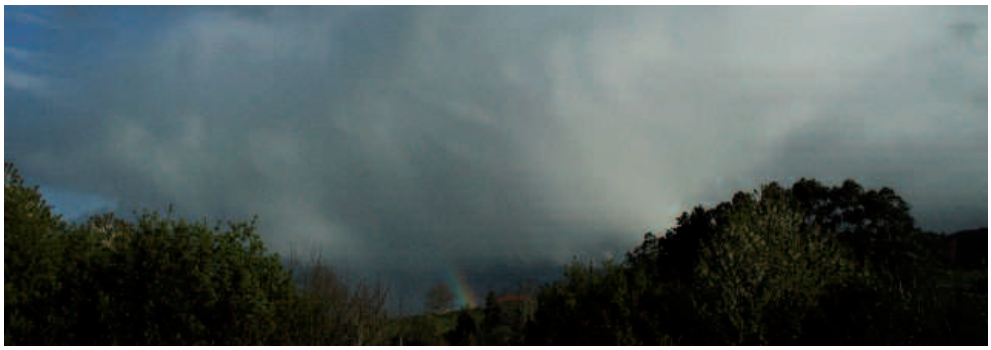
2.16 NATURAL AND TECHNOLOGICAL DISASTERS

Nature exists in a constant state of flux manifested both by regular phenomena, such as rainfall, and other extraordinary events, such as earthquakes.

Disasters arise from the conjunction of a potentially destructive natural phenomenon and a location vulnerable to such phenomena.
Generally, natural disasters (such as earthquakes, floods, landslides, hurricanes etc.) affect the normal functioning of a country. They can result in high death rates and extensive damage to infrastructure and services.

Other types of disaster, which also result in enormous losses, are due to, or are a direct consequence of, human activity. These include environmental pollution by industry; over-exploitation of renewable and non-renewable natural resources; and construction of homes and buildings in high-risk areas.



WORLDWIDE NO OF CATASTROPHES AND FATALITIES DUE TO NATURAL DISASTERS

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Events	890	701	698	699	641	648	850	960	750	850	950
Fatalities	10,300	25,063	10,576	77,886	183,000	100,995	20,000	16,000	160,000	10,500	295,000

Source: Munich Reinsurance Company (various years): Topics Geo Annual review: Natural catastrophes 2005, Topics Geo. Natural disasters 2006–2010. Website: http://www.munichre.com

According to the Munich Reinsurance Company (Munich Re), a disaster becomes a 'major catastrophe' when the affected regions cannot cope with the emergency situation without external aid. In 2010, there were five 'major catastrophes' and 50 'devastating catastrophes' (defined as catastrophes in which there are more than 500 fatalities).

2010 witnessed the second-highest ever number of natural disasters (after 2007) since 1980. Munich Re recorded 950 natural disasters, a figure well above the average of the last thirty years (615 disasters).
Forty per cent of recorded disasters in 2010 were tropical storms and weather events; 39% were floods and other hydrological events; 12% were climatic phenomena such as heatwaves; and the remaining 9% were earthquakes and volcanic eruptions. In terms of fatalities, 2010 was the second-worst 12-month period in 30 years, closing with a total of 295,000 deaths.

Disasters in Spain are insignificant compared to those that occur elsewhere in the world, but every year a varying number of people are affected and killed by these events. Over the years, and in terms of material damage and loss of human life, floods have been the most harmful natural hazard in Spain.

To facilitate assessment of flood risk and create the corresponding hazard maps and flood-risk management plans, the Spanish Government recently passed Royal Decree 903/2010 of 9 July on assessment and management of flood risk.

This year, the indicator measuring oil spills due to maritime accidents has not been included, as the figures have not varied since last year. However, it should be mentioned that in December 2010 there was an oil spill from a platform in the delta of the river Ebro.

INDICATOR	GOAL	TREND
Fatalities due to natural disasters	Prevent disasters and industrial accidents in order to reduce the number of fatalities and the environmental impact caused by natural phenomena and technological processes through implementation of appropriate preventive measures, intervention, and information	There were 13 more fatalities in 2010 than in 2009
Drought		32.9% of years between 1941 and 2010 were dry, while 67.2% were normal or wet
Forest fires		In 2010, the number of forest fires and the area affected were both below the average for the last decade
Road and rail accidents causing possible environmental damage		The figures for accidents in the transport of dangerous goods that may cause environmental damage are stable
Industrial accidents involving hazardous substances		In 2009, there were seven accidents within the scope of the Seveso Directive

Fatalities due to natural disasters

There were 13 more fatalities due to natural disasters in 2010 than in 2009

NUMBER OF FATALITIES IN SPAIN DUE TO NATURAL DISASTERS (1995–2010)

Type of natural disaster	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Floods	22	110	40	0	5	14	9	13	9	7	8	9	11	6	5	12	280
Storms	19	13	14	2	20	28	17	12	8	6	8	9	4	3	11	6	180
Forest fires	8	1	4	4	8	6	1	6	11	4	19	8	1	1	11	9	102
Landslides	7	8	2	0	0	0	1	1	2	0	0	5	2	1	2	2	33
Heatwaves	0	0	0	0	1	0	0	0	60	23	4	14	0	0	0	2	104
Avalanches	7	1	0	0	0	4	2	4	4	5	1	0	0	4	3	11	46
Snow and cold	0	2	5	1	0	2	4	0	0	3	3	0	0	0	1	1	22
Fatalities on land due to maritime storms	19	13	13	36	17	37	27	15	5	20	ND	ND	ND	4	2	5	213
ANNUAL TOTAL	82	148	78	43	51	91	61	51	99	68	43	45	18	19	35	48	980

Source: Directorate-General for Civil Protection and Emergencies (Ministry of the Interior)

Most of the 980 fatalities due to natural disasters in the last 16 years (1995–2010) in Spain were caused by floods (280 deaths, 28.6% of the total). The next biggest causes were maritime (213 deaths, 21.7%) and terrestrial storms, including lightning and strong winds (180 deaths, 18.4%). These natural phenomena, along with forest fires and heatwaves, have had the severest impact and have resulted in most fatalities over the past 15 years.

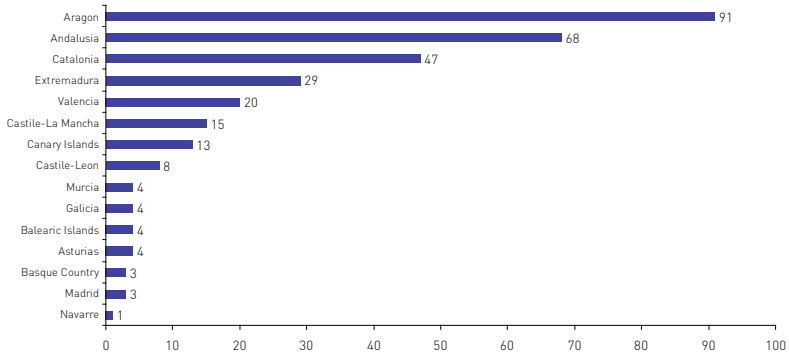
The fight against the effect of floods has long been a permanent part of civil protection and water policy. The traditional approach has been to design and build structural solutions, like dams, channels and dykes. These have been complemented in recent years with non-structural action, including civil protection plans; implementation of alert systems; corrective hydrological and forestry measures in river basins; and spatial planning measures, all intended to minimise the consequences of floods.

Royal Decree 903/2010, of 9 July, on the assessment and management of flood risks, is a further piece of legislation in this field. In 2010 there were various localised downpours of torrential rain in areas of central and northern Andalusia, in the north of the island of Majorca, and in the Canary Islands. In 2010, storms significantly damaged infrastructure and facilities and brought down numerous branches and trees. Overall, they caused 6 deaths, five fewer than in 2009. Meanwhile, torrential rainfall caused vast floods, resulting in 12 fatalities, seven more than the previous year.

Avalanches occur when a large mass of built-up snow becomes unbalanced, detaches from the rest and rolls or slides down the mountainside. It is worth highlighting the high number of deaths due to avalanches in 2010 — 11 people in total died in Spain, 8 more than the previous year.

Floods are the most frequent natural phenomenon in Spain. Analysis of flood data shows that 314 people died as a result of floods between 1990 and 2010. Aragon registered the highest number of deaths (29%), attributable mainly to the catastrophe in Biescas (Huesca) in 1996, which accounted for 87 out of the 110 fatalities in 1996, followed by Andalusia (21.7%), and Catalonia (15%). In 2010, there were 12 deaths (7 of them in Andalusia), as opposed to 5 in 2009 and 6 in 2008.

DEATHS DUE TO FLOODS AND SPATES IN SPAIN 1990–2010 (Total 314 fatalities)



Source: DGPC y E

NOTES

- Fatalities due to maritime storms refer solely to victims on land due to falls, sea surges, etc. These figures do not include fatalities at sea (drowning, falls, etc.) due to these phenomena.
- The indicator does not include volcanic eruptions, droughts and earthquakes, since although these phenomena may occur in Spain (drought recurrently and minor earthquakes periodically in certain areas), they have not caused any deaths in the period under consideration. The Canary Islands are the only part of Spain with active volcanoes and, therefore, the only area in which risk associated with this phenomenon exists. The last eruptions were that of Chinyero (a lateral volcano on the Pico del Teide) on Tenerife in 1909 and those of Nambroque in 1949 and Teneguía in 1971, both on the island of La Palma.

SOURCES

- Sub-Directorate-General for Planning, Operations and Emergencies. Directorate General for Civil Protection and Emergencies. Ministry of the Interior.

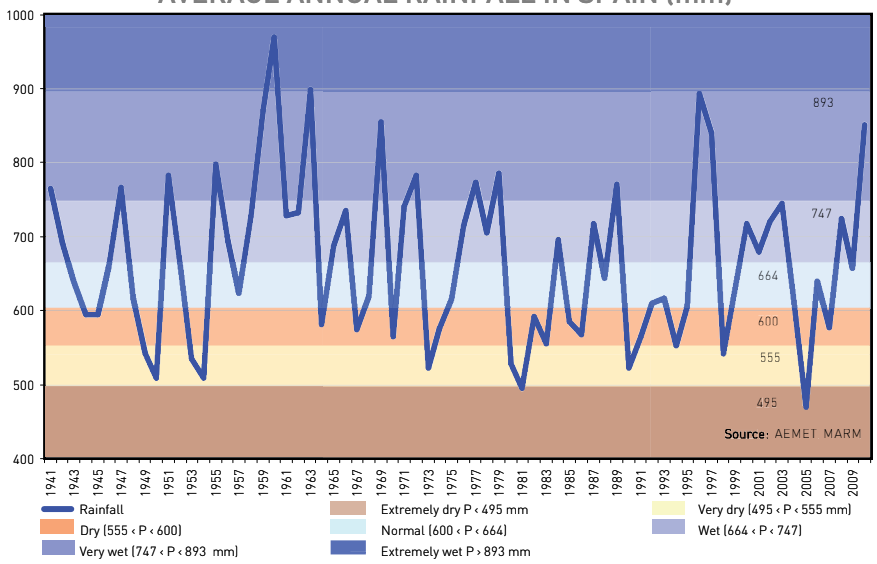
FURTHER INFORMATION

- http://www.eea.europa.eu
- http://www.proteccioncivil.org/
- http://natural-hazards.jrc.it
- http://nedies.jrc.it/

Drought

2010 was a very wet year and average rainfall was over 25% above normal

AVERAGE ANNUAL RAINFALL IN SPAIN (mm)



Drought is defined as an abnormal scarcity of water that results in a significant seasonal reduction in available water and moisture to below the expected quantity for a particular period.

Over the period 1941–2010, and taking into account average annual recorded rainfall, 32.9% of the years were dry, while the remaining 67.2% were normal or wet. In fact, using the classification based on average annual rainfall, according to the figures in the following table, 30% of those years were dry or very dry, 21.4% were normal, and 42.9% were wet or very wet. Furthermore, the percentage of years that were either extremely dry or extremely wet are similar — 2.9%.

PERCENTAGE OF YEARS, CLASSIFIED BY AVERAGE RAINFALL (1941–2010)

Extremely dry (R<495) (mm)	Very dry (495<R<555) (mm)	Dry (555<R<600) (mm)	Normal (600<R<664) (mm)	Wet (664<R<747) (mm)	Very wet (747<R<893) (mm)	Extremely wet (R>893) (mm)
2.9	14.3	15.7	21.4	24.3	18.6	2.9

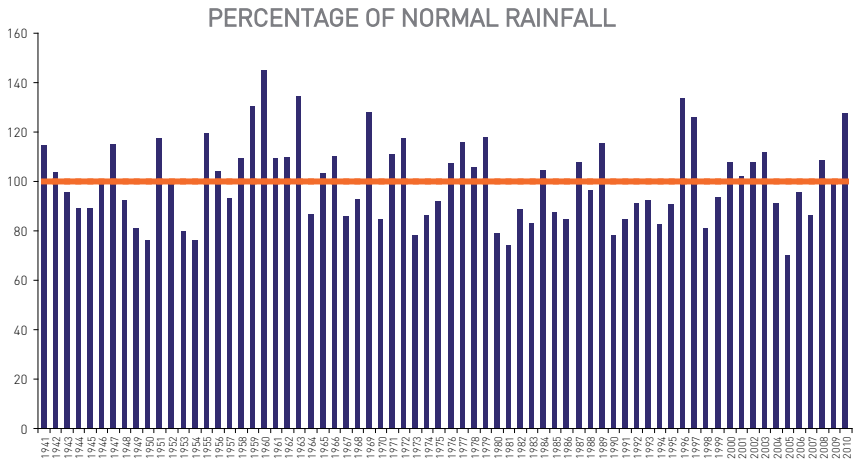
Source: Compiled in-house using data provided by the AEMET

Analysis of the Percentage of Normal Rainfall over the 1941–2010 period shows that in 54.2% of the years surveyed, annual rainfall was lower than the average for the period, whilst in 45.7% of them, annual rainfall was higher.

According to provisional data, average rainfall in Spain in 2010 was 851.5 mm. This is 27.7% above the average for the period 1941–2010, producing a surplus average rainfall of 184.9 mm.

The majority of this above-average rainfall occurred during the winter months (January, February and December), while in contrast, the summer months were dry, especially July, when rainfall in Spain as a whole was half the normal average.

In general, it was a very wet year in the southern part of the peninsula (with the exception of the south-east coast), as well as in the majority of the Balearic Islands, the most western Canary Islands, Asturias and some parts of Castile-Leon. In fact, in some western and southern areas of Andalusia and on the island of El Hierro, total rainfall in 2010 more than doubled the normal figure. In contrast, the year was normal to dry in the west of Galicia and across the north-east of the peninsula from Cantabria to the north of Valencia. In some parts of western Galicia and Valencia, rainfall was less than 25% of the average.



Source: AEMET. MARM

NOTES

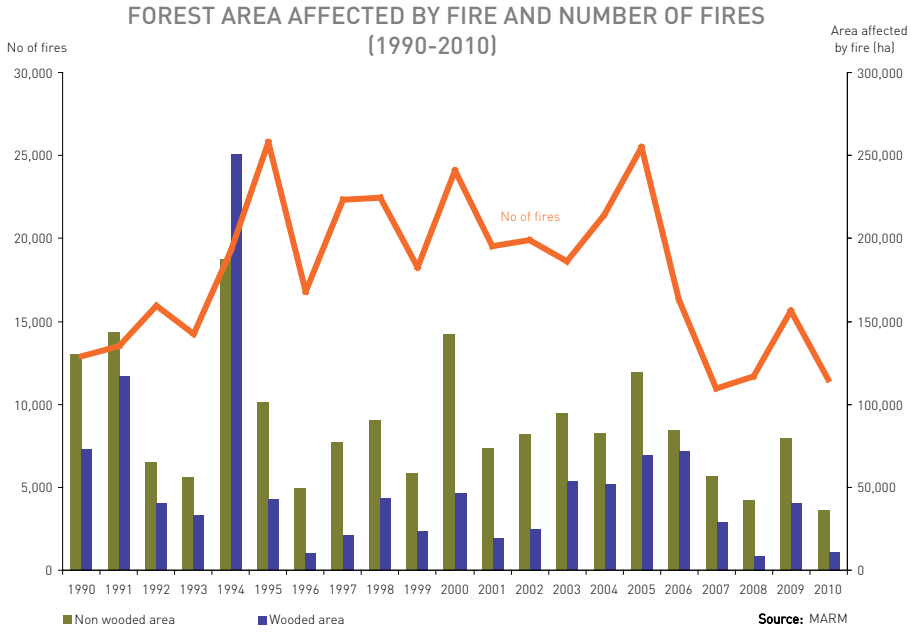
- In calculating the indicator, a year or several years are classified as drought years when average annual rainfall is significantly below the average for the period. Under the Spanish Water Information System (Hispagua), the Percentage of Normal Rainfall is one of the indicators used to study drought. It is calculated as the ratio between accumulated rainfall in a year and average annual rainfall for a particular region and period and is expressed as a percentage. Average annual rainfall is also referred to as normal rainfall and is obtained by averaging annual rainfall over a period of no less than 30 years.
- For the AEMET, the 1971–2000 reference period (30 years) is representative of rainfall in Spain and is used to establish the following ranges and create a generic classification within which to place each year in accordance with its average annual rainfall:
  - Extremely dry: rainfall is below the minimum amount recorded in the reference period (495 mm).
  - Very dry: rainfall is less than or equal to the reference period's 20 percentile and is greater than the minimum amount recorded in the reference period (495 mm ≤ R < 555 mm).
  - Dry: rainfall is greater than the 20 percentile and less than or equal to the 40 percentile (555 mm ≤ R < 600 mm).
  - Normal: rainfall is greater than the 40 percentile and less than or equal to the 60 percentile (600 mm ≤ R < 664 mm), in other words, it is around the median.
  - Wet: rainfall is greater than the 60 percentile and less than or equal to the 80 percentile (664 mm ≤ R < 747 mm).
  - Very wet: rainfall is greater than the 80 percentile and less than the maximum amount recorded in the reference period (747 mm ≤ R < 893 mm).
  - Extremely wet: rainfall is equal to or greater than the maximum amount recorded in the reference period (893 mm).
- Scarcity of precipitation (meteorological drought) may cause a shortage of water resources (hydrological drought) needed to supply existing demand. Consequently, there is no universally accepted definition of drought, as it varies from place to place and every water user has their own definition.
- Previous editions of the Report included extensive information on the definition, type and consequences of drought. The EU differentiates clearly between "drought" as a temporary drop in water availability due to lack of precipitation and "water scarcity," which arises when demand for water exceeds the water resources exploitable under sustainable conditions.

SOURCES

- Rainfall data provided by the AEMET. MARM. http://www.aemet.es/es/portada
- MARM, 2010. Drought situation. Diagnosis of the situation on March 17, 2010.

Forest fires

Forest area affected in 2010 was 63.3% below the average of the previous decade



According to provisional data, in 2010 the number of both outbreaks and fires was below the average for the previous decade (2000–2009) — 37% below the total number of forest-fire events (outbreaks and fires), and 44% below the number of actual fires. In 2010, there were 11,475 events, while the ten-year average stood at 18,367. The pattern in the number of forest fires over the year followed the average trend for the decade. Although these numbers peaked in March and August, all the monthly figures remained below the average.

The forest area affected in 2010 was 63.3% below the average of the decade 1999–2009.

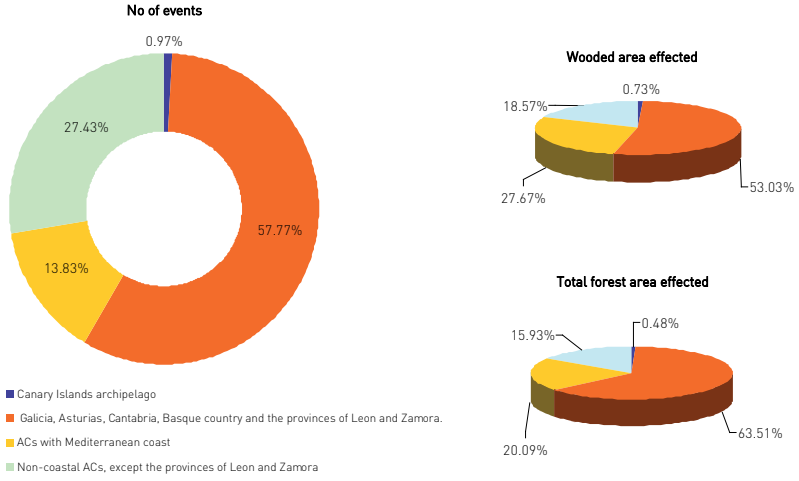
A total of 46,698 hectares were affected, while the ten-year average was 127,209 hectares. The percentage of wooded area affected also decreased substantially, to 23.18% in 2010.

	TEN-YEAR AVERAGE	2010
No of outbreaks (<1 ha)	11,675	7,687
No of fires (>1 ha)	6,692	3,788
Total no of forest-fire events	**18,367**	**11,475**
Wooded area affected (ha)	41,481.1	10,824.4
Forest area affected (ha)	127,209.1	46,697.9
% area affected / % total forest area	**0.456**	**0.168**
No of major fires (>500 ha)	**31**	**12**

Source: MARM

In 2010, the north-west of Spain (Galicia, Asturias, Cantabria and the Basque Country, together with the provinces of Leon and Zamora) suffered 57.8% of all forest-fire events, while the inland autonomous communities suffered 27.4%, the Mediterranean Arc suffered 13.8% and the Canary Islands suffered 1%.

NUMBER OF FOREST FIRE EVENTS AND AFFECTED AREA (2010)



Source: MARM

The percentage of forest or wooded area affected describes the consequences of forest fires in terms of surface area. In 2010, by proportion of wooded area affected, north-western Spain suffered most (53.03%), followed by the Mediterranean Arc (27.67%), the inland autonomous communities (18.57%) and the Canary Islands (0.73%). In terms of forest area, as before (albeit to a greater extent) the worst affected area was north-western Spain (63.51%), followed by the Mediterranean Arc (20.09%), the inland autonomous communities (15.93%) and the Canary Islands (0.48%).

The three largest fires in 2010 occurred in Ontinyent and Rafelguaraf (both in Valencia), which affected 2,512.1 and 2,059.3 hectares respectively, and in Laza,

Galicia (1,715 hectares). In 2010, there were 12 major fires (defined as affecting over 500 hectares) in Spain, which affected 29.2% (13,610.6 hectares) of the country's forest area.

NOTES
- The data for 2010 are provisional.

SOURCES
- Data provided by the Forest Fire Defence Department. Directorate-General for the Natural Environment and Forestry Policy. MARM.
- MARM, 2010. *Incendios forestales en España, 1 de enero – 31 de diciembre de 2010. Avance informativo, Enero 2011*. Published on the website.

FURTHER INFORMATION
- http://www.marm.es
- http://www.incendiosforestales.org

Road and rail accidents causing possible environmental damage

In 2009, there were 47 accidents causing possible environmental damage

NO OF ACCIDENTS CAUSING POSSIBLE ENVIRONMENTAL DAMAGE DURING THE TRANSPORT OF DANGEROUS GOODS BY ROAD AND RAIL (1997–2009)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Road	29	50	34	53	44	47	55	64	61	46	48	45	47	623
Rail	10	8	ND	4	2	1	5	4	2	1	2	1	0	40
TOTAL	39	58	34	57	46	48	60	68	63	47	50	46	47	663

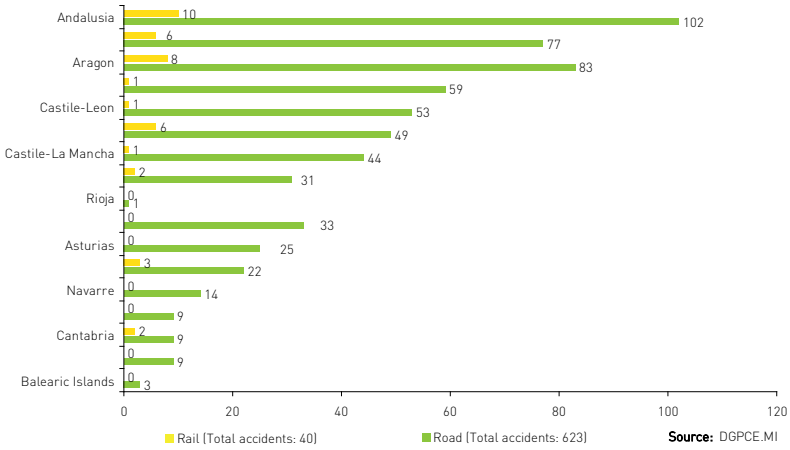
Source: Directorate-General for Civil Protection and Emergencies. Ministry of the Interior.

When categorising road and rail accidents, dangerous goods are considered those substances that, in the case of an accident during transport, may represent a hazard to the population, property and the environment. Over 1997–2009, there were 663 accidents causing possible environmental damage during the transport of dangerous goods — 623 by road and 40 by rail.

Globalisation of the economy and manufacturing specialisation are having a notable impact on transport distribution structures. The vast majority of accidents causing possible environmental damage occurred in road transport, while the number of rail accidents is much smaller, accounting for just 6% of the total. In 2009, none of the 47 recorded accidents occurred in rail transport. Road transport was the most widely used mode in 2009, carrying 84% of total freight (including dangerous goods), while only 2.1% of freight was transported by rail. The flexibility to adapt to new routes and vehicle specialisation to cater for specific transport needs are just two of the main reasons why road transport is growing rapidly and sustainedly in comparison with other modes such as rail.

The volume of goods transported, together with the size of the road network and its geographical location (either as a junction or as a strategic location such as a sea port or border crossing) are factors that contribute to the increase in freight and, therefore, to a possible increase in the risk of accidents occurring. The autonomous communities that recorded the highest number of accidents during the transport of dangerous goods were Andalusia (102 road accidents and 10 rail accidents), Aragon (83 road accidents and 8 rail accidents), and Catalonia (77 road accidents and 6 rail accidents) during the period 1997–2009.

NUMBER OF ACCIDENTS CAUSING POSSIBLE ENVIRONMENTAL DAMAGE DURING THE TRANSPORT OF DANGEROUS GOODS BY ROAD AND RAIL (1997–2009)



Between 1997 and 2009, the number of incidents affecting the environment totalled 723. The number of incidents is not the same as the total number of accidents, as a single accident may affect several environmental media. Soil was the environmental medium that suffered most (93.6% of incidents), while air was affected by 10.6% and water by 4.3%.

NO OF INCIDENTS CAUSING POSSIBLE ENVIRONMENTAL DAMAGE DURING THE TRANSPORT OF DANGEROUS GOODS (1997–2009)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Air pollution	5	3	2	4	3	0	8	8	17	7	8	4	5	74
Water pollution	7	11	6	9	5	5	4	14	9	8	7	8	2	95
Soil pollution	36	49	29	51	41	46	57	55	49	41	43	39	44	580
TOTAL	**48**	**63**	**37**	**64**	**49**	**51**	**69**	**77**	**75**	**47**	**50**	**46**	**47**	**723**

Source: Directorate-General for Civil Protection and Emergencies. Ministry of the Interior.

NOTES

- When categorising road and rail accidents, dangerous goods are considered those substances that, in the case of an accident during transport, may represent a hazard to the population, property and the environment. Possible environmental damage is considered to occur when the existence of a leak or spillage (on land, in water or into the atmosphere) with a potentially pollutant effect is reported.
- It is necessary to emphasise that the number of incidents is not the same as the number of accidents, as a single accident may affect several environmental media.

SOURCES

- Data provided by the Directorate-General for Civil Protection and Emergencies. Ministry of the Interior.
- *Libro Blanco del Transporte.*

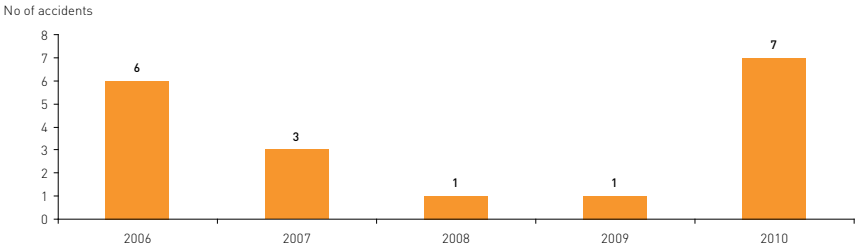
FURTHER INFORMATION

- http://www.proteccioncivil.org/
- http://mahbsrv.jrc.it/ (Major Accident Hazards Bureau –MAHB. Comisión Europea))
- http://www.eea.europa.eu

Industrial accidents involving hazardous substances

In 2010, seven accidents occurred in industrial facilities covered by the Seveso Directive

NUMBER OF ACCIDENTS OCCURRING IN INDUSTRIAL ACTIVITIES COVERED BY THE SEVESO DIRECTIVE BY AUTONOMOUS COMMUNITY



Source: DGPCE. MI

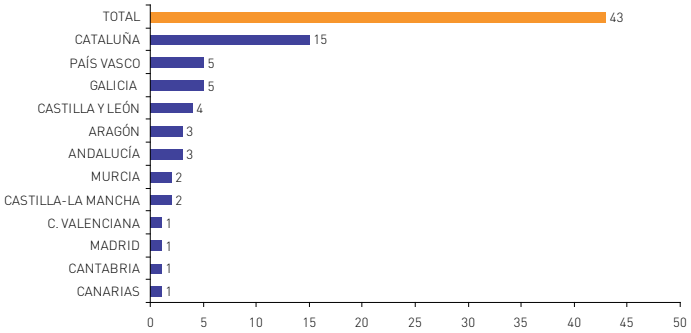
The Seveso Directive aims to improve both preventive measures and response capacity in case of an accident. By developing and maintaining an information system on accidents that have occurred and carrying out analyses and studies to compare experiences between the parties involved, it is possible to improve the design and implementation of preventive measures and mechanisms to reduce the damage caused by accidents.

In 2010, seven accidents occurred in industrial facilities covered by the Seveso Directive. This figure is much higher than those of the previous two years, when only one accident was reported. In 2010, Catalonia suffered two accidents, while Andalusia, Aragon, Castile-La Mancha, Galicia and Valencia all suffered one each.

As regards the whole period (1987-2010), there were 43 accidents overall. The majority of the incidents recorded occurred in Catalonia (34.9%), the Basque Country (11.6%) and Galicia (11.6%), which also have the highest number of industrial facilities covered by the Seveso Directive and the largest in size.

The majority of accidents occurred in the petrochemical, refining and general or basic chemical product industries. These activities are the most abundant in Spain and handle the largest quantity of highly flammable and highly reactive substances.

ACCIDENTS OCCURRING IN INDUSTRIAL ACTIVITIES COVERED BY THE SEVESO DIRECTIVE (1987–2010)



Source: DGPCE. MI

The Seveso Directive makes it compulsory for industrial facilities to draw up a self-protection plan, known as an internal emergency plan. It also stipulates that regional governments should draw up, in partnership with the industries in question, an external emergency plan. In 2010, 74 Special Civil Protection Plans were approved by the National Civil Protection Committee for facilities covered by the Seveso Directive. Between January 2003 and November 2010, a total of 286 plans were produced.

NOTES

- The accidents analysed are those covered by the Seveso Directive, i.e. accidents occurring in industry (chemical, pharmaceutical, energy industry, etc.) and include those occurring during storage, distribution and sale of dangerous substances and products.
- Directive 96/82/EC on the control of major-accident hazards involving dangerous substances (Seveso II), is intended to prevent major accidents and reduce their consequences for human health and safety and the environment. It replaces Directive 82/501/EEC (Seveso I). The Seveso II Directive was transposed into Spanish law by Royal Decree 1254/1999 of 16 July, which approved measures to control major-accident hazards involving dangerous substances. This Royal Decree was subsequently amended by Royal Decree 119/2005 of 4 February and by Royal Decree 948/2005 of 29 July. This regulatory framework is complemented by Royal Decree 1196/2003, of 19 September, which approved the Civil Protection Guidelines for the Control and Planning of Major-Accident Hazards involving Dangerous Substances (BOE no 242 of 9 October 2003).
- Serious Accident: Any incident, such as emissions in the form of leaks, spills, fires or major explosions, that is the consequence of an uncontrolled process during operation of any facility to which Royal Decree 1245/1999 is applicable and that represents a major-accident hazard, of either immediate or delayed effect, to the population, property or the environment, whether inside or outside the facility, and in which one or more dangerous substances are involved.
- It should be pointed out that other types of accident exist that, although no less serious for the environment, do not fall within the scope of the Seveso Directive. These include mining accidents, such as the one caused by failure of the Aznalcollar dam (Seville) in April 1998.

SOURCES

- Data provided by the Sub-Directorate-General for Planning, Operations and Emergencies. Directorate-General for Civil Protection and Emergencies. Ministry of the Interior.

FURTHER INFORMATION

- http://www.proteccioncivil.org