
2.2

WATER



EC policy developed over the past few years has tended to unify directives concerning water under the Water Framework Directive. Spanish law has begun to adapt to this Directive highlighting, as is the case with other environmental policies, public participation as one of the fundamental elements.

The water-related legislation approved in 2008 includes Order ARM/2656/2008, of 10 September, which approves the procedures for hydrological planning and which adapts the instructions and recommendations approved in 1992 to the new Hydrological Planning Regulations set out in RD/907/2007. This order regulates the technical content of future basin-based hydrological plans.

Public consultation periods concerning the provisional schemes concerning important water-management topics in the river basin districts of the Guadalquivir and Segura, and the Spanish sections of the river basin districts of the Cantabrian region, Miño-Limia, Duero, Tagus, Guadiana and Ebro were opened in 2008. These schemes involve the description and assessment of the water-related problems in each demarcation and their possible solutions. Once the consultation period has ended, the results will serve as a basis for the drawing up of projects for the new Hydrological Plans.



INDICATOR	GOAL	TREND
Water consumption	Reduce and optimise consumption	Consumption has fallen in agricultural and urban zones
Reservoir water levels	Have sufficient reserves to guarantee supplies	Overall increase in reserves in the majority of hydrographic basins in 2008
Natural water resources	Achieve a sufficient level of water resources, established by hydrological planning, to maintain bodies of water in a good state	Naturally available water resources decrease on average
Brackish and sea water desalination	Increase available resources	Important increase in installed desalination capacity
Nitrate pollution of groundwater	Minimise pollution	Situation unequal in the different river basin districts
Salinisation of groundwater bodies	Reduce salinisation and preserve catchments	The Mediterranean river basin districts are particularly affected
Organic pollution of rivers	Achieve "good ecological status" in rivers	Slight worsening of organic pollution in rivers
Coastal bathing-water quality	Maintain the "good health status" of coastal bathing waters to ensure they remain suitable for bathing	Unfit coastal and inland bathing waters continue to decrease in number

The indicators described in this chapter analyse water from the viewpoint of available resources, water quality and basic management aspects. These indicators show a decrease in water consumption in both homes and agriculture, together with an overall improvement in available water reserves. However, a decrease in naturally available water resources, which could be interpreted as being due to climate change, has been observed over the past few years in Spain. This improvement in reserves is combined with the effort made to increase the production of desalinated water by using new technologies that allow energy costs to be reduced.

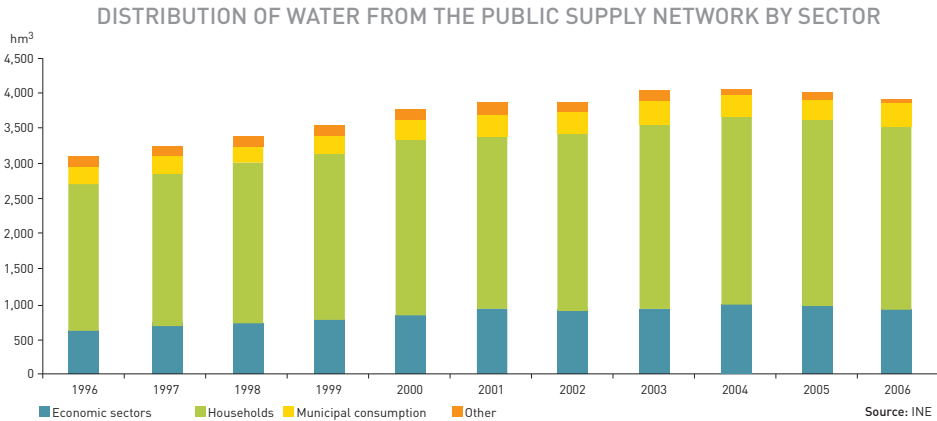
As regards quality, groundwater presents different levels of nitrate pollution depending on which river basin district it is found in. Salinisation of groundwater is limited to the Mediterranean river basin districts. On the other hand, river-based monitoring stations indicate a slight increase in organic pollution with respect to the previous year.

As for bathing water quality, the proportion of both inland and coastal bathing waters considered unfit has dropped and the proportion of bathing waters considered to be of good quality has increased, although mostly to the detriment of waters of very good quality.

The indicator “purification of urban waste water” has not been included due to methodological changes currently being implemented which have prevented data being updated. The National Water Quality Plan is being implemented by the Ministry of the Environment and Rural and Marine Affairs (MARM) via collaboration agreements with different Autonomous Regions. In 2008, Spain’s degree of compliance with Directive 91/271/EEC, regarding urban waste water treatment, was 80%.

Water consumption

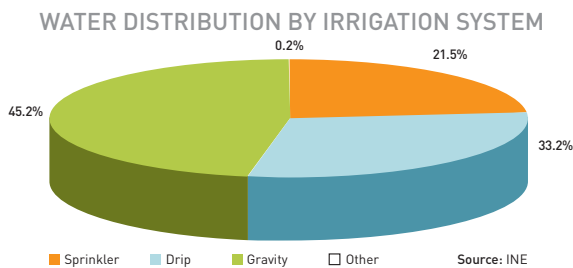
The volume of water consumed in both urban supplies and for agricultural use continued to drop in 2006



The volume of water distributed by urban supply networks in Spain in 2006 decreased by 3.6% with respect to the previous year, to 4698 hm³. This confirms the downward trend started in 2005. Domestic consumption and that by various economic sectors (industry, services and livestock farming) and municipal uses accounted for 83.3% of this amount.

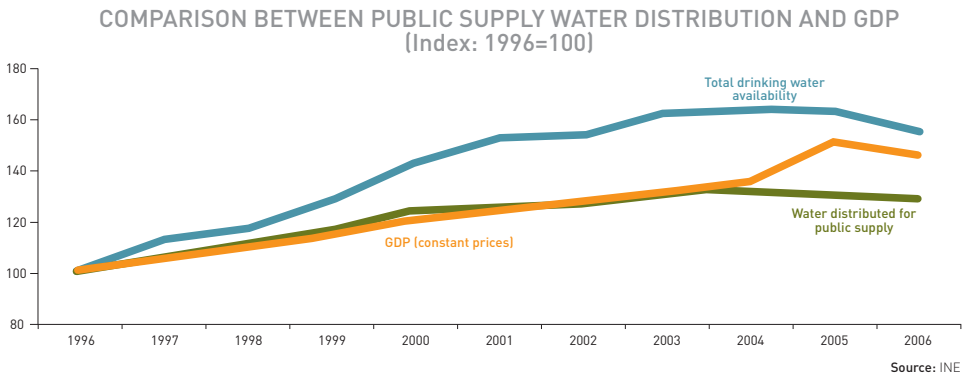
Average water consumption in the home was 160 litres per person per day in 2006, which represents a decrease on the 166 litres recorded in 2005.

Agricultural water use reached 15,865 hm³, a decrease of 3.9% with respect to 2005. The decrease in the amount of water used for irrigation continued, due above all to the modernisation programme undertaken over the past few years. The amount of water used for sprinkler and gravity irrigation continued to decrease (by 11.9% and 7.5% respectively), whereas the volume of water applied to crops by drip irrigation increased by 8.3%.



A comparison of GDP evolution (at constant prices) and water consumption, expressed as “total drinking water availability” and “water distributed for public supply” shows that, after several years when both variables increased in a similar way, in late 2004 water consumption began to decrease whilst GDP continued to increase.

The upward trend in GDP, which contrasts with the stability of the water availability values, suggests a more efficient use of the water available, which allows economic growth without the need to increase water consumption.



NOTES

- Water distributed includes all water available in the public distribution network, plus any losses from this network. It is based on total water abstraction by the supply company plus the net balance of water sales and purchases by and from other companies and local authorities.

SOURCES

- Water consumption figures: National Institute of Statistics. Environmental Statistics. Environmental Statistics on Water. In INEbase (<http://www.ine.es/inebase/cgjl>)
- Survey on Water Supply and Treatment (1996-2006).
- Survey on Water Use in the Agricultural Sector (1999-2006).
- Water consumption figures in industry:
- GDP figures: Secretariat general for energy, 2008. *Energy in Spain 2007*. Ministry of Industry, Tourism and Trade.

MORE INFORMATION

- <http://www.ine.es>
- <http://hispagua.cedex.es>
- <http://www.marm.es>

Reservoir water levels

Water reserves increased in 2008 in the majority of hydrographic basins, with an increase of more than 15% in total national reserves

HYDROLOGICAL TREND REPORT. Data as of 2 January 2009
CAPACITY (hm) AND RESERVES (%) IN NATIONAL RESERVOIRS

RIVER BASIN	Total reservoir capacity	Reserves	Reserves compared to total capacity (%)				
	hm ³	hm ³	2008	2007	2006	5-year average	10-year average
Galicia-Coast	684	471	68.9	32.9	71.5	56.5	61.5
Miño-Sil	3,030	1,684	55.6	44.1	79.2	59.4	62.4
Cantabrian	625	491	78.6	60.8	69.9	70.4	70.6
North III (1)	0	0	0	0	0	0	0
Basque Country Inland Basins	21	20	95.2	71.4	47.6	76.2	77.6
Duero	7,463	4,051	54.3	50.3	77.5	59.1	60.5
Tagus	11,012	4,944	44.9	40.8	58.9	50.1	53.3
Guadiana	8,630	3,963	45.9	54.4	59.3	63.9	61.9
Andalusian Atlantic Basin	1,878	713	38	35.8	44.1	55.7	59.5
Guadalquivir	7,306	2,621	35.9	35.3	40.2	51.9	54.9
Andalusian Mediterranean Basin	1,041	352	33.8	25.4	29.6	35.7	39.2
Segura	1,129	228	20.2	15.1	11.8	13.9	16.4
Jucar	3,346	932	27.9	20.3	14.3	24.2	24.2
Ebro	7,403	4,950	66.9	41.6	59.3	61.1	65.3
Catalonian Inland Basins	740	495	66.9	24.7	48.1	50.5	47.8
Atlantic watershed	40,649	18,958	46.6	44.7	60.3	56.4	58.1
Mediterranean watershed	13,659	6,957	50.9	32.1	41.5	44.9	47.4
Entire Peninsula	54,308	25,915	47.7	41.5	55.6	53.6	55.5

[1] Due to the separation of the Northern Hydrographic Confederation, the data for the North II and North III basins are included in those for the Cantabrian basin.

Source: MARM

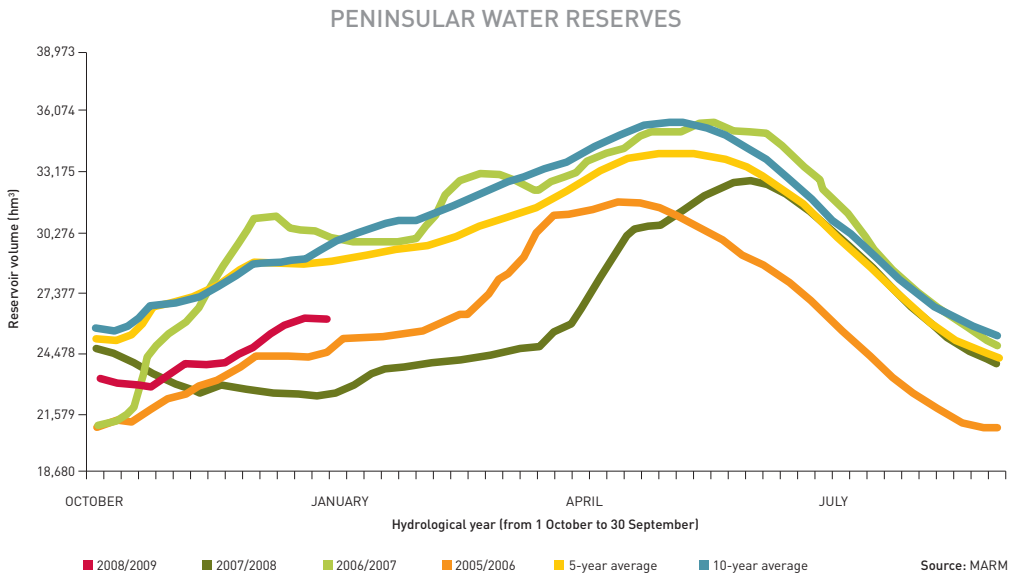
The water reserve figures for 2008 (as of 2 January 2009) show an overall increase in the majority of hydrographic basins, except those of the Guadiana and the Guadalquivir, with total national reserves increasing by 15% with respect to the previous year. This could indicate a certain upward trend in water reserves, particularly for the Mediterranean watershed (above the 10-year average). In contrast, although the Atlantic watershed improved with respect to the previous year, it remains far below the 5- and 10-year averages.

The greatest increases occurred in the Ebro, Catalonian and Galician basins. The Segura and Jucar basins increased their reserves by 30% with respect to 2007, although overall levels remained very low. Despite showing an improvement on the

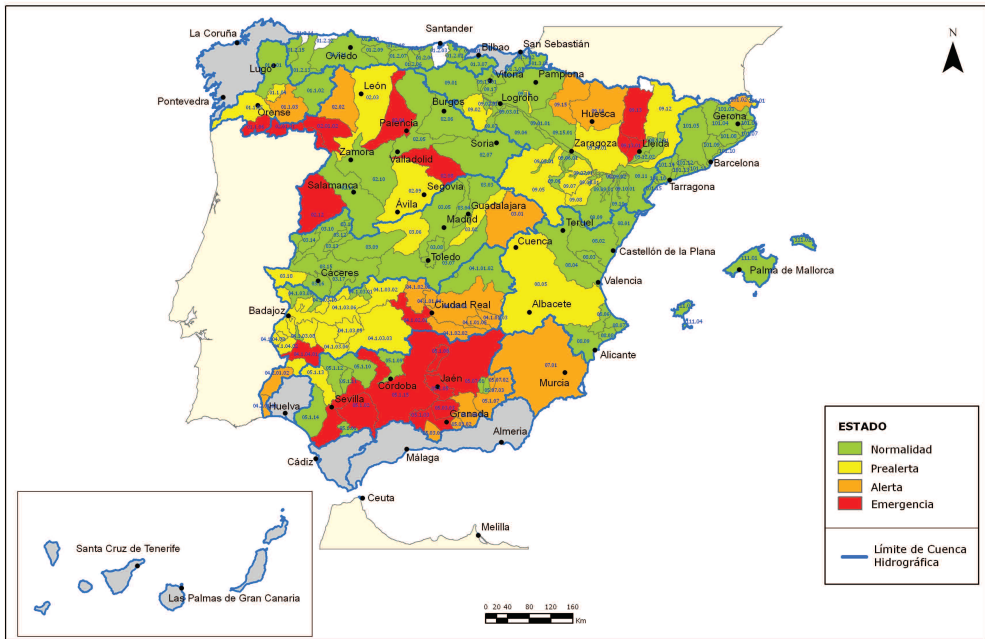
previous year, some regions in the Duero basin are still at emergency levels.

Although reserves reached their lowest levels for a number of years in winter of the hydrological year 2007-08, levels began to rise in the spring due to the significant rainfall experienced, and this increase continued into autumn 2008 (first quarter of the 2008-09 hydrological year).

The system of hydrological indicators put in place by the Directorate General for Water, which classifies the status of each exploitation system as normal, pre-alert, alert or emergency, highlights the improvements which have occurred in 2008 in numerous exploitation systems, although some regions are still in emergency status, as can be seen from the drought monitoring map for December 2008.



DROUGHT MONITORING MAP. DECEMBER 2008 RESOURCE EXPLOITATION SYSTEM (RES) STATUS



Fuente: MARM

NOTES

- The Directorate General for Water has developed a national hydrological indicator system which allows drought situations to be forecast based on the volume of water stored in reservoirs, the piezometric levels of aquifers, natural precipitation and precipitation in representative seasons. This system of indicators provides an objective characterisation of drought in each exploitation system and enables timely measures and actions to be applied at the pre-alert, alert or emergency stages.
- The hydrological year runs from 1 October to 30 September of the following year.

SOURCES

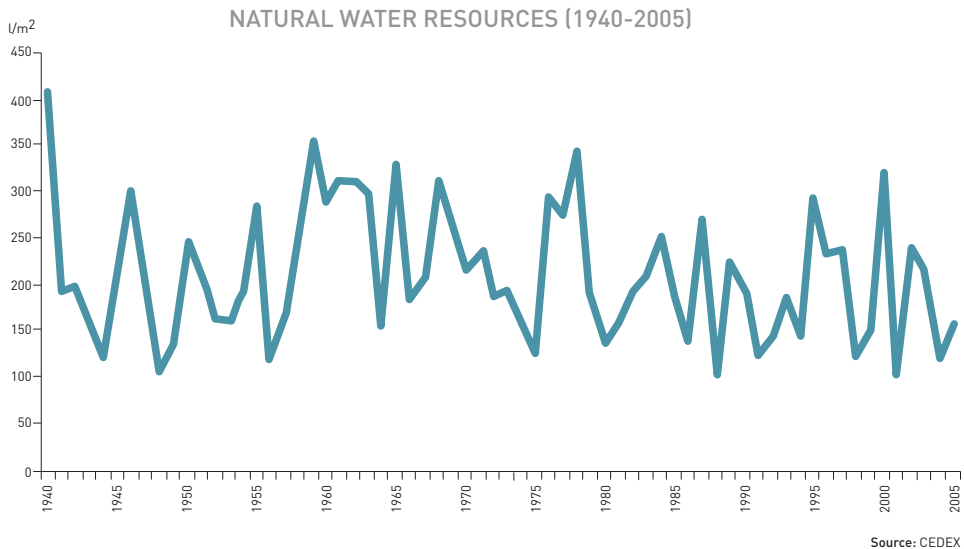
- Figures provided by the Sub-Directorate General for Water Planning and Sustainable Water Use. Directorate General for Water. MARM.

MORE INFORMATION

- <http://www.marm.es>
- <http://www.hispagua.cedex.es>

Natural water resources

Natural water resources have varied enormously from year to year over the past 20 years, although they have dropped by 5% overall



The natural water resources indicator shows the total amount of water contributed by the hydrological cycle in a region. It considers the surface contribution in the river network and the underground contribution, which leaves a region via aquifers. A lack of precipitation and water resources leads to drought.

This indicator enables water resource management as it becomes possible to estimate the resources available in a region over a certain time period based on the amount of natural water resources. This availability is reflected in the amount of water in reservoirs and influences its various uses, expressed in terms of water consumption, bearing in mind environmental needs.

The mean annual value in 2005 was 153.36 l/m². Meteorological changes result in large variations in each hydrological year, although in general terms total natural water resources have dropped by 5% in the last 20 years.

This decrease is common to all basins, except Galicia Coast and the Andalusian Atlantic Basin, where the value has remained essentially unchanged, and in the Jucar and Internal Catalanian Basin, where it has increased slightly. These exceptions are found because, although the whole country was affected by the drought of the early nineties, it was not distributed evenly.

The effects of climate change in Spain, especially higher temperatures and lower rainfall, are likely to lead to decreased water contributions and increased demand from irrigation systems. The system of available water resources and their management are therefore a key factor for the administration of excess or lack of water in the face of human demand.

NOTES

- The average annual natural water resources figure is calculated based on the average monthly values produced by the Precipitation-Contribution Simulation model (SIMPA), developed by the Public Works Study and Experimental Centre (CEDEX), which models the hydrological cycle for the country as a whole (the figures are included on a national scale and by river basin district), with a cell size of 1 km².
- Based on the precipitation, potential evapotranspiration and hydrological parameters, the model produces a map showing the various reserves, soil humidity and aquifer volume and on the hydrological cycle's exit variables, especially evapotranspiration and total runoff, the latter of which is obtained by summing the surface and underground runoffs. The indicator is expressed in units of litres per square metre (l/m²).

SOURCES

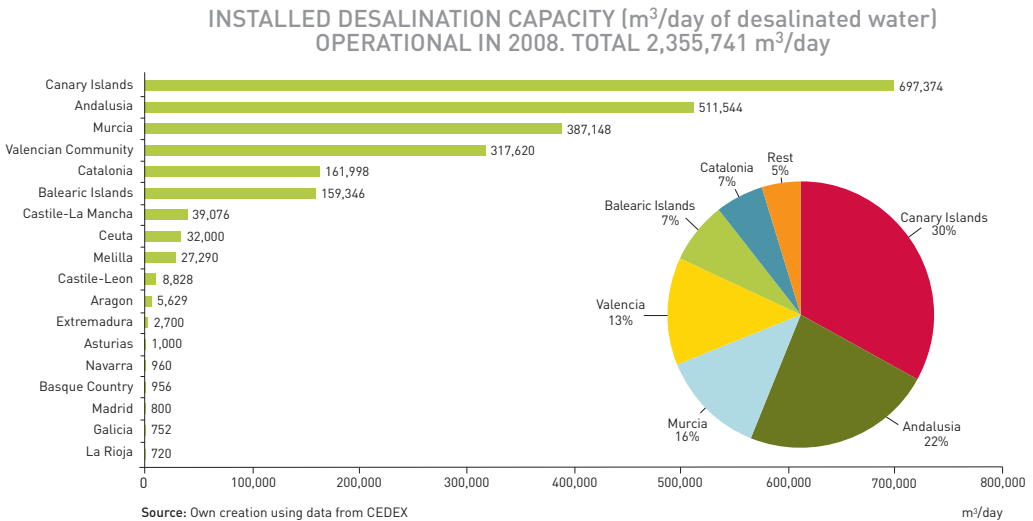
- Subdirectorate General for Water Planning and Sustainable Use. Directorate General for Water. MARM.
- Centre for Public Works Studies and Experimentation (CEDEX).
- Monitoring Centre for Sustainability in Spain, 2008. *Water and sustainability: Functionality of river basins*.

MORE INFORMATION

- <http://www.sostenibilidad-es.org>
- Ministry of the Environment, 2000. *White Book for Water in Spain*.

Desalination of brackish water and sea water

The new desalination plants have increased installed capacity by more than 11% in 2008 with respect to 2007



Together with the treatment and recycling of waste waters, one of the best ways of increasing water resources in Spain is desalination of brackish waters, both seawater and salinised groundwater. Plants which use this latter system (salinised groundwater) make up 30% of the total in Spain.

A large number of desalination plants were inaugurated in 2008, including that at Valdelentisco, Murcia. This is the largest desalination plant in Europe and the third largest in the world, with a maximum annual production of 70 hm³. These new desalination plants have contributed to the increase in installed capacity, which has grown by 11% with respect to 2007, and now has an operational desalination capacity of 2.4 hm³/day. The performance of each plant varies, however, and the actual estimated total production of desalinated water in 2008 was 1.9 hm³/day. The regions which have increased their capacity most in the past year are Valencia, with 85,000

DESALINATED WATER OUTPUT IN SPAIN

Year	1990	2000	2004	2007	2008	2009 (Forecast)
hm ³ /day	0.1	0.7	1.4	1.7	1.9	3.4

Source: Centre for Applied Technology Studies. CEDEX.

m³/day, and Murcia, with 70,000 m³/day. The Canary Islands, Andalusia and Murcia remain in the top spots in terms of desalinating capacity.

Energy consumption during the desalination process can account for between 50% and 70% of actual production costs. However, new technologies, such as the use of pressure exchangers instead of Pelton turbines, mean that more of the energy previously lost with the brine can now be recovered. These advances have led to a reduction in energy consumption of between 0.3 and 0.4 kWh per cubic metre of desalinated water produced. Improved water pre-treatment processes have also led to an overall improvement in the process as a whole.

The impact caused by brine discharges can be reduced significantly by controlling its concentration and varying the outlet point.

SOURCES

- Centre for Applied Technology Studies. CEDEX.

MORE INFORMATION

- <http://www.igme.es>
- <http://www.hispagua.es>
- <http://www.marm.es>

Nitrate pollution of groundwater

Nitrate pollution varies widely depending on the river basin district concerned

PERCENTAGE OF MONITORING STATIONS RECORDING NITRATE CONCENTRATIONS ABOVE 50 mg/l (2008)

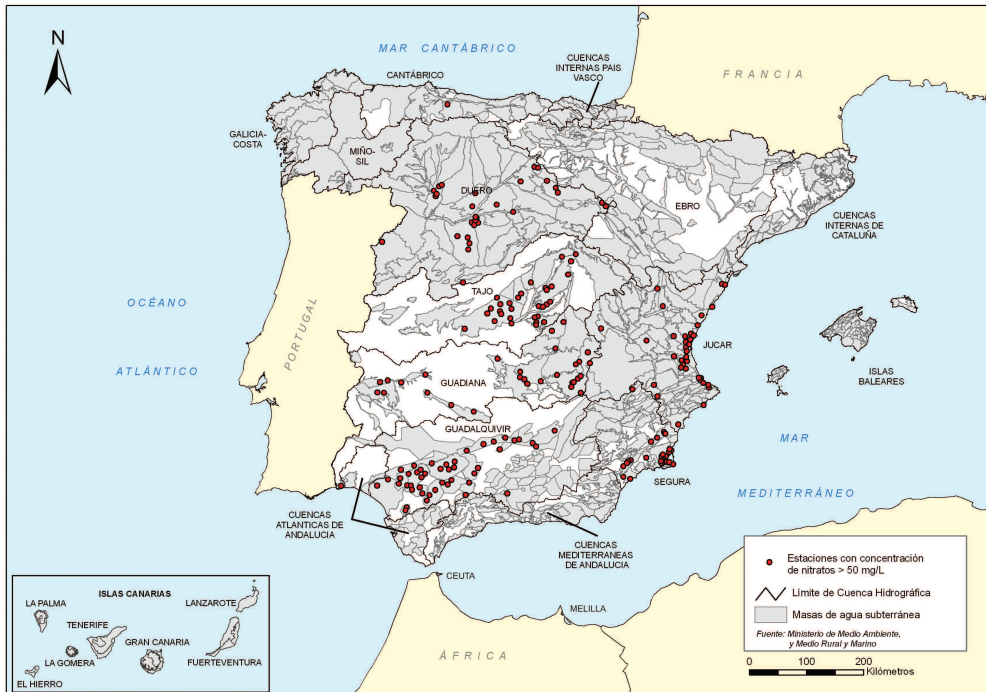
River Basin District	2006	2007	2008	River Basin District	2006	2007	2008
Galicia-Coast	SD	0%	2.44%	Guadalquivir	29.76%	27.54%	SD
Miño-Sil	SD	9%	0%	Guadiana	27.65%	29.16%	26.55%
Cantabrian	0%	0%	1.88%	Segura	22.68%	26.88%	SD
Basque Country Inland Basins	0%	0%	0%	Júcar	20.13%	20.20%	19.27%
Duero	12.78%	10.19%	12.17%	Ebro	18.70%	20.47%	SD
Tagus	25.32%	25.62%	23.66%				

Source: MARM. 2009

For the control of groundwater quality, the Water Framework Directive 2000/60/EC and Directive 2006/118/EC, on the protection of groundwater against pollution and deterioration, establish a series of indicators, including the nitrate concentration in milligrams per litre (mg/l). The proportion of control points with nitrate concentrations higher than 50 mg/l was again highly variable in 2008 and depended on the river basin district concerned.

The main causes of this type of groundwater pollution are agricultural, especially the excessive or inappropriate use of nitrogenated fertilisers, and livestock-related (discharge of slurries and other waste). High nitrate concentrations in water can affect its drinkability. The map below shows monitoring stations in the groundwater quality control network that recorded nitrate concentrations above 50 mg/l in 2008.

MONITORING STATIONS RECORDING NITRATE CONCENTRATIONS ABOVE 50 mg/l (2008)



Source: MARM

NOTES

- The definition of vulnerable zones is set out in Directive 91/676/EEC and is established according to nitrate pollution and run-off.
- Directive 2000/60/EC, which establishes the European framework for action in the field of water policy, establishes as one of its objectives the need to prevent groundwater pollution. In order to meet these objectives, rafts of measures should be established that, among other aspects, include those set out in Directive 91/676/EEC. In addition, the vulnerable zones established in accordance with Directive 91/676/EEC are also included in a register of protected areas under Directive 2000/60/EC.
- Directive 91/676/EEC, on the protection of waters against pollution caused by nitrates from agricultural sources, transposed into Spanish law by Royal Decree 261/1996, defines groundwater as being affected by this type of pollution if the nitrate concentration is above 50 mg/l, or could potentially reach this level.
- As a consequence of the work undertaken whilst preparing the four-yearly report 2004-2007 required by Directive 91/676/EEC, new monitoring stations were incorporated into both the control network for this Directive and the chemical-status monitoring network established under Directive 2000/60/EC.
- A row has been included for the Miño-Sil river basin district and another for the Cantabrian river basin district; these were both previously included in the row labelled North and Miño-Limia.
- Data for 2008 for the Guadalquivir, Segura and Ebro river basin districts are not available.
- The 2008 data for the Duero and Júcar river basin districts are calculated on the basis of data available for the first half of the year.

SOURCE

- Data provided by the Sub-Directorate General for Integrated Public Water Resource Management. Directorate General for Water. MARM.

MORE INFORMATION

- <http://www.marm.es>
- <http://www.eea.europa.eu>

Salinisation of groundwater bodies

Salt intrusion is particularly important in the Mediterranean river basin districts

A body of coastal groundwater is considered to be affected by salt intrusion when its chloride concentration in milligrams per litre (mg/l) is higher than 1000. The indicator for groundwater body salinisation is determined from the proportion of control points with a chloride concentration higher than that indicated above.

PERCENTAGE OF COASTAL GROUNDWATER MONITORING STATIONS
RECORDING CHLORIDE CONCENTRATIONS HIGHER THAN 1000 mg/l

River Basin District	2006	2007	2008	River Basin District	2006	2007	2008
Galicia-Coast	SD	0%	0%	Segura	35.71%	43.75%	SD
Cantabrian	0%	0%	0%	Júcar	5.88%	5.26%	5.26%
Basque Country Inland Basins	0%	0%	0%	Ebro	0%	14.29%	SD
Guadiana	0%	0%	0%	Guadalquivir	0%	0%	SD

Source: MARM. 2009

The Mediterranean river basin districts are most affected by salt intrusion, with the Segura basin district having the highest values in 2007. The Ebro basin district exceeded 14%, whereas the value for the Júcar remained essentially the same between 2006 and 2008.

The map below shows groundwater quality control network stations monitoring coastal groundwater bodies in which chloride levels of over 1,000 mg/l were recorded in 2006.

MAPA ESTACIONES CON CONCENTRACIÓN DE CLORUROS SUPERIORES A 1000 mg/l (2008)



Fuente: MARM

NOTES

- As a consequence of the work undertaken whilst preparing the four-yearly report 2004-2007 required by Directive 91/676/EEC, new monitoring stations were incorporated into both the control network for this Directive and the chemical-status monitoring network established under Directive 2000/60/EC.
- Data for 2008 for the Guadalquivir, Segura and Ebro river basin districts are not available.
- The 2008 data for the Júcar river basin district are calculated on the basis of data available for the first half of the year.

SOURCES

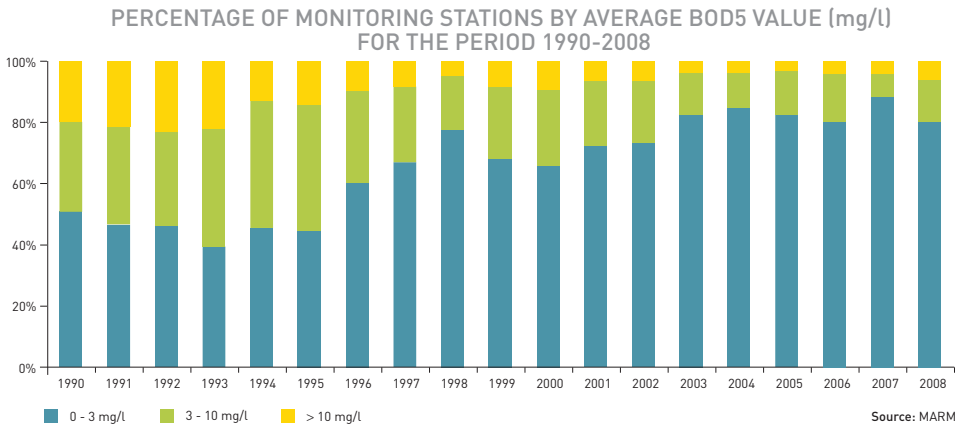
- Data provided by the Sub-Directorate General for Integrated Public Water Resource Management. Directorate General for Water. MARM.
- *Europe's water: An indicator-based assessment*. European Environment Agency, 2003.

MORE INFORMATION

- <http://www.marm.es>
- <http://www.eea.europa.eu>

Organic pollution of rivers

Organic pollution in rivers in 2008 was slightly worse than in the previous year



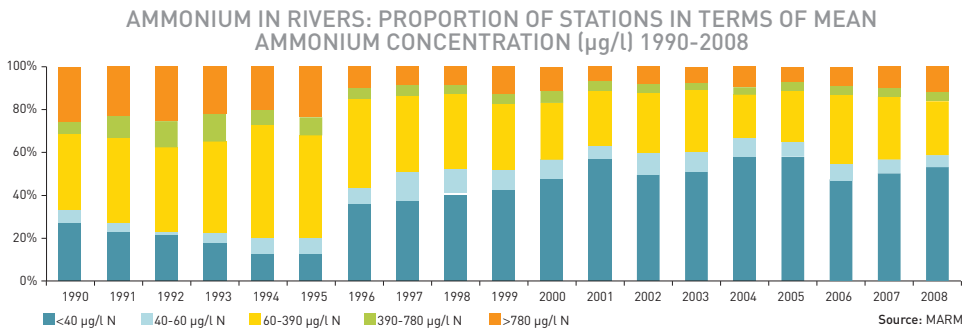
Organic pollution in rivers is a direct consequence of urban waste water discharges. The indicators used to measure this pollution are biological oxygen demand (BOD) and ammonium concentration.

BOD₅ is the amount of oxygen dissolved in water required to degrade the organic matter present in it under certain conditions and is expressed as milligrams of O₂ per litre (mg/l). This indicator covers those monitoring stations whose average BOD₅ value lies in one of three ranges: 0 to 3 mg/l, 3 to 10 mg/l and more than 10 mg/l.

A slight worsening was observed in 2008, with the proportion of control points with low organic pollution decreasing to 80% and those with higher amounts of organic matter increasing. This change can clearly be seen in the graph below.

The presence of ammonium in rivers, the majority of which comes from sewage networks, leads to an increase in nitrogen concentration, which in turn speeds up eutrophication processes.

The proportion of control points with high ammonium concentrations, measured in micrograms per litre (g/l), increased in 2008. Thus, the proportion of control points with an ammonium concentration of less than 40 g/l increased from 49.7% to 53.2%, whereas the proportion with a concentration of more than 780 g/l increased from 10.4% to 11.9%.



The new infrastructures associated with the application of the National Water Quality Plan: Sewerage and Treatment 2007-2015 is likely to reduce the pollution resulting from discharges and lead to improved river quality.

NOTES

- The National Water Quality Plan: Sewerage and Treatment 2007-2015 was approved by the Council of Ministers in June 2007.
- Biological oxygen demand, also referred to as biochemical oxygen demand (BOD), is used as a parameter to measure the quantity of matter liable to be consumed or oxidised by biological means within a liquid sample, and is used to establish the degree of pollution. This is normally measured after 5 days (BOD_5), and is stated in $\text{mg O}_2/\text{litre}$. It should not be confused with chemical oxygen demand (COD), the parameter used to measure the quantity of organic matter liable to be oxidised by chemical means within a liquid sample.
- Ammonium (NH_4^+) is the monovalent cation formed from ammonia. It is one of the components of urine, together with urea, sodium and chlorine.
- Ammonia (NH_3) is a colourless gas produced naturally by decomposing organic material. It is also produced industrially to make fertilisers, textiles, plastics, explosives, paper, foodstuffs, beverages, cleaning products and coolants, amongst others.

SOURCES

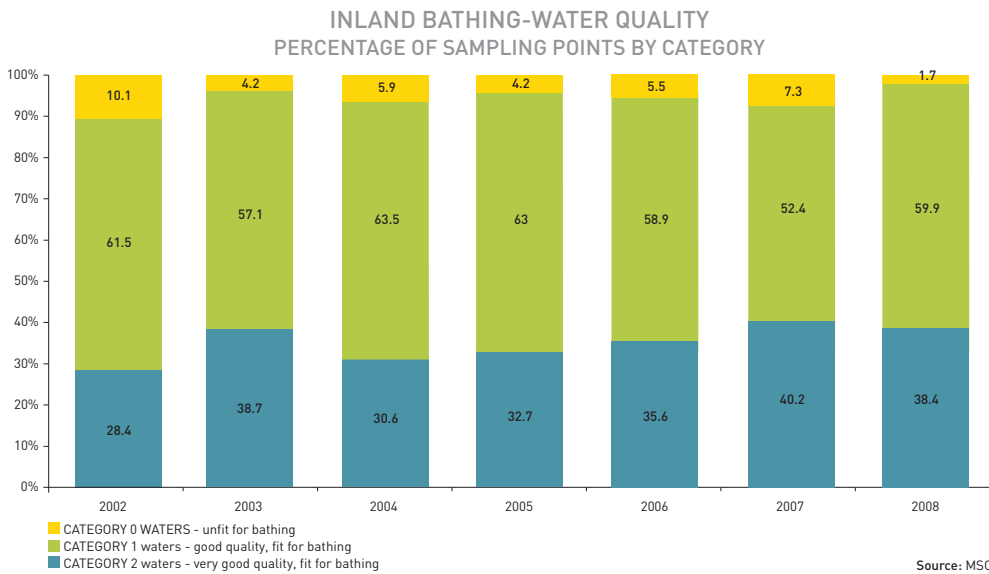
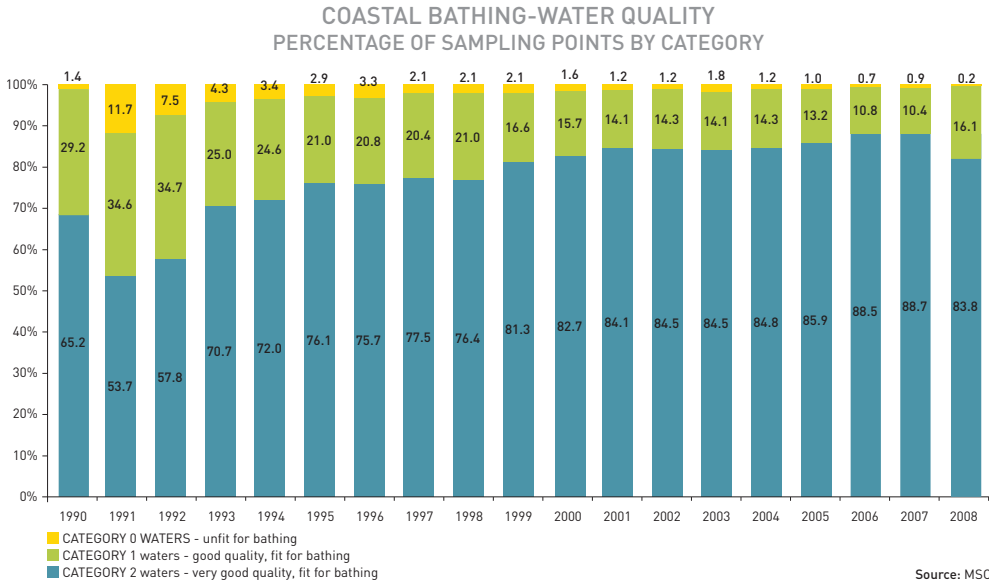
- Data provided by the Sub-Directorate General for Integrated Public Water Resource Management. Directorate General for Water. MARM.

MORE INFORMATION

- <http://www.mma.es>
- <http://www.eea.europa.eu>

Coastal bathing-water quality

The proportion of sites unfit for bathing dropped to 0.2% for coastal sites and 1.7% for inland ones



In this edition the indicator provides information concerning the quality of coastal and inland bathing waters. The annual health classification of bathing water quality into three categories is maintained: “unfit”, “good quality” and “very good quality”, as

stipulated in Royal Decree 734/88 of 1 July. This assessment is performed at the end of the bathing season by monitoring a series of microbiological and physicochemical parameters analysed at sampling points for the different coastal and inland bathing sites.

The proportion of coastal bathing sites fit for bathing (good or very good quality) was 99.84% of the sampling points. The proportion of very good quality bathing waters decreased by around 5% in favour of waters with good quality. However, the proportion of bathing waters considered unfit for bathing continued to decrease, dropping below 0.2%.

As regards the quality of inland bathing waters, the proportion of bathing sites considered unfit for bathing has decreased over the past six years to 1.7% in 2008. The proportion of inland bathing waters of very good quality has decreased somewhat to 38.4%, whereas the proportion of good quality bathing waters increased to 59.9%.

Royal Decree 1341/2007, of 11 October 2007, on the management of bathing-water quality, transposed Directive 2006/7/EC, of 15 February, classifying bathing waters into four categories: “Poor”, “Sufficient”, “Good” and “Excellent”. This new classification was accompanied by a reduction in the number of parameters analysed to the measurement of intestinal *Enterococci* and *Escherichia coli*, indicators of waste-water treatment levels and animal-related pollution, which are the main risk factors for human health. This classification began to be applied in some Autonomous Regions in 2008.

NOTES

- Classification of the quality of these waters is based on microbiological criteria: presence/absence of faecal and total coliforms. Category 2 is allocated to the best quality water, whereas water at the other end of the scale is classified as category 0.
- The most frequent sources of pollution are direct discharge of untreated waste water and temporary breakdown in waste-water treatment infrastructure.
- The Hygiene Classification of Bathing Water at Sampling Point was undertaken on the basis of the following criteria:

CATEGORY 2 WATERS: Water suitable for bathing, very good quality. These waters simultaneously meet the following conditions:

- 1) At least 95% of samples must not exceed the required values for: Total Coliforms, Faecal Coliforms, Salmonella, Enteroviruses, pH, Colour, Mineral Oils, Surfactants, Phenols and Transparency.
- 2) At least 80% of samples must not exceed the guideline values for: Total Coliforms and Faecal Coliforms.
- 3) At least 90% of samples must not exceed the guideline values for: Faecal Streptococci, Transparency, Dissolved Oxygen and Floating Materials.

CATEGORY 1 WATERS: Water suitable for bathing, good quality. These waters comply with condition 1) of Category 2, but not conditions 2) and/or 3).

CATEGORY 0 WATERS: Waters unfit for bathing. These waters do not meet condition 1) of Category 2.

- In accordance with the provisions of Directive 76/160/EEC, regarding bathing water quality, the Ministry of Health and Consumer Affairs sends an Annual Summary Report of the Bathing Water Quality in Spain to the European Commission.

SOURCES

- Data provided by the Sub-Directorate General for Environmental Health and Health and Safety at Work. Ministry of Health and Consumer Affairs.

MORE INFORMATION

- <http://www.msc.es>
- <http://ec.europa.eu>

