2. ENVIRONMENT AND QUALITY OF LIFE

Introduction

The concept of wellbeing, once synonymous with material wealth and economic development, today includes intangible factors (state of health, the environment, social relations) more closely tied to the subjective perceptions of citizens.
The living conditions of man are directly dependent on those of the ecosystem he inhabits, making it necessary to protect and preserve the environment, in order to guarantee a suitable and sustainable quality of life for both current and future generations.
This chapter focuses attention on topics that influence the state of the environment and, as a result, the health of individuals. It has been decided to conduct separate analyses on the problems regarding air quality, water quality, soil contamination and physical agents, seeing that each sector, with its specific characteristics, contributes, in a more or less direct manner, to determining the quality of life. A further objective is to draw attention not only to the topics with which the public is most familiar, such as pollution of the air and water, but also to those subjects given less emphasis by the media, such as soil contamination and physical agents, which can have equally important social, medical and economic consequences.

2.1 Air quality

2.1.1 Air quality in Italy

Air quality is one of the environmental emergencies that, together with climate changes, to which it is closely tied, as well as the management of waste and water, most worries administrators of local and central governments, involving all citizens on a daily basis.

O_3, PM_{10}, NO_2 are the pollutants that pose the greatest problem.

The most critical pollutants, given the high concentrations found in the air, and this despite the downward trend of emissions in recent years, continue to be ozone (O_3) during the summer months, PM_{10} atmospheric particulate (particle material at a size of less than 10 millionths of a meter) in the winter months and also nitrogen dioxide (NO_2).

Between 1997 and 2004, 20-45% of the European urban population was exposed to levels higher than the limits.

The impact on healthcare is anything but negligible, considering that the highest concentrations of the pollutants referred to are found in urban areas, where the population density is also highest: during the period 1997–2004, the European Environmental Agency (EEA) estimated that 20-45% of the urban population in Europe was exposed to levels of PM_{10}, ozone and nitrogen dioxide higher than the figures set as upper limits[1].

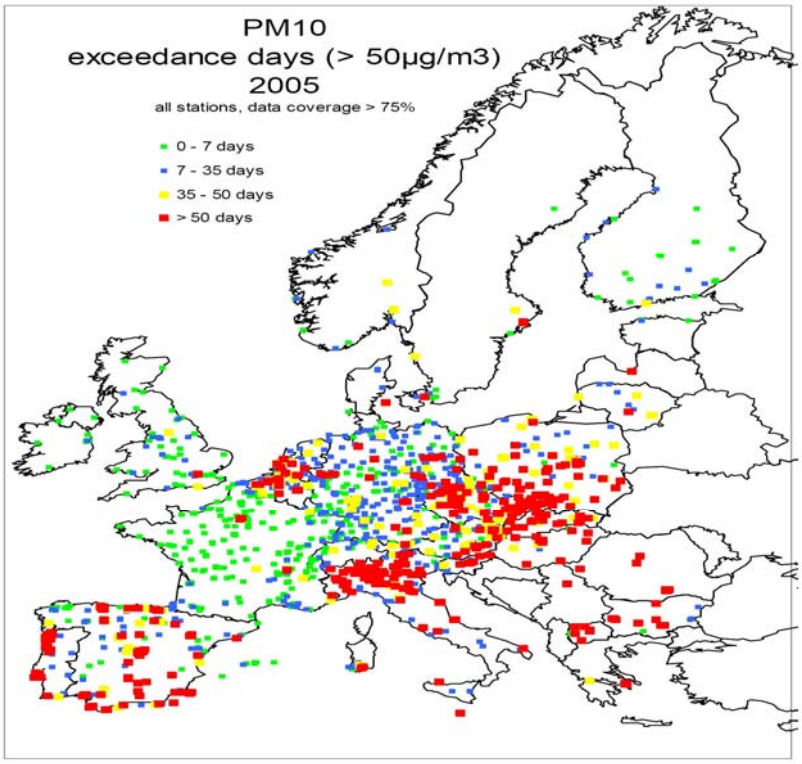
Exposure to PM_{10} in Europe causes an average loss of 9 months in life expectancy.

The EEA has also estimated that in 32 European countries, including the 25 member nations of the European Union, exposure to PM_{10} causes an average loss in life expectancy of nine months, with Italy, and especially the Po Valley zone, ranked among the "worst" areas, together with Benelux, Poland, the Czech Republic and Hungary .

Critical situation in the Po Valley zone.

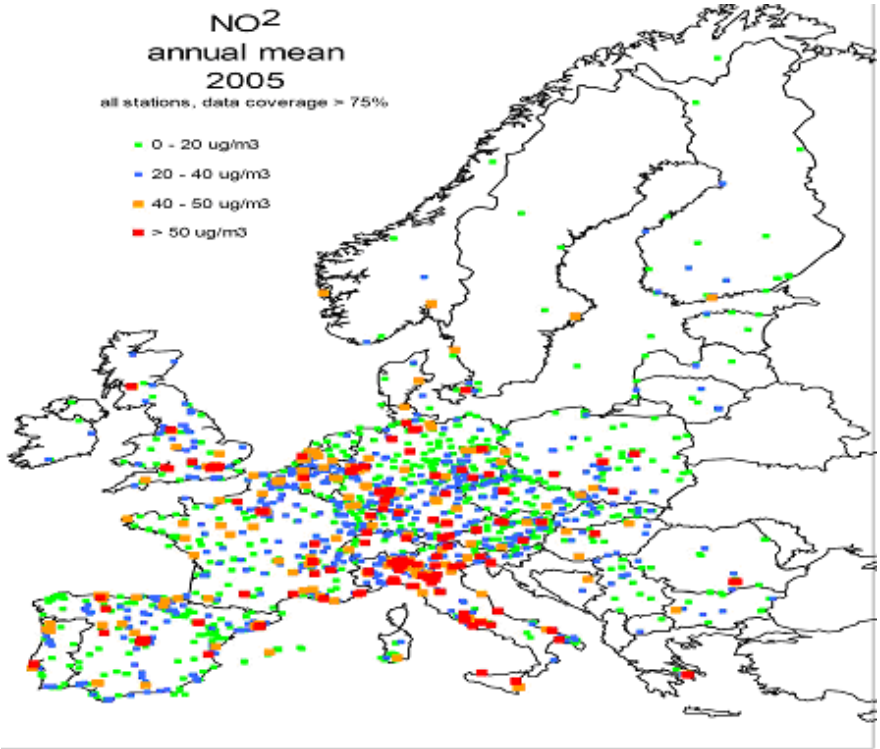
The following charts on PM_{10}, nitrogen dioxide and ozone show the situation of Italy within the European context, in particular the widely known critical situation in the Po Valley area (Figures 2.1, 2.2, 2.3).

[1] *Air Pollution in Europe* 1990-2004, EEA Report, no. 2/2007



PM_{10}, 2005 In Europe, the most critical areas, in addition to large cities, are: Benelux, Poland, the Czech Republic, Hungary and North Italy.

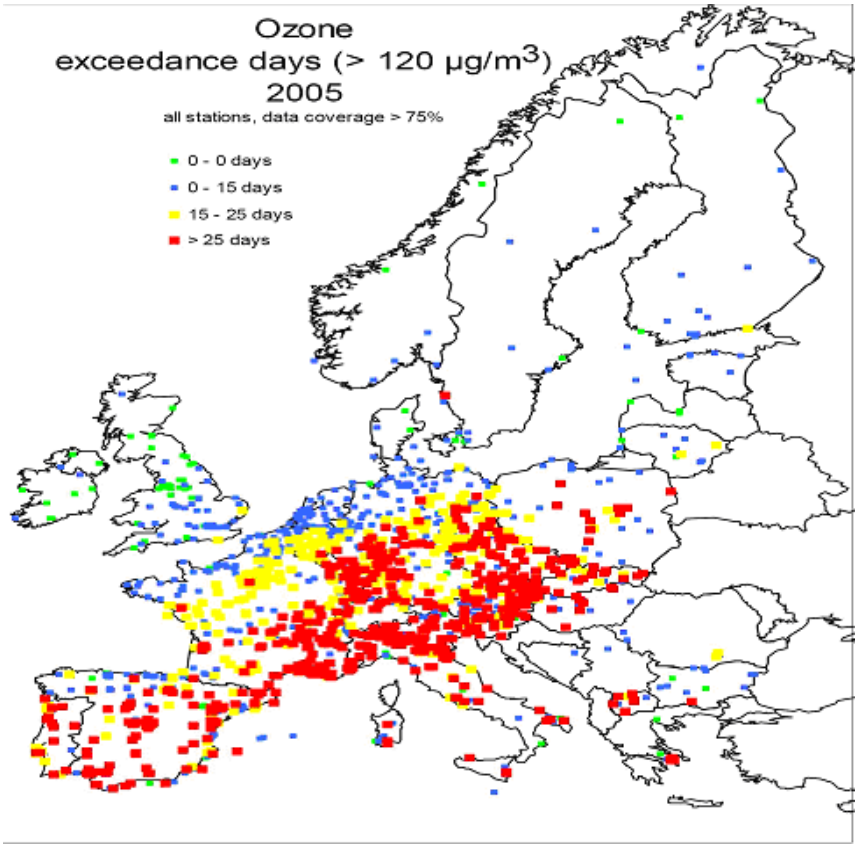
Figure 2.1: PM_{10}, - number of days in which the daily limit for the protection of human health is exceeded (50 µg/m^3, not to be exceeded more than 35 times in a calendar year) [2]



Nitrogen dioxide, 2005. In Europe, the large cities are the most critical areas.

Figure 2.2: NO_2, - average annual concentration of nitrogen dioxide (limit value 40 µg/m^3)[3]

[2] Source: http://air-climate.eionet.europa.eu/databases/airbase/eoi_maps/index_html
[3] Source: *ibidem*



Ozone, 2005: the main critical areas are Central and Southern Europe.

Figure 2.3: O_3, - number of days over the target limit for the protection of human health (120 µg/m^3 as an average for a maximum of 8 hours daily, not to be exceeded for more than an average of 25 calendar days per year over 3 years) [4]

The monitoring stations are the main source of information on air quality.

In Italy, the main source of information on air quality, and the most reliable, consists of the monitoring stations distributed throughout the national territory, operating as part of regional monitoring networks.

The concentrations of the main air pollutants registered by the monitoring stations make possible the evaluation and management of air quality by the individual Italian regions (Legislative Decree 351/99, Ministerial Decree DM 60/2002, Legislative Decree 183/2004), as well as exchanges of information between the member countries of the European Community (Decision 97/101/EC on the *Exchange of Information*, *EoI*) and the dissemination of information to the public, on both the local and national levels, through the BRACE database (www.brace.sinanet.apat.it) and the APAT Yearbook of Environmental Data.

The emissions reduction of PM_{10}, NOx and NMVOC registered in recent years has not led to an improvement in the quality of the air.

The emission reductions of PM_{10} (28%, and especially marked in the energy and industrial sectors), of nitrogen oxides (NO_X 40%) and of non-methane volatile organic compounds (NMVOC 39%) registered between 1990 and 2005 (*APAT Emissions Inventory*) have not led to a corresponding improvement in air quality, confirming the complexity of the problem of air pollution, which calls not for emergency measures but long-term integrated initiatives. What makes reducing air pollution an especially daunting task is the presence in critical pollutants of a

[4] Source: *ibidem*

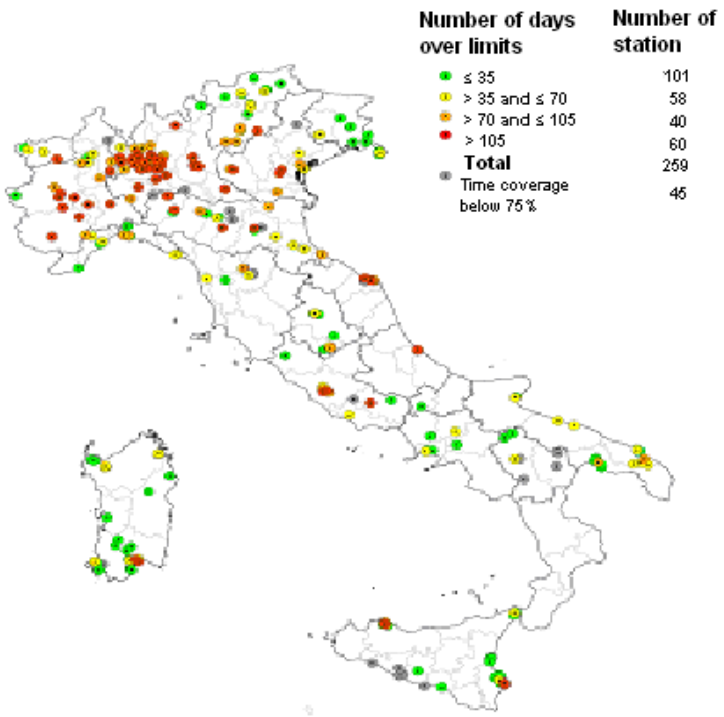
predominant secondary component that forms directly in the atmosphere, starting from other substances referred to as precursors (nitrogen oxides, volatile organic compounds, sulphur dioxide, ammonia).

In the case of PM_{10}, it distinctive characteristics (it is not a single chemical compound, but a complex and variable mix of chemical ingredients that can be of either natural or anthropogenic origin) make understanding how it pollutes, how it should be managed and what measures of reduction should be applied even more difficult than with the other pollutants.

Air pollution, and especially that caused by PM_{10}, is an extremely complex problem that calls for long-term, integrated initiatives.

The regulation for PM_{10} sets a daily maximum limit of 50 $\mu g/m^3$, which is not to be exceeded more than 35 times a year, plus an annual limit of 40 $\mu g/m^3$. These limits are frequently exceeded, especially the daily one, which proves to be stricter than the annual maximum.

In 2006, 61% of the stations (Figure 2.4) registered more than 35 days on which the daily average value was exceeded, with the 35-day limit being reached as early as the first half of February (Figure 2.5).



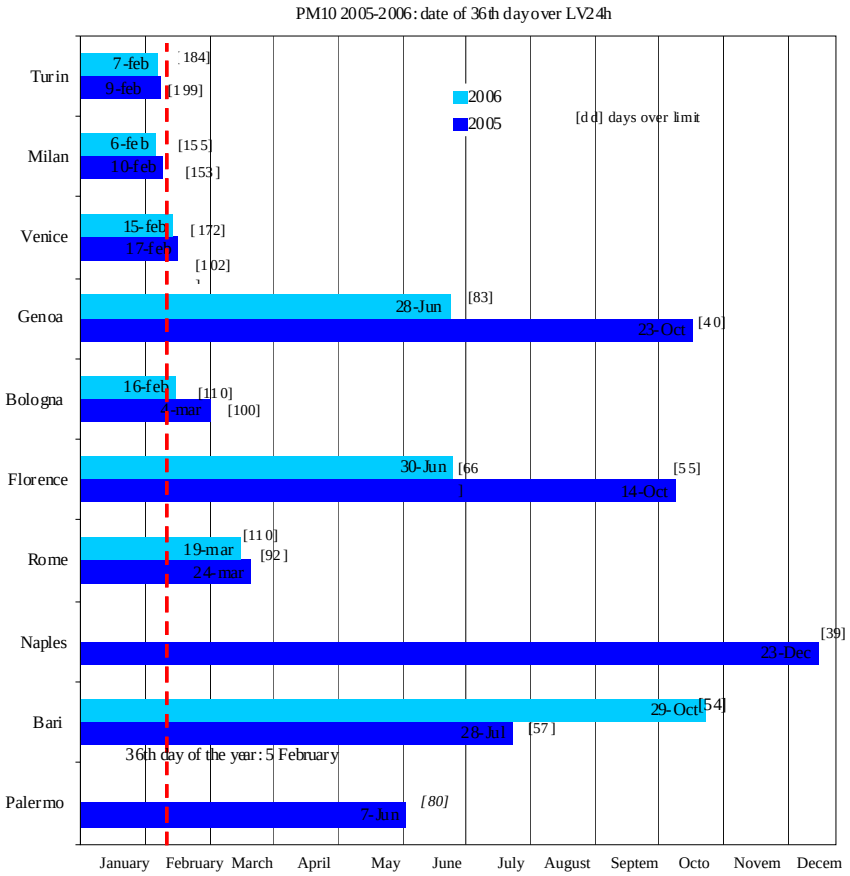
In Italy, in 2006, the daily limit (50 $\mu g/m^3$, not to be exceeded more than 35 times a year) was broken by 61% of the monitoring stations. The most critical situation is in Northern Italy. The monitoring stations are not uniformly distributed throughout the national territory.

Figure 2.4: PM_{10} – Monitoring stations by categories of days over daily limit value (2006)[5]

Even accounting for the readily apparent difference in the density of monitoring between Northern and Southern Italy (greater in the North than in the South), the figures confirm the critical state of the Po Valley areas, as already noted. The situation is generally less critical in Central-Southern Italy, though the limits are not respected there either (of the

[5] Source: APAT analysis of data communicated as part of an EoI (decision 97/101/EC)

Central-Southern Italian Cities shown in figure 2.5, Rome presents the highest levels).



PM_{10}, daily limit: the 35 days over 50 μg/m^3 are generally reached more "quickly" in the cities of the Po Valley area than in the cities of the rest of Italy.

Figure 2.5: PM_{10} – Date on which limit on days over daily limit is reached and total number of days over limit (2005-2006)[6]

There are evident signs of a relation between high concentrations of PM_{10} in the air breathed and negative effects on health: the World Health Organisation (WHO) recently estimated[7], based on a study carried out in the years 2002-2004 in Italy's largest cities, that more than 8,000 deaths a year can be attributed to average concentrations of PM_{10} greater than 20 μg/m^3.

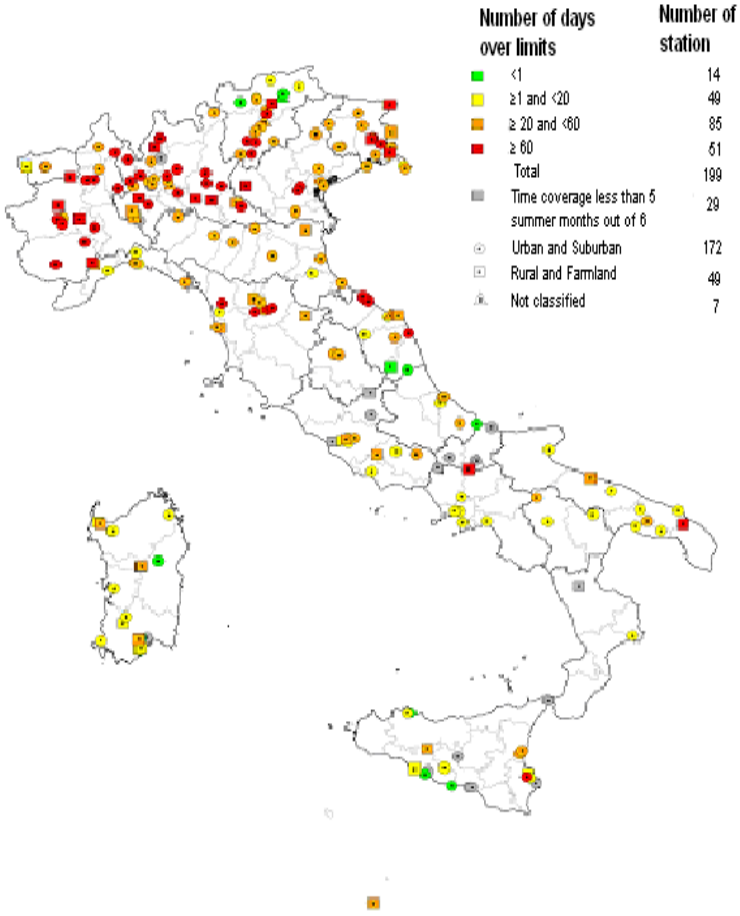
WHO: 8,000 deaths a year attributable to average PM_{10} concentrations > 20 μg/m^3.

Ozone pollution is a problem typical of summer: the highest concentrations are registered in the hottest months of the year and during the hours of maximum solar radiation, given that the ozone is formed through photochemical reactions starting from precursors that consist of volatile organic compounds and nitrogen oxides. Especially in urban areas, the ozone forms and is transformed extremely rapidly, showing highly complex behaviour that differs from that of other pollutants: unlike PM_{10}, the highest levels of ozone are registered not at sites characterised by high traffic density but at sites where the impact of traffic is not direct.

The highest levels of ozone are registered during the summer season and at sites where the impact of traffic is not direct.

[6] Source: APAT analysis of data communicated as part of an EoI (decision 97/101/EC)
[7] M. Martuzzi, F. Mitis, I. Iavarone, M. Serinelli "Impatto sanitario di PM_{10} e Ozono in 13 città italiane", WHO, APAT, 2007

The long-term objective for the protection of human health (120 μg/m^3) - which, of all the parameters defined under the legislation is the one that best describes situations of pollution and exposure of the population weighted over time (from the start of April to the end of September) – was exceeded by the vast majority of the stations: during the summer period of 2007, only 7% of the stations did not register levels in excess of the long-term objective (Figure 2.6).



Ozone, summer period 2007: 93% of the stations registered levels over the long-term objective. The situation was most critical in Northern Italy. The monitoring stations are not uniformly distributed throughout the national territory.

Figure 2.6: Summer O_3, monitoring by categories of days in excess of long-term objective for the protection of human health (120 μg/m^3) (2007)[8]

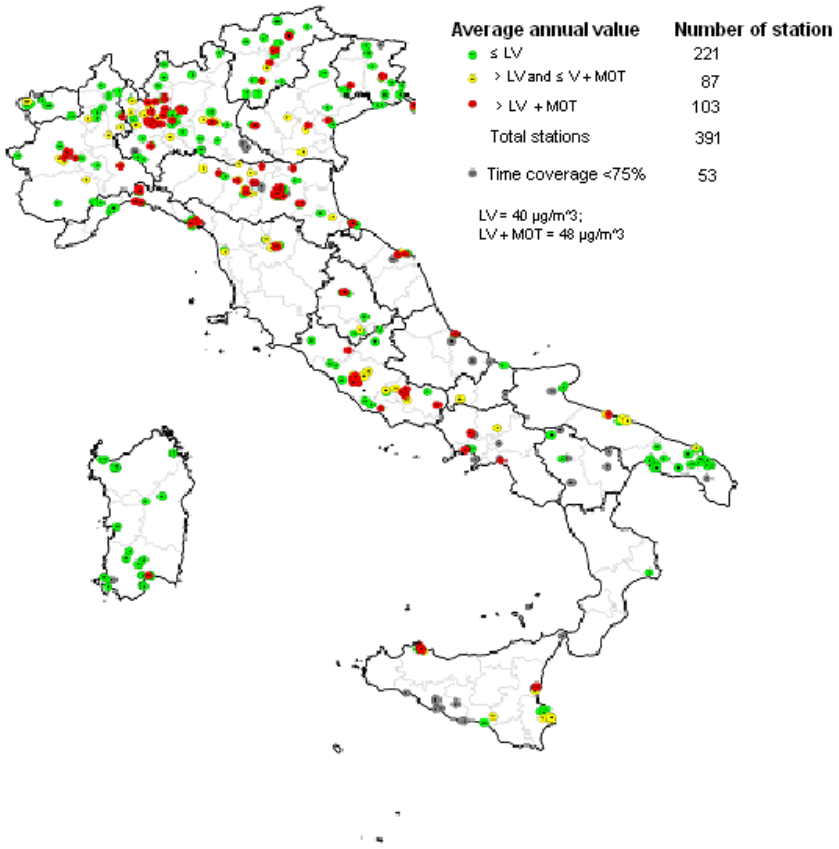
Even considering the undeniable difference in monitoring density between Northern and Southern Italy, the areas with the most critical ozone situations, as was the case for PM_{10}, are the regions of Northern Italy.

[8] Source: APAT analysis of data communicated by the Regions, in compliance with Legislative Decree 183/2004

Ozone also has negative effects on human health, though to a lesser extent than PM_{10}; the WHO has estimated[9] that approximately 500 deaths a year can be blamed on this pollutant.

OMS: 500 deaths a year blamed on ozone.

In the case of nitrogen dioxide, the annual upper limit for the protection of human health (40 µg/m^3), which shall go into force in 2010, was met by 56% of the stations in 2006 (Figure 2.7).



Nitrogen dioxide, 2006: at 56% of the stations, the annual limit for the protection of human health was not exceeded (40 µg/m^3). The monitoring stations are not uniformly distributed throughout the national territory.

Figure 2.7: NO_2 – Monitoring stations by categories of annual average value (2006)[10]

2.1.2 The main causes of air quality deterioration

The economic sectors contribute in different ways to emissions in the air of the main pollutants.

The information provided by the National Emissions Inventory for 2005, drawn up by the APAT, shows that, in the case of PM_{10}, with regard only to the primary component of the pollutant, transport is the main source of pollution, accounting for 43% of the total, of which approximately 27% is attributable to roadway transport; next come agriculture (17%), industry

In 2005, 43% of PM_{10}, 65% of NO_x and 43% of NMVOC were caused by the transport sector.

[9] *Op. cit.*
[10] Source: APAT analysis of data communicated as part of an EoI (decision 97/101/EC)

(14%) and the residential sector (12%).

In terms of tropospheric ozone, meaning that found in the lower layers of the atmosphere, there are no direct sources of ozone, seeing that it is a secondary pollutant. In terms of its precursors, the main source of nitrogen oxide emissions (NO_x) is transport, which accounts for 65%, with roadway transport representing approximately 45%; industry is responsible for 13%, the production of electricity for 12% and the residential sector for 8%.

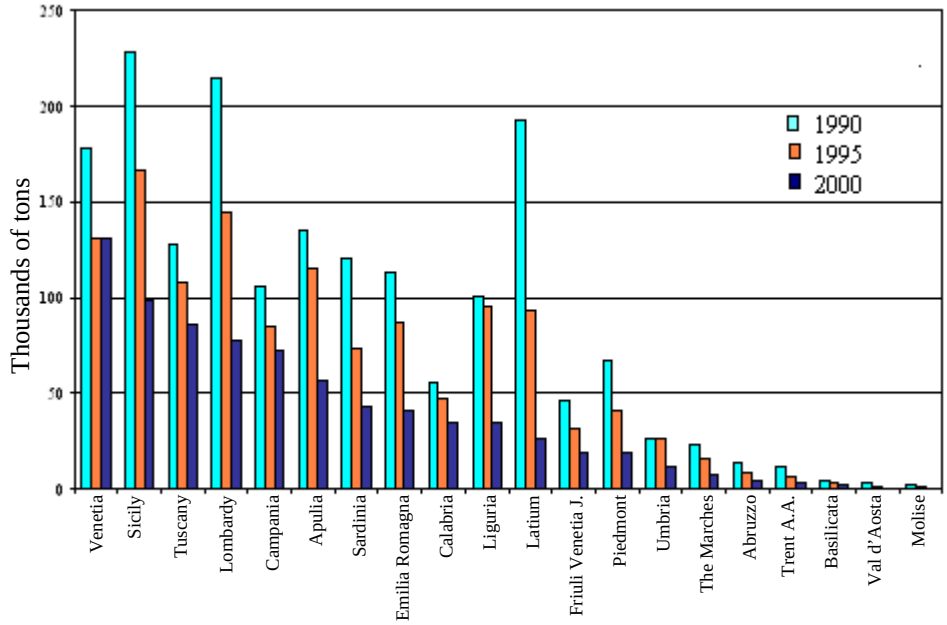
As for volatile organic compounds, but solely with regard to the non-methane ones (NMVOC), transport is responsible for 43%, while 39% come from the use of solvents, and the remainder from the industrial sector and other minor sectors.

Between 1990 and 2005, in the countries of the EU27, emissions of NO_x dropped by 34%, of NMVOC by 42% and of SO_x by 70%. Between 2000 and 2005, emissions of PM_{10} dropped by 10%.

The national trends in emission reductions have also been observed on the European level. As noted in EEA report no. 14/2007, emissions of NO_x in the countries of the EU27 fell, between 1990 and 2005, by 34%, emissions of NMVOC by 42% and those of SO_x by approximately 70%. Emissions of PM_{10}, on the other hand, showed a 10% decrease between 2000 and 2005. In the countries of the EU15, roadway transport was the main source of emissions in 2005, responsible for 40% of emissions of NO_x and 20% of NMVOC. The other main sources of NO_x emissions are electricity (17%), industrial combustion (15%) and other forms of transport (11%). The main sources of NMVOC, apart from roadway transport, are domestic and industrial uses of solvents (18%), the use of solvents in paints (16%) and domestic heating (9%).

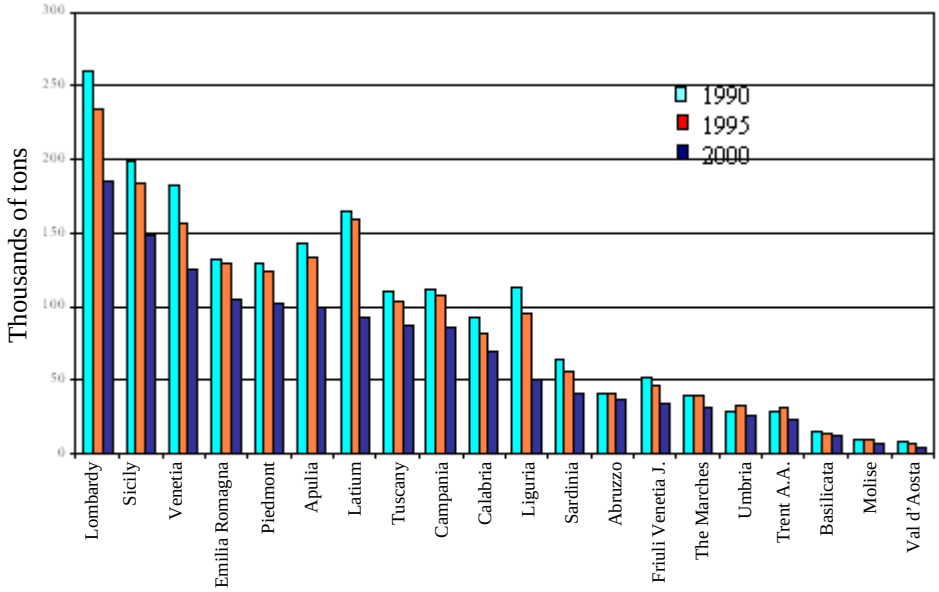
Emissions of PM10, SO_x and NO_x fell in all the regions, and especially those where large-scale combustion plants are found.

Emissions of both tropospheric ozone precursors and PM_{10} have fallen considerably in all the regions, with the size of the magnitude of the decrease depending on the presence of large-scale industrial plants, for which stringent limits were introduced in the 90's on smokestack emissions of SO_x, NO_x and PM_{10}. In fact, emissions of these substances from plants of industrial combustion and energy production have dropped significantly between 1990 and the present. The regional emissions for the substances indicated above are illustrated for the years 1990, 1995 and 2000 (Figure 2.8, 2.9, 2.10).



Since 1990 to 2000, SOx emissions decrease in every single region (national reduction is about 56%). Latium shows the main decrement (-86%), while Venetia shows the lowest (-27%).
In 2000 Venetia provides the highest contribution to the total emission (about 17%).
Latium emissions in 1990 have been 11% of the total amount; it falls to 3% in 2000.
Emissions supply of Trent A.A., Basilicata, Val D'Aosta and Molise is so small it could be ignore (<1%).

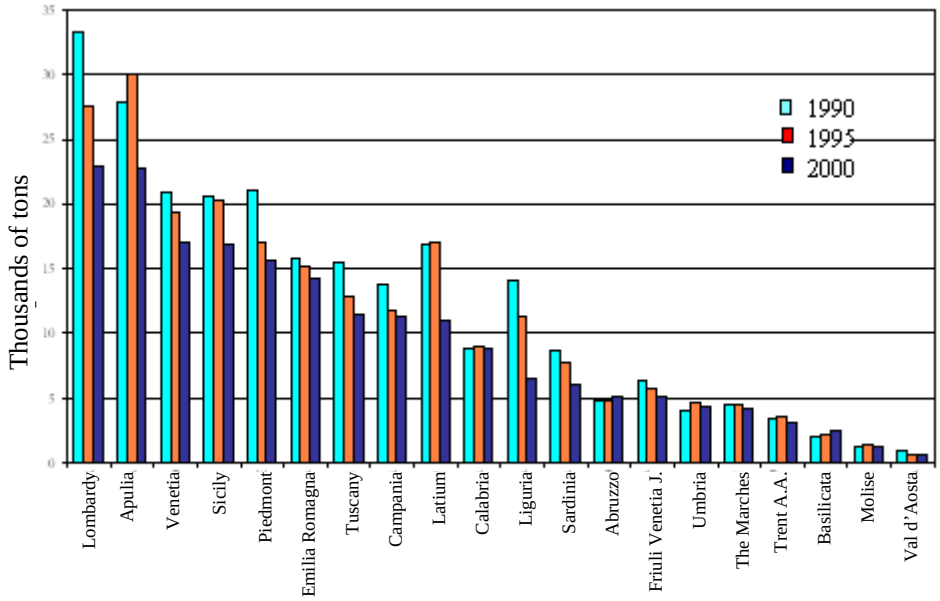
Figure 2.8: Regional emissions of SO_x[11]



Lombardy is the most important NOx polluter in each of years considered (around 13%).
Sicily's emissions supply is also noteworthy (10% in 1990 and 1995; 11% in 2000).
NOx emissions decrease in every region since 1990 to 2000: Liguria shows the main decrement (-56%) even though the weight on total is negligible(4% in 2000); Umbria shows the lowest decrement (9%); also in this case the weight on total is negligible(about 2% in each of the years considered

Figure 2.9: Regional emissions of NO_x [12]

[11] Source: APAT
[12] Source: APAT



Lombardy and Apulia are the most important polluter with reference to PM10 (12% each one of total emission in 2000). The region which shows the most important reduction is Liguria (-54%); the region with the most important increase is Basilicata (+17%) even though the weight on total is negligible (1% in each of the years considered).

Figure 2.10: Regional emissions of PM_{10} [13]

The emissions of industrial plants, as well as those of other production sectors, including agriculture, and those due to heating in the residential sector, effect urban air quality in different ways, depending on the characteristics of diffusion and concentration of the pollutants in the atmosphere and the conditions of weather and climate. In the regions of the Po basin, for example, levels of air quality are highly influenced by complex emissions, together with the specific conditions of weather and climate in force, especially during the winter period. Within this scenario, emissions of PM_{10} caused by the combustion of wood in fireplaces and stoves for the heating of homes, an emissions source concentrated in the winter months, become equally as relevant as emissions due to roadway transport in terms of exceeding the levels stipulated under the legislation. In the case of large urban population centres, on the other hand, the main sources of urban emissions, such as those tied to roadway transport, are the primary cause for the registration of levels of pollutants in excess of the legal limits.

Levels of PM_{10} in excess of the limits in urban settings depend not only on emissions, but also on the prevalent conditions of weather and climate.

On the European level as well, reductions in emissions of primary PM_{10} and its precursors, and in the emissions of the precursors of tropospheric ozone, have not resulted in equivalent reductions in the concentrations of PM_{10} and ozone observed between 1997 and 2004; furthermore, as stated in the EEA report on air quality in Europe[14], approximately 20-30% of the European urban population lives in cities where the air-quality limits on PM_{10}, as well as those on ozone and NO_2, are exceeded at the urban ground monitoring stations. In the case of SO_x, CO, benzene and lead, on the other hand, reductions in emissions were matched by reductions in the concentrations in the air, with the result that these substances, on the whole, are no longer a threat to human health, except in certain local

On the European level, reduced emissions have not led to improved air quality.

[13] Source : APAT
[14] EEA Report no. 2/2007

areas and under specific circumstances[15].

The points briefly illustrated indicate that transport, and especially the roadway mode, is one of the main causes of the high concentrations of PM_{10} and ozone registered in the air. This critical problem is especially acute in cities where the levels of population and transport density are highest. In urban settings, emissions from roadway transport account for more than 70% of overall emissions of PM_{10}, NO_x and NMVOC.

The transport sector is responsible for the high concentrations of PM_{10} and ozone registered in the air.

As is plainly evident, the transport sector is the main source of the emission of harmful substances in the air. This situation is common to the majority of European countries, obliging the European Environmental Agency to draw up an annual set of indexes entitled TERM (*Transport and Environment Reporting Mechanism*), covering the main elements of the transport – environment system.
Harmful gas emissions during the period 1990-2005 were the result of two contrasting trends: emissions tend to increase, because of the continuous growth in the vehicle pool and the distances travelled, though, in reality, they decrease, thanks to the renewal of the vehicle pool.

In the years since 1995, NO_x, COV and benzene have fallen at significant rates, thanks primarily to the renewal of the vehicle pool.
As for the other harmful compounds, concentrations of PM_{10}, whose main source, at present, are light and heavy commercial vehicles, have fallen to a limited extent, while concentrations of benzene and lead have fallen significantly, thanks primarily to the reduction of their content in gasoline.

Since 1995, there have been significant reductions in NOx, COV, Pb and C_6H_6, as well as PM10, though to a lesser extent, on account of the renewal of the vehicle pool and the quality of the fuels

Demand for mobility, and especially the portion consisting of roadway transport, has grown constantly during the period under examination. During the years 1990-2005, the demand for passenger transport increased by 29%, at a rate often higher than the increase in the GDP.

The demand for passenger transport increased by 29% between 1990 and 2005.

The demand for transport has been satisfied to an increasing extent by private transport, which now accounts for approximately 81.4%.

Private transport covers 81.4%.

During the same period, rail transport increased by 8.7% and bus transport by 20.6%, while air transport was the mode that grew most rapidly (+99.7%).

Air transport shows extremely rapid growth (99.7%).

The growth in cargo transport for the period 1990-2005 is closely tied to economic growth. Changes in the structure of production processes ("just in time" and delocalisation of production among the EU-27 countries), as well as in consumption patterns, have resulted in a dizzying increase in cargo traffic, at a rate of +33% from 1990 to 2005, which increasingly travels on the road. This trend is forecast to continue

Between 1990 and 2005 there was a noteworthy increase in cargo traffic (33%), especially that travelling on roadways.

[15] EEA, 2007

over the next few years. If transport with foreign countries is also considered, then roadway transport absorbed 69.6% of the demand, railway 9% and short-haul shipping 17.1%.

2.1.3 Initiatives designed to improve air quality

Directive 96/62/EC[16], transposed into Italian law under Legislative Decree no. 351 of 4 August 1999[17], sets the criteria for the assessment and management of the environmental air quality. These criteria are based of a series of steps that range from assessing air quality to formulating plans or programs, whose contents are to address, among other considerations, measures designed to safeguard the air quality and comply with the maximum values set for pollutants, taking into account the characteristics of the territory and of the emission sources.
In cases where the levels of regulated pollutants are greater than the value set by law, the regions and the autonomous provinces are required to implement a plan or program (art. 8 of Legislative Decree 351/99), in order to bring the levels under the limit within the deadlines stipulated under Ministerial Decree no. 60 of 2 April 2002[18].

[16] Directive 1996/62/EC, issued by the Council on 27 September 1996, regarding the evaluation and management of the quality of the ambient air - Official Gazette L 296 of 21 November 1996
[17] Implementation of Directive 96/62/EC on the evaluation and management of the quality of the ambient air – Official Gazette, issue no. 241 of 13 October 1999
[18] Transposition of Directive 1999/30/EC, passed by the Council on 22 April 1999, regarding the upper limits on ambient air quality with respect to sulphur dioxide, nitrogen dioxide, nitrogen oxides, particulate and lead, as well as Directive 2000/69/EC on the upper limits, for ambient air quality, of benzene and carbon monoxide – Official Gazette, Issue no. 87 of 13 April 2002 – Ordinary Supplement no. 77

Table 2.1: Local inventories of emissions[19]

Region /Autonomous Province	Year of local inventory[a]											
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Piedmont			X				X				X	
Val d'Aosta				X		X		X	X	X		
Lombardy							X		X		X	
Bolzano			X			X				X		
Trent	X					X				X		
Venetia						X				X[b]		
Friuli Venetia Julia			X			X					X[b]	
Liguria	X				X		X				X[b]	
Emilia Romagna							X		X			
Tuscany	X					X			X		X[b]	
Umbria					X					X		
The Marches										X		
Latium						X					X[b]	
Abruzzo								X				X[b]
Molise												
Campania								X				
Apulia	2000-2003 (diffuse and linear emissions)										X	
	2004-2005 (registry of precise emissions)											
Basilicata										X		
Calabria												
Sicily											X[b]	
Sardinia							X					

legend:
[a] data updated to November 2007
[b] Inventory still underway

Plans: investigative phase (local inventories), assessment phase (data on air quality), proposal phase (additional measure, emission and air-quality scenarios).

The starting point for drawing up a plan is the *investigative* phase, which includes an analysis of the regulatory framework and of the characteristics of the territory, including the typical climatic and meteorological conditions and pressures (*local inventories*).
The second phase, the *assessment* phase, involves *air quality assessment*. The purpose of the assessment is to describe the state of the atmospheric environment, identifying any critical problems. This assessment must cover the entire territory being examined, and it must draw on both the precise data provided by a meteorological monitoring network and the "techniques in spatial data analysis", to analyse the distribution of the pollutants, in order to identify the portions of the territory (zones) inside of which initiatives of upgrading must be undertaken. As a rule, these areas, within the Italian context, correspond to the administrative borders of one or more municipalities.

The characterisation of the territory and the assessment of the air pollution should lead, through a modelling system able to forecast air quality, to a subsequent *trend assessment* that simulates the concentrations of air pollutants over time, under certain meteorological

[19]Source: APAT analysis of data supplied by the ARPA/APPA

conditions and in the presence of certain emissions input.

The trend analysis, carried out through the modelling evaluation of the scenario, represents the third, or *proposal* stage. It must contain the elements necessary for:

- determining the objectives for reducing air-pollution emissions necessary to obtaining compliance with the air-quality limits. Action should be focussed on emissions in the sectors that contribute significantly to exceedances of the levels set by law (essentially transport, plus commercial and domestic activities);
- indicating the *"additional" measures* through which the region/autonomous province counts on being able to achieve these objectives. The measures identified can involve economic/tax initiatives (tax reductions, incentives), technical considerations (use of lower-impact technologies) or even information (campaigns to heighten awareness);
- quantifying the air-quality benefits to result from application of the additional measures, as well as the estimated time needed to obtain them.

Under Legislative Decree 351/1999 (art. 12, paragraph 3), the regions and the autonomous provinces must transmit to the Ministry of the Environment, Land and Sea, and to the Ministry of Health, doing so through the APAT, information on their plans and/or programs (in accordance with the structure set out in the Annex to Commission Decision 2004/224/EC) no later than eighteen months after the end of the year during which the exceedances were observed; the Ministry of the Environment, Land and Sea, in turn, transmits the plans or programs to the European Commission within two years after the end of the year during which the exceedances were observed (in 2007 the plans for 2005 are transmitted).

The current situation of the transmissions of the plans is indicated on table 2.2.

Table 2.2: Questionnaires sent by the regions/autonomous provinces, as per the legislation currently in force[20]

Year to which the plan refers	**2001**	**2002**	**2003**	**2004**	**2005[a]**
Year of sending in questionnaire	***2003***	***2004***	***2005***	***2006***	***2007***
Piedmont	YES	YES	YES	YES	YES
Val d'Aosta	*	*	*	*	YES
Lombardy	YES	YES	YES	YES	YES
Bolzano	*	*	*	*YES*	*YES*
Trent	*	*	*	*YES*	*YES*
Venetia	YES	YES	YES	YES	**NO**
Friuli Venetia Julia	*	YES	YES	YES	YES
Liguria	YES	YES	YES	YES	YES
Emilia Romagna	YES	YES	YES	YES	YES
Tuscany	YES	YES	YES	YES	YES
Umbria	YES	YES	YES	YES	YES
The Marches	YES	YES	YES	YES	YES
Latium	YES	YES	YES	YES	YES
Abruzzo	YES	YES	YES	YES	YES
Molise	*	*	**NO**	**	**
Campania	YES	YES	YES	YES	YES
Apulia	YES	YES	YES	YES	YES
Basilicata	*	*	*	*	**NO**
Calabria	*	*	*	**NO**	*
Sicily	YES	YES	**NO**	**NO**	**NO**
Sardinia	YES	YES	YES	YES	**NO**

legend:
[a] temporary figures: the regions are still sending in the questionnaires
* No exceedance; plan not necessary
** No questionnaires or plans sent in
Note: The information on the restoration plans and programs is sent in according to the timetables and procedures stipulated under Directive 96/62/EC (Legislative Decree 351/99) and in the format established under Decision 2004/224/EC, which lists 7 standard modules. These documents are sent to the responsible local authorities (the regions and the autonomous provinces), through the APAT, to the Ministry of Health and the Ministry of the Environment and the Defence of the Territory, with the latter forwarding the documents to the European Commission.

Approximately 24% of the regions/autonomous provinces have still not presented the information for the year 2005.

As can be seen, presentation of the information was rather methodical in years past (it was always the same regions that sent in the information), whereas significant delays can be observed for the year 2005; in fact, even though the deadline (June 30th) has expired, the sending-in of the information has still not been completed.
As far as the contents of the documents are concerned, those analysed show critical problems with regard to the "proposal" section; as a rule, the information is incomplete, especially in the portions regarding:

- assessment of the actual effectiveness of the additional measures identified;
- quantification of the time required for these measures to be effective.

The primary critical problems regard assessment of the efficiency of the proposed additional measures and quantification of their effectiveness over time.

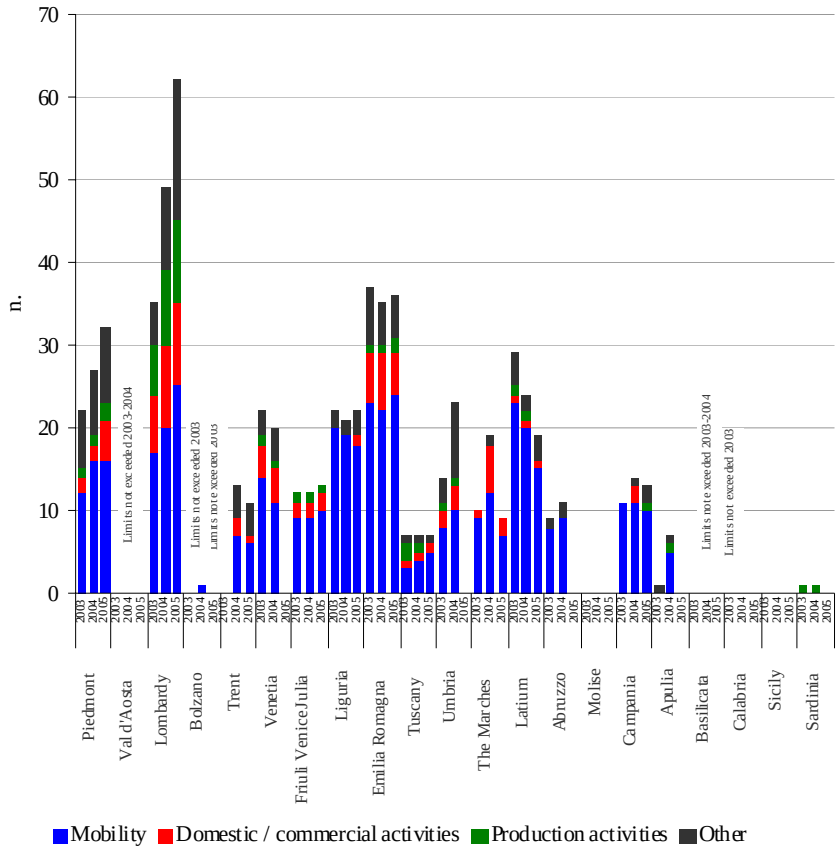
Moving on to an analysis of the additional actions selected, there are four main sectors of intervention in which the measures identified by the regions can be classified: Mobility, Domestic/Commercial

Sectors of intervention:

[20] Source: APAT analysis of data provided by the regions/autonomous provinces

Activities, Production Activities, Other[21].

Mobility, Domestic-Commercial Activities, Production Activities, Other.



Between 2003 and 2005 there was a significant increase in the measures taken to restore the air quality in the Lombardy and Piedmont Regions, while the number of measures in the Latium Region decreased. The sector most frequently involved was mobility.

Figure 2.11: Measures taken to restore air quality, detailed by region (2001-2005[a])[22]
legend:
[a] Provisional data

In the last three years (Figure 2.11), the number of measures undertaken by each region to restore air quality has increased. In 2003 there were 232 measures throughout the national territory, with the number rising to 284 in 2004 and expected to reach 300 (statistics still incomplete) in 2005.

It is forecast that 300 measures will be taken in 2005, compared to 232 in 2003.

In 2004 the most active regions were: Lombardy, with 62 measures; Emilia Romagna (36); Piedmont (27) and Latium (20); the measures most frequently taken regard sustainable mobility[23].

The regions that undertook the most measures in 2004 were: Lombardy, Emilia Romagna,

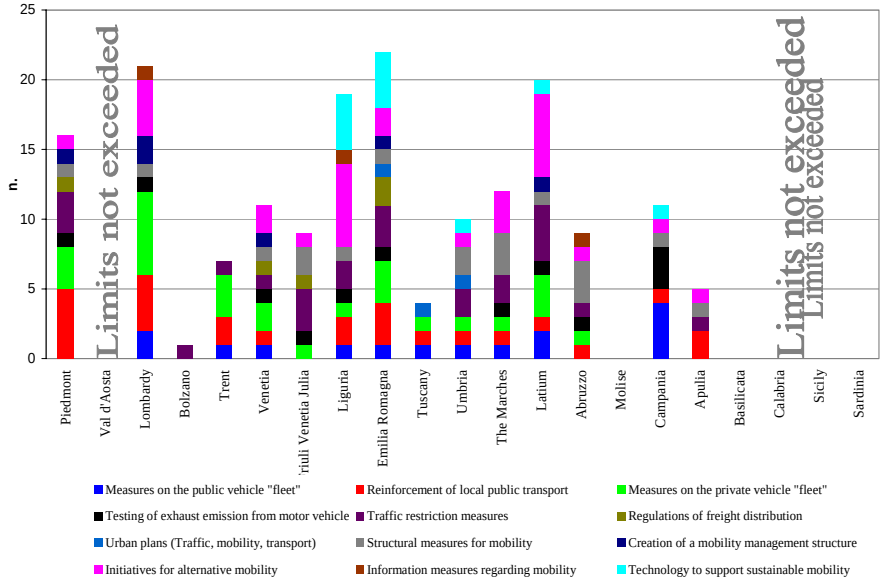
[21] The category "Other" includes: accessory measures in urban centres; studies and projects and initiatives for restructuring or expansion of air quality monitoring networks
[22] Source: APAT analysis of data from the regions and the autonomous provinces
[23] The expression *sustainable mobility* means "a system for the transport and movement of merchandise and people capable of guaranteeing that everyone has the opportunity to exercise their right to mobility, while taking into consideration economic and social factors, the consumption of resources and the impact on the environment"

Piedmont and Latium.

In particular, these initiatives include the following types of measures:

Measures of sustainable mobility.

1. Testing of exhaust emissions from motor vehicles
2. Initiatives for alternative mobility[24]
3. Traffic restriction measures
4. Structural initiatives regarding mobility
5. Reinforcement of local public transport (LPT)
6. Promotion and dissemination of clean vehicles in freight transport[25]
7. Promotion and dissemination of clean vehicles in private transport
8. Promotion and dissemination of clean vehicles in public transport
9. Use of telematic systems for sustainable mobility
10. Drafting of the Urban Traffic Plan
11. Drafting of the Urban Mobility Plan
12. Regulation of urban freight distribution.



Half of the measures regarding mobility were undertaken by 5 regions: Piedmont, Lombardy, Liguria, Emilia Romagna and Latium.

Figure 2.12: Regional restoration measures in the macro-sector of sustainable mobility (2004)[26]

Of particular note (Figure 2.12) is that, in 2004 (the last year all reports were sent), five regions alone (Piedmont, Lombardy, Liguria, Emilia Romagna and Latium) accounted for half the measures on mobility undertaken nationally.

The measures most often adopted regard

The measures most frequently taken were those for sustainable mobility (16%), promotion and dissemination of clean vehicles in private

[24] Examples of initiatives in favour of alternative mobility: initiatives favouring two-wheeled mobility, systems of collective transport, car-sharing, car-pooling, on-call services, collective taxis
[25] Low Environmental Impact

transport (15%) and in public transport (14%), and traffic restrictions (14%).

sustainable mobility (16%) and clean vehicles in private and public transport (15% and 14% respectively).

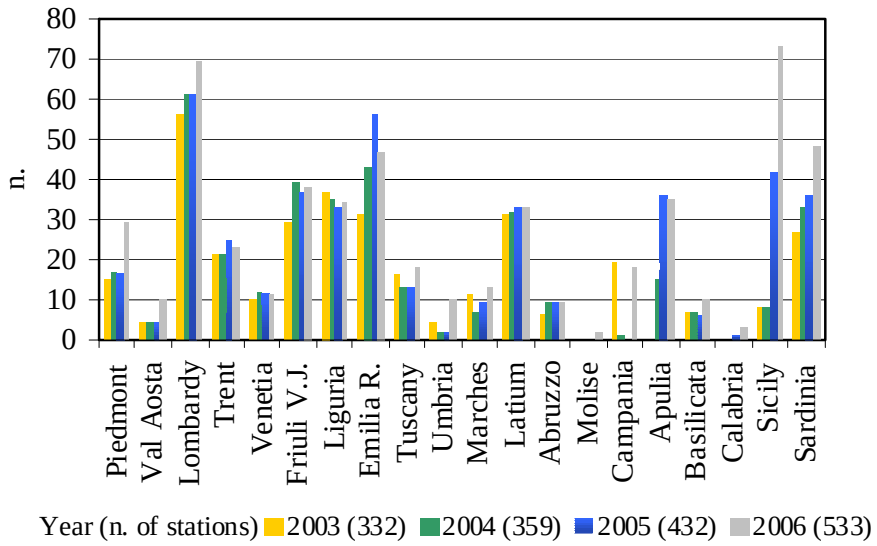
In terms of actions for the restoration of air quality, investigative initiatives, an area in which the APAT plays a major role, should not be neglected. At present, the prevalent and most reliable source of information on air in Italy consists of the monitoring stations distributed throughout the national territory, operating as part of the regional monitoring networks. Communication of information on the local, national and European levels is currently complicated by the fact that two distinct flows of information exist: one whose purpose is primarily informative (Decision 97/101/EC on the *Exchange of Information*, *EoI*); the other specifically designed for corroboration of compliance with the air-quality limits (Legislative Decree 351/99, Ministerial Decree 60/2002, Legislative Decree 183/2004). The problems stemming from the existence of two flows of information are currently being resolved: this places our country in a relatively positive position in terms of transposing into Italian Law the imminent new directive on air quality, which calls for a single information flow, to be carried exclusively by telematic technology.

The imminent new directive on air quality calls for a single, telematic information flow.

In terms of the quality of the monitoring networks and their compliance with regulatory criteria, an updating process is currently underway, involving the APAT and the Agencies System, together with the Ministry of the Environment, Land and Sea, plus the regional governments. This process of rationalising the monitoring networks, which calls for variations in the number and types of monitoring stations, while it may momentarily add some complications to the comparability of the data over time and space, will, in the long run, make it possible to procure information that proves more uniform and suitable for comparison throughout the national and European territories.

The regional monitoring networks are currently being updated and revised, in order to make available information that proves more uniform and suitable for comparison, throughout Italian territory and with the rest of Europe.

[26] Source: APAT analysis of data from the regions and the autonomous provinces



The number of monitoring stations used under EoI has risen from 332 in 2003 to 533 in 2006.

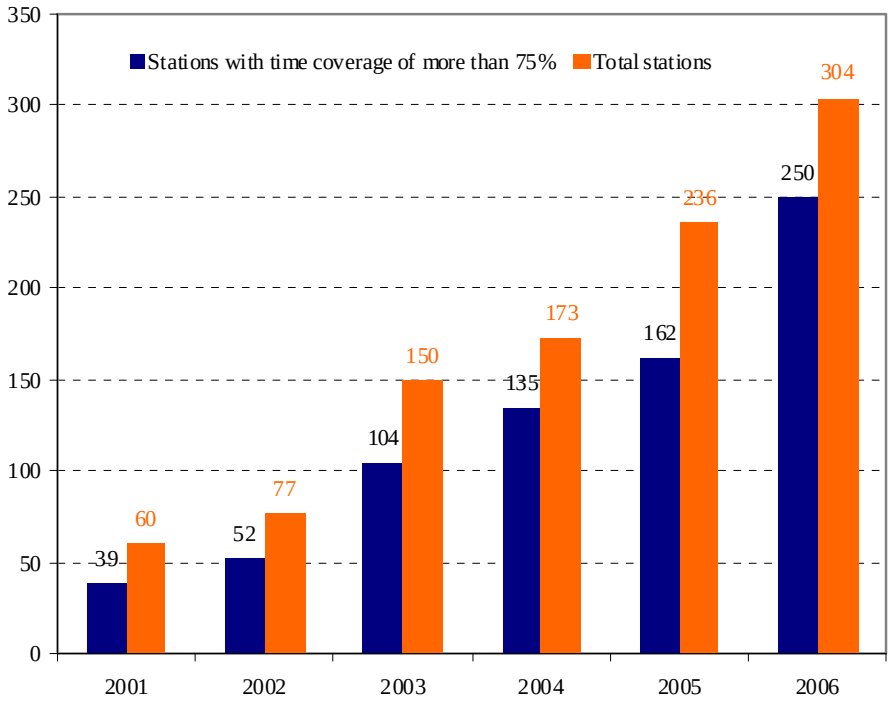
Figure 2.13: Number of monitoring stations per region (2003-2006)[27]

Looking at the rationalisation of the monitoring networks, what stands out is that the number of stations utilised under the EoI continues to grow (Figure 2.13), making for an increase of approximately 23% in 2006, as compared to the previous year.
This increase, which proved especially marked in the regions of Southern Italy and the major islands, partially made up for the shortage of information on these areas in the past.

The increase in the number of stations used under EoI, especially significant in Southern Italy and the islands, partially made up for the shortage of information registered in the past on these areas.

As the number of stations communicating data increased, so did the number of sets of data whose representation of time complied with the regulatory criteria, as is shown in Figure 2.14 for PM_{10}: all these developments point to an improvement in monitoring activities and the communication of information on the local and national levels.

[27] Source: APAT analysis of data communicated under an EoI (Decision 97/101/EC)



There are clear signs of improvement in the activities of monitoring and the communication of information, on both the local and national levels.

Figure 2.14: PM_{10} – Number of monitoring stations with time coverage of more than 75% and total number of stations (2001-2006)[28]

[28] Source: APAT analysis of data communicated under an EoI (Decision 97/101/EC)

2.2 Water Quality

Introduction

Water as an environmental component and a raw material.

Until a few years ago, water was considered a "natural" resource available to everyone, completely renewable and free: of great value, but without a price. In contrast, today water has acquired a dual role: as an environmental component and a raw material.
As an environmental component, water is no longer free or naturally renewable, given the time required to restore the quality/quantity of compromised water bodies. For both surface and ground waters, response time can be extremely long[1], even when complex and costly remedial actions or clean-up efforts are undertaken. When the load capacity[2] of the aquatic ecosystem has been exceeded, such operations cannot return it to the levels that existed prior to degradation, but residual degrees of deterioration remain and may jeopardise the availability of water for future generations.

Water plays a key role in the preservation of ecological and territorial balances, in the quality of the landscape and in defending the quality of life and health.

Desertification can be observed in most Mediterranean coastal areas. It is caused not only by climatic factors, but also by anthropogenic causes and unsustainable practices.

In this context, it should be noted that desertification[3] has extended to increasingly large areas of Southern Italy and to the main islands, which are thus exposed to greater climate-related stress. It is important to point out that this desertification, at different levels of intensity and extension, concerns all the European countries along the Mediterranean basin.
Contrary to what might be thought, desertification is not due solely to motives of climate, but can also be attributed to certain anthropogenic causes, such as excessive exploitation of water tables in zones near coastal areas, followed by entry of the salt table, as well as unsustainable practices (deforestation, poor management of the territory and drainage channels etc.).

The strategic importance of water in supporting a model of life and development.

As a raw material, water has taken on strategic importance, on account of the scarcity that afflicts vast areas of the planet, even in zones which, in the past, have not suffered from the problem, given the need to support the model of water-intensive living and development that has taken hold. As a result, water should be assigned an adequate economic value and managed in a manner that takes into account the laws of economics, though without forgetting that, first and foremost, it is an indispensable resource for survival.

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[1] Over the last fifteen years, the "basic resource" has been diminished, seeing that surface runoff has dropped by approximately 30% throughout the national territory, while intake has dropped by 10-15%

[2] Load capacity: the maximum estimable level of utilisation of natural resources (meaning both the procurement of supplies of materials and the release of runoff and refuse) that an ecosystem can tolerate without suffering irreversible alterations

[3] Desertification: "Deterioration of soil into arid, semi-arid areas or sub-humid pockets, on account of various causes, including variations in the climate and activities on the part of man"

A distinction must be made between the *availability* of water and its *usability*: a certain amount of water can be included in the calculation of (available) quantity, but, if it does not present the characteristics of quality required for its assigned use, then it is not usable. In other words, two types of problems come into play: quantitative and qualitative. And these factors manifest themselves in the form of scarcity and pollution, which are closely connected, seeing that the existence of the one brings about the other, or exacerbates its effects.

Available water is not necessary usable water.

The Water Directive (2000/60 EC), which provides a strategic framework for Community action on the subject, constitutes a major advance in European policy, given that introduces into the regulatory context the concepts of "ecological status", regarding the water quality in terms of local responsibilities, and of "planning, management and governance of water on the watershed level".

The new concepts introduced by the Water Directive (2000/60/EC): Ecological status and management of the entire watershed.

Ecological status must included an assessment of the biological communities, of the habitats and of the hydrological and morphological characteristics of water bodies, as well as the traditional physical and chemical determinants. For the first time, measures must be issued to maintain sustainable hydrological levels and systems and to defend and restore coastal habitats.

Legislative Decree 152 (environmental measures), approved in Italy in April 2006, transposes the European directive into Italian Law, though only in part, and sets the following objectives for:

- *environmental quality,* based on the capacity of the water bodies to maintain natural processes of self-purification and to support extensive and highly diversified animal and vegetable communities;
- *quality for specific use***,** which identifies the status of water bodies suitable for a certain use by man, or for the lives of fishes and molluscs.

Legislative Decree 152/06 defines objectives of environmental quality and of quality for specific uses.

The objectives of quality (Appendix 1, part three, of Legislative Decree 152/06) to be achieved by 2015 are the maintenance or attainment, for major bodies of surface or underground water, of "good" status or, if that status is already met, maintenance of a "high" environmental quality rating.

Reach, by 2015, the objective of "good" ecological and chemical status for surface and underground water bodies.

2.2.1 The state of water quality

The quality of water bodies is assessed with regard both to its specific assigned use (internal surface waters used to produce drinking water, waters meant for bathing activities, fresh water that needs to be protected or upgraded to be fit for the lives of fish and molluscs) and the specific objectives of environmental quality.

Assessment of the quality of water bodies with regard to their assigned use and specific objectives of environmental quality.

In 2006, water was monitored in accordance with the institutions assigned to the task under Legislative Decree 152/99, plus subsequent modifications and additions, an act since superseded, though a portion of its contents constituted a forerunner of Directive 2000/60/EC. The start-up of monitoring, in accordance with the European Directive and Legislative Decree. 152/06, including preliminary identification of the types of water bodies and the respective reference sites[4], is scheduled for 2008.
In terms of the biological monitoring of water bodies, studies shall begin to examine, as in the case of rivers, not only the benthos, but also the macrophytes, the diatoms and the water fauna, ultimately producing an integrated judgment of quality, based on the results for the different biotic components.

In 2006, the data on the Ecological Status of Waterways (SECA), which combine the results of chemical analysis (LIM – Level of Pollution from Macro-descriptors) with those of biological analysis (IBE – Extended Biotic Index), showed that 43% of the sites monitored fell under classes 1 and 2, meaning an ecological status of "high" (5%) or "good" (38%) (Figure 2.15).
The number of stations monitored rose significantly (from 716 to 1,257), as did the percentage of the stations in class 1 (from 2% to 5%), in class 2 (from 37% to 38%) and in class 5 (from 5% to 6%). In contrast, the percentage of stations in class 3 fell (from 40% to 35%).

The SECA index defines the ecological status of waterways as a result of the impact of the primary pollutants of anthropogenic origin, as well as physical or morphological alterations in the rivers, when such changes have repercussions on the quality of the water, sediments or biota.

[4] The determination of categories of rivers, based on a methodology developed by a workgroup coordinated by the Ministry of the Environment, Land and Sea (and manned by experts of APAT, IRSA-CNR.ISS, ICRAM, ARPA-APPA etc.), entails two successive levels of in-depth analysis, with the definition of Hydro-Ecoregions (HER), meaning areas inside of which there is limited variation in the chemical-physical and biological characteristics, as well as types of rivers, within the individual HER, based on a limited group of variables different from those used to establish the Hydro-Ecoregions.
The main factors underlying the characteristics of water systems (first level and second level) are geology, orography, the climate, the origin, the influence of the Hydro-Ecoregions upstream and the distance from the source, calculated in terms of the nodes of the watershed. The reference sites are identified using criteria of pressure (hydrological, anthropogenic, biological), confirmed by examining the ecological conditions of the water body and by means of an "expert judgment"

Intensification of the network of control (from 716 to 1,257 stations): 43% of the points monitored fall within the quality classes of "good" and "high".

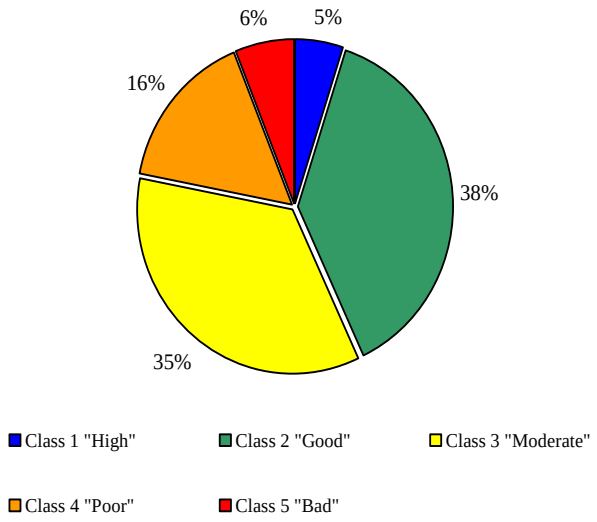
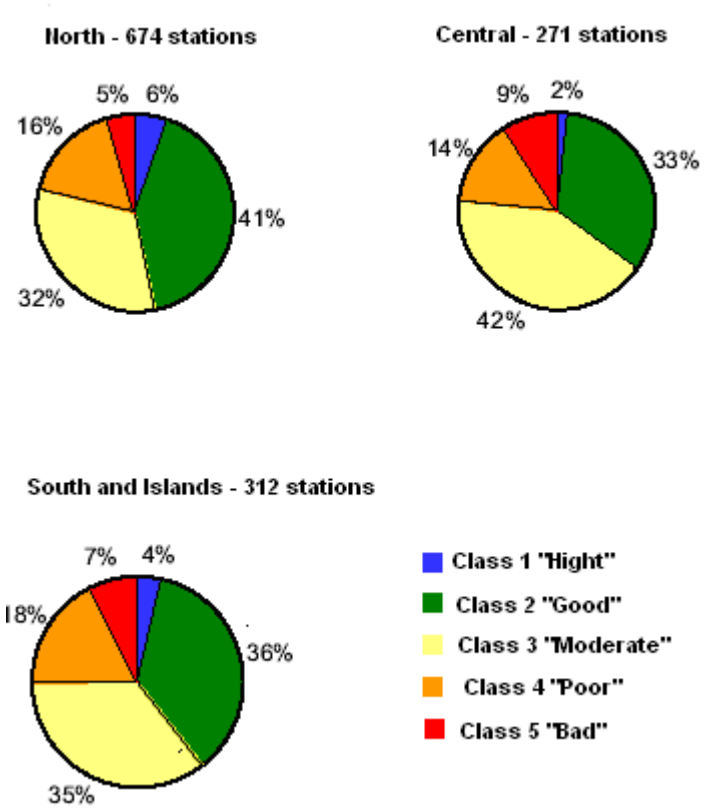


Figure 2.15: Percentage distribution of the classes of the SECA quality index (2006)[5]

In Northern Italy, 47% of the points monitored fall in classes 1 and 2.

The analysis of the data (Figure 2.16) shows that the best situation is found in Northern Italy, where the percentage of stations falling under classes 1 and 2 is 47%, while the figure is 35% for the Central Italy and 40% for the South and the Islands. In evaluating these results, however, consideration should be given to the differences in the numbers of stations monitored in the various macro-areas, as well as the fact, with regard to Southern Italy and the Islands, that no figures are available for Calabria or Sardinia.

[5] Source: APAT analysis of ARPA/APPA data

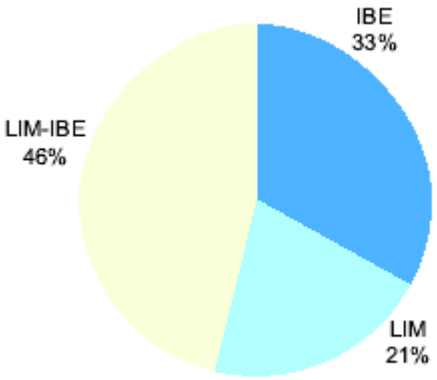


In 2006 the ecological status of waterways in Italy was not especially critical.
Of the 674 stations in Northern Italy, 47% fell within classes 1 and 2.
Of the 271 stations in central Italy, 35% were rated in the "high" or "good" classes, while 40% of the 312 stations in Southern Italy and the Islands were rated in these classes.

Figure 2.16: Percentage distribution of the SECA index quality classes by macro-region (2006)[6]

As noted earlier, seeing that the SECA is established with the integrated results of the chemical and biological analyses, when the incidence of the LIM and the IBE in determining the SECA is examined (Figure 2.17), it is found that, in the case of almost half the points sampled, the chemical and biological analyses both contribute to determining the ecological status, though, in the majority of the cases where the results show discrepancies, it is the biological analysis that determines the ecological status, given that the animal organisms analysed are sensitive not only to the water quality, but also to alterations and artificial modifications in the river and stream beds, as well as fluctuations in the flow.

[6]Source: APAT analysis of ARPA/APPA data

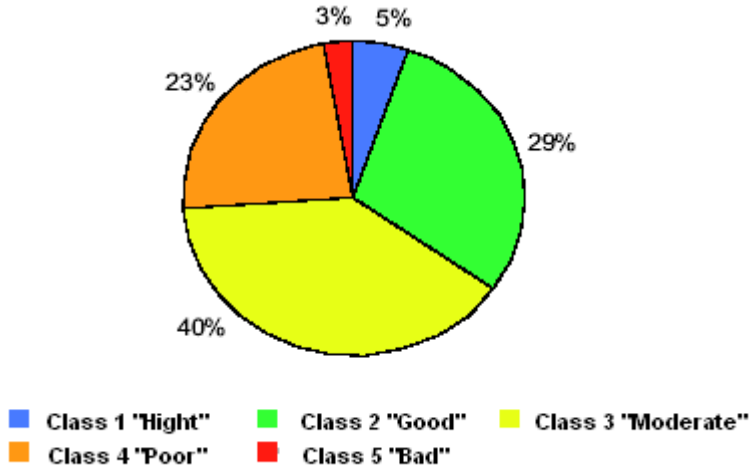


In 2006, as in previous years, the macrobenthic community played a greater role in determining the SECA than did the chemical-physical macro-descriptors.

Figure 2.17: The percentage incidence of the LIM and IBE indexes on the SECA index (2006)[7]

Lake quality (Ecological Status of Lakes - SEL), taken from a total of 173 stations in 14 regions, falls within the classes of "moderate" to "high" 74% of the time (Figure 2.18), an incidence that has risen by 4% compared to 2005.

The SEL is used to determine the ecological status of lakes by evaluating their different trophic states.



In 2006, 74% of the stations (173, representing 158 lakes) were ranked in the classes from "moderate" to "high".

Figure 2.18: Percentage distribution of the SEL quality classes (2006)[8]

[7] Source: APAT analysis of ARPA/APPA data
[8] Source: Ibidem

The best situation was observed in Northern Italy, where 44% of the stations were classified as “high” or “good” (Figure 2.19). But these data must be interpreted in light of the spatial distribution of Italy’s lake areas, which show a greater presence in the north, as can also be seen from the difference in the number of stations in the various macro-areas.

The spatial distribution of the lake areas is more concentrated in Northern Italy. Of the 108 stations found in the north, 44% are rated in the “high/good” class.

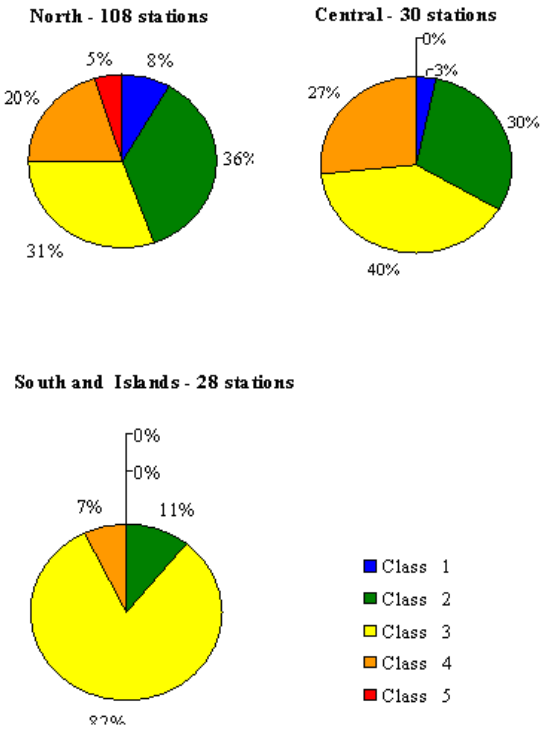


Figure 2.19: Percentage distribution of the SEL quality classes by macro-region (2006)[9]
Legend:
Class 1 = High; Class 2 = Good; Class 3 = Moderate; Class 4 = Poor; Class 5 = Bad

[9] Source: APAT analysis of ARPA/APPA data

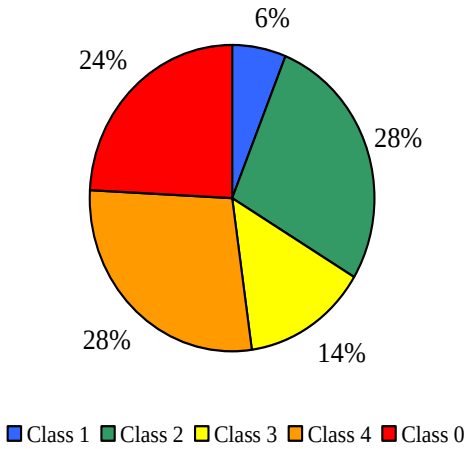
Looking ahead, in light of the data generated by the monitoring in 2006, it can be assumed, in the case of surface water bodies, that the stations ranked in ecological quality classes 1 and 2 for rivers and lakes (SECA and SEL) belong to water bodies that shall not experience particular problems in achieving the quality objective set under the new legislation.

The Chemical Status of Underground Waters (SCAS) points to the zones that present the most critical problems in terms of quantity, expressing the rating in five classes (1-2-3-4-0).
The most serious problems with the chemical quality of underground waters are attributable to the presence of nitrates beyond the limit of 50 mg/l (drinking-water limit), the main cause of demotion to class 4 for many of the regions considered. The presence of nitrates is correlated to forms of pollution that are widespread, such as the use of nitrate-enriched fertilisers, the disposal of livestock waste, poor management of slime and dispersion from sewage systems, as well as specific sources of pollution, such as discharges of urban and industrial liquid waste that have not been denitrified.
Apart from nitrate pollution, a number of dangerous substances were found to be present at certain sampling points, such as heavy metals (primarily chrome, lead and nickel), pesticides and total aliphatic halogenate compounds, placing the water in class 4. The presence of arsenic, iron, manganese, the ammonia ion, chlorides and conductivity beyond the legal limit has been attributed by various regions to natural causes, producing a class 0 result.

The Chemical Status of Underground Waters is obtained by analysing the distribution within the territory of the pollutants generated by the activities of man, combined with the distribution of chemical parameters which, even if their origin is natural, can compromise the use of the water.

An examination of the results (Figure 2.20) shows that 48% of the sampling points present a chemical status falling within classes 1 to 3, while a major percentage of the sampling points (24%) are characterised by water of inferior chemical quality, due to causes of natural origin.

In 2006, at the national level, out of 2,863 sampling stations distributed in 10 regions, 48% present a chemical status ranked between classes 1 and 3, while a significant percentage (24%) is characterised by water of poor chemical quality, due to natural causes.

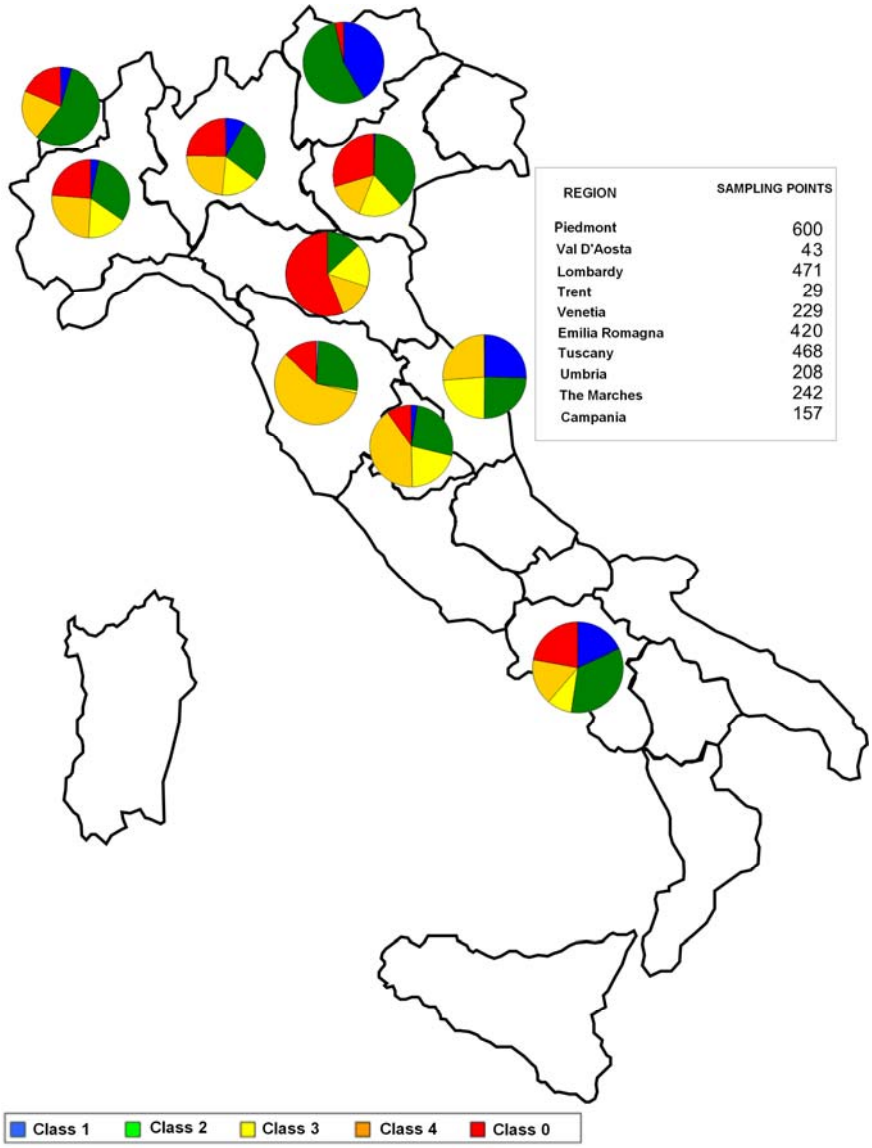


NOTE: Judgment of quality attributed to the classes:
Class 1 – Anthropogenic impact non-existent or negligible, with excellent hydrochemical characteristics;
Class 2 – Anthropogenic impact limited and sustainable long-term, with good hydrochemical characteristics;
Class 3 – Anthropogenic impact noteworthy and hydrochemical characteristics generally good, but with certain signs of compromise;
Class 4 – Anthropogenic impact significant, with poor hydrochemical characteristics;
Class 0 – Anthropogenic impact non-existent or negligible, but with certain natural hydrochemical *facies* present in concentrations above the class-3 levels.

Figure 2.20: Sampling points for SCAS quality classes (2,863 stations – 10 regions) (2006)[10]

Taking into consideration the different numbers of points monitored in the 10 regions, Figure 2.21 shows that, in the Marches, Trent, Campania, Val d'Aosta and Venetia, between 56% and 96% of the sampling points fall within classes 1 to 3, while, of the sampling points monitored in Emilia Romagna and Tuscany, respective levels of 70% and 60% fall within classes 4 and 0.

[10] Source: APAT/ARPA Emilia Romagna analysis of data supplied by the regions, the autonomous provinces and the ARPA/APPA.



The numbers of sampling points in the regions vary widely (from 29 to 600). In the Marches, Trent, Campania, Val d'Aosta and Venetia, the percentage of sampling points ranked in classes 1 to 3 falls between 56% e 96%, while the sampling points in Emilia Romagna and Tuscany fall within classes 4 and 0 at respective percentages of 70% and 60%.

Figure 2.21: The quality status of underground water bodies on the regional level (2,863 points monitored – 10 regions) (2006)[11]

Another assessment of the water bodies quality regards the satisfactory state of segments of waterways and of lake areas that require protection or upgrading to be suitable for fish to live in.
The monitoring data for 2004 (on 15 regions) show that the state of the designated waterways complies with the irremovable values set under Legislative Decree 152/99 for chemical and physical parameters, and that only 1.9% of the segments classified are not suitable. Lake bodies, on the other hand, proved 100% suitable.

In 2004, based on the monitoring of segments of waterways and lake areas designated as being suitable for fish to live in, almost 98% of the segments examined and 100% of the lakes were found to be suitable.

[11] Source: APAT analysis of data supplied by the regions, the autonomous provinces and the ARPA/APPA

Looking at marine areas and brackish waters suitable for molluscs to live in, 65 were found to be so, consisting of 48 marine areas and 17 brackish zones.

The monitoring for 2004 (data on 8 coastal regions) of marine and brackish areas suitable for molluscs to live in, designated by region, bank sites and natural populations of bivalve and gastropod mollusc-beds, but requiring protection and/or upgrading, in part to contribute to the quality as food of the products of the mollusc growing, regards a total of 81 designated areas, of which 61 are marine zones and 20 brackish areas. A ranking of suitable was given to 65 areas, of which 48 are marine and 17 brackish.
The waters designated are considered suitable when the values of the parameters contemplated under the legislation fall within the guideline values or satisfy the irremovable limits listed under appendix 2 of Legislative Decree 152/99, plus subsequent modifications and additions. The waters were found to be suitable for 100% of the samples in terms of halogen substances and metals; for 95% of the samples in terms of salinity and dissolved oxygen; for 75% of the samples in terms of pH, temperature, colouring, suspended materials, hydrocarbons originating from petroleum (substances that influence the taste of the molluscs) and faecal coliforms.

Water quality objectives for the Venice Lagoon are set under the "Ronchi – Costa" Decree.

In the case of the Venetian Lagoon, the Inter-Ministerial Decree of April 23, 1998 ("Ronchi-Costa") set objectives of coastal water quality. These objectives are not legal limits, but rather concentrations of pollutants in lagoon waters to be aimed at in order to ensure the protection of human health and the integrity of the lagoon ecosystem, and they are to serve as an aid in defining environmental policies for the protection and the environmental reclamation of the Lagoon.
In setting these criteria, a variety of different factors must be taken into account. First of all, it is necessary to guarantee that there exists no accumulation, on a more or less indefinite basis, of pollutants in the lagoon environment, and in particular in the sediments and the organisms that populate the lagoon, making possible self-purification of the environment. It is also of fundamental importance that controls be run on bio-accumulative products, such as dioxins and other persistent organic pollutants (POP[12]), which tend to persist for lengthy periods in water-based environments. Secondly, an obvious reference for the formulation of objectives of quality is the environmental condition of comparable areas where anthropogenic influxes are negligible. In practice, the range within which a quality objective may be set for a lagoon environment has a lower limit consisting of the background situation, in this case the unpolluted state of the Adriatic Sea, and an upper limit established on the basis of evaluations of toxicity and eco-toxicity, as well as the assigned uses of the different lagoon settings, should such exist.

Based on these considerations, the "Ronchi-Costa" Decree

[12] Persistent Organic Pollutant

introduced two values as objectives for the Venetian Lagoon: the "guide" value, which can be compared with the background situation, and the "irremovable" value, which is higher than the first figure, but not higher than the values that point to a threat to human health or water life. The "Ronchi-Costa" Decree set a single value as the objective for the entire Lagoon, without the distinction between irremovable and guide values, thus ignoring consideration as to the designated use of the different lagoon settings.

An improvement has been observed, in recent decades, in lagoon waters, thanks in large part to the anti-pollution efforts involving industrial waste discharges in the Porto Marghera area. Of continuing concern is the presence of chemical substances, POP, dioxins and polychlorobiphenyl.

There can be no doubt that, thanks to anti-pollution efforts involving industrial waste discharge in the Porto Marghera area, as well as the water flowing into the entire drainage basin and the historic core of Venice, the quality of the lagoon water has improved decisively over the last few decades. Nevertheless, there is growing concern over the ubiquitous presence of chemical substances produced by man: the POP and substances capable of interfering with the endocrine system, including dioxins and polychlorobiphenyls, which, though found in the waters at only trace levels, are capable of accumulating in tissues, first those of animals and then man, with a series of grave repercussions on health and the environment.

Refinement of monitoring techniques.

For this reason, the Decree of April 23rd set irremovable values for POP that were extremely low (0.013 pg/L I-TE for dioxins and 40 pg/L for polychlorobiphenyls), without fixing guideline values, seeing that the required level is so low as to not be observable with even the most sensitive analytical techniques commonly in use. The refinement of environmental monitoring techniques has made it possible to detect hazardous substances at the levels stipulated for the quality objectives for the lagoon, and to determine the pollution status of waters due to POP and to other pollutants, an indispensable precondition for the planning and orientation of initiatives of environmental defence.

2.2.2 The main causes of alteration

The massive human development of the territory, plus the dimensions of the production system, place noteworthy pressure on national water resources.

National water resources are subject to multiple and widely varying forms of pressure, as a result of massive human settlement in the territory, as well as the dimensions of the production system, including services, small and medium size industry (SME), large-scale industry and the agricultural and zootechnical sectors.
The areas highly settled by man constitute a critical component in the elevated water demand for civic, industrial, agricultural and recreational uses, as well as the equally voluminous flows of waste needing to be purified. In certain cases, the systems of collection and purification prove to be inadequate and not sufficiently suitable (in terms of potential, levels of processing, absence of appropriate

measures to control stormwater runoff) for reducing the pollution content of the volumes of sewage and industrial waste water produced by vast areas of development. A further difficulty is managing to monitor industrial discharges precisely, as well as the lack of awareness of such problems on the part of operators in the various production sectors.

The Framework Directive on Water calls for examination of the impact of human activities on the status of water.

Of particular note, from this prospective, is the absence of a full national framework for industrial discharges, regarding both quality and quantity, a key instrument in attempts to meet the obligations arising from the legislation in force, which calls for the implementation of measures designed to reduce the pollution caused by the substances referred to above. Along these lines, it should be remembered that art. 5 of the Framework Directive on Water calls for an analysis of the impact of human activities on the status of surface and underground waters within four years of its enactment.

Another problem tied to areas developed by man regards pollution caused by the washing away of soil rendered impermeable in urban areas and in zones falling within the range of small-scale industrial and service activities (stormwater runoff).

The noteworthy use of fertilisers and plant care products has an impact on water life, in addition to modifying the quality of surface and underground waters.

The intensive use in agriculture of fertilisers (mineral, organic, organo-mineral fertilisers and soil enhancers), as well as plant care products (herbicides, fungicides, insecticides, miticides and various others), used to defend crops against parasites and pathogens, to control the development of infesting plants and to ensure greater quantities and higher quality standards of agricultural products, can have an impact of water life, in addition to modifying the quality of both surface and underground drinking water.

From 1998 to 2006 there was an increase of 12% in the fertilisers placed on the market.

More than 5 million tons of fertilisers were placed on the market in 2006, of which approximately 3 million tons consisted of mineral fertilisers, with a further breakdown of 60% simple fertilisers (nitrogen based) and 40% compound fertilisers (based on two or three nutritional elements); taken together, organic and organo-mineral fertilisers total approximately 600,000 tons, with soil enhancers registering approximately one and a half million.

The amount of fertilisers placed on the market in 2006, as compared to 2005, showed a reduction of 1.5%; looking at the figures between 1998 and 2006, there has been a rise of 12%.

Plant care products registered a decrease of 6.4% between 1997 and 2005.

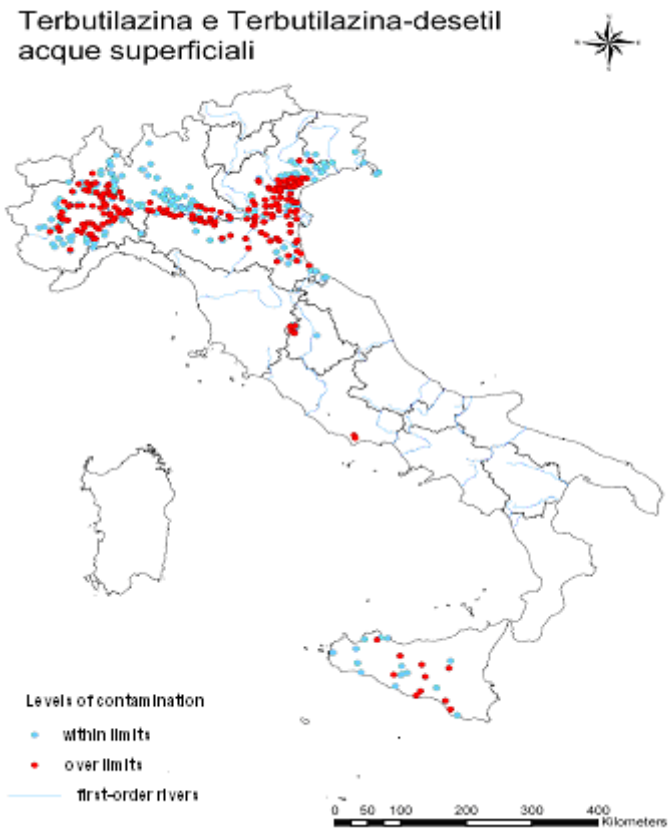
Plant care products placed on the market in 2005 showed an increase of 1.3% over 2004. During the period of 1997-2005, there was a 6.4% drop in distribution. To varying degrees, the decrease affected all the different categories, with the exception of "miscellaneous", which rose by 26.7%. There was also an increase in biological products, which rose from 68 tons in 1999 to 425 tons in 2005.

Herbicides are the substances found to the greatest extent in

Based on the latest report on residues of plant care products, prepared by the APAT, the substances found at the highest levels

during the last three years of surveys, at concentrations often greater than the limit of 0.1 µg/l set for drinking water, were herbicides, such as atrazine, simazine, terbutylazine and its metabolites[13]. Contamination from these substances is widespread in Northern Italy, were their use has been, and continues to be, especially extensive, though they are also found in Central-Southern Italy.

analyses of water, at values greater than the limit of 0.1 µg/l, especially in northern Italy.



An example of the distribution of a herbicide in first-order rivers (flowing directly into the sea), indicating the density of the sites and the levels of contamination. Herbicides, such as atrazine, simazine, terbutylazne and its metabolites, are substances often observed in waters, at values above the limit of 0.1 µg/l. The contamination is especially widespread in Northern Italy, though it is also found in Central-Southern Italy.

Figure 2.22: Distribution of the sites monitored and the levels of contamination from herbicides (terbutylazine and terbutylazine-desethyl) in surface waters[14]

Assessing the presence of residues of plant care products (which generally consist of toxic substances) in water is an important operation, seeing that it gauges the risks and dangers to which man and water organisms are exposed. The complexity of this assessment is further increased by a series of conditions characterising the exposure, with the most significant including seasonal differences and the presence of mixes and metabolites.
Seasonal differences in the contamination of surface water bodies consist of changes in levels of concentration as a result of the period of agronomic use of the substances and developments tied to

The presence of plant care products in waters leads to risks for both man and water organisms.
The contamination is influenced both by seasonal differences and by the presence of mixes and metabolites, which can result in peak concentrations,

[13] Substances generated by processes of environmental deterioration mediated by enzymatic and chemical-physical reactions
[14] Source: APAT, 2007 – National Plan for Controlling the Environmental Effects of Plant Care Products. Residues of plant care products in waters. Annual Report, data for 2005

precipitation. The latter, while they may also dilute pollutants by increasing the flows of waterways, also increase the wash-off of hazardous substances transported from treated land to river and streams, raising the level of pollutant drainage into underground water.

plus the formation of toxic and eco-toxic mixes.

The simultaneous presence of various chemical compounds can lead to the formation of mixes that may develop synergistic effects, making the combined toxicity of the mix greater than its component substances.

Based on the national data collected, the presence of the mixes is higher in surface waters than in underground waters. The primary components of the mixes belong to the category of herbicides, which includes atrazine, a substance whose use has been banned in Italy since 1990, though it is still detected, together with its metabolites, on account of its elevated environmental persistence. The presence of products of deterioration whose toxicological characteristics are, at times, more pronounced than those of the parent compounds, creates additional problems. As a rule, reactions of deterioration lead to the detoxification of plant pharmaceuticals, though they can also result in the formation, either planned or accidental, of metabolites with their own phyto-toxic, toxicological or eco-toxicological properties, which may prove similar to, greater than or completely different from those of the initial compounds.

The presence of mixes, often belonging to the category of herbicides (which includes atrazine), is higher in surface waters.

The shortcomings in the quality of water resources are traceable not only to widespread pollution from fertilisers and plant-care products, but also to inadequacies in the design and operation of the civic purification system, as well as the difficulty of controlling water supplies and discharges in the sectors of agriculture and industry, plus insufficient government efforts in terms of policies to heighten awareness and provide incentives for practices leading to sustainable use.

The quality of water resources is influenced both by widespread pollution and specific industrial discharges, as well as by the civic purification system.

The quantitative factor, expressed as the water demand on the national level, found Italy, at the end of the 90's, at approximately 740 m^3/year per inhabitant (more than 2,000 l/day[15]), among the leading countries in terms of water consumption per inhabitant (EU15 average: 612 m^3/year – 1,677 l/day).

At the end of the 90's, water consumption in Italy, approximately 2,000 l/day per inhabitant, was higher than the European average (1,677 l/day).

The use of water in Europe breaks down as follows: 30% in agriculture, 14% for civic purposes, 10% for industry, 46% for energy production[16].

Uses of water in Europe:
30% Agriculture,
40% Industry,
46% Energy,
14% Civic.

Italy presents a situation fairly distant from the European average, but similar to that of other countries facing onto the Mediterranean; table 2.3 shows that the civic sector, in quantitative terms, though it is given priority, accounts for only a minor fraction of the sum total of "off-stream" uses of water resources, absorbing approximately

In Italy, the bulk of water consumption occurs in the agricultural and industrial sectors (48% and 19%).

[15] IRSA, 1999
[16] Annual report to Parliament on the Status of Waterworks Services (2005), CO.VI.RI, July 2006

19%. The production sectors, meaning agriculture and industry, which account for 67% of all consumption, with respective percentages of 48% and 19%, constitute the primary user of water resources. Also of note is the contribution of agriculture to the widespread pollution of surface and underground waters.

Table 2.3: Annual consumption of fresh water in Italy in 1998, broken down by geographical area and designated use[17]

Zone	Civic	Industrial	Irrigation	Energy	TOTAL
	%				
Northwest	5.4	8.4	19.5	8.3	41.6
Northeast	3.5	3.9	12.6	4.3%	24.2
Centre	3.9	3.5	2.3	1.4	11.1
South	4.3	2.1	8.4	0.1	14.8
Islands	1.9	1.1	5.2	0.0	8.2
ITALY	**18.9**	**19.0**	**48.0**	**14.1**	**100**

In Italy, 48% of fresh-water consumption is used for irrigation purposes, especially in the north.

High level of exploitation of water-bearing stratum.

In terms of the way in which water supplies are procured, a distinguishing characteristic of Italy is the elevated rate of exploitation of water-bearing stratum, a practice regarding which the Annual Report to Parliament on the State of Water Services for 2005 of the CO.VI.RI. (Committee for Oversight of the Use of Water Resources) can be cited, specifically where it states (pg. 30): "*23 % of total supplies are procured at the expense of the water table, as compared to a European average of 13%. Much of this underground water (approximately 50%) is meant for civic uses: supplies procured from the water table and springs account for at least 80% of total supplies earmarked for consumption as drinking water*". The situation outlined above is traceable, in part, to bad habits dating back in history, but also, if not to an even greater extent, to shortcomings in the quality of surface water, compared to which underground water presents better organoleptic and bacteriological characteristics, a situation that has purely economic repercussions as well, seeing that underground water costs less in terms of treatment to render it drinkable.
Finally, the already delicate situation tied to excessive withdrawals from the water table is made even more precarious by widespread tapping into the same supply, authorised and otherwise, for industrial and agricultural uses, activities that often escape the notice of the controlling bodies. This results in excessive exploitation of underground resources, with the appearance in areas in the vicinity of coasts, as already noted, of saline infiltrations that, when utilised for agriculture, contribute to lowering the fertility of the soil, setting off a vicious circle.

In our country, the problem of the scarcity of water has not yet taken the form of a level of demand that nears or exceeds the supply

[17]Source: APAT analysis of IRSA-CNR data

(tables 2.4-2.5), though Southern Italy and the Islands are considered zones to which the maximum attention should be paid.

Table 2.4: Intensity of the use of water resources compared to the total and to local availability[18]

In Italy, the demand for water does not yet exceed the supply, though close attention should be paid to the situation in the South and the Islands.

Zone	Availability in the area	Consumption out of area availability	Consumption out of total
	$10^6 m^3$	%	
North	33,925	78	65
Central	7,825	52	15
South-Islands	10,070	96	20
ITALY	**51,819**	**78**	**100**

Table 2.5: Annual consumption of fresh water in Italy in 1998, broken down by geographic area and designated use[19]

In 1998, the highest levels of fresh water consumption were registered in Northern Italy.

Zone	Civic	Industrial	Irrigation	Energy	TOTAL
	$10^6 m^3/a$				
Northwest	2,268	3,520	8,193	3,502	**17,483**
Northeast	1,453	1,648	5,277	1,800	**10,178**
Centre	1,618	1,482	970	581	**4,651**
South	1,803	879	3,506	36	**6,224**
Islands	798	457	2,191	0	**3,446**
ITALY	**7,940**	**7,986**	**20,136**	**5,919**	**41,981**

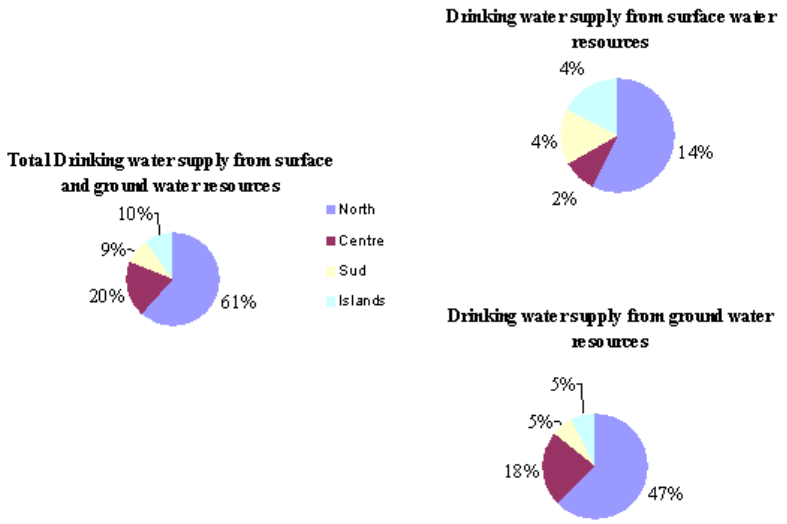
The primary civil use is the consumption of water for domestic purposes (water invoiced). Based on a survey carried out by the ISTAT and by the Environmental Observatory of Cities and Towns, in 111 municipalities that are provincial seats, with data aggregated on the municipal level, it was found that the per capita consumption of water for domestic use in 2006 was practically unvaried, compared to 2005 (+0.1%), registering a level of 69.4 m^3/year per inhabitant. This rate of consumption falls far below the figure of 75.3 m^3/year recorded in 2000; the decrease has been particularly sharp since 2002.

The regional data on drinking water supply (which are provided by sources other than those usually referred to[20]) shows that the highest levels are recorded in Northern Italy (Figure 2.23), and especially in Lombardy and Venetia.

[18]Source: APAT analysis of the data from "Un futuro per l'acqua in Italia", CNR-IRSA 1999, report on the state of the environment for 2001

[19] Source: APAT analysis of IRSA-CNR data

[20] The data analysed are usually provided by the Ministry of Health, Department of Prevention. The data are collected at three-year intervals



Drinking water is mostly supplied by ground water resources, most of which is provided by Northern Italy (61%).

Figure 2.23: Percentage of drinking water supply from surface and ground water resources in the different Italian geographical areas[21].

2.2.3 Actions designed to protect water quality

The defence and improvement of the overall state of water resources draws on a variety of different instruments of legislation, control, planning and management that render policies increasingly elaborate and complex, seeing that the objectives to be reached call for initiatives to be taken on different levels, and always in an integrated manner.

On the national level, the key planning instrument for formulating strategies of action regarding underground, surface and marine waters is the Water Defence Plan (PTA) drawn up by the regions. Approval of this document by the regional governments, together with the first characterisation of significant watersheds and the classification of surface and underground water bodies, are making possible updated knowledge of the state of the resource, definition of the environmental objectives and the measures necessary for achieving them, plus definition of the program for controlling the effectiveness of the measures implemented.

The Water Protection Plan makes possible updated knowledge of the state of the resource, plus definition of environmental objectives and of the measures to be undertaken, as well as control of their effectiveness.

The current national situation in terms of protection plans consists of four plans that have been implemented (Liguria, Venetia, Campania, Apulia) and nine plans that have been approved (Val d'Aosta, Piedmont, Lombardy, Emilia Romagna, Tuscany, Latium, Sardinia, the Autonomous Province of Trent and the Autonomous Province of Bolzano).

To date, 4 PTA have been implemented and 9 have been approved.

[21] Source: APAT analysis of data excerpted from: Water Protection Plans, Individual Basin Plans, General Aqueduct Plans, Water Use Plans, Reports on the State of the Environment, websites of the Regional Governments; non-institutional sources (articles, memorandums, press releases etc.)

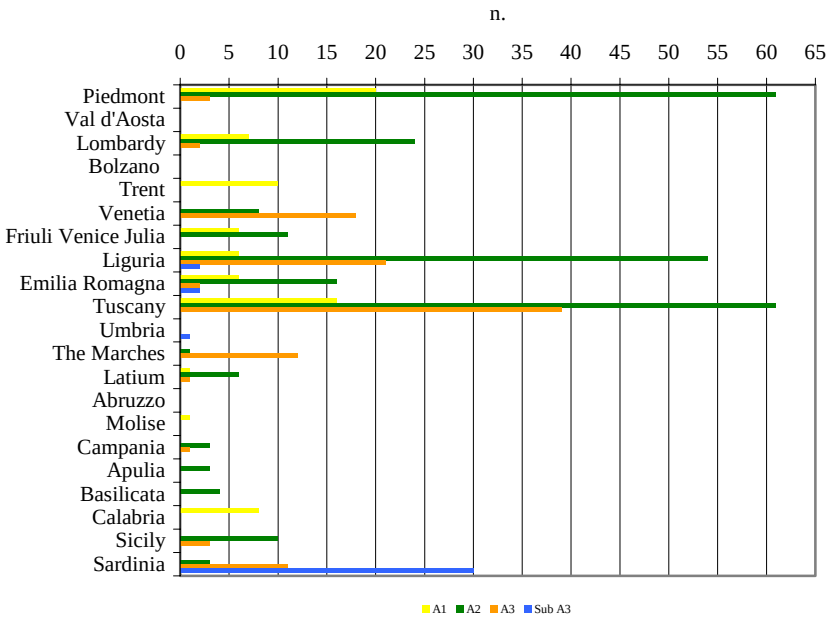
With the publication of Legislative Decree 152/06 (art. 121), the deadline for implementation of the defence plans by the regions was extended to December 31, 2007, and the deadline for approval to December 31, 2008.

To defend the resource, the regions must present programs of measures for water bodies to be used for drinking supplies.

In terms of planning and management tools for the protection of aquatic resources, the legislation requires that regional governments present programs of measures for water bodies used for drinking, in order to constantly increase water quality.
In order to be used for the production of drinking water, surface waters are ranked by the region, based on the physical, chemical and biological characteristics contemplated under the legislation, and classified as: A1 (requiring simple physical treatment and disinfection); A2 (requiring normal physical and chemical treatment and disinfection); A3 (requiring intensive physical and chemical treatment, refinement and disinfection); sub-class A3 (waters that present parameters beyond the allowable limits, which the regions may exceed in the event of flooding, natural disasters, exceptional meteorological circumstances or extraordinary geographic conditions).

Noteworthy increase in the water bodies ranked in sub-class A3, especially in Sardinia, Liguria, Emilia Romagna and Umbria. General worsening of the situation in Liguria.

Monitoring in 2002-2004 of the 494 surface water bodies used for drinking places 81 water bodies in class A1, 265 in A2, 113 in A3 and 35 in the sub-class A3.
Compared to the monitoring for the previous three-year period, there was a significant increase in the water bodies ranked in the sub-class A3. Sardinia, with 30 water bodies in sub-class A3, is the region with the greatest critical problems regarding quality. Other regions with water bodies in sub-class A3 are Liguria, Emilia Romagna and Umbria, with a monitoring point on Lake Trasimeno (which is used only in the event of water emergencies). Liguria shows a generalised worsening of its situation, with a decrease in the number of water bodies classified A1 and an increase in those falling under class A3 (Figure 2.24).



Monitoring for 2002-2004 on 494 water bodies ranked 81 of them as class A1, 265 as A2, 113 as A3 and 35 as sub-class A3. The number of water bodies classified under sub-class A3 has increased, especially in Sardinia (30), the region with the highest level of critical problems, followed by Liguria and Emilia Romagna.

Figure 2.24: The number of water bodies for drinking supplies, subdivided by category (2002-2004)[22]

Programs for improvement have been presented by 7 regions: Lombardy, Venetia, Friuli Venetia Julia, Emilia Romagna, Tuscany, Latium and Sardinia (110 programs regarding 78 water bodies). In Molise there is a water body classified as needing improvement, but, no known measure of improvement has been implemented (Figure 2.25).
Application of the programs of improvement undertaken on the basis of the quality levels shown by the monitoring for the three-year period 2002-2004 has not achieved the objective of improving quality.

[22]Source: APAT analysis of data from the Ministry of Health

110 improvement programs were presented by 7 regions, regarding 78 water bodies. Based on the monitoring for the period of 2002-2004, application of these programs has not reached the objective of improving quality.

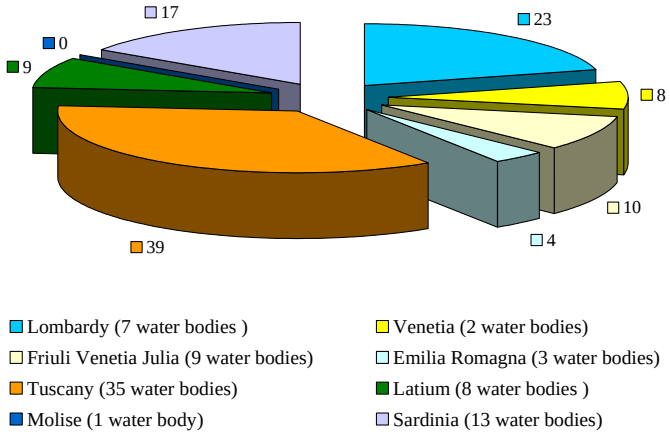


Figure 2.25: Actions programs presented and the number of water bodies requiring improvement[23]

Improvement programs for the reclamation of sites not suitable for swimming.

Another response instrument is represented by the improvement programs of the regions for the reclamation of sites not suitable for swimming.
The 2005 monitoring, performed on waters earmarked for swimming, regarded 5,295 sites, breaking down into 4,746 points for marine waters, 541 for lakes and 8 for rivers. The classification of unsuitable was given to 147 sites.
In 2005, the number of unsuitable sites, based on articles 6 and 7, 1/A and 1/B of Presidential Decree 470/82, was reduced from 191 to 126, while those classified as unsuitable on account of insufficient monitoring (art. 7.2) was reduced from 77 to 21 (Figure 2.26).

[23] Source: APAT analysis of data from the Ministry of Health

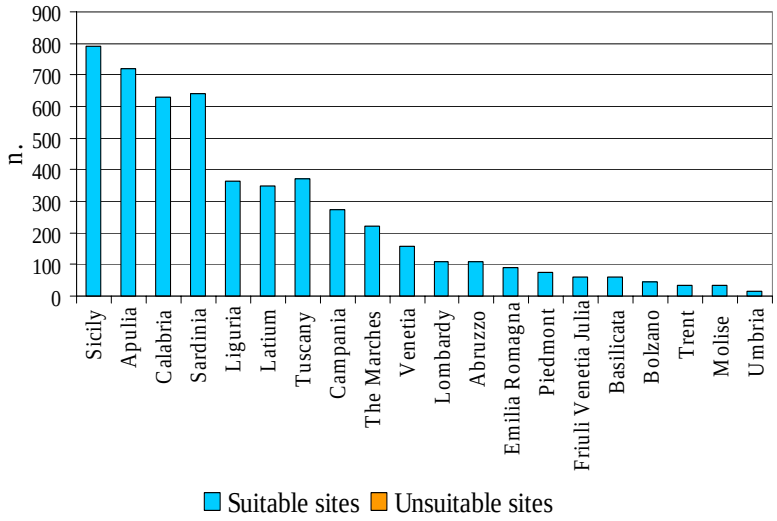


Figure 2.26: Sites unsuitable for swimming out of the total sites monitored[24]

The improvement programs for the restoration of sites unsuitable for swimming are another instrument of response. The 2005 monitoring, carried out on waters earmarked for swimming, covered 5,295 sites, breaking down into 4,746 points for marine waters, 541 for lakes and 8 for rivers. The unsuitable classification was given to 147 sites.

With regard to the measures of improvement implemented for the reclamation of zones unsuitable for swimming, the regional governments have sent in programs for 121 sites, while information on the reasons for the unsuitability has been sent in for 38 other sites.

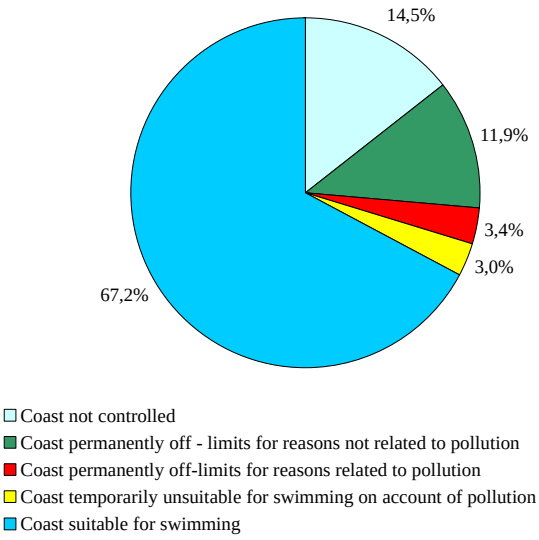
In 2005, the programs and the information presented by the regional governments increased, going from 129 to 159 (+23%). An initial positive effect of the implementation of the programs of improvement was an increase in the number of sites recovered compared to previous years: 219 sites were reclaimed for swimming in 2005.

In 2005 the programs presented by the regional governments increased by 23%, and 219 sites were restored for swimming.

Data are also available on coastal waters used for swimming, expressed as the ratio of kilometres controlled to the total kilometres to be controlled. The statistics show that 100% of the coast was controlled in 25 provinces (34 provinces in 2005), with controls of between 95% and 99% in 14 other provinces. The numbers were lower for the remaining provinces, given the scarce environmental significance of monitoring island zones exempt from significant impact, on account of their socio-geographic characteristics (distance from the coasts of the continent, scarce anthropogenic settlement and development, good or high rate of exchange of the waters etc.) (Figure 2.27).

Control of the coast.

[24] Source: Ibidem



In 2006 100% of the coast was controlled in 25 provinces, while coverage ranged from 95% to 99% in 14 other provinces. Controls of coasts decreased, but the overall outlook was satisfactory.

Figure 2.27: Control of swimming with regard to the full length of the coast (2006)[25]

Compared to 2005, the total percentage of coastline controlled decreased by approximately 0.34%, corresponding to roughly 24 km; despite this decrease, the overall outlook confirms the excellent implementation of a measure firmly entrenched, thanks to a lengthy period of application. The decrease in controls along the coastline was widespread, regarding the entire national territory.

When listing actions for the protection of water, the construction and upgrading of collecting systems and waste water treatment plants should be included. In terms of the compliance with Directive requirements and level of completeness of collecting systems and urban waste water treatment plants, Council Directive 91/271/EEC(UWWTD) concerning urban waste water treatment, set 31 December 2005 as the deadline for the technical upgrading of waste water treatment plants for all agglomerations with equivalent populations (e.p.) of more than 2,000.

Initiatives for the protection of water include the construction and upgrading of collecting systems and urban waste water treatment plants.

It has not been possible to complete the national reference framework for comparison with 2005, regarding either the index of compliance of waste water treatment systems or that of collecting systems, given that only partial information are currently available. In 2005, the national level of compliance was 80% for sensitive areas and 77% for normal areas. Data for 2006 are available for 9 regions, within which compliance with Directive requirements is approximately 76%.

In 2005 the level of national compliance of waste water treatment systems was 80% in sensitive areas and 77% in normal areas.

Compliance of collecting systems has been calculated on the basis of the level of territorial coverage. The average national level of

The level of compliance of collecting systems

[25]Source: APAT analysis of Data from the Ministry of Health

compliance for 2005 was equal to 82% in sensitive areas and 78% in normal areas. For 2006 data are available for normal areas in 6 regions and for sensitive areas in 9 regions, meaning that it is not possible to determine the national level of compliance.

in 2005 was 82% in sensitive areas and 78% in normal areas.

A critical problem affecting the overall system for rationalising the use of the resource on the national level is represented by the scarce reuse of treated waste water. In Italy initiatives involving the reuse of waste water are much more limited than in other countries, though there is a positive trend that has resulted in an increase in such efforts in recent years.

Scarce reuse of treated waste water.

The reuse of treated waste water is governed by Ministerial Decree no. 185 of 2003. The decree regulates the designated uses and the related quality requirements, in order to protect the quality and quantity of water resources, and with the objective of limiting the procurement of supplies of surface and underground waters, reducing the impact of discharges on the receiving water bodies and favouring water savings through the multiple use of waste water.
The measure referred to above stipulates that treated waste water may be used for *irrigation purposes* (crops meant for the production of food for human and animal consumption, areas earmarked as green oases or for recreational or sports activities), *civic purposes* (washing of streets in urban population centres, feeding of heating or cooling systems, feeding of dual supply networks for the operation of the discharge plants of hygienic services) and *industrial purposes* (such as water for fire prevention, processing, washing and the thermal cycles of industrial processes). The reuse must occur under conditions of environmental security, avoiding alterations in the ecosystems, in the soil and in crops, as well as hygienic-healthcare risks for the exposed population, all the while complying with the measures currently in force on health and safety, as well as the rules of proper industrial and agricultural practice.

Ministerial Decree 185/2003 stipulates that treated waste water may be used for irrigation or for civic or industrial purposes.
Reuse must take place under conditions of environmental security, in order to avoid alterations in ecosystems, the soil or crops, as well as hygienic-healthcare risks for the exposed populations.

In terms of pollution caused by nitrates from agriculture, in ’91 the Council of the European Communities passed Directive 91/676/EEC (the Nitrates Directive), transposed into Italian Law first under Legislative Decree 152/99 and then under Legislative Decree 152/06, for the purpose of reducing or preventing the pollution of waters caused either directly or indirectly by nitrates from an agricultural source. Following implementation of this decree, the member states are required to carry out controls on the nitrate concentration of fresh waters, to designate “vulnerable zones” and to draw up action programmes for the same, in addition to formulating Codes of Good Practice and drawing up programs for training and informing farmers.

The Nitrates Directive, in order to reduce or prevent water pollution caused by nitrates of agricultural source, calls for the member nations to carry out controls of concentrations, designate vulnerable zones, draw up codes of good practices etc..

The systematic continuation of the monitoring of lagoon waters by

Systematic

the Waters Magistrate will make it possible to assess, over time, the effectiveness of the environmental restoration measures implemented in the Venice Lagoon, which, given its complex, distinctive characteristics, has always constituted a "test case", providing both inspiration and a framework for evaluation of subsequent measures issued, and initiatives implemented, in the rest of the national territory.

monitoring of the waters of the Venice Lagoon makes it possible to evaluate the effectiveness of the restoration measures implemented.

The solution of the most urgent water-resource problems noted herein involves not only institutional and socio-economic considerations, but technical-scientific factors as well.
The underlying criteria for the most recent national legislation (Legislative Decree 152/06, Ministerial Decree No. 185 of June 12, 2003, Ministerial Decree no. 367 of November 6, 2003) and European-Community measures (Directive 2000/60/EC) set the groundwork for the development of an integrated, sustainable operating strategy.

An integrated and sustainable operating strategy.

This benchmark strategy can accompany the initiatives for the upgrading of availability with an optimisation of the uses of water as an economic resource, stressing savings, reuse and recycling[26] in industrial processes, agricultural activities and civic use, in addition to restructuring the treatment of waste water as a means of supplementing the resource[27].
A similar strategy must necessarily take into consideration the following principles of sustainability:

- Integration of the environment and of development;
- Principles of "precaution", "prevention" and "if you pollute, you pay";
- Sharing of responsibility;
- Recovery of costs for uses of water within a framework of socio-economic compatibility.

In addition to initiatives meant to upgrade availability, steps must be taken to optimise the uses of water.

The correct approach would be to concentrate resources on a select number of activities geared towards reaching the following priority objectives:

1. formulation of a certain and consolidated reference framework regarding existing levels of availability, the state of quality and the procedures for use, with closer consideration given to unregulated uses;
2. reduction of demand in the agricultural, industrial and domestic sectors through the rationalisation of uses, as well as the optimisation of plants, cycles, production processes, transport infrastructures and distribution networks, plus the dissemination of practices of recycling and reuse;

The priority objectives to be achieved include the formulation of a background framework on the resources in terms of availability, state of quality and use, reduction in demand, limitation of pollution and research and training.

[26] The term *recycling* refers to the reuse of water within the same production cycle, while the term *reuse* is employed when water is reutilised outside of the production cycle in question
[27] The reuse of purified waste waters is also recommended in the "National Program for Initiatives in the Water Sector" (2004) of the Ministry of the Environment, Land and Sea

3. limitation of problems tied to pollution through a rationalisation of industrial plants and an optimisation of agronomic and animal-husbandry techniques, combined with the development and spread of innovative technologies regarding processes and plants for the treatment of water (production of drinking water, purification, refining, desalination etc.), also taking into account the latest trends and legislative measures, which view as a single entity the purification plant, the receiving water body and the environmental and territorial reality in which these are found;
4. research and training.

The European strategy for the sustainable use of water resources has led to noteworthy changes in Community and Italian legislation, making necessary a radical transformation in the planning, management and safeguarding of resources for achievement of the objectives listed above.

2.3 Exposure to Physical Agents

Introduction

The term “Physical Agent” refers to the sum total of the forms of environmental pollution considered to be physical in nature, on account of the characteristics of the agent, the interaction with the individual and the extent of propagation within the environment, such as ionising radiation, electromagnetic fields, noise in the inhabited and living environment, vibrations, light pollution and UV radiation.
As a rule, the relevance of each of these agents from an environmental/medical standpoint is not directly proportionate to the social attention they receive, in addition to which legislative efforts would appear to be imbalanced with regard to the different topics. Noise in the living environment definitely represents the most widespread form of pollution, and one of those with the greatest impact on the population: its effects are extensively documented, even though the medical consequences of the same are less evident. In contrast, electromagnetic pollution is the agent that receives the greatest social attention, on account of its feared – though yet to be demonstrated – consequences on human health, and especially on the weaker segments of the population.
In both fields legislators have passed specific measures designed to safeguard individuals in an unequivocal manner.
Ionising radiation consists of particles and/or energy of natural or artificial origin capable of modifying the structure of the matter with which it interacts. The interaction with biological tissue can result in possible damage to the cells, in the form of morphological or functional alterations, as well as medical consequences observable on the clinical level in the individuals exposed. There are no nuclear plants in operation in Italy. Nevertheless, the growing production and circulation worldwide of radioactive materials and radiation of natural origin (radon and NORM), which constitute the main source of exposure, call for radiation-protection capacity to be kept at high levels, along with protection of the environment, the population and workers, through activities involving the control and monitoring of radioactivity in the environment and in foodstuffs.
Less attention, on the part of both private citizens and legislators, is placed on the other agents, understandable in light of the different impact – or what is perceived to a be a lower impact – that they have on man and the environment. Vibrations, for example, disturb an extremely limited percentage of individuals, and in very specific situations (in the proximity of certain types of transport infrastructures); light pollution, although it exists, does not create readily apparent inconveniences for the individual, and this affects interest in the topic, while UV radiation merits greater attention, in consideration of its consequences on health – in this case demonstrated – and given the relationship between exposure and effect, with higher levels of exposure leading to different effects in a greater proportion of subjects. Here too, the taking of action appears problematic, as it would have to change individual habits and limit practices that are a source of satisfaction (such as tanning in the summer or artificial tanning).

2.3.1 Noise

The problem

Noise pollution is still one of the leading environmental problems, as well as one of the chief causes of concern among citizens, at a level of priority that has led the European Community to increase the resources and research aimed at formulating effective measures for the control and pursuit of the main objective: a reduction in the number of people exposed to levels of noise held to damage the quality of life and have consequences on the health conditions of citizens.

Noise pollution is one of the most pressing environmental problems, leading the European Community to draw up measures meant to limit it.

The available data analysis on the percentage of the population exposed to equivalent sound pressure levels greater than 55 Leq dBA at night and 65 Leq dBA during the day – the levels used as the limit values, above which the population is held to be disturbed – point to noteworthy numbers of exposed individuals.

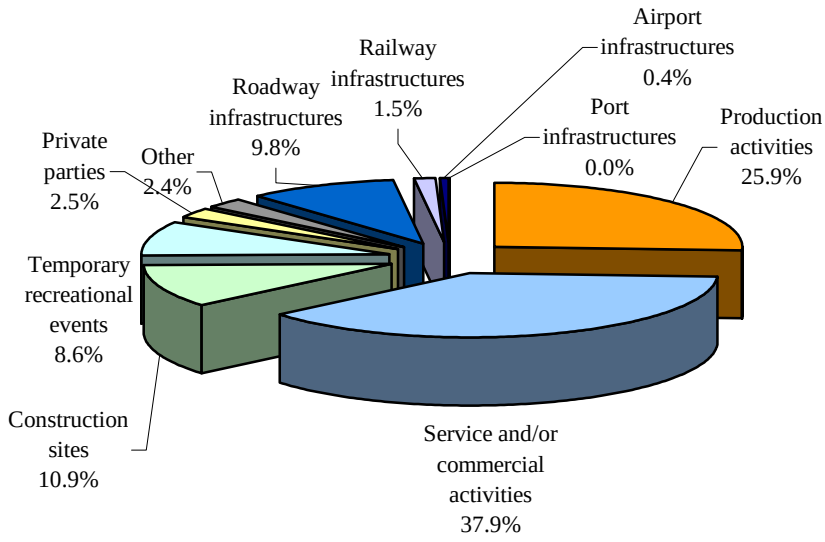
The data are collected from individual local settings, with evident limits due to discontinuity and the use of methodologies and acoustic parameters not yet in line with the European Directive on assessment and management of environmental noise, but suitable to describing existing conditions.

European Directive 2002/49/EC on the management of environmental noise, partially acknowledged by Italian law, has defined a methodology and parameters able to harmonise the data of the member nations; the first national results for urban areas with populations of more than 250,000 inhabitants and for large-scale infrastructures shall be available in January of 2008.

The control activities carried out by the System of Regional and Provincial Environmental Agencies, performed primarily in response to complaints presented by citizens, demonstrate citizens' attention towards the defence of the environment, at the same time confirming that the legal limits are exceeded in the cases reported: out of 100 controls performed, 71 are based on citizen complaints, with the percentages varying among the different sectors: 97% of the cases involving service and/or commercial operations; 26% of the controls carried out on roadway infrastructures. In addition, approximately 60% of the sources reported by citizens effectively exceed limit values, showing that a real problem exists.

Citizens show attention to the defence of the environment: 71 out of 100 controls are based on citizen complaints, with 60% of the sources reported by citizens effectively exceeding limit values.

Based on the data, the types of sources that citizens find to be most disturbing can be identified: the majority of the sources controlled are commercial and tertiary activities, accounting for 38%, followed by production activities (26%), construction sites (11%) and roadway infrastructures (10%) (Figure 2.28).



The sources controlled and held by citizens to be highly disturbing are commercial and tertiary activities (38%), production activities (26%), construction sites (11%)and roadway infrastructures (10%).

Figure 2.28: Distribution of the sources controlled (4,278) among the different categories of activities/infrastructures (2006)[1]

The main sources of noise

To date, the following observations can be made: the initiatives designed to prevent or mitigate the effects of noise pollution remain, generally speaking, fragmented; there are differences between the various areas, with in-depth efforts and attention focussed on certain sectors (involving the individual infrastructure sources) and clear shortcomings in others, observable, first and foremost, in terms of specific planning in the sector on acoustics, plus a lack of dialogue and integration with other instruments of local planning.

The main sources are roadway, railway and air traffic, which all registered increases in volume.

Roadway, railway and air traffic have registered a general increase in volume, with distinctive characteristics of the rise tied to the individual sources. The figures on airport traffic, for example, show a percentage variation of +8.2% in 2006, compared to 2004, while vehicle traffic on highways registered a percentage increase of approximately 58% between 1990 and 2004. As for railway traffic, 338.5 million trains-km travelled on the State Railway system in 2005 (+2.7% compared to 2004), of which 81.3% were passenger trains-km and the remaining 18.7% cargo trains-km.

Legislative shortcomings, together with a lack of dialogue between the main participants, prevent effective action from being taken.

The increase in these factors of pressure, together with shortcomings in the implementation of legislation, plus the lack of synergy and forms of dialogue between the main participants, represent the primary obstacles to be overcome in order to establish virtuous trends.

Vehicle traffic represents the main source of urban noise pollution,

[1] Source: APAT analysis of ARPA/APPA data

though other sources should not be forgotten, such as: industrial and small-scale production activities, commercial activities and the related plants and systems (air conditioning, refrigerators etc.) and discotheques, whose impact is noteworthy in the proximity of the source itself.

Actions to limit noise pollution

The existing legislative strategy of prevention and mitigation is characterised by fragmented actions and an absence of coordination.

The existing situation is characterised by the absence of a strategic system of initiatives designed to prevent and mitigate the effects of noise pollution, as well as by the resulting fragmentation of the actions taken and the lack of coordination between the various subjects. In certain sectors, such as transport, more initiatives are carried out, while in many other areas, including acoustical and territorial planning, environment communications and education, and acoustics in construction, worrisome shortcomings persist.

A variety of actions have been formulated in response to the critical problems illustrated. The national system of law on the subject, which must still be completed, has passed through a complex phase of harmonisation with the obligations stipulated under European Directive 2002/49/EC, since the passage of Framework Law no. 447 of 1995. The system established, and currently in force, proves extremely elaborate, with regulatory measures for specific sources and activities generating noises, completed by regional laws of transposition, all presenting noteworthy differences in terms of the actual state of implementation in the various sectors and territorial spheres.

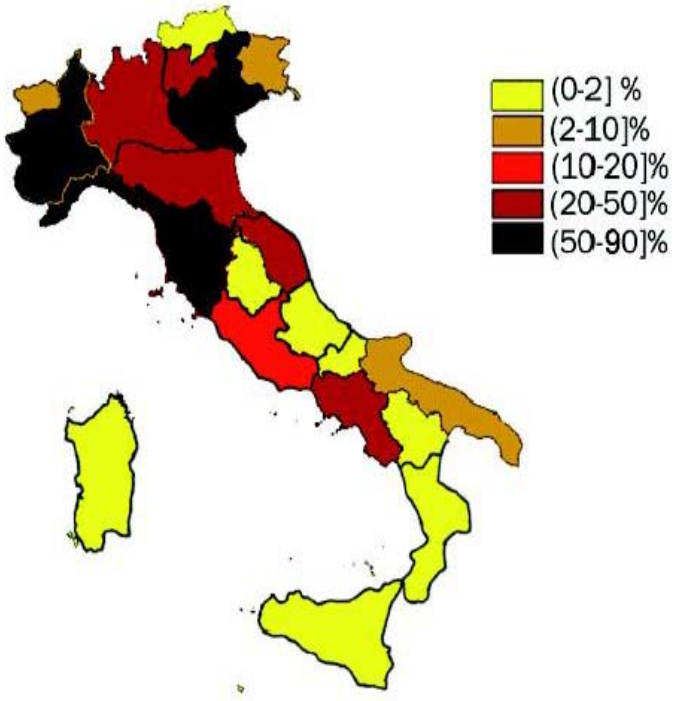
Initiatives have been undertaken to heighten the awareness of local government bodies, so as to favour activities of prevention.

The institutional activities carried out by the Agency System have been intensified in response to the increased demands from citizens. Efforts have been undertaken to raise the awareness of local government bodies, in the interests of an accurate and fully aware management of instruments of prevention, such as the acoustical classification of municipal territories, and of mitigation, such as the reclamation plan, capable of defining forms of development acoustically compatible with the territory. Unfortunately, the response of the local government bodies has not been fully satisfactory.

In fact, an analysis of the data on fulfilment of the required procedures stipulated under the legislation on the different sectors shows, as of 2006, a situation that remains stationary, compared to earlier years, meaning that little has been done regarding the existing situations. In particular, the failure of a large number of regions to issue a regional law containing measures on noise pollution, as established by the Framework Law, points to the inadequacy of the response and the fragmentation that characterises action on the national level. Based on the available data, seven regions have not yet passed such regional laws: Molise, Campania, Apulia, Basilicata, Calabria, Sicily and Sardinia.

Regarding the acoustical classification, meaning the main tool for establishing how the territory should be used and, therefore, the priority initiative in terms of measures of reclamation and abatement, the percentage of Italian municipalities that has

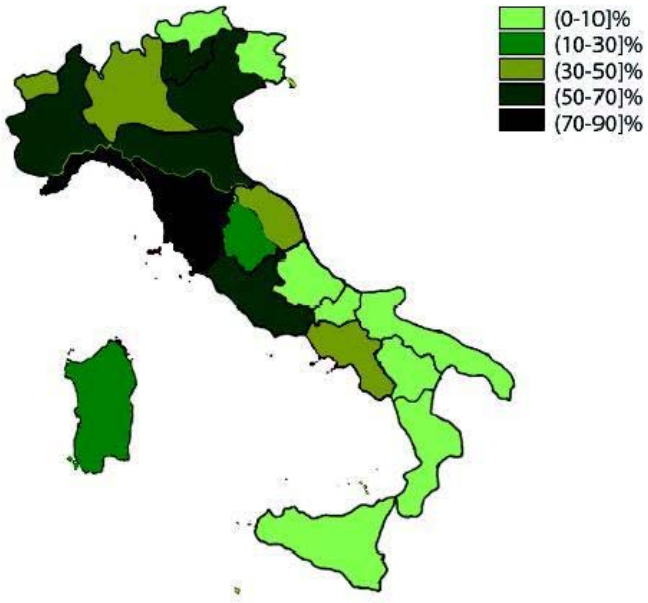
approved this classification, as of 2006, was equal to 31.5%, compared to the figure of 17.4% for 2003, while the percentage of the resident population in municipalities that have approved such zoning was 40.8%, compared to 31% in 2003. There were noteworthy differences between the situations in the different regions: in Tuscany, 84% of the municipalities have approved acoustical zoning plans, in Liguria 77%, in Venetia 69% and in Piedmont 64%, while in Molise and in Basilicata no municipalities, based on the data currently available, have approved them. As a percentage of the surface area of the national territory, the municipalities that have approved acoustical classifications account for 26.9%, a figure that stood at approximately 14 % in 2003 (Figures 2.29, 2.30 and 2.31).



The percentage of Italian municipalities that has approved the acoustical classification, as of 2006, is equal to 32% . Tuscany(84%), Liguria (77%), Venetia(69%),Piedmont (64%).

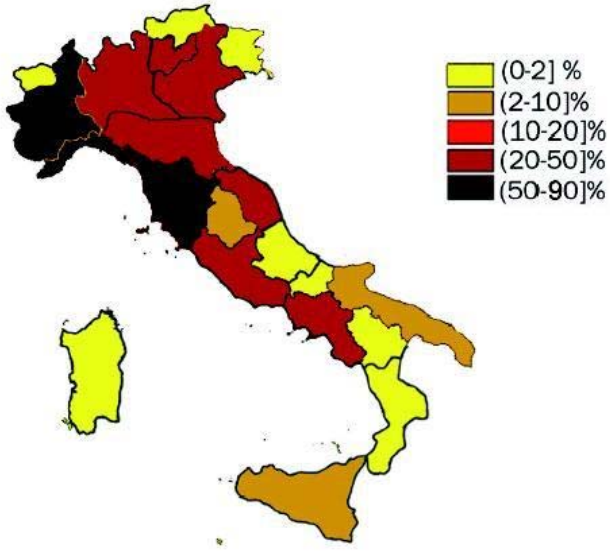
Figure 2.29: Percentage of municipalities that have approved acoustical classifications, out of the total number of municipalities for each region/autonomous province (2006)[2]

[2] Source: APAT analysis of ARPA/APPA data



The percentage of the population residing in municipalities that have approved acoustical zoning plans is 40.8%, a figure that has risen compared to 2003.

Figure 2.30: Percentage of the population residing in municipalities that have approved an acoustical classification out of the total population of each region/autonomous province (2006)[3]



The percentage of the territorial surface area of the municipalities that have approved a classification is 26.3%, while the figure for 2003 was approximately 14%.

Figure 2.31: Percentage of the territorial surface area of the municipalities that have approved acoustical classifications out of the total surface area of the municipalities in each region/autonomous province (2006)[4]

[3] Source: APAT analysis of ARPA/APPA data
[4] Source: APAT analysis of ARPA/APPA data

The obligation of drawing up a report on the acoustical status of municipalities at two-year intervals, as established by Law 447/95, in what constitutes an important act for the analysis and management of the problem of noise pollution, goes largely unmet, demonstrating the weak response of the municipalities to legislative requirements. Out of a total of 144 municipalities with populations of more than 50,000 inhabitants, meaning those required to draw up the report, as of 2006 only 22 had approved a report on their acoustical status (15%, the same as the figure for 2003). The most reports were turned in by Tuscany, with 9 municipalities out of 12 handing them in, and Lombardy, where 5 of the 14 municipalities required to do so presented reports. Implementation of the municipal acoustical reclamation plan, as called for under Law 447/95, is not widespread and undoubtedly suffers from insufficient enactment of other instruments of acoustical planning, such as the municipal acoustical classification, together with the failure to issue regional laws on the subject. The available data show that 54 reclamation plans were enacted, with the highest concentrations in two regions: Tuscany, with 32, and Liguria with 13 (followed by Emilia Romagna with 4, Venetia with 2, Val d'Aosta, Trent and the Marches with 1). The number of plans enacted, as a percentage of the number of municipalities that have drawn up acoustical classifications, is 2.4%.

The response of the municipalities has been weak, with only 15% meeting the regulatory obligations.

The acoustical classification of the areas surrounding airports, called for under Law 447/95 on the subject of airport noise, a fundamental act in terms of the planning of airport noise and a point of intersection with the problems of the municipalities involved, was enacted by 10 out of the 39 main national airports. The initiatives of reclamation required of managers/owners of transportation infrastructures under the Framework Law present differences in results: in the case of railways and highways, studies were completed on the critical problems presented by the infrastructure networks, and an initial series of measures of mitigation was planned, while similar efforts regarding roadways and airports are lagging considerably behind.

At present 10 airports out of 39 have enacted an acoustical classification, a fundamental tool in the planning of airport noise.

Running parallel to the European commitments, undertaken primarily as a result of the issue of Directive 2002/49/EC, national efforts may be directed at recouping delays and unfulfilled initiatives that have rendered the situation static for more than a decade now, in addition to pursuing objectives common to the European-Community countries, in terms of legislation, in order to harmonise the methods and instruments used, and as regards acoustical planning and the formulation of plans of action, in addition to devoting more attention to keeping citizens informed. Along these lines, the European Directive introduces and reinforces opportunities for active participation by the population in the process of formulating instruments of acoustical planning, initiatives held to be of fundamental importance to achieving a greater awareness of environmental developments, identifying the need, during this phase, for the enactment of information projects on various levels, so as to involve the community, seeing that acoustic pollution is closely tied to the day-to-day living habits of the individual.

Compared to roadways and airports, railways and highways have proven more proactive in terms of plans and programs of mitigation.

2.3.2 Electromagnetic Pollution

The problem

Prolonged exposure to electromagnetic fields is considered a potential threat to human health.

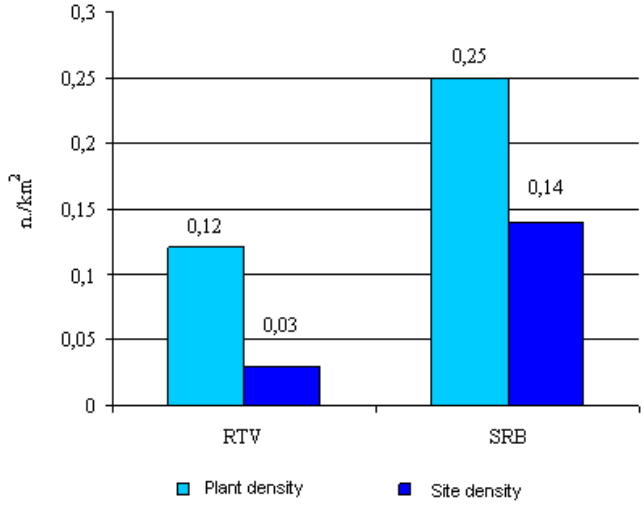
The form of pollution commonly referred to as “electromagnetic” is extremely relevant, given the frenetic development of new telecommunications systems, whose plants have spread throughout urban areas, giving rise to doubts and concerns as to the potential danger they pose. The intensification of the electricity transmission network, a result of the increased demand for electric energy, as well as the urban development of previously uninhabited areas, bringing with it electricity supply lines and radio and television broadcast plants, has also contributed to unease over the possible effects on human health of extended permanence in the vicinity of such installations.
These technological innovations have definitely led to improvements in terms of the quality of life, though they are often associated with instances of environmental impact and socio-medical problems.
Indeed, in recent years there have been heated social clashes between citizens and consumer associations, on the one hand, and the managers of the plants, on the other, with local government administrators being caught in the middle, together with, quite often, the agencies of control that are supposed to serve as mediators and support the citizenry, though without losing sight of the rights of the operators.

The main EMF sources

There are two main categories of sources of electromagnetic fields: sources of low frequency fields (0-300 Hz) or ELF (Extremely Low Frequency) fields, due essentially to systems for the production, distribution and use of electric energy (electric power lines, substations, home appliances etc.), which, in Italy, are based on the constant industrial frequency of 50 Hz; sources of high-frequency fields (100 kHz - 300 GHz), or RF (Radio Frequency) fields, caused by radio and telecommunications plants (radio, TV, cell phones, radar).

Between 2003 and 2006 there were increases in violations of the limits by both RTV plants (+25%) and RBS plants (+50%).

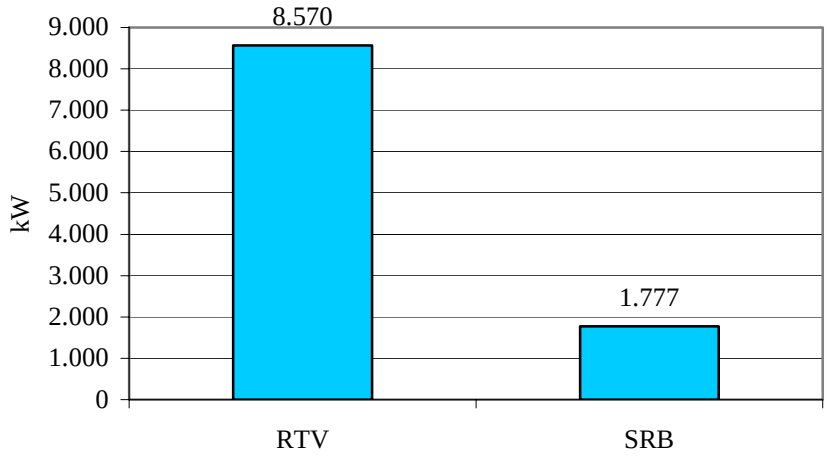
In terms of radio and television plants (RTV) and radio base stations (RBS), the environmental impact, meaning electromagnetic emissions, evaluated with respect to violations of the limits stipulated under the legislation currently in force, show respective increases of approximately 25% and 50% between 2003 and 2006. These percentages were arrived at by analysing the data found on the NIR (Non Ionising Radiation) Observatory and for those regions for which full results are available.
Analysis of the data on the density of RTV and RBS plants (Figure 2.32) shows that the density of the radio base stations is roughly double that of the radio-television systems (respectively 0.12 and 0.25 plants per km^2), while the density of the latter type of site (0.03 sites per km^2) is roughly five times lower than that of the RBS sites (0.14 sites per km^2).



RBS plants present a density roughly double that of RTV plants. The situation is similar in terms of site density, with 5 times more RBS sites than RTV ones.

Figure 2.32: Density of plants and sites, a comparison of RTV and RBS for the regions for which full results are available (2006)[5]

In terms of the overall power of RTV and RBS plants (Figure 2.33), there is no mistaking the fact that the most noteworthy environmental pressure from electromagnetic fields is generated by radio and television plants; in fact, the total RTV power (8,569.50 kW) is nearly 5 times greater than the RBS level (1,776.63 kW).



The most noteworthy environmental pressure comes from the RTV plants, whose power level is 5 times greater than that of the RBS plants.

Figure 2.33: Total power, comparison between RTV and RBS for regions for which complete results are available (2006)[6]

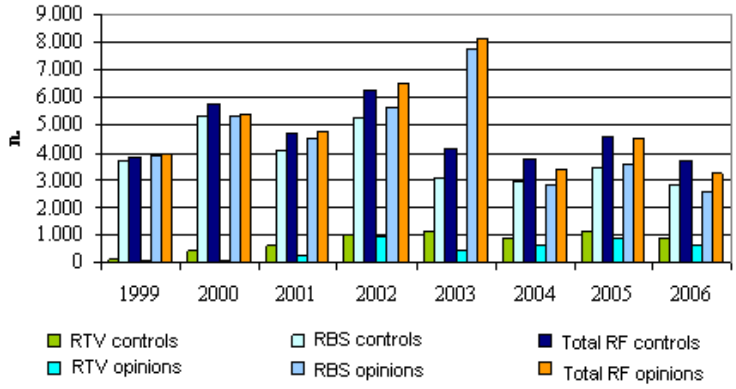
[5] Source: APAT analysis of ARPA/APPA/APPA data (NIR Observatory)
[6] Source: APAT analysis of ARPA/APPA/APPA data (NIR Observatory)

Actions to limit electromagnetic pollution

Control activities are of key importance in cases where initiatives reveal violations of the limits on exposure.

In terms of both radio frequencies (RTV and RBS) and extremely low frequencies (ELF), control activities constitute a fundamental operation on the part of the responsible authorities (ARPA/APPA), in cases where such initiatives point to violations of the limits of exposure, safeguard levels and objectives of quality, leading to the necessary restoration activities on the part of the subjects that manage or own the plants.
Analysis of the data from the NIR Observatory shows that, between 2004 and 2006, there was a decrease of 8.9% in the number of preliminary opinions for RBS plants and an increase (approximately 4.2%) in the number of opinions for RTV plants. As for the number of controls, both experimental and using models, there was a decrease of 2.8% for RBS and a slight rise, 0.8%, for RTV (Figure 2.34).

Between 2004 and 2006 there was a decrease in preliminary opinions for RBS (-8.9%), an increase in the number of opinions for RTV (+4.2%), a decrease in the number of controls for RBS (-2.8%) and a slight increase for RTV (+0.8%).

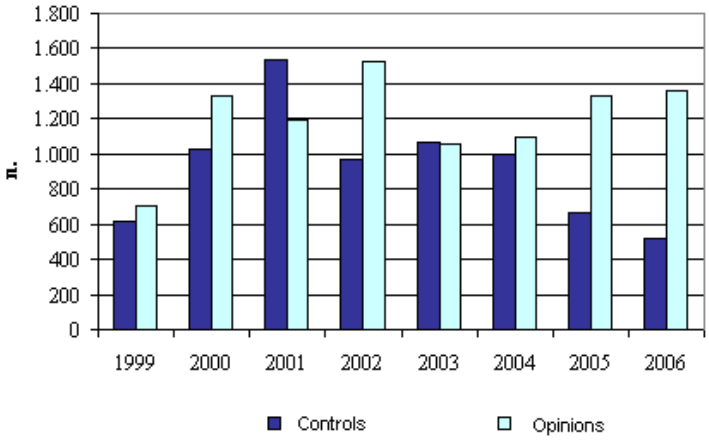


Note: the data regard only the regions/autonomous provinces for which complete results are available

Figure 2.34: Opinions and controls carried out on RF plants in Italy, broken down by type of source [7]

An analysis of the data available on the website www.monitoraggio.fub.it for monitoring efforts carried out by the Ugo Bordoni Foundation between 2002 and 2006 on electromagnetic fields generated by RF plants also shows an increase in controls in private homes and schools.
In terms of the opinions and controls of power lines (ELF), figure 2.35 shows that the number of opinions, between 2004 and 2006, rose by 2.64%, while the number of controls carried out registered a slight decrease of 4.8%.

[7] Source: APAT analysis of ARPA/APPA/APPA data (NIR Observatory)



Between 2004 and 2006 the number of opinions increased by 2.64%, while the number of controls performed showed a slight decrease of 4.8%.

Note: the data regard only the regions/autonomous provinces for which complete results are available

Figure 2.35: Trends in the number of opinions and controls for sources of ELF fields in Italy [8]

In terms of the restoration initiatives undertaken to date, regarding the violations observed during the control activities, it is interesting to note (Figure 2.36) the differences between the two types of sources, RTV and RBS, with regard to the restoration efforts concluded and those underway: for RBS plants, the difference between the percentage of restoration efforts concluded and those still underway was notably higher than that for RTV plants. This is due to the fact that, in the case of the RTV plants, the reclamation effort is technically more complex, seeing that more plants are involved and that it is frequently not possible to maintain the quality of service stipulated in the acts of concession, whereas, in the case of the RBS, the actions of restoration are generally immediate, technically less demanding and performed at costs that are generally more limited.

Fewer initiatives were completed for RTV plants than for RBS plants because of the greater complexity of the restoration efforts.

There is no information available on reclamation activities involving electrical power lines, with this probably being due to the lack of a decree of implementation for Law 36/2001 (art. 4, paragraph 4), which should regulate the criteria for the formulation of reclamation plans.

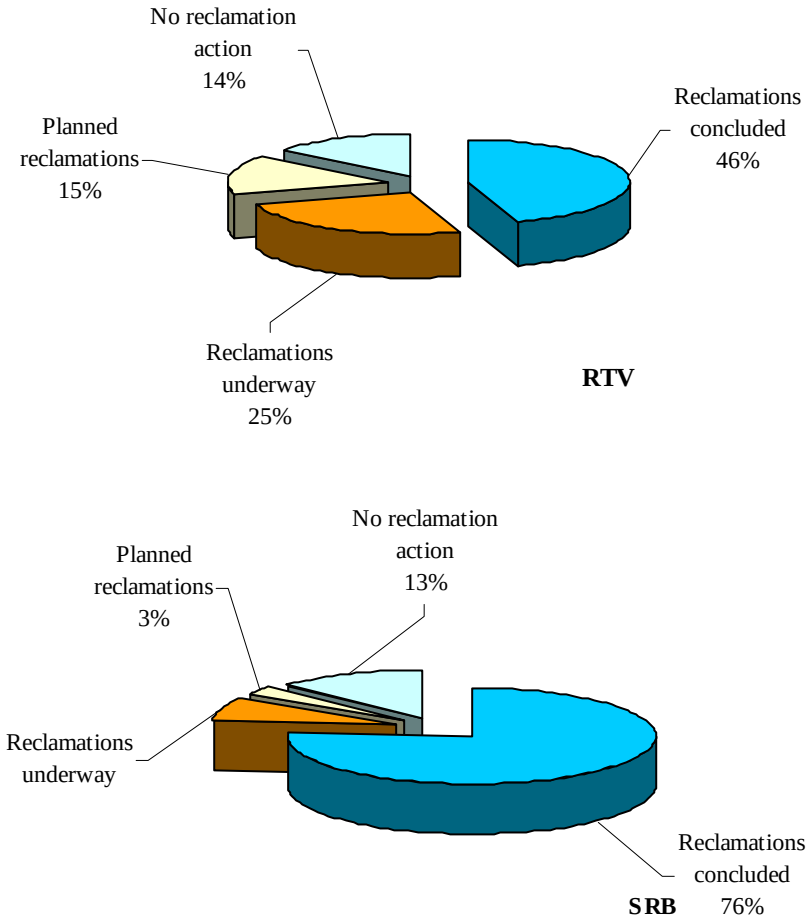
The current Italian legislative scenario has as its guideline the concept of "prudent avoidance", which underlines the importance of avoiding or reducing exposure to an external agent, to the greatest extent possible, should doubts arise as to its potential threat to human health. In fact, even in the absence of a confirmed cause-effect connection between exposure to electrical, magnetic and electromagnetic fields and medical consequences, the practice on the national level is to take into due consideration the risk connected with prolonged exposure to low levels over time.

The guideline for Italian legislation is the concept of "prudent avoidance", with consideration given to the risk tied to prolonged exposure even at low levels.

At present, 17 regions have drawn up regulatory measures, in compliance with the current national legislation. In addition to a legislative framework that places a special focus on the defence of the

[8] Source: APAT analysis of ARPA/APPA/APPA data (NIR Observatory)

individual and the respect of the environment (correct urban/environmental development of plants and systems, techniques for mitigating the visual impact of the same etc.), the awareness of citizens is quite high and shows no signs of waning, meaning that social attention to the issue remains elevated.



In 2006, the percentage of reclamations concluded for RBS (76%) was far higher than that for RTV (46%).

Note: the data regard only the regions/autonomous provinces for which complete results are available

Figure 2.36: Status of the reclamation actions at sites where a violation of a limit was recorded on account of RTV or RBS plants (2006)[9]

[9] Source: APAT analysis of ARPA/APPA/APPA data (NIR Observatory)

2.3.3 Light Pollution

The problem

Light pollution is an alteration in the natural quantity of light caused by the introduction of artificial light.

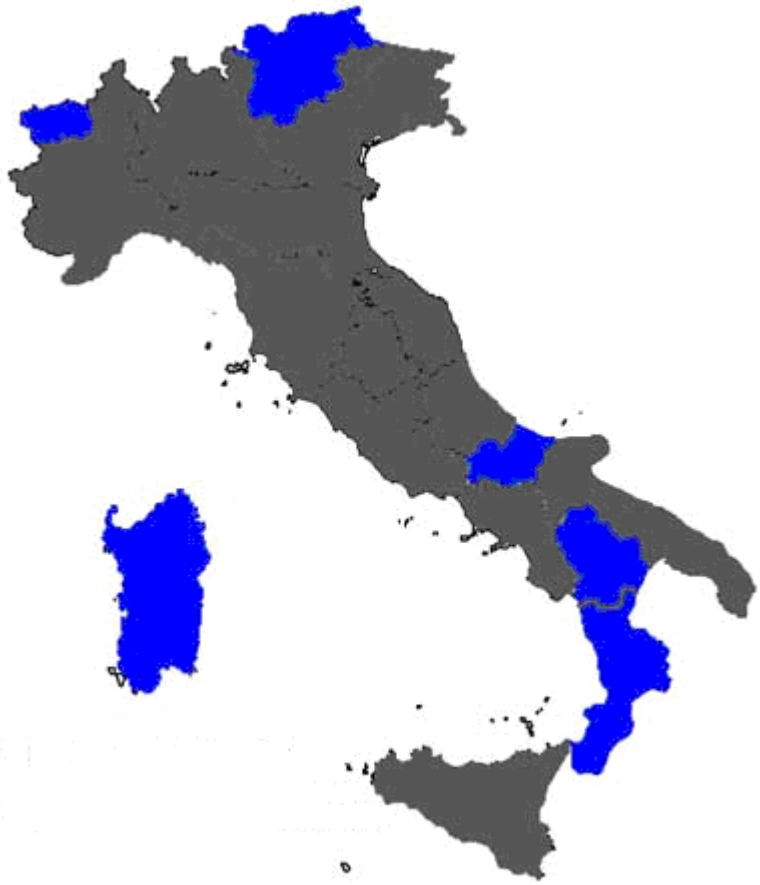
Light pollution is an alteration of the natural quantity of light present in the night-time environment, on account of the addition of artificial light. The night is not completely dark, on account of a number of sources of natural light, such as starlight, the light of the Sun spread by interplanetary dust and the light generated by the recombination of ionising atoms in the upper layers of the atmosphere, to which the diffusion of artificial light must be added.

The introduction in the environment of radiating light of anthropogenic origin causes an alteration in the night-time environment, in the form of light pollution. This type of pollution constitutes a major environmental problem, especially in densely urbanised areas. Though it is held to be less significant than other forms of pollution, the increased luminosity of the night-time sky has negative repercussions on the quality of the environment, and therefore on human life. Recent studies show that alterations brought about by excess luminosity of the environment during the night-time hours lead to the following negative consequences:

The increased luminosity of the night-time sky has a negative effect on the quality of the environment, on the life of man and on astronomical research.

- environment damage, resulting from:
  effects on the flora (such as a reduction of chlorophyll photosynthesis) and distortions in the photosynthetic processes of plants, as well as the timing of photosynthesis;
  effects on fauna (disorientation of migratory species), alterations in the living and hunting habits of animals, disturbances of reproduction and migration and alterations of circadian rhythms;
- damage to man , consisting of:
  dimming, alterations of eyesight;
  possible alterations in the production of melatonin;
- damage to astronomical research, together with the irreplaceable loss, even for current generations, of the shared heritage of humanity that is the starry sky, which, in turn, would cause incalculable socio-cultural damage, seeing that, in addition to a fabled aspect of our living habitat, the stars in the sky have always served as a fundamental stimulus to human culture, both humanistic and scientific.

In figure 2.37, the regions highlighted in blue (Sardinia, Val D'Aosta, the two autonomous provinces of Trent Alto Adige, Molise, Basilicata and Calabria) are those where weak stars, meaning the less visible ones, can still be seen from than 60% of the regional territory. It should also be noted that a large number of these regions (as shown by the figures that follow, 2.39 and 2.40) have still not formulated a regional law safeguarding the star-filled sky.

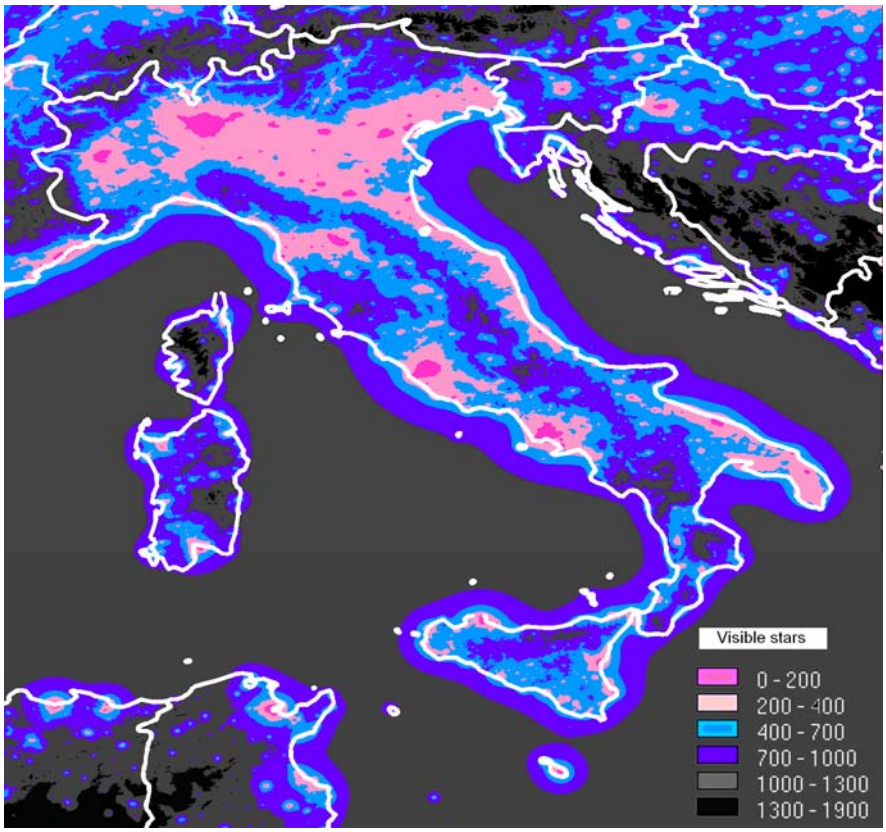


The regions highlighted in blue are those where the less luminous stars are still visible from more than 60% of the regional territory.

Figure 2.37: Italian regions in which weak stars are visible from more than 60% of the regional territory[10]

The map of the number of visible stars (Figure 2.38) makes it easier to evaluate the distribution of the state of light pollution in Italian territory. The zones of the map coloured pink are those where it is possible, on a clear night, for an observer with an average amount of experience and skill, age approximately 40 and eyes accustomed to the dark, to count no more than 200 stars sighted with certainty (98% probability of identification) in the celestial panorama, using both eyes. As shown by the map, these zones coincide with the portions of the territory where the largest residential and industrial agglomerates are located. But even in the mountainous zones of the Alps and the Apennines, there is little comfort to be taken from the results, seeing that the areas where the sky is completely dark (coloured black on the map), making it possible to count more than 1,300 stars, are extremely rare, especially considering the vast areas of black in Corsica and in the desert zones of North Africa. The map takes into account the altitude of the observation sight and the extent to which the atmosphere extinguishes starlight. An expert observer capable of identifying barely perceptible stars, as opposed to stars that can be sighted with certainty, would arrive at much higher counts.

[10] Source: ISTIL Report 2001



The zones affected by light pollution (pink zones) coincide with the portions of the territory containing the largest residential and industrial agglomerates.

Figure 2.38: Number of visible stars[11]

The main sources of light pollution

The main source of light pollution is the flow of light dispersed towards the sky, originating primarily from private electrical plants and, to a lesser degree, public systems (25%-30%).

This form of pollution originates from the flow of light dispersed towards the sky from various manmade activities, both as a result of inefficient equipment (lighting systems, lighted signs etc.) and on account of a lack of planning. On the average, at least 25%-30% of the electric energy of public lighting systems is dispersed in the direction of the sky, and the percentage from privately operated systems is even higher. A reduction in consumption would contribute both to energy savings (1.8 GWh, as estimated by the Italian Astrophile Union) and to reducing the related emissions (estimate of the Italian Astrophile Union: 1.4 Mt/years of CO_2). The environmental impact of light pollution can be broken down into two main categories:

- the atmosphere of artificial light and its subsequent diffusion by molecules and particles of aerosol, which behave as secondary sources of light. Evaluation of this impact entails determining the maximum input of each device, so that the sum total of the effects of all the active plants and systems produces a negligible alteration of the natural environment, meaning an alteration in the quantity of natural light present in the environment.
- the second “proximal” is due to direct lighting caused by plants, surface areas, objects and subjects in the vicinity that do not need

[11] Source: P. Cinzano/ISTIL

to be lit (at times referred to as optical pollution). To evaluate proximal light pollution, the light flow that arrives on the surface area or the subject involved must be determined, meaning that the parameters to be utilised are the horizontal or vertical lighting, as well as those regarding the subject itself, such as debilitating glare and bothersome glare.

The International Astronomical Union (IAU) provides a quantitative definition for the degree of light pollution of the night-time environment, in order to evaluate the effects on the ecosystem and the deterioration of stellar visibility: «The increase in the luminosity of the night-time sky at a 45° angle of elevation, due to the diffusion of artificial light in a clean sky, should not exceed 10% of the lowest natural level in each portion of the spectrum between the wavelengths of 3,000 Å and 10,000 Å. Above this level, the sky should be considered "polluted[12]" ».

The increase in the luminosity of the night-time sky, due to the diffusion of artificial light, should not exceed 10% of the lowest natural level, above which limit the sky should be considered "polluted".

Actions to limit light pollution

The Third Conference of the United Nations on the Peaceful Exploration and Use of Space (UNISPACE III, Vienna 12-16 July 1999) called on the member nations "to take steps to reduce pollution of the sky from light and other causes, in order to obtain energy savings and benefit the natural environment".

Italy has the most advanced laws to be enacted for the protection of the night-time sky and the promotion of energy savings.

Italian legislation on the subject is fairly varied and continually evolving. In actual fact, Italy currently has the most advanced laws on the protection of the night-time sky to be found in a national territory of noteworthy size.

Though there is not yet a national legislative act endorsed by all the different operators in the sector (designers, manufacturers and associations for the protection of the night-time sky), on the regional level, no fewer than 17 out of 20 regions, as well as an autonomous province, have passed legislation which, using various approaches, interprets the need to safeguard the night-time sky and, in some cases, promote energy savings.

Figure 2.40 shows the Italian regions that have passed a regional law, subdivided by texts that call for similar levels of upward emissions.

[12] Smith F.G., 1979, Report on Astronomy, IAU Trans., XVIIA, 218-222

No fewer than 17 regions out of 20 have passed laws meant to safeguard the night-time sky and promote energy savings.

Figure 2.39: Italian regions that have a regional law on light pollution[13]

The regions in blue have passed legislative acts geared towards obtaining zero emissions towards the sky.

Legend

upward emissions ≤0

0 < upward emissions < 35 cd/klm

allow an upwards light flow of 3%

direct or indirect technical reference to the UNI10819 technical standard;

regions/provinces governed under special statues that have still not passed laws in the sector, but use as their lone regulatory reference the UNI10819 technical standard.

Figure 2.40: Italian regions with regional laws, subdivided by texts [14]

[13] Source: ISTIL 2001 Report

[14] Source: ISTIL 2001 Report

The parameter of upward emission is the one that makes possible the primary comparison of the laws. The emissions are measured in cd/klm (candle/kilolumen), given that this ratio provides an efficient measure of the directional dispersion of luminous emissions in the atmosphere; the ratio is determined on the basis of the angle formed by the luminous emission with the horizontal plane. This angle is set at 0 on the vertical axis, and it rises up to 90 decrees on the horizontal plane passing through the body of light. Therefore, a reference to 0 emissions at 90° and beyond means that there is no upward light flow beyond the horizontal plane passing through the body of light, except for small margins of error allowed under the law. The comparison becomes difficult, however, when the distinguishing characteristics of the individual legislative texts are examined. We shall thus limit ourselves to providing a brief outline of some of the most important elements.

A law for limiting light pollution must include irremovable minimum prerequisites for upward emissions, in addition to defining the subjects involved, the controls and evaluations, the approval procedure and an adequate system of organised penalties.

Any law to limit light pollution must contain irremovable minimum requirements for upward emissions, in addition to which it must stipulate all the other prerequisites identified in the preceding paragraphs, in addition to providing a solid legislative framework that defines the subjects involved, together with the controls and the evaluations, the approval procedure and an adequate system of organised sanctions.

The following are the essential technical measures found in the most effective laws:

- application of the measures to the entire regional territory, without pointless subdivisions into protected areas, seeing that light pollution spreads quite far;
- application of the measures to all new systems and plants, both public and private;
- limitation of the light pollution caused by light reflected from illuminated surfaces, by means of a ban against excess lighting and through the use of flow reducers at appropriate times, plus the turning-off of lights whenever possible;
- limitation of light emissions in the atmosphere by lighting devices through application of a parameter that depends on direction (intensity per unit of flow in cd/klm). This makes possible effective limitation of light emissions in any direction, including those at low angles above the horizon, which are the most harmful;
- limit of 0 cd/klm on light emissions at 90 degrees and beyond, making it possible to minimise emissions from lighting devices that reflect light from streets (in effect, corresponding to 0.49 cd/klm, because the readings taken are approximated to the nearest whole number);
- obligation to illuminate buildings and monuments with downward light flows, plus the same limitations previously placed on upward light emissions, unless the impossibility of doing so is confirmed (in which case, however, the band of light must remain within the bounds of the surface area illuminated);
- illumination of large areas within the same limits applied to street illumination;

- obligatory use of lighting units with the highest level of efficiency possible, in order to limit useless emissions at wavelengths that the eye cannot see;
- prohibition against bands of light for the purpose of advertising or similar luminous notifications (in actual fact, already prohibited under art. 23 of the Highway Code, because they distract drivers);
- penalties commensurate “to each light source”;
- upgrading of at least the categories of plants that cause the most pollution and that are inherently large polluters;
- obligatory presentation of a technical lighting plan, complete with the photometric data on the lighting devices, signed by the technical manager of the laboratory that has issued the plans.

In Europe, to date, there are only 3 examples of national or regional laws on light pollution.

At present, there are only 3 examples of national or regional laws in Europe. The oldest approved European regional law is definitely the one passed to protect the European Astronomical Observatory in the Canary Islands, in response to the need to safeguard one of the most important observatory sites for astronomical research. In terms of national laws, the first to be approved by a European country was that of the Czech Republic, followed, in September of 2007, by a legislative act in Slovenia. Both texts cite Law no. 17/2000 of the Lombardy Region as their source of reference and inspiration.

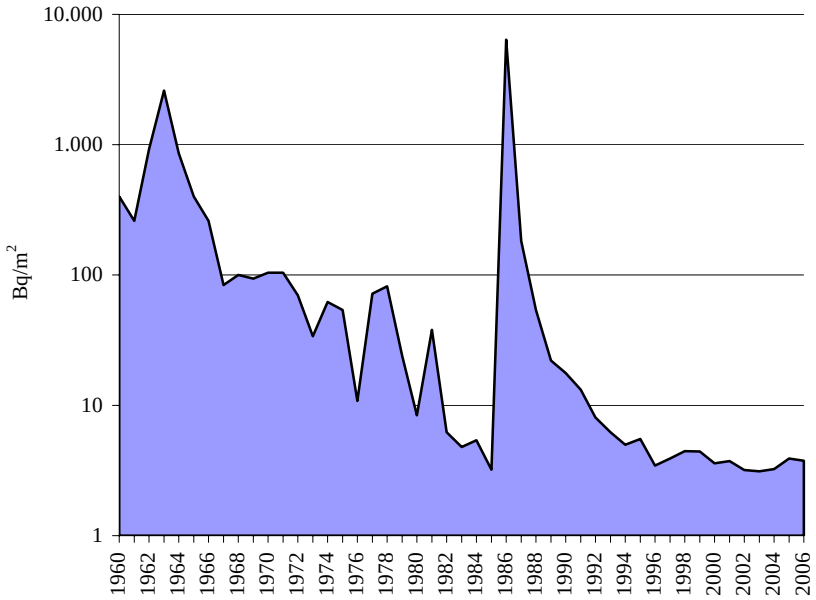
2.3.4 Ionising Radiation

The problem

The control of environmental radioactivity in Italy is justified by the need to protect the population and workers from exposure to ionising radiation. It got underway following the first tests of nuclear warheads carried out in the atmosphere in the 50's and the 60's, as a result of which large-scale dispersion and fallout of radio nuclides led to pollution of food chains, and controls were intensified following the construction of the first nuclear plants in our country, peeking even further in the years following the Chernobyl incident, in the wake of which public awareness of the issue grew considerably.

The control of the environmental radioactivity in Italy was initiated following the first tests of nuclear warheads carried out in the atmosphere in the 50's and 60's.

In order to obtain a rough idea of the state of radioactivity in Italy, the concentration of artificial radio nuclide activity over time can be observed; to this end, figure 2.41 shows the amounts of Caesium 137 accumulated in the soil (^{137}Cs). The graph plots the fallout events associated with the tests performed in the atmosphere in the 50's-60's, with the peek corresponding to the accident at the Chernobyl plant in 1986, after which the figures for contamination systematically decreased.

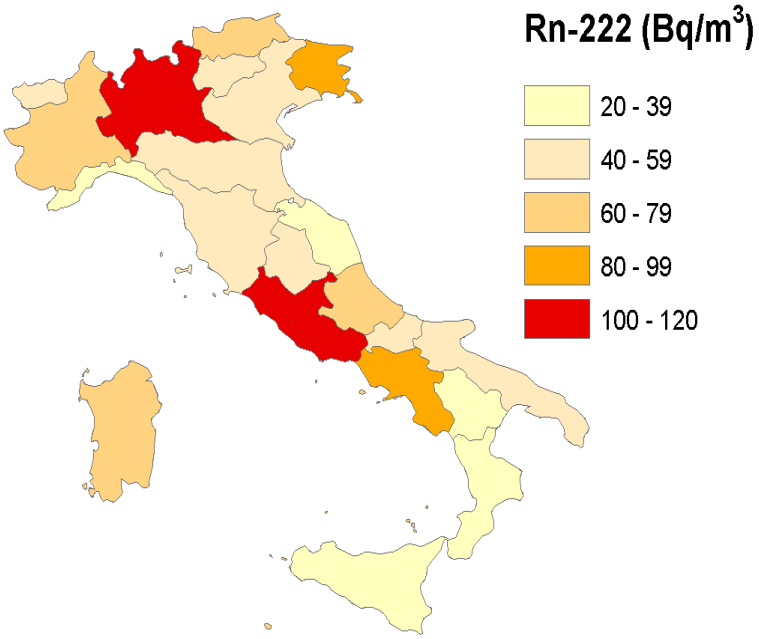


The graph shows the instances of fallout associated with the tests carried out in the atmosphere in the 50's – 60's, plus the peek tied to the accident at the Chernobyl plant in 1986, after which the contamination levels systematically decreased.

Figure 2.41: Trend for ^{137}Cs fallout in Italy [15]

[15] Source: APAT analysis of APAT/ARPA/APPA data collected by the APAT Environmental Radiation Laboratory Service; OECD-ENEA, 1987, The Radiological Impact of the Chernobyl Accident in OECD Countries, Paris; APAT

The state of radon exposure is also expressed by the results of a survey carried out during the 80's and the 90's, but still valid for the characteristics of such exposure, with full national coverage, as shown in figure 2.42, which illustrates the noteworthy differences in the average concentrations of Rn-222 in the various regions. This distribution, in line with the results recorded in other countries, can be ascribed to the natural spatial variability of Radon exposure, due primarily to the differences in uranium content of the rocks and soils, as well as variations in their permeability.



Latium and Lombardy show high concentrations of radon (Rn-222.) The difference compared to the other regions is due to the different uranium contents of rocks and soils and to variations in their permeability.

Figure 2.42: A map showing the concentrations of Rn-222 activity in habitations, by region and autonomous province (the intervals selected are meant merely as examples) (1989-1997)[16]

The main sources of ionising radiation

In Italy, the generation of energy from processes of nuclear fission was interrupted following the passage of the 1987 national referendum, but the continuing, and growing, production and cross-border circulation of radioactive materials calls for maintenance and constant refinement of the capacity to protect against radiation, as well as a broadening of the scope of commitments to safeguard the environment, the population and workers.

A second consideration that has emerged in the last few decades, and one more relevant with regard to its impact on the population, is exposure to natural sources. Of such sources, radon exposure represents the number-one source of radiation risk (barring nuclear accidents or explosions).

The main sources of ionising radiation are those tied to the cross-border circulation of radioactive materials, natural sources (radon) and exposure for therapeutic purposes.

[16] Source: Bochicchio, F. et al., Results of the National Survey on Indoor Radon in all 21 Italian Regions, Proceedings of Radon in the Living Environment Workshop, Athens, April 1999

A third consideration regards exposure to ionising radiation for medical, diagnostic or therapeutic purposes, which is amply justified, considering the attendant benefits. In such cases, the control is essentially focussed on the proper operation and use of machinery and procedures.

Actions to limit pollution from ionising radiation

Control of radioactivity in Italy is structured in three levels: local, regional and national.

The monitoring of environmental radioactivity is organised, in compliance with Legislative Decree 230/95 and subsequent modifications and additions, as well as with European-Community legislation, around a set of networks structured on three levels: local, regional and national.

The local networks carry out controls around nuclear plants, the regional networks have the task of monitoring environmental radioactivity within their territories, and the national networks provide the general framework for the situation in Italy, in addition to sounding the alarm in the case of widespread contamination.

In terms of response, an overview of the situation in Italy is provided through implementation of the network monitoring program.

Table 2.6 illustrates the point scores awarded for evaluation of national monitoring since 1997. In determining the annual point score, consideration is given to the following matrices: atmospheric particulate, gamma dose in the air, cow's milk, surface water and drinking water. The following factors were monitored for each of these matrices: frequency of measurement, sensitivity of measurement, territorial distribution of controls, regularity of monitoring and organisation of and participation in initiatives of comparison and control on a national scale.

An analysis of the state of the monitoring plan has pointed to less than complete coverage of the national territory, meaning that corrective action must be taken.

In terms of response, it was determined that the zones with the greatest probability of high concentrations of radon must be identified, meaning that the territory must be mapped, making it possible to implement differentiated strategies of action while fulfilling the tasks assigned under Legislative Decree 230/95, plus subsequent modifications and additions, to the regions, which are responsible for the activity in question. The mapping was rendered official through publication in the Official Gazette. To date, mapping studies have been initiated in many Italian regions, but the results have not yet been published in the Official Gazette.

Table 2.6: Evaluation of the state of implementation of the monitoring for national networks [17]

Year	Point score	Judgment
1997	15	sufficient
1998	17	sufficient
1999	13	insufficient
2000	17	sufficient
2001	17	sufficient
2002	17	sufficient
2003	17	sufficient
2004	17	sufficient
2005	17	sufficient
2006	17	sufficient

Legend: Classes of quality: insufficient 0- <15 sufficient 15- <21 good 21-25

Analysis of the implementation of the monitoring plan has shown less than complete coverage of the national territory, pointing to the need for corrective measures.

[17] Source: Analysis APAT/ARPA Emilia Romagna

2.4 Soil Contamination

Introduction

Soil plays a fundamental function in protecting the environment, serving as a filter and a barrier, so as to mitigate the effect of pollutant dispersion. Soil, if heavily contaminated by hazardous substances, may lose its intrinsic properties to such a level that not only its protective functions, but also its productive and ecological functions are degraded.

Soil plays a key role in protecting the environment, by mitigating the negative effects of pollutants.

Similar degradation processes do not affect only the soil, since contaminants, through complex transport processes governed by the soil itself, as well as the chemical-physical characteristics of the contaminant and the hydrogeological and climatic conditions, are carried to other environmental matrixes. It follows that impacts due to soil contamination may often imply the dispersion of polluting substances into surface and ground waters and the atmosphere, in addition to contaminating the food chain.
Soil contamination may also cause a series of social, economic and health consequences. Contaminants in the soil can make their way into the food chain through assimilation by flora and fauna, with negative effects on human health and on ecosystems. Short or long term exposure of workers and of the population to dangerous substances, can result in the onset of serious pathologies. The economic consequences are linked primarily to the massive financial efforts needed for environmental restoration and reclamation, as well as to the loss in value of contaminated land and to the possible refusal by consumers to purchase products grown on agricultural soil declared or suspected to be polluted.

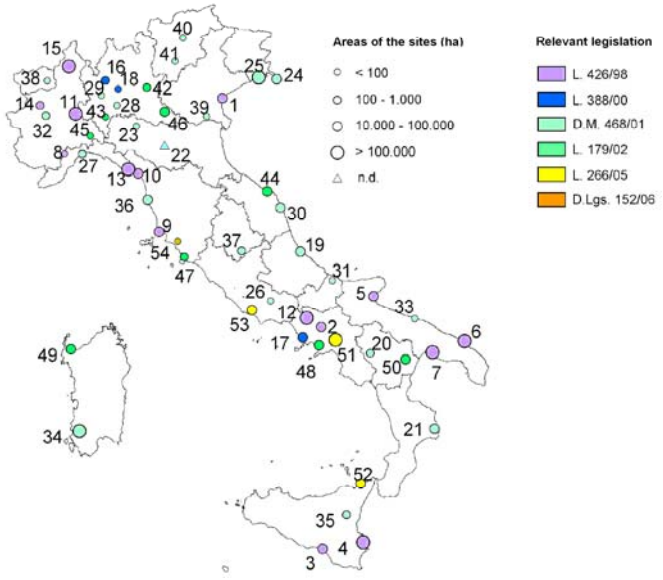
Impacts of soil contamination on surface and ground waters, on air and the food chain, may generate risks to human health.

Soil contamination may impact on limited and well defined areas, corresponding to known point sources (contaminated sites), or it can affect extensive areas by release into the environment of large quantities of polluting substances from multiple sources dispersed throughout the territory (diffuse contamination).

2.4.1 The situation in Italy

At present, in Italian national territory, 54 contaminated Sites of National Interest have been located (SIN, Figure 2.43). These sites were identified by issue of specific decrees, on the basis of the site characteristics, quantity and level of danger of the polluting substances, plus the magnitude of health and ecological risks and the detrimental effects on cultural and environmental resources. The restoration efforts of these sites are directly coordinated by the Ministry of the Environment, Land and Sea, which draws on the services of the APAT for the assessment of site characterization and remediation projects.

There are 54 contaminated sites of national interest. The Ministry of the Environment, Land and Sea coordinates their restoration directly.



The Sites of National Interest are concentrated in areas subject to high anthropogenic impact (industrial areas, waste disposal sites, mining areas etc.).

Figure 2.43: Localisation, dimensions and relevant legislation on Sites of National Interest (2007)[1]

There are approximately 15,000 potentially contaminated sites, more than 4,000 of them to be reclaimed, under the responsibility of the regions.

A number of these sites present levels and extent of soil and groundwater contamination such that implementation of actions for full site recovery over the medium-short term (25 years) is a difficult objective in technical, economic and environmental terms. For this reason, a number of these sites are classified as so-called "mega-sites". In addition to the Sites of National Interest, there are several thousand contaminated or potentially contaminated sites falling under regional responsibility, and which, based on the legislation currently in force, should be included in special "Regional Registries of Sites to be Restored" (Table 2.8).

A separate topic is that of "brownfields", meaning abandoned, inactive or unused sites that have hosted industrial or commercial activities in the past, where site reuse faces the obstacle of an identified or suspected pollution. Such sites are often located within urban land, and thus present a high economic potential. The regions with the greatest number of "brownfields" are located in the north of Italy: these are Lombardy, Piedmont and Venetia, i.e. regions where industrial development has been most intense in past decades. The central-southern regions, on the other hand, are characterised by the presence of few but quite large industrial districts, based on a pattern of industrial development concentrated in a limited number of areas.

Cases of diffuse contamination are found in almost all Italian regions, though there are no homogeneous datasets or a complete national overview.

A national homogeneous overview of diffuse soil contamination is not yet available, even though the related problems are present in almost all Italian regions. Accumulations of heavy metals have been reported in the proximity of roadway infrastructures (Pb), in wine-growing areas (Cu) and in heavily farmed zones. Soils contaminated by organic compounds can be found in the vicinity of industrial areas, especially in the Campania region, where pollution from PCBs, furans and dioxins is

[1] Source: APAT

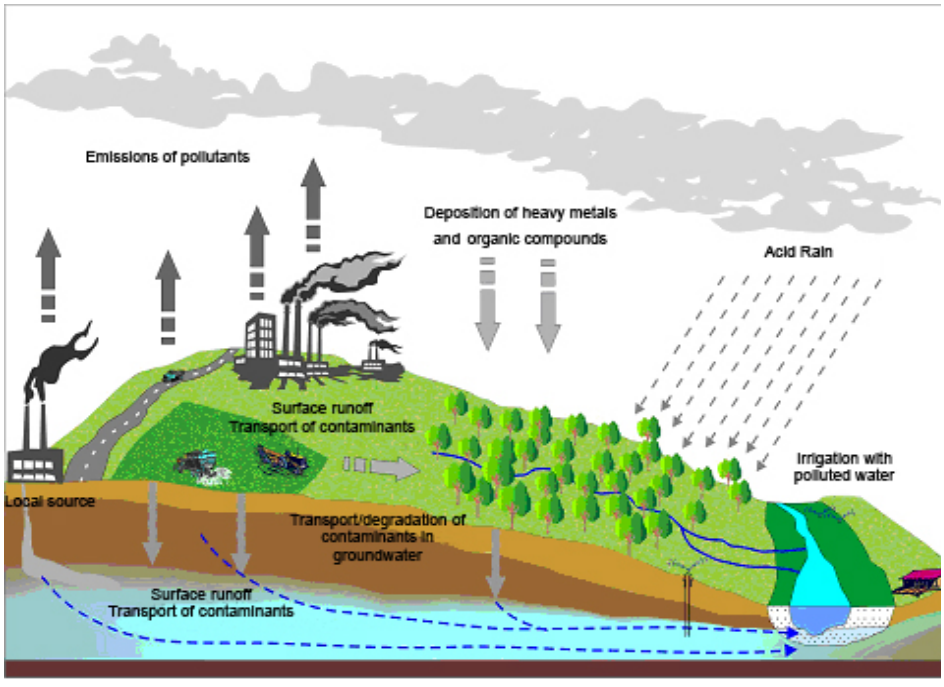
considered a relevant problem. In terms of pollution from nitrates, available data show a surplus of nitrogen and phosphorus in almost all Italian regions, with the highest levels in regions with large agricultural areas, and especially in certain districts of the Po Valley.

2.4.2 The main causes of local and diffuse soil contamination

The presence of contaminated sites is a problem common to all industrialised countries, as it is often linked to human activities such as: industries, mines, waste disposal sites and other plants that, because of spills, leaks from plants/tanks, improper management of waste, etc., may have an impact on local soil contamination. In Italy, the main industrial activities which have given rise to local soil contamination are the refining of petroleum products, the chemical industry, the metallurgical industry, the manufacture of asbestos and certain waste management activities.

The activities involved in local contamination include: the industrial refining of petroleum products, chemical and metallurgical operations, the manufacture of asbestos and certain waste management activities.

In the case of diffuse contamination, contributing causes can be atmospheric fall-out and intensive agricultural/farming or other human activities scattered throughout the territory and/or prolonged over time and that cannot be easily identified as individual or point contaminant sources (Figure 2.44).



Diffuse contamination results from industrial, urban and agricultural sources.
When soil can no longer perform its protective function, the polluting substances may also contaminate rivers, streams and groundwater and enter the food chain.

Figure 2.44: Diffuse contamination processes[2]

Industrial and vehicle emissions into the atmosphere lead to fall-out in soil of acidifying contaminants (SO_x, NO_x, NH_3), heavy metals (Pb, Hg, Cd, As, Cr, Cu, Ni, Se, Zn) and organic compounds (linear-chain

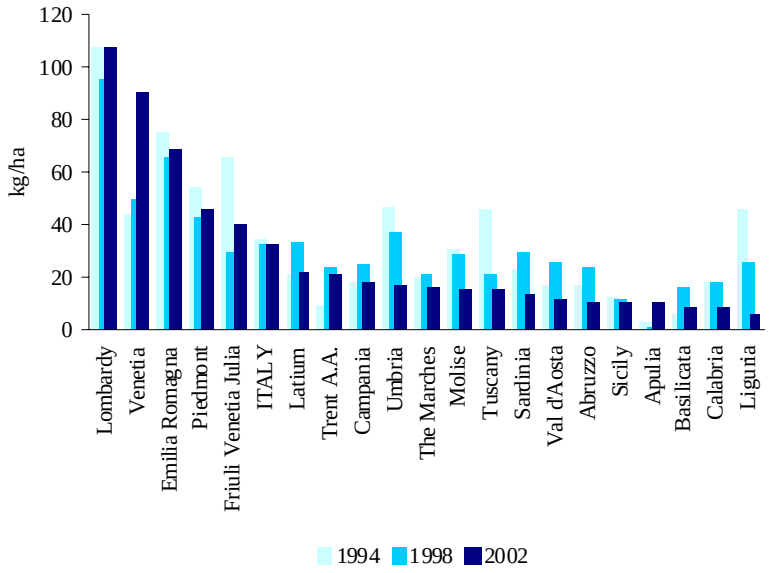
Industrial and urban activities release acidifying substances, heavy metals and

[2] Source: APAT

hydrocarbons, PAH, dioxins, furans etc.). Intensive farming practices, making abundant use of pesticides, chemical fertilisers and manure, can result in an excess of nutritional elements (N, P, K), in accumulation of heavy metals and in the spread of biocide substances. Given that nitrates are extremely soluble in water, and not easily retained by soil, an excess of nutritional elements can result in serious groundwater pollution, and in eutrophication of surface water ecosystems.

organic compounds into the atmosphere. Farming practices result in excess nutritional elements, accumulation of heavy metals and the spread of biocide substances.

The observed trend of excess nitrates has gradually decreased in almost all Italian regions in the last decades, thanks to the measures taken to comply with the current legislation (Figures 2.45 and 2.46). In some cases, the use for farming practices of sludges generated by the treatment of urban and industrial waste water - sludges which can contain substantial amounts of hazardous substances - can be a matter of concern, if this use is not properly managed and controlled. Finally, the high levels of certain contaminants in a number of environmental matrixes can have a natural origin. In fact, an elevated concentration of heavy metals in the soil can be determined by the chemical characteristics of the rock/parent material. This means that a correct identification of the natural component is needed before assessing the extent of any anthropogenic contaminating component and the impact of these particular chemicals.



The surplus nitrate trend is gradually decreasing in almost all Italian regions, mainly as a result of measures taken to comply with the current legislation.

Figure 2.45: Regional surplus of nitrogen on Utilised Agricultural Area (UAA) (1994-2002)[3]

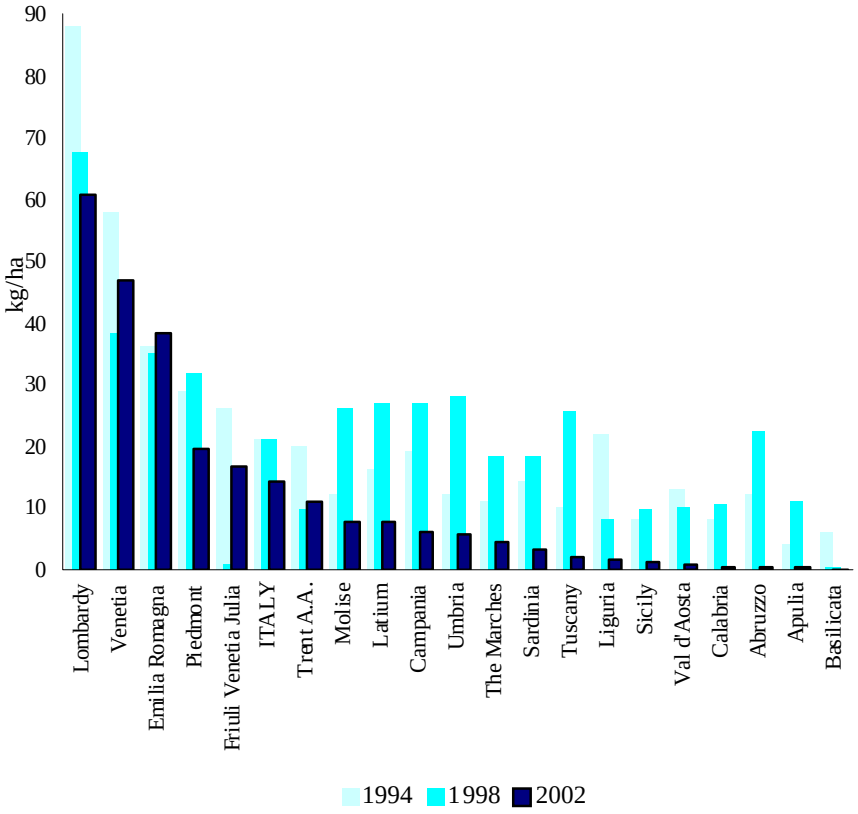
The analyses performed by APAT (2005) on a limited number of samples taken from a large portion of the Italian regions indicate an accumulation of Zn, Cu, Pb and Cd in the top 30 cm of soil, demonstrating the presence

In the case of heavy metals found in the soil, it is extremely important that the

[3] Source: APAT analysis, using the ELBA model (*Environmental Liveliness and Blent Agriculture*) – University of Bologna

of anthropogenic contamination linked to industrial and urban activities (Pb and Cd) as well as to agriculture (Cu, Zn). Other elements (Ni, Cr and As) present higher concentrations below the topsoil, which could confirm that, in the sampled areas, they are of natural origin, given the geological composition of the parent materials.

natural content (background value) be distinguished from that originated by human activities.



Phosphorus surplus is found in all Italian regions, showing higher levels in regions where larger areas are dedicated to intensive farming.

Figure 2.46: Regional surplus of phosphorus on UAA (1994-2002)[4]

2.4.3 Contaminated site restoration actions

The restoration of contaminated sites can be achieved through reclamation procedures of varying complexity. These procedures are established in Italy under Legislative Decree 152/06, which replaced Ministerial Decree 471/99. Legislative Decree 152/06, "Environmental Regulations", Part Four, Title V, "Restoration of Contaminated Sites", presents important new provisions, under which a potentially contaminated site is defined as: *"a site in which one or more values for the concentration of polluting substances observed in the environmental matrices is higher than the generic Contamination Threshold Concentrations (CTC). At a potentially contaminated site, site-specific characterisation and environmental risk analyses are then carried out, which, by evaluation of site-specific Risk Threshold Concentrations (RTC), determine whether or not the site is contaminated"*. A

Legislative Decree 152/06, which governs the process for restoring contaminated sites, introduces the concept of risk analysis.

[4] Source: APAT analysis using the ELBA model (*Environmental Liveliness and Blent Agriculture*) – University of Bologna

contaminated site, therefore, is defined as: "*a site at which the values of the Risk Threshold Concentrations (RTC), determined through application of the risk-analysis procedure referred to under Appendix 1 to the Part Four of the present decree, are found to have been exceeded, based on the results of the characterisation plan*".
There is an important difference, therefore, when it comes to reaching decisions on the identification and management of contaminated sites, between Contamination Threshold Concentrations (CTC) and Risk Threshold Concentrations (RTC). When the first threshold is exceeded, a site characterisation and risk analysis must be carried out; when the second level is exceeded, the site is declared to be "contaminated" and safety and/or cleanup measures are taken.

The "table approach" of Ministerial Decree 471/99, based on tables of generic threshold concentration values identical for sites with the same land use, has been replaced with Legislative Decree 152/06, introducing a new decisional approach based on a site-specific risk-analysis. The recent norm, therefore, updates the previous definition of contaminated site.

In terms of the SNI, the percentage of areas released and/or reclaimed is still very low.

At present, characterisation and restoration projects that have already been initiated and/or authorised before the enforcement of the new legislation follow the procedure stipulated under Ministerial Decree 471/99, unless the proponent has requested a review of the documents already presented, according to the provisions of the new decree; the projects presented after the enactment of Legislative Decree 152/06 follow the procedure laid down by this last measure. As far as Sites of National Interest (SNI) are concerned, nine years after the issue of the first relevant provision (2001), the percentage of areas released for use and/or restored is still minimal. As a rule, the greatest percentage of restored and/or released areas is located within less complex SNI.

During the last year, partly as a result of legislative changes, the progress registered on remedial activities has been scarce, mainly limited - though not in all SNI - to the approval of preliminary surveys, site characterisation plans and safety measures .

Contaminated sites for which the regional governments are responsible must be included in specific "Regional Registers of Sites to be Reclaimed".

Ministerial Decree 471/99 called for the regions to establish systems for the collection and updating of data on polluted sites by creating "Regional Registers of Sites to be Restored" and to implement the related reclamation plans. The progress on the completion of the registers definitely lags behind the timing laid out in the decree; what is more, the registers established by the regions show a marked lack of uniformity, due to differences in the criteria used to identify contaminated sites. In some cases in fact, any changes in production activities and land-use destination must be checked in advance, while, in other cases, entry in the registry is limited to more complex sites.

The obligation that regional registers be completed was confirmed under Legislative Decree 152/06, but the modifications introduced by the decree in the site identification procedures leads to difficulties when comparing information collected at sites evaluated under different policies. In

addition, entry of contaminated sites in the regional registers is frequently impaired by the lack, as a first step, of a systematic and homogeneous national procedure for the identification of potentially polluting activities.

With respect to brownfields, steps are being taken to revitalize the abandoned areas, in order to make them an active part of the urban structure and of productive processes. Many areas have already been recovered and, in general, put to use as residential zones, public parks, commercial areas and common public spaces. On the other hand the activities for the recycling of abandoned areas within "mega-sites", and especially those located in Southern Italy, fall significantly short of their actual potential.

In the case of widespread contamination, the most effective response is to undertake initiatives designed to mitigate the pressures.

In the case of diffuse contamination, the most effective responses are to: undertake initiatives of prevention and mitigation of pressures by improving controls on emissions into the atmosphere or into water; limit the use and trade of substances with contamination potential; establish quality criteria for the products utilised in farming practices; limit, based on their composition, the quantities of fertilisers that can be used. The quality of sludges produced from purification activities for use in agriculture is defined by Directive 86/278/EEC, transposed into Italian Law with Legislative Decree 99/92. The decree, issued by the Ministry of Agricultural and Forestry Planning on 19 April 1999, the “Code of Proper Agricultural Practice”, aims at a correct use of fertilisers, in order to avoid the use of excessive amounts of nutritional elements. Legislative Decree 152/99, which transposes Directive 91/676/EEC into Italian Law, contains recommendations for the mitigation of water pollution from nitrates, in addition to laying out the regional identification of the Zones Vulnerable to Nitrates (ZVN). Determination of the ZVN is a complex process involving the merging of data on the productive capacities of soils and their hydrogeological characteristics with data on pollutant loads of agricultural origin and data on water quality (Figures 2.47 and 2.48). These zones were identified, at different times, throughout the national territory, with the exception of the Val d’Aosta, Trent and Bolzano, which do not suffer from this type of problem. An estimate, at the river basin scale, of the pressure on water bodies, including both local and diffuse contamination, is also required by Directive 2000/60/EC (the “Water” Directive).

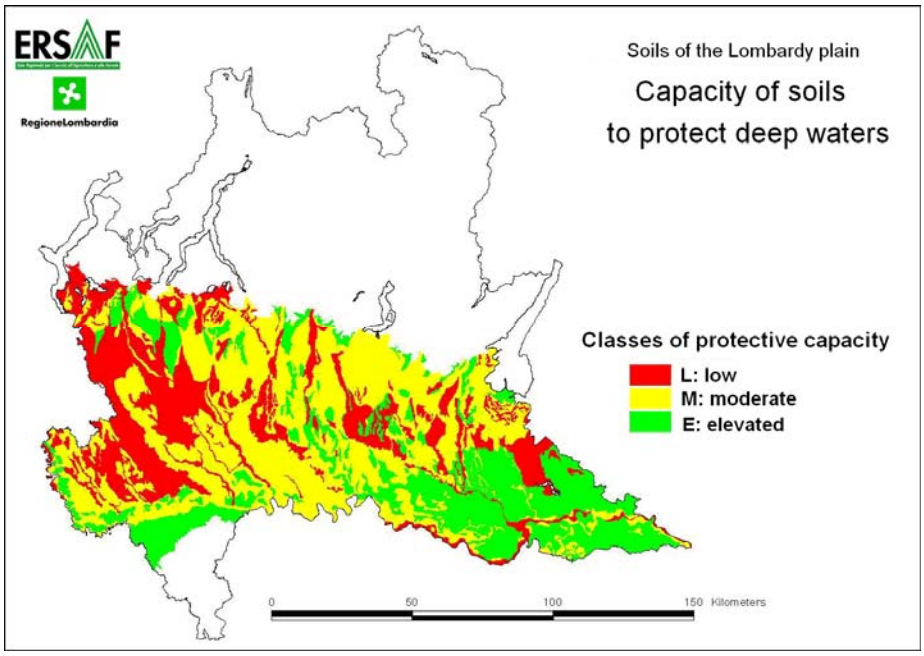


Figure 2.47: Map of the capacity of soils of the Lombardy plain to protect groundwater (2005)[5]

The Map illustrates the potential capacity of soil to retain pesticides within the root zone and for a sufficient amount of time to allow their degradation.

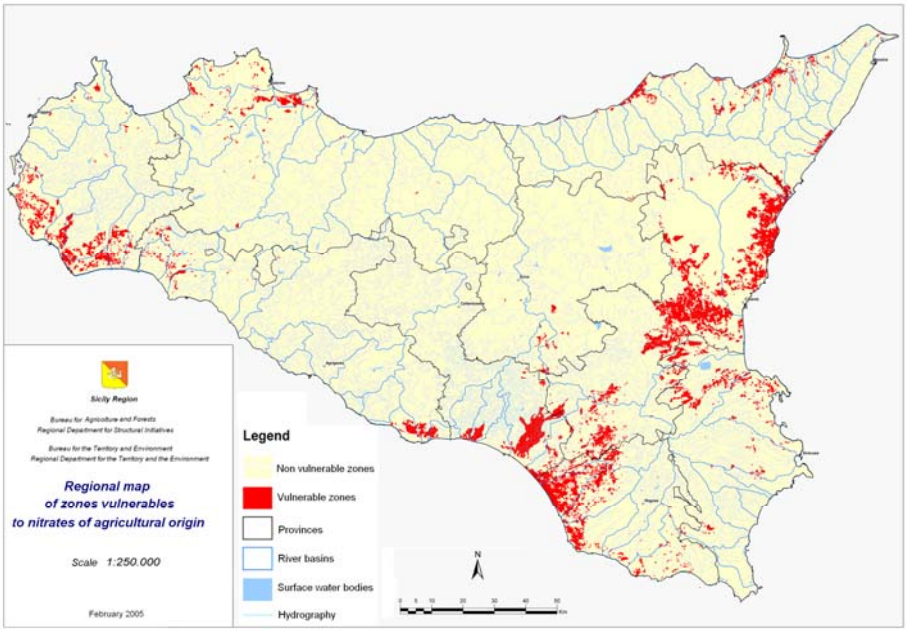


Figure 2.48: Regional map of zones vulnerable to nitrates of agricultural origin (2005)[6]

In the areas identified as vulnerable, a series of obligatory measures must be taken, regarding the management of fertilisers and other farming practices, together with the binding measures described in the Code of Proper Agricultural Practices.

Soil contamination problems affect all industrialised countries and represent a priority issue in environmental policies at the European level.

Soil contamination affects all industrialised countries. Over the last 15 years,

As a result, a variety of different initiatives for cooperation, research and technical development have been undertaken by the various EU and non-EU countries over the last 15 years in the field of contaminated site management. These include the following concerted actions, financed

[5] Source: ERSAF (Regional Agency for Agricultural and Forestry Services) Lombardy
[6] Source: Region of Sicily

by the European Commission: CARACAS (Concerted Action on Risk Assessment for Contaminated Sites in the European Union), designed to stimulate exchange of experiences between EU countries on the subject of risk analysis of contaminated sites; CLARINET (Contaminated Land Rehabilitation Network for Environmental Technologies), whose main objective was to provide technical recommendations for decisions involving the sustainable management of contaminated sites, all of which translated into the formulation of the *Risk-Based Land Management* (RBLM) approach; NICOLE (Network for Industrially Contaminated Land in Europe), meant to promote collaboration between industry, the academic world, and service providers, for the development and application of sustainable technologies. Further initiatives include the Common Forum For Contaminated Land in Europe, whose objective is to develop, within the framework of European national institutions, strategies for the management of contaminated sites and for the reuse of degraded land in accordance with the principle of "sustainable protection of resources"; at a broader international level, the NATO/CCMS Pilot Studies led to the formulation of technical-scientific reports on the application of existing and recently developed technologies in the field of the reclamation of contaminated sites..

numerous international initiatives have been developed to define joint strategies for the management of the problem.

At the European level, information regarding contaminated sites is collected and managed by the EEA under the '*Core-Set'* indicator *Progress in Management of Contaminated Sites (CSI-015)* of the EIONET system. As part of initiatives involving contaminated sites, the European Topic Centre on Terrestrial Environment *(ETC-TE)* of the EEA has developed a methodology (PRA.MS) designed to identify areas at risk for soil contamination of European concern *(*Potential Problem Areas of EU Concern), in addition to carrying out a pilot study for their characterisation and assessment within the EIONET countries.

In September 2006, as the result of a process of consultation initiated in February 2003, the European Commission implemented the "Thematic Strategy for the Protection of Soil", which included a proposal for a "Soil Framework Directive" (COM (2006) 232). Contamination is identified as one of the "priority threats" to the functions of soil. The main elements regarding contamination are: a joint risk-based definition of "contaminated site" and of "reclamation"; a systematic procedure for the identification of contaminated sites, starting from a shared "list of activities with the potential to pollute the soil"; the "report on the state of the soil" for the buying and selling of sites affected by potentially polluting activities; the "National Reclamation Strategy" formulated by member states, which would include objectives (number of sites to be reclaimed), priorities of action and a timeline for implementation. The proposed Framework Directive on the Protection of Soil – together with a series of amendments – was approved by a large majority of the European Parliament in November 2007.

The European Commission considers contamination one of the priority threats to the function of soil, based on what is indicated in the Framework Directive on the Protection of Soil" (COM (2006) 232), approved in November of 2007.