and phosphorous-containing salts, all of which contribute to a high pollution load. However, water quality is better in the winter than in the summer, at least in terms of the BOD, COD,  $\text{NH}_4$ ,  $\text{P}_{\text{tot}}$  and FC parameters.

According to studies carried out under the MED POL monitoring programme (2011–2012), the concentration of two industrial pollution indicators remained below the discharge threshold values (national reports of the MED POL programme: 2005 and 2012). The concentration of phosphorus varied according to the location of the sampling point in relation to the discharge points, on the one hand, and the flow rates of effluents, which may fluctuate with the seasons, on the other. However, these concentrations were generally below the discharge threshold value for this parameter<sup>(5)</sup>. Figure A4.4 indicates the concentrations of this parameter, recorded in 2004 and 2012, at certain points covered by the programme.

As regards TKN, concentrations recorded at the monitoring points in the Tangier-Tetouan region sometimes exceeded the threshold value in 2004, but the situation improved greatly in 2012, due to actions taken in the region to enhance sanitation infrastructure and reduce industrial pollution.

<sup>(5)</sup> Order used for laying out the grid for surface-water quality (2002).

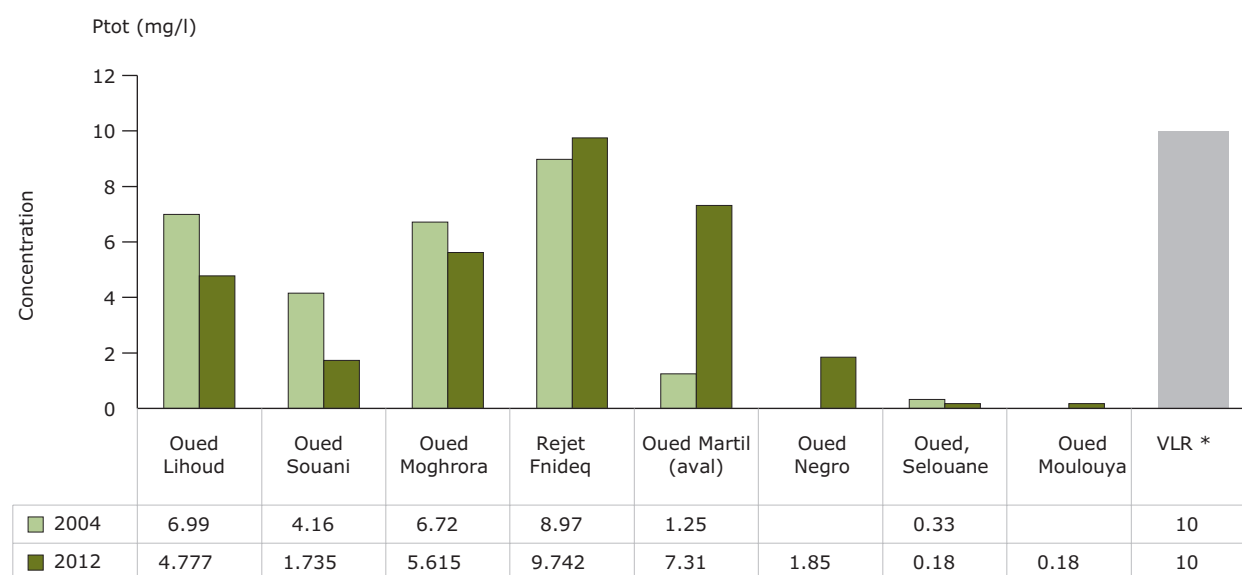
**Table A4.7 Simplified water-quality grids****a) Water quality grid for surface water**

Quality parameter	Dissolved O <sub>2</sub> (mg/I)	BOD (mg O <sub>2</sub> /I)	COD (mg O <sub>2</sub> /I)	NH <sub>4</sub> <sup>+</sup> (mg/I)	Ptot (mg/I)	FC (/100 ml)
Excellent	> 7	< 3	< 30	< 0.1	< 0.1	< 20
Good	7–5	3–5	30–35	0.1–0.5	0.1–0.3	20–2000
Average	5–3	5–10	35–40	0.5–2	0.3–0.5	2 000–20 000
Poor	3–1	10–25	40–30	2–8	0.5–3	> 20 000
Very poor	< 1	> 25	> 80	> 8	> 3	n/a

**b) Water quality grid for ground water**

Quality parameter	Conductivity (µs/cm)	Cl- (mg/I)	NO <sub>3</sub> <sup>-</sup> (mg/I)	NH <sub>4</sub> <sup>+</sup> (mg/I)	MO (mg/I)	FC (/100 ml)
Excellent	< 400	< 200	< 5	< 0.1	< 3	< 20
Good	400–1 300	200–300	May–25	0.1–0.5	03–May	20–2 000
Average	1 300–2 700	300–750	25–50	0.5–2	05–Aug	2 000–20 000
Poor	2 700–3 000	750–1000	>50	2–8	> 8	> 20 000
Very poor	> 3 000	> 1 000		> 8	n/a	n/a

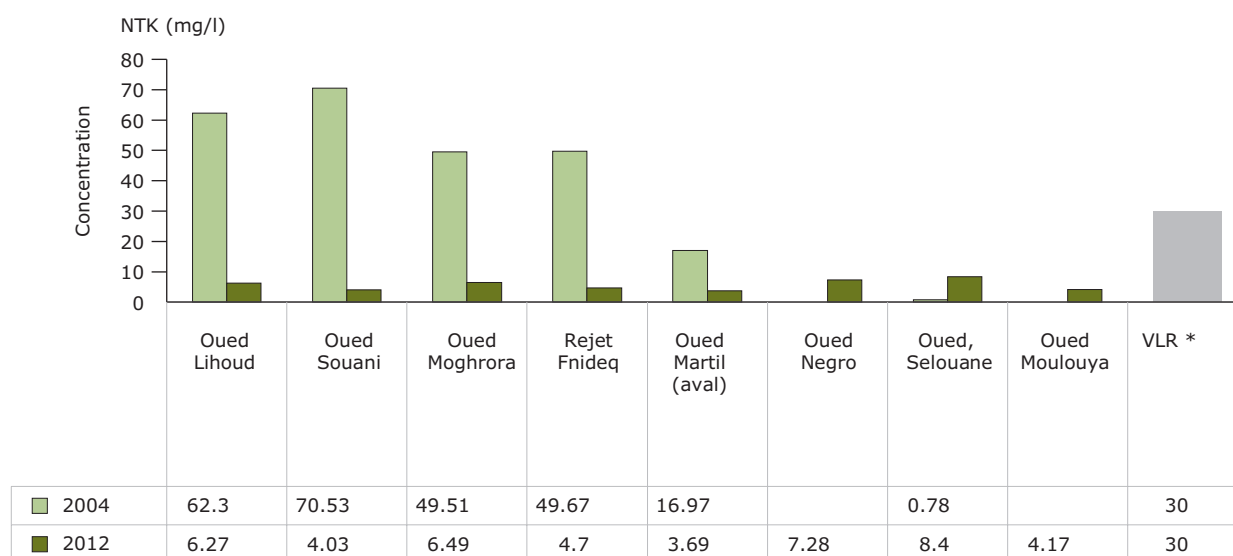
Source: MEDPOL–Morocco.

**Figure A4.4 Total phosphorus (P<sub>tot</sub>) concentrations at the MED POL monitoring points**

Note: Oued = River; Rejet Fnideq = Fnideq discharge; aval = downstream, VLR = DTV.

\* DTV: Discharge threshold value defined by order/decree.

Source: MEDPOL–Morocco.

**Figure A4.5 Total Kjeldahl nitrogen (TKN) concentrations at the MED POL monitoring points**

**Note:** Oued = River; Rejet Fnideq = Fnideq discharge; aval = downstream, VLR = DTV.

\* DTV: Discharge threshold value defined by order/decree.

**Source:** MEDPOL–Morocco.

As regards heavy metals, studies have shown that the amounts of elements present in the sediment were generally lower than the average natural sedimentary contents, except for certain parameters that occasionally exceeded this norm: iron for the discharges at Fnideq, chromium for the Moghgha River and zinc for the Souani River. Table A4.8 provides the results of studies carried out in June 2012.

#### *Pressures and driving forces*

Industrial pollution is mainly generated by industrial plants situated in urban areas, in particular the conurbations of Tangier and Tetouan. The majority of industrial plants in the latter city are located in urban areas and in the valley of the Martil River, where there is a high concentration of pollution originating from metallurgy, textile,

**Table A4.8 Heavy metal concentrations in sediment at the MED POL monitoring points**

Parameter	Souani River	Moghgha River	Fnideq discharge	Negro River	Cabaillo River	Selouane River	Bni Ansar	Kariat Arkmane	Moulouya River	ANSC (°)
Cd (µg/g)	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	0.6
Cu (µg/g)	12.3	10.01	0.706	4.3	0.531	18.3	3.03	1.6	5.2	26
Cr (µg/g)	30	67.9	15.6	15	6.05	12.4	20.3	5.3	35	45
Ni (µg/g)	11.8	25.2	20.1	10.9	1.2	10.5	13.5	1.4	23.3	22
Pb (µg/g)	75.8	10.2	7.14	12.5	6.3	20.5	12.7	2.7	36.9	22
Zn (µg/g)	158	65	47.1	77	10.3	182	56.3	7.9	97.5	88
Hg (µg/g)	0.112	0.092	0.061	0.064	0.058	0.092	0.08	0.069	0.086	-
Fe (mg/g)	13.14	24.72	20.83	12.82	4.020	28.37	14.56	4.332	23.64	20 (*)
Mn (µg/g)	270.05	688	210	278	147	325	212	117	513	400

**Note:** (°) Average natural sedimentary contents (in µg/g) ((\*) Fe in mg/g).

**Source:** MEDPOL–Morocco.

chemical and paper-making plants, food-processing factories and slaughterhouses.

Industrial pollution in Tangier, on the other hand, stems from the following four sources:

- the industrial zone lying next to the Route de Tétouan (the main road leading to Tetouan), from which liquid effluents (textiles, aluminium, paper making, food processing, etc.) are discharged into the urban sanitation network;
- the Mghogha district (textiles, tanneries, food processing, etc.), from which liquid effluents are discharged into the Mghogha River;
- the Moulay Ismael district (flour milling and textiles) to the south of the city, which is connected to the municipal drainage system;
- the cluster of industrial plants (dyeing workshops) on the road leading to the airport, south-west of the city, from which wastewater is discharged into the Lihoud River.

The textiles and leather sector is the second most polluting industry in the Tangier-Tetouan region; it generates around 42 % of the total pollution load emitted in the area, and is mainly concentrated in the city of Tangier. More than 80 % of the area's chemical pollution, meanwhile, originates from ceramics, surface treatment and chemical manufacturing plants.

In the Oriental region, industrial activities are concentrated in Oujda, Nador, Salouane and Bni Ansar, which together account for almost 75 % of the industrial plants in the region. The chemical/parachemical and food-processing sectors have the most plants and produce the greatest volumes in the region.

While a number of large industrial plants, such as Sucrafor, Sonasid, the Bni Snassen Tannery and Atlas Bottling, have equipment to treat their residual waters, their discharges are still occasionally rife with pollutants and micro-pollutants. Some of these plants also discharge pollution directly into rivers.

### *Responses*

Several initiatives and programmes are currently being implemented by various stakeholders, in a bid to curtail the pressures generated by industrial emissions.

### **Financial instruments to combat industrial pollution**

In 1998, the Department for the Environment launched a programme to combat industrial pollution, which involved encouraging industrial and artisanal companies to invest in anti-pollution measures, make more efficient use of raw materials and use clean technologies. An Industrial Depollution Fund (IDF) was set aside for the programme, with further financial support being provided by partner organisations based in Germany.

Seven projects (six of which focusing on the treatment of liquid discharges) have been rolled out in the Tangier-Tetouan region, at a total cost of MAD 35 million, of which the IDF has contributed MAD 14 million.

A new Industrial Water Depollution Incentive Mechanism (IWDIM) has recently been put in place in Morocco, to continue encouraging companies to cut back their pollution levels. The mechanism provides river basin agencies with the financial means necessary for subsidising anti-pollution projects by 20 % to 40 %. These projects specifically relate to construction of plants for treating liquids discharged by industrial entities. It was granted a budget of MAD 100 million for the 2011–2013 period. The Moulouya River Basin Agency has given the green light to three different projects, at a total cost of MAD 43 million, with MAD 10 million being sourced from funds.

### **Legal framework**

Moroccan legislation governing the protection of water resources has been bolstered by a substantial number of laws and regulations, most notably Law No 10-95 on water and the texts implementing it.

This framework has resulted in a number of standards being adopted concerning discharges of household wastewater and discharges of liquids from certain industrial sectors (the pulp, paper and cardboard industries and the sugar industry). Further standards concerning the direct and indirect discharges of other industrial sectors are currently in the process of being drawn up or adopted.

In addition, a draft law on the protection and enhancement of the coastline is on the verge of being adopted by the Moroccan government. This law seeks to pave the way for a national coastline protection policy, based on an integrated vision of coastal areas.

# National profile

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## Introduction

Morocco is a sovereign Islamic state that is committed to its national unity and territorial integrity. The country is a constitutional, democratic, parliamentary and social monarchy. Its constitutional system is based on the separation, balance and cooperation of powers, democratic and participatory citizenship, the principles of good governance, and the close relationship between assuming responsibility and being subject to accountability.

The Kingdom of Morocco is currently going through a phase of environmental transition, alongside a phase of economic and social transition. The issues and challenges it faces, together with the nature and scope of the environmental problems with which it has to contend, clearly indicate an increasing deterioration of the country's ecological heritage, some of which cannot be recovered. This poses a threat, not only for the economic and social progress made over the past decades, but also for the livelihoods and well-being of present and future generations.

By signing the majority of international environmental agreements, Morocco has shown the international community just how committed it is to overcoming challenges of environmental protection and sustainable development. These levels of commitment have been demonstrated not only by the ratification of over 80 multilateral environmental agreements, but also by the country's active involvement in various international forums seeking solutions to environmental problems.

## Environmental governance

### Institutional framework

One of the country's ministerial departments is responsible for overseeing government policy on all matters concerning environmental protection. This department currently forms part of a large ministry that also encompasses energy, mining and water. Needless to say, there are many other public,

semi-public and private entities that play an active role in environmental management and sustainable development. In particular, a great many specialist agencies have very recently been set up, especially in the renewable energy field. In addition, Morocco has a wide array of institutions and councils that serve to foster dialogue and involve all stakeholders in the environmental decision-making process (e.g. the National Environment Council, the High Council for Water and the Climate and the High Council for Land Management).

### Legal framework

Morocco's legal framework is outlined by the adoption of two different types of laws. The first type includes laws that reinforce environmental protection (such as the laws on water, on impact studies, on combating air pollution, on waste management, on protected areas, and on degradable and biodegradable plastic bags). The second type, including laws passed more recently, place more focus on sustainable development (such as the laws on renewable energies, on the creation of the National Agency for Renewable Energies and Energy Efficiency, and on setting up the Moroccan Solar Energy Agency). Other texts are currently on the verge of being adopted, such as the draft framework law relating to the National Charter for the Environment and Sustainable Development, and the draft law for the protection and integrated management of the coastline, to name but two examples.

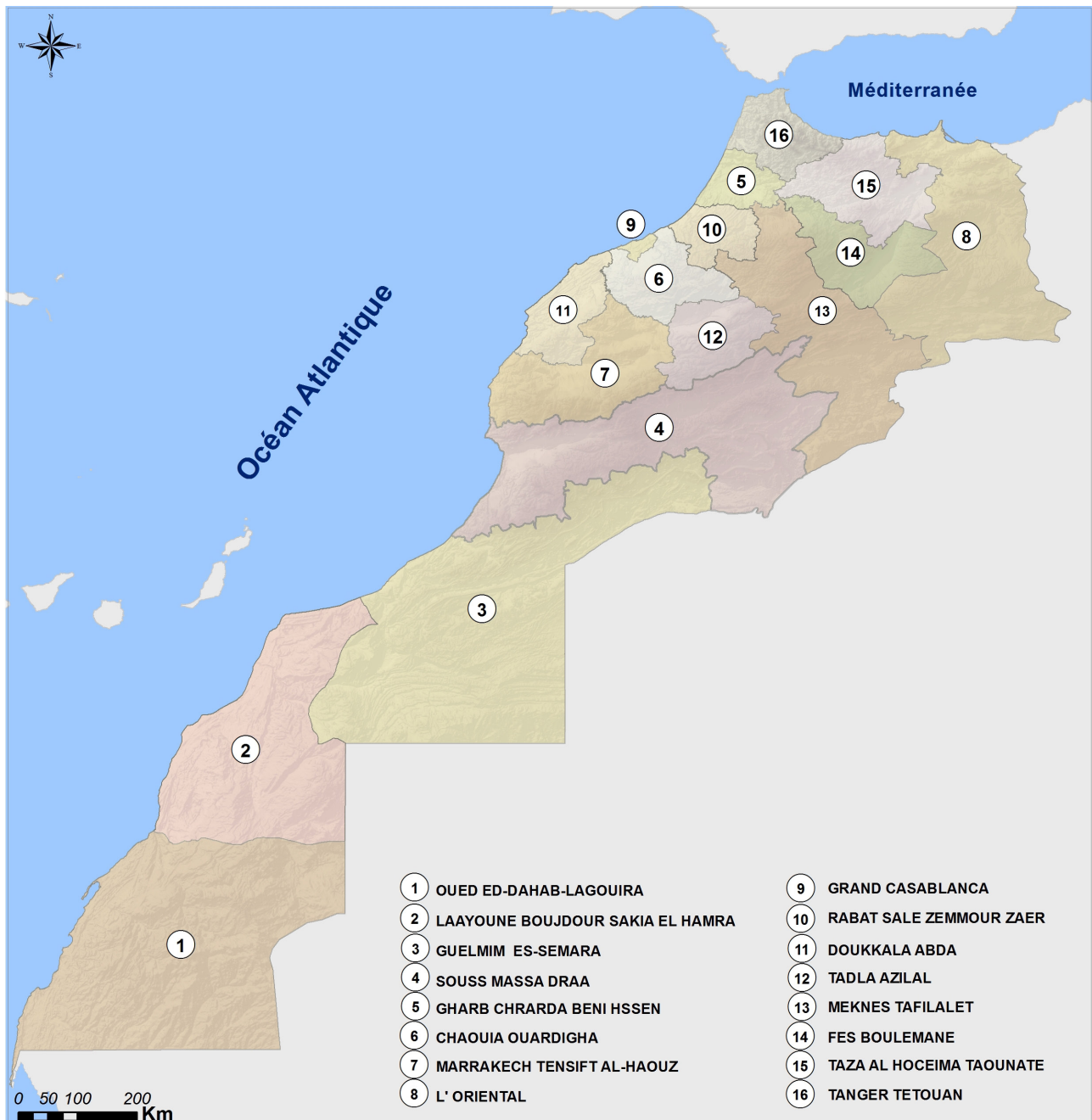
### Monitoring, assessment and prevention tools

Examples are the construction of the National Environmental Laboratory and of observatories (the National Environmental Observatory and the Regional Environmental and Sustainable Development Observatories), the monitoring of sustainable development indicators, and the creation of a national committee and regional committees focusing on environmental impact studies.

### Economic and financial instruments

National funds have been set up, like the National Environment Fund, the IDF, the Liquid Sanitation

Map A4.3 Administrative map, regions of Morocco



Source: ONEM.

and Waste Water Treatment Fund, and the Energy Development Fund. New cooperation mechanisms (subsidies, agreements, public/private partnerships) have also been established to support measures taken to protect resources and the environment.

#### International cooperation

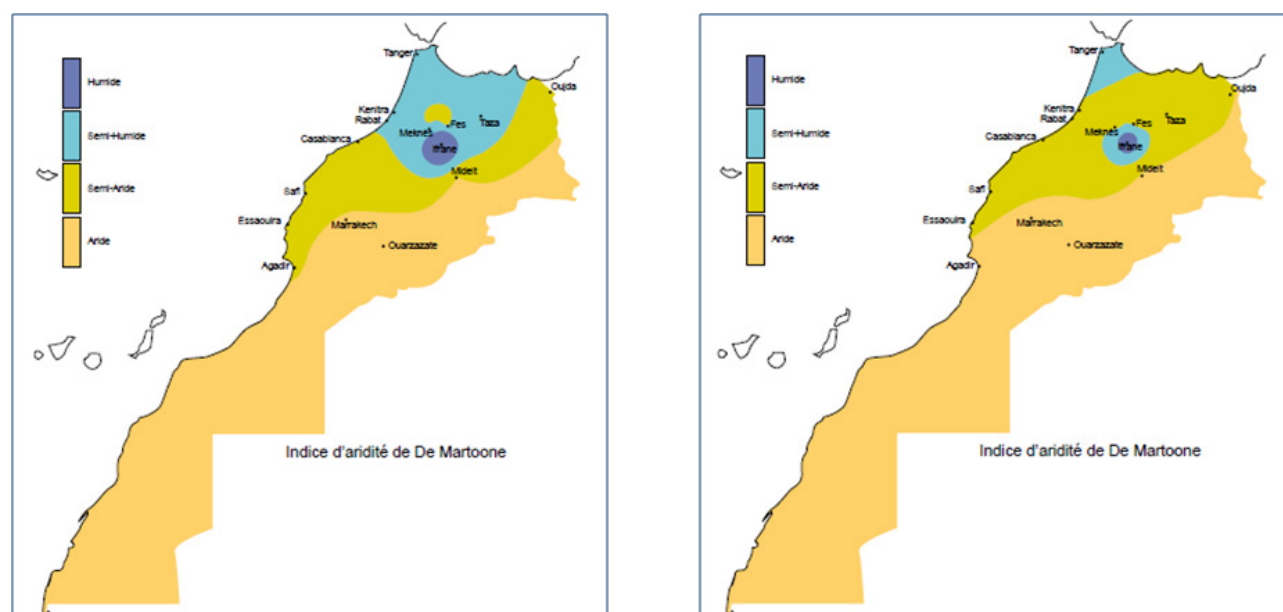
Morocco is actively involved in international efforts to protect the environment and promote sustainable development: it has established a set

of commitments, developed cooperative projects at regional and subregional levels, and reinforced south-south and triangular cooperation.

#### Natural features

Morocco covers an area of 710 850 km<sup>2</sup> in the north-west of Africa. The Strait of Gibraltar and Mediterranean Sea lie to its north and the Atlantic



**Map A4.5 Climatic vulnerability: clear expansion of arid and semi-arid areas**

**Note:** Humide = Humid; Semi Humide = Semi-humid; Semi-Aride = Semi-arid; Aride = Arid.

**Source:** ONEM.

Ocean to its west, and it is bordered by Mauritania to the south and Algeria to the east. The country's coastline is 3 500 km long, and runs along the southern Mediterranean to the north-west point of Africa and the gates of Europe (the Strait of Gibraltar), with its westernmost point marking the end of the Arab/Muslim world and Maghreb region.

Morocco enjoys a favourable geostrategic position. Its coastline is roughly 3 500 km long: its northern section borders the Mediterranean Sea and stretches

around 500 km from Saidia to Cape Spartel, with its western section, facing the Atlantic Ocean, running roughly 3 000 km from Cape Spartel to Lagouira. Morocco's Mediterranean coastline has an abundance of natural sites and landscapes, as well as several highly populated areas, especially between Tangier and Tetouan.

Morocco has a wide diversity of climate types, which vary depending on location. The climate is subject to Mediterranean influences towards the north, oceanic influences towards the west, continental influences

**Table A4.9 Principal socio-economic indicators**

Indicator	1992	2012
Population	22.5 million (approx.)	32 million (approx.)
Rate of natural increase	2.2 %	1.32 %
Average life expectancy	65	74.8
GDP	USD 28.7 billion	USD 96 billion (2011)
GDP per capita	USD 1 150	USD 3 200
Access to drinking water: rural (RDWSP)	14 %	92 % (2012)
Rural electrification rate (REP)	15 %	97.4 % (2012)
Poverty rate	16.5 %	8.8 % (2008)
Extreme poverty rate	3 %	0.6 % (2008)
Gross enrolment ratio	52.4 %	93.6 % (2010)
Illiteracy rate	58 %	39 % (2010)

**Source:** ONEM.

towards the centre, and Saharan influences towards the south and south-east.

Morocco's climate is mainly characterised by hot and dry summers, during which there is practically no rainfall and evaporation rates are particularly high. Its winters are generally mild near the coast, and cold in the centre of the country, where the Atlas Mountains, Rif Mountains and High Plateaus in the Oriental region are located. The average annual rainfall varies, depending on the area in question, from under 100 mm (in the south) to 1 200 mm, with two seasonal peaks (in winter and spring).

The scarcity of water is a major vulnerability, especially given the increasingly pronounced effects of climate change. The volume of water available to each person fell from 2 560 m<sup>3</sup>/year in 1960 to just 730 m<sup>3</sup>/year in 2010.

### **Socio-demographic characteristics**

Morocco has a population of 32 million and a population density of 45 people/km<sup>2</sup> (2011 figures). Its rate of natural increase stood at 1.32 % in 2010, compared with 2.7 % in the 1960s. More than half its total population (54 % in 2004) live in provinces and prefectures along the coastline, even though they account for only 43.3 % of the country's surface area. These coastal provinces and prefectures therefore have a population density that is higher than the national average. In 2010, this figure stood at 55.98 people/km<sup>2</sup>, with the national average being 44.85 people/km<sup>2</sup>; this means that on average, for every square kilometre, there are 11.13 more people living in coastal regions than in other areas of the country.

Table A4.9 sets out how several key indicators have changed over the past two decades (from 1992 to 2012). These changes reflect the social and economic progress the country has made in that time.

### **Socio-economic activities and pressures on the environment**

Environmental problems are becoming increasingly severe in various regions of the country, with the latest diagnostic and analytic reports on the state of the environment at both national and regional level underlining just how serious the situation is becoming in Morocco. There has been a marked deterioration in natural resources and the quality of life of the population, due in particular to air, inland water and seawater pollution, desertification,

degradation to forests, biodiversity and the coastline, and also because of the risks posed by uncontrolled landfills. This has had a negative impact on the health of the population, and has also hampered Morocco's economic development, since some natural resources, vital for ensuring the country's sustainable development, have already been exhausted.

#### **Household utilities**

Over the past three decades, the public authorities have focused much of their attention on providing safe drinking-water to the whole country. In urban areas, 96.5 % of all properties were connected to the water mains in 2009, compared to 92 % in 2006 and 81 % in 1995, and today every single household in urban areas receives safe drinking-water (including those situated in the desert, via drinking fountains). Meanwhile, the Rural Drinking Water Supply Programme (RDWSP) launched in the country's rural areas has seen access to drinking water increase from just 14 % in 1994 to 89 % in 2009, and to 93 % in 2012.

As regards sanitation, it should be noted that roughly 415 Mm<sup>3</sup> (55 %) of wastewater produced by households in coastal towns and cities are discharged into the sea every year, with several major conurbations and more than 60 % of Morocco's urban population being located in the country's coastal regions.

Electricity is now available to everyone in urban areas, and 97 % of the rural population also had access to it in 2012, thanks largely to the Rural Electrification Programme (REP) launched by the Moroccan government in 1995.

#### **Industry**

The majority of industrial waste is discharged into the sea, since over 80 % of all the country's industrial plants are concentrated on the coastline. Sea pollution levels are further exacerbated by accidents accompanying industrial activities performed along the coastline.

#### **Marine transport**

Discharges from vessels and ports along the Moroccan coastline are placing huge pressures on the marine environment. Every day, some 240 vessels pass through the Strait of Gibraltar, with a further 360 skirting the Atlantic coast.

#### **Fishing**

Overfishing is placing fishery resources under enormous strain, with the number and size of catches continuing to fall despite the ever-increasing

size of the fishing fleet, which today consists of more than 2 540 large vessels and over 17 670 fishing boats. The increased acidity levels and higher sea temperatures, which have been attributed to climate change, are also having an impact on sea life, resulting in fishery resources deteriorating on both a quantitative and qualitative level.

### Tourism

Over the past 30 years, Morocco's coastline has undergone significant development as the country has sought to attract more tourists to its coastal resorts. Such sustained development has been detrimental to its natural habitats and surroundings, and also to reforestation efforts (especially on the Mediterranean coast and in Agadir, which is home to almost a quarter of all the country's hotels). The number of overnight stays per 100 residents has increased over the last decade or so, rising from 37.85 in 2003 to 56.58 in 2010.

### Agriculture

Morocco's Useful Agricultural Surface (UAS) covers around 9 million ha, and is supplemented by some 65 million ha of rangeland and around 9.7 million ha of forestland. In total, 1.5 million ha of land are irrigated, accounting for approximately 16 % of the UAS.

Morocco's soils are rather fragile overall, due to their low content of organic material (less than 2 % (even in humid areas)); they deteriorating even further owing to natural and anthropogenic factors. This deterioration stems from the synergistic effects of the climate, the aggressiveness of certain natural conditions, and above all the impact of human activities on fragile and rather infertile soils.

The report on the state of the environment published in 2010 provides details on the various pressures being generated by different socio-economic activities, and also on the state of the environment in Morocco (see <http://www.environnement.gov.ma/PDFs/rdeem.pdf> (in French)).

### Outlook for the environment and sustainable development

Morocco's determination to make the environment a national priority is reflected at the highest level of government. For over a decade now, the country has been resolutely committed to overcoming the challenges posed in the 21st century, and has made sustainable development a key strategy in this regard: nationwide reforms have been adopted to protect the

environment and human development. This level of commitment was underlined in the annual speeches made by King Mohamed VI in 2009 and 2010, in which he called on the Moroccan government to accelerate the sustainable development process by drawing up a National Charter for the Environment and Sustainable Development (NCESD), which was adopted in February 2011.

The NCESD, a genuinely pioneering and unifying document, sets out rights and responsibilities for all parties, together with the commitments and fundamental principles needed to ensure long-term sustainable development.

It is implemented via two different approaches, explained below.

- The first approach, which is regulatory and institutional in nature, is based on a framework law that is currently in the process of being adopted. Essentially, it aims to provide a legal basis for the principles, rights, responsibilities and commitments set out in the NCESD. It also aims to define the future direction of public policy in terms of strategies and programmes on environmental protection and sustainable development.
- The second approach, which is technical in nature, is based on the fulfilment of the three major objectives making up the Sustainable Environmental Protection System. It aims to implement the principles and values of the NCESD on the ground, through progressive strategic planning with the following objectives in mind:
  - returning the environment to its previously unspoiled state, through an environmental upgrading strategy which propounds a clear, one-dimensional view of the environment: it introduces specific environmental themes into programmes that are essentially curative in nature (such as the NLSWWTP and the NHSWMP);
  - putting a national environmental strategy in place that makes the environment a multidimensional pillar, by implementing in all sectors a strategic approach that focuses on both prevention and cure;
  - implementing a national sustainable development strategy that makes it possible to incorporate new factors relating to regions and to the socio-economic and sociocultural situation, which form the typical elements of sustainable development.

## Specific thematic area

### Cleaning up the Marchica Lagoon

The Marchica Lagoon, which lies next to the city of Nador, is one of the most important lagoons in the Mediterranean, in terms of both size (14 000 ha) and biodiversity. Officially listed as a Ramsar site, it is of crucial importance to the local region owing to its biological and ecological assets, the economic benefits that it brings, and its attractive landscape. In the past, this ecosystem has suffered from anthropogenic 'stress' brought about by population growth, urban, industrial and agricultural discharges, and the various economic activities carried out on the lagoon. It had even been identified as a 'Pollution Hot Spot Area' by the Mediterranean Action Plan (MAP).

The cleaning up and long-term protection of the Marchica Lagoon were absolutely vital to the sustainable socio-economic development of the local population, and key to the success of various tourist, residential and business projects in the region. Consequently, in 2010, the Department for the Environment, the Lagoon Development Agency, the Province of Nador and the Oriental Regional

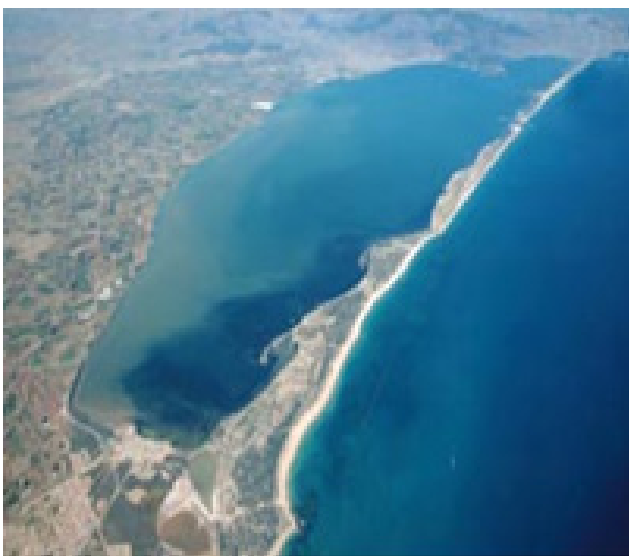


Photo 1: Marchica Lagoon

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Agency for Economic and Social Development and Progress, all fully aware of the issues at stake, signed an agreement on cleaning up the Marchica Lagoon and protecting its surrounding environment. The agreement set out how an action plan could be put in place, financed and executed, that would reduce the levels of pollution in the Marchica Lagoon, target all potential sources of future pollution, and protect the surrounding environment.

The action plan encompasses all the concerted efforts made around the lagoon, with the ultimate aim being to achieve a sustainable form of development that fully respects the lagoon's natural surroundings. It focuses on four specific areas:

- cleaning up the lagoon;
- sustainably developing the lagoon and its surrounding landscape;
- monitoring the lagoon and gaining a better understanding of it;
- educating people about the environment, and making them more aware of the issues surrounding the protection of the lagoon.

In order to further reduce pollution levels and protect the Marchica Lagoon, several initiatives have already been carried out, and others are currently under way.

- The set-up of an agency with an overview of the area to be developed. Its main mission is to protect and develop the areas surrounding the Marchica Lagoon.
- Construction of a wastewater treatment plant in Greater Nador in 2010, under the NLSWWTP. This activated sludge treatment plant has a capacity of 20 600 m<sup>3</sup>/day, and treats water up to tertiary level.
- Construction of a treatment plant at Kariat Arekmane — a natural lagooning plant with a capacity of 1 500 m<sup>3</sup>/day.

- Extension (currently under way) of the sanitation network serving the urban areas in Greater Nador, which involves around 300 km of pipes being laid in Nador, Bni Ansar, Taouima, Selouane, Segangan, Jaadar and Ihaddaden.
- The opening, in 2011, of the channel separating the Marchica Lagoon from the Mediterranean Sea. This project replenished and improved water quality, made maritime navigation easier and paved the way for a leisure port to be built, following the closure of the old channel.
- Depollution of water in the Marchica Lagoon (covering an area of 14 000 ha, and its edges, stretching across 64 km). The water in the lagoon has been cleaned regularly since 2010, and is today much clearer.
- The establishment of a bird sanctuary by the Marchica Med Agency. This project, which

got under way in 2011, involves transforming the old lagooning basins near the lagoon that formed part of the old treatment plant complex into new marshland, and is expected to be completed in 2014.

The clean-up operation focused on the banks of the Marchica Lagoon and the mouth of the River Bouserdoun, from which 26 000 m<sup>3</sup> of solid waste were removed. In addition, the stretch of sand dunes and the beaches at Arekmane and Bni Ansar had already been cleaned thoroughly. The depollution and clean-up operations were performed by the company Marchica Med, with assistance from the Ministry of the Interior, the Department for the Environment, the Province of Nador and the Oriental Regional Agency. The budget set aside for these operations stood at MAD 75 million.



Photo 2: The lagoon's location

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Photo 3: Before the clean-up operation

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Photo 4: After the clean-up operation

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# Acronyms

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BOD	Biological oxygen demand
COD	Chemical oxygen demand
DPSIR	Driving forces, Pressures, State, Impacts and Resources
FEE	Foundation for Environmental Education
GDP	Gross domestic product
GPHC	General Population and Housing Census
H2020	Horizon 2020 initiative
IDF	Industrial Depollution Fund
IWDIM	Industrial Water Depollution Incentive Mechanism
MAD	Moroccan dirham
MAP	Mediterranean Action Plan
Mm <sup>3</sup> /year	Million cubic metres per year
NCESD	National Charter for the Environment and Sustainable Development
NHSWMP	National Household and Solid Waste Management Programme
NLSWWTP	National Liquid Sanitation and Waste Water Treatment Programme
RDWSP	Rural Drinking Water Supply Programme
REP	Rural Electrification Programme
res.	Resident
RESDO	Regional Environmental and Sustainable Development Observatory
SAP	Strategic Action Programme
SBEI	Sites of biological and ecological interest
SEIS	Shared Environmental Information System
SM	Suspended matter
TKN	Total Kjeldahl nitrogen
TP	Treatment plant
UAS	Useful Agricultural Surface

# Annex A4.1 Population changes in the 41 towns and cities situated in the area under study

## Population changes in the 41 towns and cities in the area under study

Region	Prefecture/ province	Municipality	2004	2005	2006	2007	2008	2009	2010	2011
Fes-Boulemane	Boulemane	Missour	19 506	19 921	20 337	20 757	21 231	21 665	22 136	22 615
		Outat El Haj	12 967	13 243	13 519	13 798	14 113	14 401	14 715	15 033
Oriental	Berkane	Aklim	8 913	9 036	9 157	9 279	9 407	9 532	9 662	9 794
		Berkane	79 516	80 613	81 694	82 780	83 920	85 036	86 193	87 373
		Saidja	3 317	3 363	3 408	3 453	3 501	3 548	3 596	3 645
		Sidi Slimane Echcherraa	22 762	23 076	23 385	23 696	24 023	24 342	24 673	25 011
Driouch	Driouch	Ben Taieb	20 866	21 192	21 517	21 841	22 175	22 506	22 842	23 181
		Driouch	10 346	10 572	10 797	11 022	11 255	11 484	11 718	11 956
		Midar	15 980	16 295	16 608	16 921	17 243	17 562	17 888	18 218
Jerada	Jerada	Ain Bni Mathar	13 494	13 573	13 649	13 727	13 813	13 895	13 984	14 077
		Jerada	43 812	44 069	44 316	44 567	44 847	45 114	45 403	45 703
Nador	Nador	Al Aaroui	35 810	36 435	37 052	37 671	38 315	38 948	39 600	40 262
		Bni Ansar	31 614	32 165	32 710	33 257	33 825	34 384	34 960	35 544
		Nador	125 469	127 657	129 819	131 989	134 246	136 462	138 747	141 067
		Ras El Ma	9 899	9 868	9 838	9 806	9 775	9 747	9 715	9 684
Selouane	Selouane	Selouane	24 933	24 772	24 615	24 453	24 290	24 135	23 970	23 804
		Zaio	29 676	30 194	30 705	31 219	31 752	32 277	32 817	33 366
		Segangan	20 063	20 413	20 759	21 106	21 466	21 821	22 186	22 557
Taourirt	Taourirt	Debdou	4 504	4 657	4 810	4 963	5 119	5 274	5 431	5 590
		El Aïoun Sidi Mellouk	34 488	35 665	36 835	38 006	39 203	40 387	41 592	42 809
Oujda-Angad	Oujda-Angad	Taourirt	79 381	82 091	84 783	87 480	90 234	92 960	95 734	98 534
		Bni Drar	8 855	9 025	9 193	9 361	9 536	9 708	9 885	10 065
Meknes-Tafilalet	Meknes-Tafilalet	Oujda	397 840	405 480	413 036	420 619	428 476	436 206	444 154	452 216
		Midelt	44 429	45 031	45 712	46 572	47 462	48 338	49 239	50 152
Tangier-Tetouan	Tangier-Tetouan	Chefchaouen	35 797	36 549	38 039	38 935	40 304	41 288	42 593	43 760

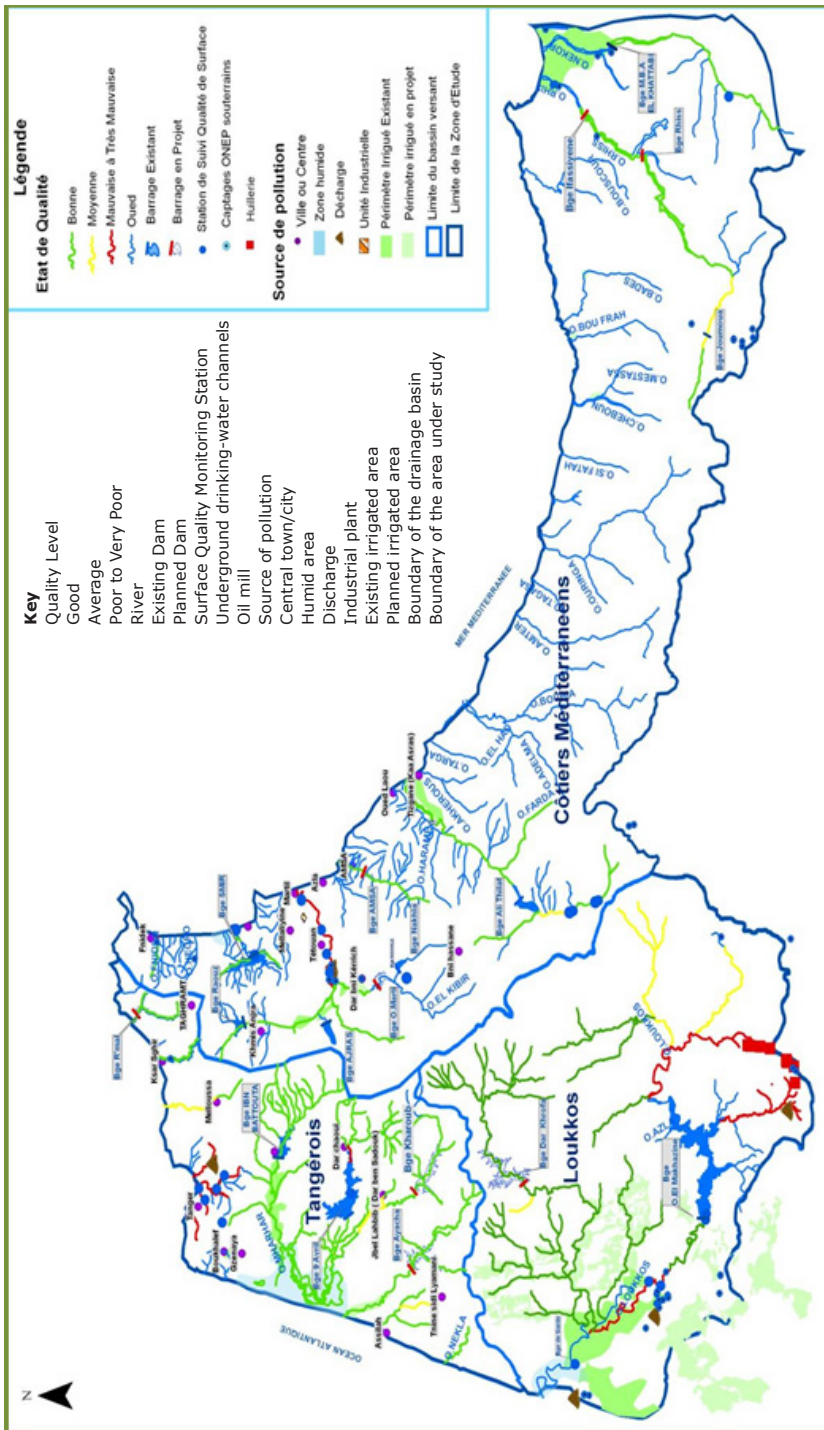


## Population changes in the 41 towns and cities in the area under study (cont.)

Region	Prefecture/ province	Municipality	2004	2005	2006	2007	2008	2009	2010	2011	
Tangier-Tetouan	Fahs Anjra	Anjra	10 354	11 214	12 074	12 932	13 793	14 655	15 518	16 382	
		M'diq-Fnideq	37 703	39 341	40 956	42 589	44 205	45 778	47 258	48 694	
	M'diq	M'diq	55 179	57 576	59 940	62 330	64 694	66 997	69 163	71 264	
		Martil	40 191	41 937	43 659	45 399	47 122	48 799	50 377	51 907	
	Tangier-Assilah	Charf Souani	117 989	120 917	123 818	126 728	129 720	132 673	135 694	138 750	
		Charf Mghogha	144 622	148 211	151 768	155 334	159 001	162 621	166 323	170 069	
	Tetouan	Tangier Medina	176 697	181 081	185 427	189 784	194 265	198 688	203 211	207 787	
		Oued Laou	8 284	8 486	8 687	9 037	9 344	9 696	10 182	10 479	
	Taza-Al Hoceima-Taounate	Al Hoceima	Tetouan	316 751	324 484	332 154	345 947	357 276	370 739	389 308	400 700
			Al Hoceima	54 385	55 461	56 525	57 592	58 697	59 785	60 903	62 036
Ajdjr		Ajdjr	3 917	3 994	4 071	4 148	4 228	4 306	4 386	4 468	
		Bni Bouayach	15 225	15 526	15 824	16 123	16 432	16 737	17 050	17 367	
Imzouren		Imzouren	26 108	26 625	27 135	27 648	28 179	28 701	29 237	29 782	
		Targuist	11 357	11 582	11 804	12 027	12 258	12 485	12 718	12 955	
Guercif		Guercif	64 657	67 193	69 714	72 239	74 810	77 360	79 949	82 559	
		Aknoul	3 983	4 046	4 108	4 170	4 235	4 299	4 365	4 432	
<b>Total</b>			2 221 639	2 272 629	2 323 957	2 380 905	2 437 790	2 495 339	2 559 075		

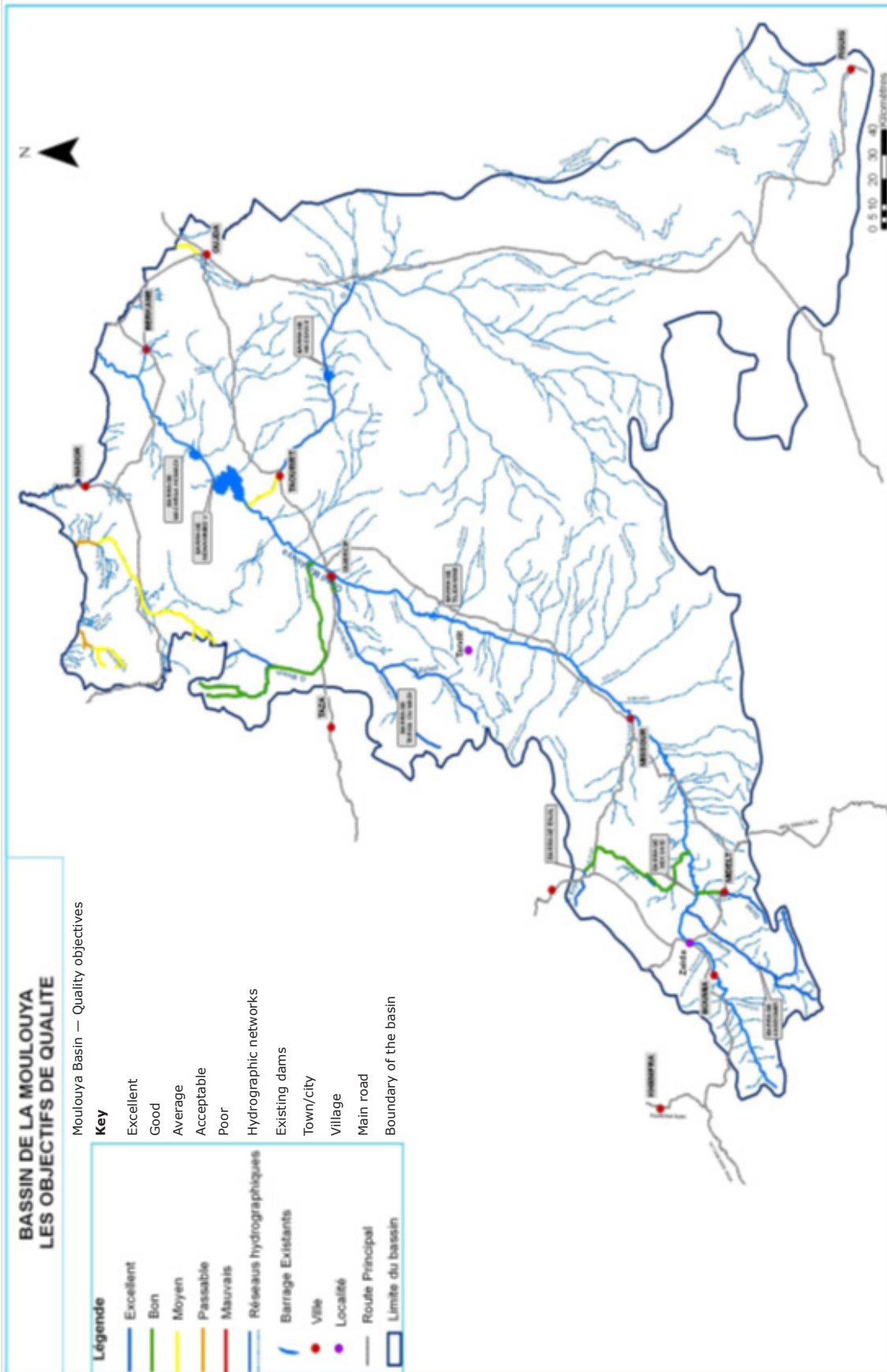
# Annex A4.2 Maps showing surface-water quality in the area under study

## The Loukkos, Tanger and Mediterranean coastal basins



Source: Integrated Master plan for Water Resources, 2011.

The Moulouya Basin



Source: Integrated Master plan for Water Resources, 2011.

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