APAT
Agenzia per la protezione dell'ambiente
e per i servizi tecnici

ANNUARIO DEI DATI AMBIENTALI 2007

KEY TOPICS

CAMBIAMENTI CLIMATICI

QUALITA' DELL'ARIA

BIODIVERSITA'

RUMORE

RISCHIO ANTROPOGENICO

ARPA APPA
Agenzie Regionali e delle Province Autonome per la Protezione dell'Ambiente

APAT
Agenzia per la protezione dell'ambiente
E per i servizi tecnici

Key Topics

Environmental Data Yearbook

2007

ENVIRONMENTAL PROTECTION AGENCIES OF THE REGIONS AND AUTONOMOUS PROVINCES

APAT – Environmental Protection and Technical Services Agency
Via Vitaliano Brancati, 48 - 00144 ROME
State of Environment and Environmental Metrology Department
Environmental Statistics and Yearbook Project Service
www.apat.gov.it

ISBN 978-88-448-0335-3

Graphic treatment
Graphic designer: Franco Iozzoli, APAT
Cover photo: Paolo Orlandi, APAT

Coordination of printing and distribution
Olimpia Girolamo, Michela Porcarelli, Simonetta Turco
APAT-Communications Service
Publishing Sector

Layout
APAT

Traslation:
PAROLE sas
Via di Vigna del piano 29
00060 Riano (RM)
Traslator: William C. LEE

Printing completed in the month of April 2008

Text available on the internet websites:
www.apat.gov.it
http://annuario.apat.it

Sic unum quicquid paulatim protrahit aetas
in medium ratioque in luminis erigit oras[1]*...*

Titi Lucreti Cari – De rerum natura
(Liber V, 1454-1455)

[1] Little by little, time reveals all things, and reason brings them to light…

FORWARD

The need to find effective responses to complex situations and developments, such as those involving the environment and human activities, has come to represent a full-fledged emergency.
The recent National Conference on Climate Change has brought to light the exceptional nature of the state of our planet at present, pointing to the wisdom of a dual response: on the one hand, actions focussed on the causes of the changes and, on the other, the promotion of suitable measures for adjusting to the new climatic conditions. Such efforts call for clear, reliable, constantly updated information capable of promptly describing the ongoing development of trends and situations, in order to gain an understanding of their magnitude and prepare suitable countermeasures.

APAT, with the invaluable assistance of the Environmental Protection Agencies of the Regions and the Autonomous Provinces, has always played a role of fundamental importance in the production, processing and dissemination of official environmental information in our country.
The experience accumulated over time by the whole System of Agencies has made it possible to construct a solid and reliable base of information that is always capable of responding to the demand for knowledge in the environmental sector. In order to draw the greatest possible benefit from a similar resource, I shall take it upon myself to ensure that the entire System is strengthened and that it operates in harmonious fashion.

The present publication, the fruit of the work of numerous, highly qualified professionals, constitutes a valid source of knowledge, capable of providing technical-scientific information that proves complete and reliable. I am convinced that those reading it in order to understand or to obtain in-depth information on the environment and its proper management will inevitably find the document to be of noteworthy interest.

Alfonso Pecoraro Scanio
Minister for Environment, Land and Sea

INTRODUCTION

The APAT Yearbook, being published for the sixth year, can be considered the most extensive and complete collection of official environmental data published in Italy.
The work is the result of the activities carried out by the Agency, in accordance with the institutional tasks assigned to it under the Law, involving the collection and dissemination of environmental information.
As in years past, a key factor in preparing the product has been the synergy established between APAT and the Environmental Protection Agencies of the Regions and the Autonomous Provinces.
Nor would it be right to omit mention of the invaluable contribution made by the many technical-scientific bodies, the so-called Main Reference Institutions, which have provided Agency with support throughout the formulation of the work, and especially during the phases in which the data was confirmed and the information was processed.

The **Full Version of the Yearbook** contains all the information forms filled out during 2007, organised by production sectors, environmental conditions and responses. Its purpose is to provide as detailed an illustration as possible of the environmental topics addressed.

There are a number of new features compared to the earlier editions. The topic area *Atmosphere* has been supplemented with the topic "Climate", which contains new indexes. In the topic area *Hydrosphere*, a special topic on coastlines has been introduced. The topic area *Industry* contains a new index of eco-efficiency.
The full edition for this year holds more than 270 indicators, of which 10 are new and 190 updated. Of this last group, 60% were updated between 2006 and 2007.

Starting with the 2007 edition, the full version shall be presented annually only in the electronic format (PDF) and made available on CD-ROM and at the sites www.apat.gov.it and http://annuario.apat.it; the paper format of the publication shall be published once every three years.

In addition to the full version, the core information shall be provided in three other products:

- **Key Topics –** A version containing supplementary information on priority environmental issues that have been the subject of specific initiatives of prevention and reclamation;
- ***Vademecum* –** An extremely abbreviated version (pocket) of the assessments contained in the preceding volume;
- ***Database* –** An instrument designed for telematic consultation of the indicator fact sheets and the production of reports.

With the volume **Key Topics**, APAT has set out to present a possible mode of use of the information base of the Yearbook for evaluating contextual situations regarding the environmental topics that currently constitute the priority concerns of environmental policies. Indeed, in the case of many of the areas considered, the topics addressed are the same as those found in the EU's 6th Environmental Action Plan.

And there is no question that climate change, environment and health, the use of resources and waste generation constitute subjects regarding which the general public wishes to be kept informed.

The same topics are addressed in extremely abbreviated form in the *Vademecum*. In this case the intended purpose is to provide, through the selection of pieces of information that are few in number but extremely significant, an immediate overview of the situations and developments described.

In-depth study of the topics based on the data collected by APAT may still be carried out using the Yearbook **Database** and the **full version** of the publication.

The creation of a number of different information products using the same database is explained by the need to render the elements of knowledge in possession of the Agency available for use in as extensive and varied a manner as possible. Everyone from public-sector decision-makers to researchers to stakeholders to citizens must be provided with the opportunity to access the environmental information. As I have stressed on a number of occasions, I hold that APAT's work in terms of disseminating information can make a noteworthy contribution to the key function of increasing the knowledge of all citizens regarding environmental issues, a fundamental precondition to the success of policies for heightening public awareness.
It is to be hoped that APAT shall always meet with success in carrying out this important task, and I shall take it upon myself to ensure that it always receives all the resources, both intellectual and material, necessary for doing just that.

Giancarlo Viglione
President of APAT

CONTRIBUTORS and THANKS

General considerations

As is known, the Agency's main institutional tasks include coordination of the entire life cycle of environmental information, running from the production of the core set of data up through the dissemination of the information, and including the phases of management, processing and assessment. To this end, it began publishing the Yearbook some time ago, updating its information base annually.
The publication is fruit of a complex work of analysis carried out by a noteworthy number of the technical units of the Agency most directly involved in activities of environmental reporting, and specifically the following departments: State of the Environment and Environmental Metrology; Marine and Inland Waters Protection; Land Resources and Soil Protection; Nature Protection; Nuclear, Technological and Industrial Risk; Library, Documentation and Information; Inter-Departmental Services; Environmental Emergencies; Environmental Information; Guidance, Coordination and Control of Inspection Activities; and Environmental Certification. Equally important were the contributions of the ARPA/APPA agencies, plus the numerous technical-scientific bodies.
As in past years, the information base of the Yearbook shall once again be presented in the form of various products: a document, in both the Italian and English languages, addressing a number of environmental topics of relevance to the European Community, with the information elements presented in abbreviated form; a pocket *Vademecum* touching on the key elements of the environmental topics; the database of the indicators found in the Yearbook, plus the full version in the Italian language.
Starting with this edition, the full version shall be drawn up annually in the electronic format, available from the month of March 2008 on CD-ROM and at the websites www.apat.gov.it and http://annuario.apat.it/. The paper version shall be published once every three years.

The planning and coordination of the overall production of the work are handled by the State of the Environment and Environmental Metrology Department, through the Special Yearbook Project and Environmental Statistics Service.

Specific contributions to the present document

Purposes of the document, structure of the document
Appendix

Authors: Mariaconcetta GIUNTA, Cristina FRIZZA, Alessandra GALOSI, Luca SEGAZZI

Chapter 1. Climate Change

Coordination: Domenico GAUDIOSO
Authors: Antonio CAPUTO, Alessandra GALOSI, Domenico GAUDIOSO
Contributors:
Mario CONTALDI, Stefano CORSINI, Maurizio FERLA, Riccardo DE LAURETIS, Franco DESIATO, Francesca GIORDANO, Giulia IORIO (ENEA), Piero LEONE (TERNA), Riccardo LIBURDI, Anna LUISE, Roberta PIGNATELLI, Andrea TORETI

Chapter 2. Environment and Quality of Life

Coordination: Mariaconcetta GIUNTA
Authors of *Air Quality*: Patrizia BONANNI, Anna Maria CARICCHIA, Silvia IACCARINO

Contributors:
Silvia BARTOLETTI, Giorgio CATTANI, Mario CONTALDI, Maria Carmela CUSANO, Roberto DAFFINÀ, Riccardo DE LAURETIS, Alessandro DI MENNO di BUCCHIANICO, Alessandra GAETA, Giuseppe GANDOLFO, Cristina SARTI

Authors of *Waters Quality*: Serena BERNABEI, Martina BUSSETTINI, Ardiana DONATI, Silvia IACCARINO, Silvana SALVATI, Carlo OTTAVI
Contributors:
Ottavia BARISIELLO, Stefano DE VINCENZI, Giancarlo DE GIRONIMO, Antonio FAVA (ARPA of the Emilia Romagna Region), Giorgio FERRARI (Magistrate overseeing the waters of Venice), Emanuele LICOPODIO, Marco MARCACCIO (ARPA of the Emilia Romagna Region), Paolo NEGRI (APPA of the Trent Region), Massimo PALEARI (Arpa of the Lombardy Region), CECILIA SILVESTRI, Emanuela SPADA, Saverio VENTURELLI

Authors of *Physical Agents:* Salvatore CURCURUTO, Cristina FRIZZA, Giancarlo TORRI
Contributors:
Diego BONATA (Cielo Buio), Pierantonio CINZANO (ISTIL), Sonia FONTANI, Maria LOGORELLI, Giuseppe MENNA, Celine NDONG, Francesca SACCHETTI, Rosalba SILVAGGIO, Roberto SPAMPINATO, Massimo STORTINI

Authors of *Soil Quality*: Fiorenzo FUMANTI, Paola SESTILI
Contributors:
Federico ARANEO, Andrea DI FABBIO, Fabio PASCARELLA, Francesca QUERCIA, Antonella VECCHIO

Chapter 3. Biodiversity and Natural, Agricultural and Forest Areas

Coordination: Claudio PICCINI

Authors: Giovanni FINOCCHIARO, Stefano LUCCI, Claudio PICCINI
Contributors:
Anna ALONZI, Antonella ARCANGELI, Valter BELLUCCI, Carmela CASCONE, Salvatore CIPOLLARO, Roberto CROSTI, Stefania ERCOLE, Vanna FORCONI, Valeria GIOVANNELLI, Marzia MIRABILE, Valentina RASTELLI, Roberto SANNINO, Luca SEGAZZI, Paola SESTILI, Giovanni STAIANO

Chapter 4. Use of Resources and Production of Waste

Coordination: Mariaconcetta GIUNTA
Authors of *Use of Resources*: Cesare COSTANTINO (ISTAT), Aldo FEMIA (ISTAT) and Donatella VIGNANI (ISTAT);

Authors of *Production of Waste*: Rosanna LARAIA, Cristina FRIZZA, Andrea LANZ
Contributors:
Gabriella ARAGONA, Valeria FRITTELLONI, Andrea PAINA

Chapter 5. Environmental Risk

Coordination: Eutizio VITTORI, Alberto RICCHIUTI
Authors of *Natural Risk*: Stefano CORSINI, Luca SEGAZZI, Eutizio VITTORI, Giorgio VIZZINI

Contributors:
Angela BARBANO, Anna Maria BLUMETTI, Domenico BERTI, Valerio COMERCI, Carlo D'ACQUINO, Marco DI LEGINIO, Pio DI MANNA, Fiorenzo FUMANTI, Carla IADANZA, Luca GUERRIERI, Mauro LUCARINI, Alessandro TRIGILA

Authors of *Anthropogenic Risk*: Francesco ASTORRI, Alfredo LOTTI, Gianluca MASCHIO, Luca SEGAZZI, Alberto RICCHIUTI

Chapter 6 . Instruments for Environmental Knowledge and Awareness:

Integration of the texts and author of the *Introduction*: Paola SESTILI

Authors of *Dissemination of Environmental Information:* Rita CALICCHIA, Alessandra GALOSI, Franco GUIDUCCI, Anna Maria RIZZO, Anna Laura SASO, Nadia SBREGLIA

Authors of *Inter-Calibration of Laboratories*: Maria Elisa BELLI, Enrico DE ZORZI, Maria Gabriella SIMEONE,

Authors of *Environmental Education and Training:* Daniela ANTONIETTI, Stefania CALICCHIA, Adolfo PIROZZI

Authors of *Emas and Ecolabel*: Roberta ALANI, Gianluca CESAREI, Rocco IELASI, Stefania MINESTRINI, Mariangela SORACI

Editing

The phases of the editing of the document were handled by a workgroup coordinated by Mariaconcetta GIUNTA and consisting of: Giovanni FINOCCHIARO (processing and statistical control of the data), Cristina FRIZZA (processing and statistical control of the data), Alessandra GALOSI (processing and statistical control of the data), Silvia IACCARINO (coordination of fact-sheet and technical revision), Alessandra MUCCI (revision and editing of texts), Alessia PENNESI, Luca SEGAZZI (overall technical revision, processing and statistical control of the data), Paola SESTILI (contact for the processing and statistical control of the data). The Databank of the Yearbook Indicators was managed by Raffaele MORELLI of the AMB MPA Service and by Matteo SALOMONE (AMB). Optimisation of communications considerations was handled by Claudia DELFINI of the Communications Service.
The Group has also handled the preparation of specific techniques, together with the related guidelines, for compilation of the indicator fact-sheet and the Yearbook Indicators Database, as well as the integration of the contents of the work, the processing and statistical control of the data published and the overall technical review of both the information contents and the methodological/editing techniques used on those contents.

Information contents – APAT Reference Units

The work involved in the preparation of the information contents of the "Environmental Data Yearbook" was carried out by a Task Force coordinated by Mariaconcetta GIUNTA.
In the interests of updating the indicators found in the Yearbook Indicators Database for each environmental topic, the following contacts were identified within APAT:

Environmental Topics	**Contact**	**Departments[a] Service/Sector**	**AMB ASA Contact**
AGRICULTURE and FOREST CULTIVATION	Stefano LUCCI	NAT-SOS	Luca SEGAZZI
ENERGY	Domenico GAUDIOSO	AMB-MPA	Alessandra GALOSI
TRASPORT	Mario CONTALDI Roberta PIGNATELLI	AMB-MPA AMB-RAS	Alessandra GALOSI

Environmental Topics	Contact	Departments[a] Service/Sector	AMB ASA Contact
TOURISM	Silvia IACCARINO	AMB-ASA	Luca SEGAZZI
INDUSTRY	Antonino LETIZIA	ISP	Luca SEGAZZI
ATMOSPHERE	Riccardo DE LAURETIS (Emissions) Anna Maria CARICCHIA (Air Quality) with the contribution of Patrizia BONANNI Franco DESIATO (Climate)	AMB-MPA	Alessandra GALOSI Cristina FRIZZA
BIOSPHERE	Claudio PICCINI	NAT-BIO	Giovanni FINOCCHIARO
HYDROSPHERE	Carlo OTTAVI Stefano CORSINI	ACQ-MON ACQ-COS	Silvia IACCARINO
GEOSPHERE	Fiorenzo FUMANTI with the contribution of Anna LUISE (desertification)	SUO-IST	Paola SESTILI/ Alessandra MUCCI
WASTE	Rosanna LARAIA	AMB-RIF	Cristina FRIZZA
IONISING RADIATION	Giancarlo TORRI, with the contribution of Giuseppe MENNA	RIS-LAB	Silvia IACCARINO
NON-IONISING RADIATION	Salvatore CURCURUTO	AMB-AGF	Matteo SALOMONE
NOISE	Salvatore CURCURUTO	AMB-AGF	Cristina FRIZZA
NATURAL RISK	Eutizio VITTORI with the contribution of Giorgio VIZZINI	SUO-RIS	Giovanni FINOCCHIARO
ANTHROPOGENIC RISK	Alberto RICCHIUTI Alfredo LOTTI	RIS-IND	Luca SEGAZZI
ENVIRONMENTAL QUALITY OF ORGANISATIONS, FIRMS and PRODUCTS	Rocco IELASI	CER	Silvia IACCARINO
MONITORING and CONTROL	Maria BELLI , with the contribution of Maria Gabriella SIMEONE (Monitoring) Alessandra BURALI (Control)	AMB-LAB	Paola SESTILI/ Alessandra MUCCI
PROMOTION and DISSEMINATION of ENVIRONMENTAL CULTURE	Adolfo PIROZZI Rita CALICCHIA	BIB-FOR AMB-RAS	Matteo SALOMONE
ENVIRONMENT and HEALTH	Luciana SINISI Patrizia FIORLETTI	AMB-VAL	Cristina FRIZZA

Contacts were also identified for the phases of implementation not directly connected with the information contents of the Yearbook, as shown below:

Connected activities			
APAT website	Franco GUIDUCCI	BIB-WEB	Matteo SALOMONE
Printing	Renata MONTESANTI Daria MAZZELLA	DIR-COM	
Graphics/Photography	Franco IOZZOLI Paolo ORLANDI	DIR-COM DIR	

The full meanings of the symbols for the departments, inter-departmental services, services and sectors are spelled out below:

Departments/Inter-Departmental Services	SYMBOL
Office of the Provisional Commissioner	DIR
Communications Service	DIR/COM
Inter-Departmental Service for Guidance, Coordination and Control of Inspection Activities	ISP
Inter-Departmental Service for Environmental Certification	CER
Department for Land Resources and Soil Protection	SUO/DIR
Service of Background Investigations, Basin Plans and Data Collection	SUO/IST
Natural Risks Service	SUO/RIS
Department for Marine and Inland Waters Protection	ACQ/DIR
Coastal Protection Service	ACQ/COS
Service for the Monitoring and Hydrology of Inland Waters	ACQ/MON
Service for the Lagoon of Venice	ACQ/VEN
Department for the State of Environment and Environmental Metrology	AMB/DIR
Special Yearbook Project and Environmental Statistics Service	AMB/ASA
Service for the Monitoring and Prevention of Atmospheric Impact	AMB/MPA
Physical Agents Service	AMB/AGF
Environmental Metrology Service	AMB/LAB
Environmental Assessment Service	AMB/VAL
Environmental Reporting and Instruments of Sustainability Service	AMB/RAS
Waste Service	AMB/RIF
Department of Nuclear, Technological and Industrial Risk	RIS/DIR
Industrial Risk Service	RIS/IND
Radiometric Measurement Service	RIS/LAB
Department of the Protection of Nature	NAT/DIR
Service for the Sustainable Use of Natural Resources	NAT/SOS
Service for the Protection of Biodiversity	NAT/BIO
Department of Library, Documentation and Information Activities	BIB/DIR
Environmental Education and Training Service	BIB/FOR
Library Service	BIB/DOC
WEB Portal Service	BIB/WEB

Authors of information contents

A detailed listing of specific contributors (authors and collaborators for the specific topics) shall be included at the start of each chapter of the full version in the electronic format**.**

Contributions of the Agency System

The contribution of the System was greatest during the phases involving the collection of the data and the formulation of the methodologies.

Other contributions from the APAT Technical Units

Other specific **technical contributions** were made by the APAT Units, including:

- on topics regarding the environment and wellbeing, the quality of urban areas, monitoring, the atmosphere, waste and the production sectors of energy, industry, tourism and transportation, from the State of the Environment and Environmental Metrology Department;
- on topics regarding water resources, from the Marine and Inland Waters Department;
- on topics regarding the soil and natural risks, from the Land Resources and Soil Protection Department;

- on topics regarding the biosphere and the agricultural production sector, from the Nature Protection Department;

- on topics regarding ionising radiation and anthropogenic risk, from the Nuclear, Technological and Industrial Risk Department;

- on topics involving the promotion and dissemination of environmental culture, from the Library, Documentation and Information Activities Department;

- on the topic of control, from the Inter-Departmental Service for Guidance, Coordination and Control of Inspection Activities;

- on considerations regarding the environmental quality of organisations, firms and products, from the Inter-Departmental Service for Environmental Certification.

Specific contributions ***on considerations of methodology and liaison*** were supplied by:

- SISTAN interface, through the APAT Statistics Office: Mariaconcetta GIUNTA;

- the chapter on the Promotion and Dissemination of Environmental Culture: the CIFE Workgroup and the library network of the Agency System;

Other contributions by APAT Units

The following contributions were made on operating considerations:

- procedural and administrative considerations: Vincenzo PEZZILLO, Elisabetta GIOVANNINI;

- administrative considerations: the Department of General Services and Personnel Management and the Inter-Departmental Service for the Administration and Planning of Activities. With regard to the activities involved in carrying out tenders, the Tender and Contracting Sector;

- the functional support was overseen by Elisabetta GIOVANNINI, Roberta RASTELLI, Maria Loreta VITELLOZZI.

Contributions by Subjects outside of the Agency System

Numerous contributions from central and local government bodies have also been drawn on, as well as from technical-scientific structures and individual experts in different sectors.
With reference to government bodies, specific mention should be made of: the departments of the Ministry of the Environment, Land and Sea, the Ministry of Economic Development, the Ministry of Cultural Resources and Activities, the Ministry of Infrastructures, the Ministry of Agricultural, Food and Forestry Policies, the Ministry of Health, the Ministry of Transport, the Carabinieri Police Command for the Protection of the Environment, the Italian National Forestry Corps, the Manager of the National Transmission Network, the Marine Environmental Unit of the Harbourmasters' Corps, the National Fire-Fighters' Corps, the Regional and Provincial Waste Observatories, the Commissioners for the Waste Emergencies in the Regions of Campania, Calabria, Apulia and Sicily, the regional, provincial and municipal governments, the PMP and local government bodies. Of the technical-scientific authorities and organisations, both public and private, the following should be acknowledged: the ICRAM, the ISTAT, the ISS, the basin authorities, the magistrates of bodies of water, the CNR (IIA, IRSA, ICT, IMAA, III), the ACI, the ENEA, the Italian Glaciological Committee, the Italian Meteorological Society, the ENEL, the European Soil Bureau of the Common

Research Centre of the European Commission in Ispra (VA), EUROSTAT, Agecontrol S.p.A., Biobank, the National Register of the organisations EMAS, ISTIL, ODYSSEE, TELEATLAS, TERNA and Tethys.

Referees

As was done with previous editions, in addition to the numerous contributions received from subjects (individual experts and organisations) outside of the Agency System during the phases involving the formulation and production of the present document, it was held best to request an additional and independent assessment of the final product from experts on the individual topics addressed in the publication.
These experts shared their comments, though it was not always possible to transpose them into modifications of the present edition, both because of the limited time available and on account of the lack of basic data. We shall be sure to return to these comments in editing subsequent editions.
The following individuals, after being consulted, have provided supplementary observations and contributions:

Gianfranco BOLOGNA (WWF Italia), Fabrizio BULGARINI (WWF Italia), Sergio CASTELLARI (Punto Focale Italiano IPCC), Pietro COMBA (ISS), Giovanna FINZI (University of Brescia), Filippo GIORGI (ICTP), Alessandro Maria MICHETTI (University of Insubria - Como), Romano PAGNOTTA (IRSA CNR) and Michele VURRO (IRSA-CNR).

Thanks

Heartfelt thanks are once again expressed to those whose contributions have made publication of the 2007 edition of the Yearbook possible.
The listing of those who have contributed in one way or another, an exercise that may prove tedious but is definitely deserved, further demonstrates, were there any need for such evidence, the complexity of the work behind this volume, which increasingly constitutes an indispensable reference for those who use environmental data and information in the course of their own activities or in order to keep themselves up-to-date on our country's environmental status.
These thanks go to everyone, including those who, though they contributed, are not explicitly mentioned. A few names may have been left out by mistake. We ask these people to accept our most sincere apology.
Finally, we ask that readers send us any observations and suggestions for modifications they might have, so that, on the strength of such contributions, we can continue our ongoing improvements in the development of the Yearbook.

Roberto Caracciolo
Director of the State of Environment and
Environmental Metrology Department

CONTENTS

Objectives and Structure of the Document

Objectives

The volume presents an abbreviated analysis of a number of major environmental topics considered by the European Union to be “priority areas for policy initiatives”.

Unlike the complete edition, which is designed to make a direct and, to a certain extent, “raw” presentation of the environmental information by means of individual indicator fact-sheets, the purpose of this work is to describe select topics through a cohesive organisation of the data that make up the information base of the Yearbook. These data are arrayed in a “system”, in order to provide the reader the value-added of their causal integration.
The end result is a pondered analysis of the environmental information found in the individual indicator fact-sheets that make up the full version.

The volume also sets out to achieve another important objective: that of proving to be easily accessible to a wide range of users. This goal, which regards the sphere of the modes through which the environmental information is transmitted, is pursued by utilising modern reporting techniques, together with a language that proves both clear and rigorous.
In order to attain this objective, particular importance has been placed on the graphic presentation of the information, using special information boxes that are often accompanied by extensive comments capable of explaining not only the individual image but also the broader trend or situation being investigated.

Structure of the Document

As noted, the document addresses environmental topics of primary importance to the European Community, using the information base constituted by the indicator fact-sheets found in the Yearbook Database, as well as in the full version. Each topic has been developed by drawing on the information content of the fact-sheets, making necessary, first and foremost, an attentive selection of the information, as well as a different organisational approach, meaning one better suited to the characteristics of the new product.

The work consists of six chapters: the first five dedicated to a different environmental topic, while the sixth chapter focuses on the instruments of environmental knowledge.
The following causal logic has been used to describe each environmental topic: first the present environmental situation is illustrated, then the causal factors of this situation are analysed and, finally, a description is given of the solutions implemented or to be aimed at in the future.

It should also be remembered that there are three different methods for consulting chapters one through five. By using the text, the reader obtains a complete and exhaustive analysis of the topic; the “focuses” in the margin serve for rapid identification of the topics addressed prior to deciding whether to examine them in depth; by consulting the graphic boxes, the reader can obtain information that is sufficiently complete, though limited to the individual situation or development illustrated.

Included as an appendix is a thorough description of the Yearbook Indicator Database, the instrument from which the information elements used in the present volume have been taken.

1. CLIMATE CHANGE

Introduction

During 2007, the scientific community, political decision-makers and public opinion focused their attention on the issue of climate change, primarily as a result of the approval of the Fourth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC). The conclusions of this document underlie a number of the first important political commitments in terms of reducing emissions and energy policies, in particular those undertaken by the European Union through the conclusions of the European Council of 8-9 March 2007. There is a growing need, therefore, for indicators suitable to representing the totality of the phenomena connected with this topic, both for the purpose of expanding knowledge and as a basis for mitigation and adaptation initiatives.

In 2007 the scientific community, political decision-makers and public opinion focused their attention on the issue of climate change.

1.1 Current climate trends

The increase in average global temperatures in recent years is a clear sign of the climate change underway. Two of the main conclusions reached by the Fourth Assessment Report of the Intergovernmental Panel on Climate Change[1] indicate that:

Global warming is unmistakable, and it is highly likely that anthropogenic emissions of greenhouses gases are the cause.

- the warming of the climatic system is unmistakable, as demonstrated by observations of increased temperatures of the atmosphere and the ocean, the melting of snow and glaciers and the global rise in the level of the seas;
- the increased concentration of greenhouse gases generated by human activity is most probably the main cause of the global warming observed since the middle of the 20th century.

The most recent analyses point to the fact that not all instances of global warming are alike. Alongside areas where the temperature has increased, there are others where a decrease has been observed. Recent worldwide analyses confirm the estimate of an average warming of the earth's surface of approximately 0.74 °C over the last century. The temperature increase has been especially pronounced in the most recent period; over the last 50 years, the rate of warming (+0.13 °C per decade) has nearly doubled, as compared to the last 100 years[2]. As far as Italy is concerned, the most recent estimates obtained by the Agency for the Protection of the Environment and Technical Services (APAT), through an analysis of the data contained in the SCIA System (National System for the Collection, Processing and Dissemination of Climatic Data), point to a decrease of 0.6°C in the average temperature between 1961 and 1981, followed by an increase of 1.54 °C through 2006, for an overall increase of approximately 0.94 °C in 45 years. No significant

Average warming in Italy was 0.94 °C between 1961 and 2006 and 1.54 °C between 1981 and 2006.

[1] IPCC (2007). *Climate Change 2007* – WG-I, *Technical Summary*
[2] IPCC (2007). *Climate Change 2007* – WG-I, *Technical Summary*

differences were registered between the various areas of the national territory, confirming that the variations in temperature are caused primarily by large-scale climatic factors[3]. The comparison between the national and global trends illustrates that average warming in Italy is more pronounced than the global average.

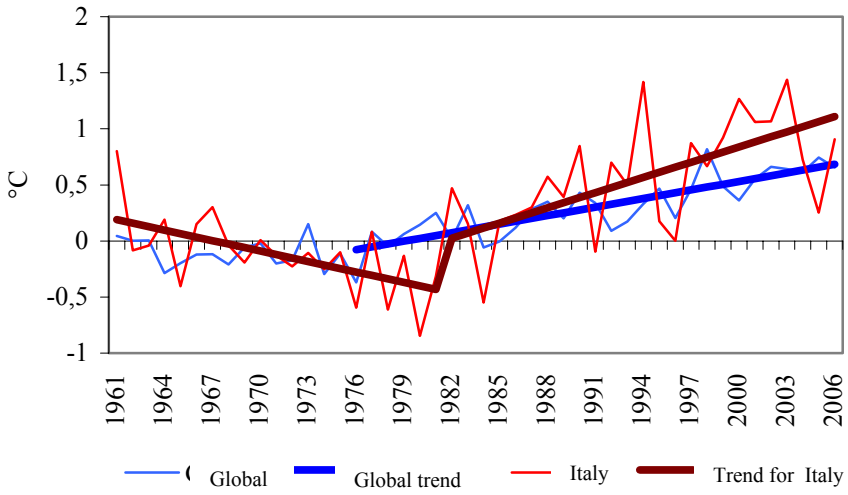
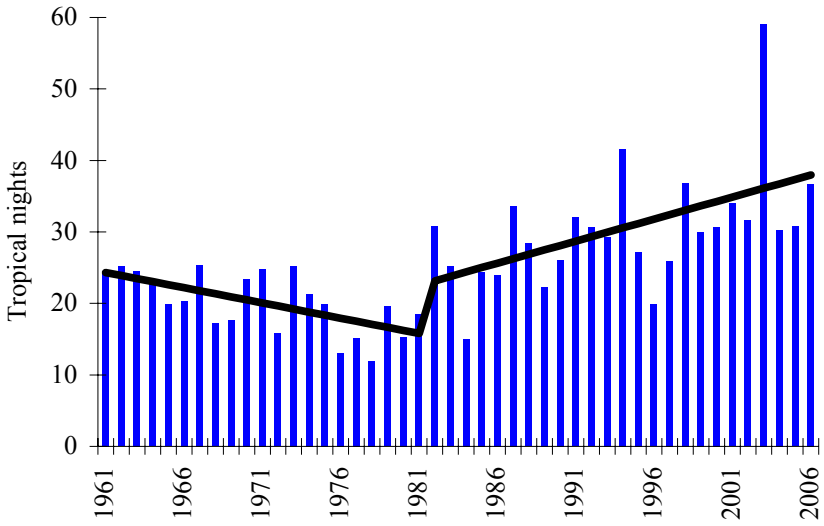


Figure 1.1: Mean temperature anomaly (with respect to 1961-1990 normals) series and estimated trend between 1961 and 2006. Global (blue) and national (red)[4]

The increase in the average global temperature in recent decades is a clear sign of the climate changes underway.
The average warming in Italy was 0.94 °C between 1961 and 2006 and 1.54 °C from 1981 to 2006.
A comparison of the national and global trend illustrates that average warming in Italy is more pronounced than the global average.

Globally, the upward trend is more pronounced for minimum night-time temperatures than for maximum daytime temperatures. For Italy, it is estimated that the average number of tropical nights (i.e. with minimum temperature ≥20 °C) increased by 21 nights during the period 1981-2006, and by 12.5 nights between 1961 and 2006. The increase in tropical nights in the last 27-28 years is connected to the increase in heat wave events. The average number of tropical nights in 2006 was higher than the normal levels during the reference period 1961-1990. In particular, 2006 was the fourth highest in the last 46 years[5].

[3] Toreti A. and Desiato F., 2007, *Temperature trend over Italy from 1961 to 2004. Theor. Appl. Climatology*. DOI 10.1007/s00704-006-0289-6
[4] Source: APAT and the University of East Anglia, in collaboration with the Hadley Center
[5] Toreti A. and Desiato F., 2007, *Changes in temperature extremes over Italy in the last 44 years, Int. J. Climatology, DOI 10.1002/joc.1576*



Globally the upward trend is more pronounced for minimum night-times temperatures than for maximum day-time temperatures. In 2006, the average number of tropical nights in Italy was higher than the normal levels in the reference period 1961-1990. In particular, 2006 was the fourth highest in the last 46 years.

Legend:
The jagged line shows the trend

Figure 1.2: Annual series from 1961 to 2006 of the average number of tropical nights in Italy[6]

As far as precipitation is concerned, national averages do not show significant variations in amounts, although they may be significant for specific areas and periods. On the global scale, however, an increase in intense precipitations since 1950 has been observed [7].

1.2 The impact of climate change

The conclusions of the IPCC[8] state that "observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, and especially temperature increases."

Many natural systems are showing the effects of regional climate change, especially in terms of increased temperatures.

The impacts on many physical and biological systems become increasingly evident; based on the available data, it can be held that there is a probability of roughly 8 out of 10 that climate changes are influencing natural systems, and especially water resources, coastal zones and oceans.

A number of examples of the changes underway, referred to by the IPCC[9], are listed on the following table with regard to the different environmental systems.

[6] Source: APAT
[7] IPCC (2007). *Climate Change 2007* – WG-I, *Technical summary*
[8] IPCC (2007). *Climate Change 2007* – WG-II, *Summary for policymakers*
[9] IPCC (2007). *Climate Change 2007* – WG-II, *Summary for policymakers*

Table 1.1: Examples of changes underway[10]

Snow, ice and frozen ground	Hydrological systems	Terrestrial biological systems	Marine and freshwater biological systems
• enlargement and increased number of glacial lakes	• increased run-off and earlier spring peak discharge in many glacier- and snow-fed rivers	• earlier timing of Spring events, such as leaf-unfolding, bird migration and egg-laying	• shifts in ranges of environmental parameters (ice cover, salinity, oxygen levels, circulation), plus changes in algal, plankton and fish abundance in high-latitude oceans
• increasing ground instability in permafrost regions, and rock avalanches in mountain regions	• warming of lakes and rivers in many regions, with effects on thermal structure and water quality	• poleward and upward shifts in ranges of plant and animal species	• increases in algal and zooplankton abundance in high-latitude and high-altitude lakes
• changes in some Arctic and Antarctic ecosystems, including those in sea-ice biomes, and also predators at the higher levels of the food chain			• changes in the ranges of environmental parameters and earlier migrations of fish in rivers

New effects of regional climate changes on natural and human environments are emerging, though they are often hard to distinguish, on account of adaptation and non-climatic drivers.

Based on satellite observations since the early eighties, the early "greening" of vegetation in Spring is held to be tied to the increased length of the growing seasons, due to warming.

In addition, the uptake of anthropogenic carbon since 1750 has caused the oceans to become more acidic, with an average decrease of 0.1 units in the pH level[11]. There is not yet sufficient documentation, however, on the effects of the oceans' acidification on the marine biosphere.

Other effects of regional climate changes on natural and human environments are also coming to the fore, though many are difficult to distinguish, on account of adaptation and non-climatic drivers.[12]

For example, the effects of temperature increases were documented in the following sectors:

- effects on the management of agriculture and forests at Northern Hemisphere higher latitudes, such as earlier Spring planting of crops, as well as alterations in the pattern of disturbances in forests due to fires and pests;
- factors regarding human health, such as heat-related

[10] Source: IPCC (2007). *Climate Change 2007* – WG-II, *Summary for policymakers*
[11] IPCC (2007). *Climate Change 2007* – WG-I, *Technical Summary*
[12]

mortality in Europe, vectors of infectious diseases in some areas and allergenic pollen in medium and high latitudes of the Northern Hemisphere;

- activities in the Arctic (e.g. hunting and travel over snow and ice) and in Alpine areas at lower altitudes (as in the case of mountain sports).

Finally, recent climate changes and variations are starting to have an effect on many other natural and human systems, though, according to the published literature, the impacts have not yet resulted in demonstrable trends. Examples include:

- settlements in mountain regions subject to a greater risk of glacier lake outburst floods on account of melting glaciers. In certain cases, the response consists of building dams and drainage works;
- in the African region of Sahel, warmer and drier conditions have reduced the length of the growing season, with a negative effect on harvests. In southern Africa, longer dry seasons and greater uncertainty of rainfall have given rise to adaptation measures.
- sea-level rise, together with human development, is contributing to the loss of coastal wetlands and mangroves, as well as to increased damage from coastal flooding in many areas.

According to the Green Paper of the European Commission on "Adapting to Climate Change in Europe – options for EU action" (COM(2007)354), the most vulnerable areas of Europe are:

- Southern Europe and the entire Mediterranean Basin, where the combined effect of high temperature increase and reduced precipitation has aggravated the situation in areas already suffering from shortages of water;
- Mountain zones, such as the Alps, where higher temperatures cause melting of glaciers and snow, with inevitable impacts on river flows;
- coastal zones, on account of sea-level rise, combined with the greater risk of storms;
- flood plains with high population densities, where the risk of storms, intense rainfall and flash floods causes damages to built-up zones and infrastructures;

The areas of Europe most vulnerable to climate change are:

- *Southern Europe and the entire Mediterranean Basin;*
- *the mountain zones;*
- *the coastal zones;*
- *highly populated flood plains;*
- *Scandinavia;*
- *the Arctic region.*

- Scandinavia, where much higher levels of precipitation are forecast, more frequently in the form of rain than snow;
- the Arctic region, where the variations in temperature are more notable than in other regions of the Earth.

For Italy, the results of the preparatory works for the National Conference on Climate Change[13] organised by the Ministry of the Environment, Land and Sea, together with APAT, have been used to draw up a framework of national priorities regarding the most probable areas of impact. Shown below is the table prepared by APAT to identify the most vulnerable environmental systems and economic sectors:

Table 1.2: Chart showing the areas most likely to be vulnerable to climate change[14]

AREAS OF IMPACT	**Climate variables**		***Workshop***				
	Temperature	Precipitation	Desertification	Glacier melting	Hydro-geological risk	Marine-coastal environment	Po Basin
Water resources	++	++	++	++	++	++	++
Marine and coastal environments	++	++	++	+	+	++	++
Mountain environment and cryosphere	++	++	-	++	+	-	-
Wetlands and aquatic ecosystems	++	++	-	-	+	++	++
Biodiversity and forests	++	++	++	++	++	++	++
Agriculture and fishery	++	++	++	+	++	++	++
Energy	++	++	-	++	-	-	++
Tourism	++	+	-	++	++	++	+
Health	++	++	-	+	++	-	-
Urban settlements	-	++	-	+	++	++	+
Infrastructures and transport	-	++	-	-	++	++	-
Artistic heritage	-	++	-	-	++	++	-

Legend :
++ very likely; + likely; - unlikely

In our country, therefore, climate change impacts are highly likely for water resources, biodiversity and forests, the soil and marine-coastal environments. The economic activities most vulnerable to climate change are agriculture and fisheries, as well as tourism.

In Italy, climate change impacts are highly likely for water resources, biodiversity and forests, soil, marine and coastal environments and economic activities such as agriculture, fisheries and tourism.

[13] APAT (2007). *Gli eventi preparatori della Conferenza*. Summary of the proceedings
[14] Source: APAT

Erosion and coastal flooding

The scenarios of the IPCC estimate the effect of the rise in the level of the Mediterranean Sea, as a result of thermal dilation, at approximately 38 cm by 2100. However, specific studies on the Italian-Mediterranean context indicate that our sea is not currently rising, primarily on account of increased salinity, which counterbalances the thermal dilation.

According to the IPCC scenarios, by 2100 the level of the Mediterranean will have risen by 38 cm. Our sea is not currently rising because the increased salinity counterbalances the effect of the thermal dilation.

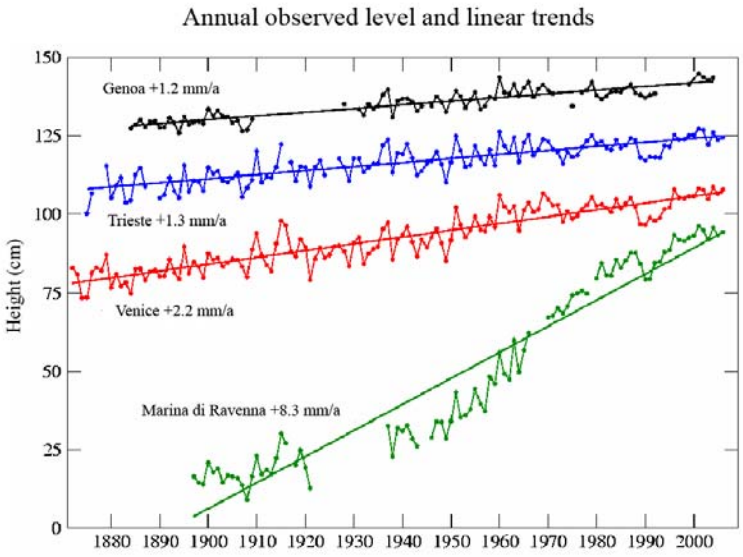
In the Mediterranean area, therefore, sea-level rise would not currently appear to be the main parameter for increased vulnerability of coastal areas to climate change (unlike the situation in Northern Europe), apart from sectors where anthropogenic and natural subsidence magnify the effect.
The sea-level rise produces not only a variation in the relationship between the land and the sea, but also a noteworthy increase in the salt table, making coastal areas extremely sensitive to this parameter. The most susceptible zones are sandy beaches with smaller surface areas and those lacking dune systems to their rear, as well as badly deteriorated beaches.

The most susceptible zones are sandy beaches without dunes. The northern Adriatic coast is the Italian area at greatest risk.

The Italian area at greatest risk is that found between the Ravenna area and the mouth of the Tagliamento River, along the northern Adriatic coast. These areas are subject to vertical movements compacting the soil (subsidence); in addition, they are extremely vulnerable to increases in the average level of the sea (eustatism).

The average annual level of the sea shows different trends in different areas: from 1.2 mm/year in Genoa to 8.3 mm/year in the Ravenna area.

An analysis of the mean sea level registrations (msl) at the coastal stations of Trieste, Venice, Ravenna and Genoa from the end of the 1800's to the present show results that vary considerably between different areas. The stations located on terrains not subject to subsidence, such as Genoa and Trieste, show a limited growth trend of roughly 1.2-1.3 mm/year. In Venice, on the other hand, the current growth rate for the msl is calculated at 2.2 mm/year, though it was much higher in the period between the 50's and the 70's. Of particular note is the case of Ravenna, where the annual average growth rate stands at 8.3 mm. In such cases, elevated pressure of human origin accounts for most of the subsidence recorded.



The Italian coastal area facing the greatest risk of erosion and flooding is that between the Ravenna area and the mouth of the Tagliamento River, on the northern Adriatic coast.
These areas are vulnerable to subsidence and to increases in the average sea level. Increases in the average sea level since the late 1800's range from 1.2 mm/year in Genoa to 8.3 mm/year in the Ravenna area.

Figure 1.3: Average sea levels observed at the measuring stations of Genoa, Trieste, Venice and Marina di Ravenna from the late 1800's to the present[15]

The categories of vulnerable "resources" consist of economic activities tied to beach tourism, the many SCI (Sites of Community Importance) coastal areas, the coastal dunes, the pine groves and the prized species of flora and fauna found along much of the Italian coast, as well as the roadway (streets and highways) and railway infrastructures in the vicinity of the current coast. Also at risk are the agricultural activities in the coastal plains (i.e. the Fondi plain) and fish-hatchery activities, which are typically located in transitional zones (i.e. the Goro lagoon).

The categories of "resources" vulnerable to erosion and flooding are the SCI coastal areas, costal dunes, pine groves and species of flora and fauna, plus roadway and railway infrastructures in the vicinity of the current coast.

[15] Source: Raicich, F. "*Scenari di sea level rise nel Mediterraneo*", presented at the workshop entitled "Cambiamenti climatici e rischio costiero" 27-28 June 2007, Palermo

Desertification

Processes of desertification are tied to current climatic trends, as well as to excessive exploitation and unsustainable management of soil resources.

In terms of their impact on the territory, current climate trends, as well as those forecast for the future, combine their effect with other factors of pressure tied to the excessive exploitation and unsustainable management of the land resources. Among these are cited crop-growing practices, the raising of livestock, the management of water resources and the heightened susceptibility of the environment to desertification not only in arid and semi-arid areas, as well as sub-humid pockets of the globe, but also in other areas subject to water shortages and conditions of stressful soil management.

Desertification, considered in its most intensive forms, affects more than 100 countries, threatening the survival of more than a billion people. In Italy, even though drought and desertification do not occur in as dramatic a fashion as in other areas of the planet, such conditions are becoming increasingly apparent in at least five regions (Sardinia, Sicily, Basilicata, Apulia and Calabria), while negative signs have also been observed in other areas of the central-northern regions[16]. Assessment of the intensity and extent of desertification is a difficult task, given the lack of a common method suitable for use on both the global and regional levels. The estimates vary, depending on the method of analysis used, ranging from a percentage of vulnerable areas equal to approximately 5.5% of the national territory (the preliminary map drawn up by the National Committee for the Fight against Desertification, as part of the process of formulating the National Action Program, 1999) to figures showing 3% of the territory to be highly sensitive to desertification while 32% presents an average sensitivity (the *Desertification Information System for the Mediterranean*[17] project, coordinated by the UNCCD, in collaboration with the European Agency for the Environment and the Foundation of Applied Meteorology, 2004).

1.3 The pressures on the climate system

Much of the warming observed during the last 50 years can be attributed to human activities.

Though the effects of natural factors, such as variations in the intensity of the solar radiation, are not neglected, the vast majority of the scientific community is convinced that "There are new and more significant grounds" for holding that "much of the warming observed over the last 50 years is attributable to human activities"[18]; extensive confirmation of these results has been provided by the Fourth Assessment Report of the IPCC[19].

[16] APAT (2006). *Environmental Data Yearbook*, 2006 edition
[17] http://dismed.eionet.eu.int
[18] IPCC (2001). *Climate Change 2001 – Synthesis Report*
[19] IPCC (2007). *Climate Change 2007 – WG-I, WG-II, WG-III, Technical Summary*

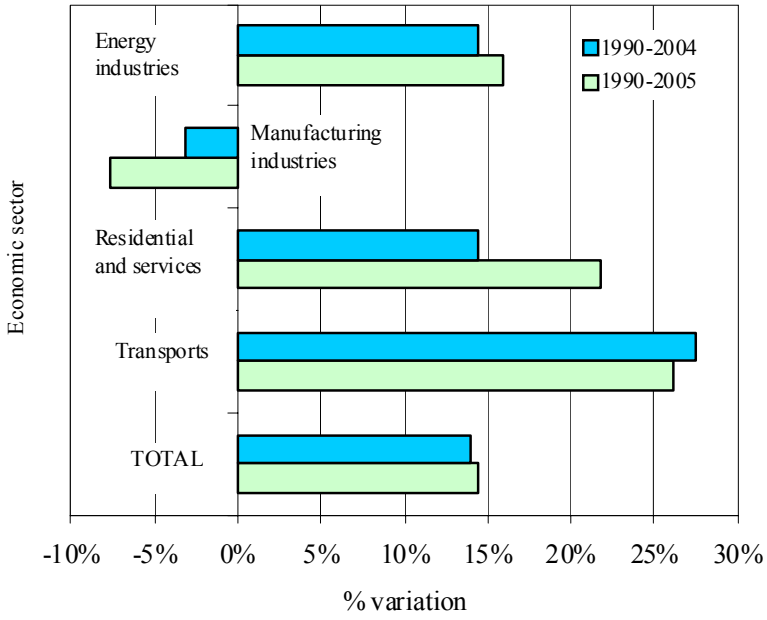
In terms of CO_2, the primary greenhouse gas, the average global concentration of carbon dioxide has risen from 280 ppm during the period 1000-1750 to 379 ppm in 2005, paralleling a rise in carbon dioxide emissions from practically zero to approximately 26.6 billion tons, taking into account only emissions generated by processes of combustion[20]. Similar, if not sharper, growth rates have been recorded for other greenhouse gases as well, including methane, nitrous oxide and fluorocarbons.

Italy is not exempt from this upward trend in the emission of greenhouse gases: the most recent figures of the national greenhouse gas emissions inventory show an increase from 516.85 to 579.55 million tons CO_2 equivalent during the period 1990-2005, corresponding to 12.1%, while, according to the Kyoto Protocol, Italy should reduce its emissions, during the 2008-2012 period, to levels 6.5% lower than those of 1990, i.e. to 483.26 Mt CO_2 equivalent.
Globally, Italy is responsible for no more than 1.74% of the overall emissions generated by the use of fossil fuels, meaning that it ranks ninth out of the ten countries with the highest levels of greenhouse gas emissions[21] .

Between 1990 and 2005 greenhouse gas emissions in Italy increased from 516,9 to 579,6 Mt CO_2, equivalent, for an increase of 12.1%. Under the Kyoto Protocol, Italy should reduce its emissions, during the 2008-2012 period to levels 6.5% lower than emissions in 1990: i.e. to 483.26 Mt CO_2. equivalent.

Between 1990 and 2005, overall emissions of greenhouse gases in Italy rose by 62.70 million equivalent tons carbon dioxide (Mt CO_2eq). During this period, there were decreases in the levels of emissions from the manufacturing industry (-6.96 Mt CO_2eq), agriculture (-3.36 Mt CO_2eq) and the use of solvents (-0.30 Mt CO_2eq), while emissions generated by waste (+1.41 Mt CO_2eq), industrial processes (+4.25 Mt CO_2eq), the residential and services sector (+16.91 Mt CO_2eq) and, to an even greater extent, the energy industry (+23.24 Mt CO_2eq) and transport (+27.50 Mt CO_2eq) rose. In 2005, as compared to the previous year, drops in emissions were registered for the manufacturing industries (-4.73%, equal to 4.15 Mt CO_2eq) and transport (-1.07%; 1.44 Mt CO_2eq), though these reductions were offset by increased emissions from the energy industries (+1.30%; 2.17 Mt CO_2eq) and, most of all, the residential and services sectors (+6.50%; 5.77 Mt CO_2eq). In 2005 energy processes as a whole registered an increase of 0.49% in emissions (2.34 Mt CO_2eq), as compared to 2004.

[20] IEA (2006). *CO_2 Emissions from Fuel Combustion*, 1971-2004
[21] IEA (2006). *CO_2 Emissions from Fuel Combustion*, 1971-2004

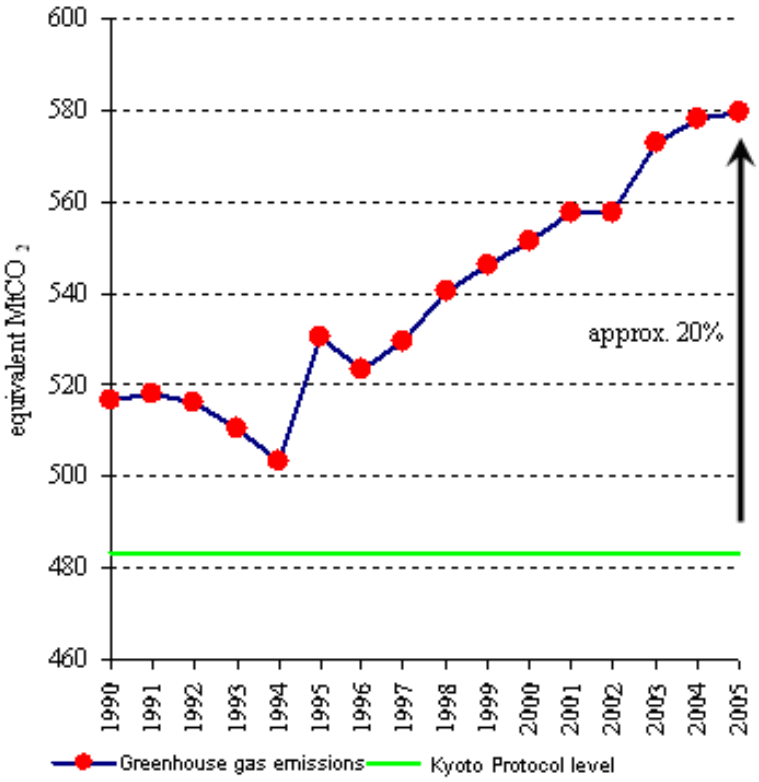


From 1990 to 2005, greenhouse gas emissions in Italy increased from 516.9 to 579.6 Mt CO_2,eq, a 12.1% rise (62.70 Mt CO_2,eq).
Increased emissions were registered from waste, industrial processes, the residential sector and services, and, to an even greater extent, from energy industries and transport, while there were decreases in emissions from the manufacturing industries.

Figure 1.4: Percentage variations in emissions of greenhouse gases by economic sector in the years 2004 and 2005, compared with 1990[22]

As a result of the increase in emissions from energy industries and transport, Italy is foreseen as not being able to achieve the Kyoto objective through domestic measures alone, meaning that it will have to draw on credits generated by forestry activities and by international cooperation initiatives (*Clean Development Mechanism, Joint Implementation*), as these are defined under the Kyoto Protocol. In 2005, emissions of greenhouse gases exceeded the Kyoto objective by slightly more than 96 Mt (~ +20%).

[22] Source: APAT



Under the Kyoto Protocol, Italy should reduce its emissions for the 2008-2012 period to levels 6.5% lower than those of 1990: i.e. to 483.26 Mt CO_2,eq. Greenhouse gas emissions for 2005 were slightly more than 96 Mt higher than the Kyoto objective (~ +20%).

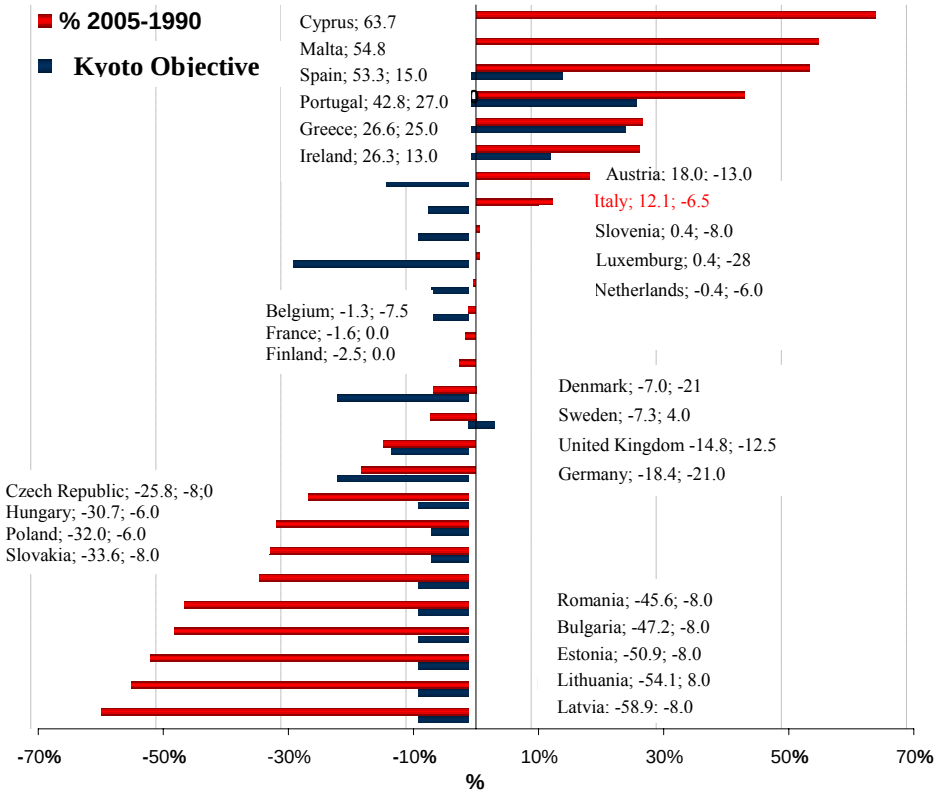
Figure 1.5: Total greenhouse gas emissions and level set for compliance with the Kyoto Protocol[23]

Within the European Union (EU15), the majority of the countries is not in line with the objectives set under the Kyoto Protocol.

Within the European Union (EU15), there is no question that the great majority of the countries are not in line with the objectives set under the Kyoto Protocol. Germany has met the objectives, while the United Kingdom, Finland, France and Sweden reduced emissions in 2005 beyond the objectives set for the period of 2008-2012.

As a rule, the newly admitted countries (with the exception of Slovenia) have reduced their emissions well beyond the Kyoto objectives. Cyprus and Malta, which are not included in Annex I of the Framework Convention on Climate Change (being developing countries), do not have obligations regarding the reduction of emissions.

[23] Source: APAT



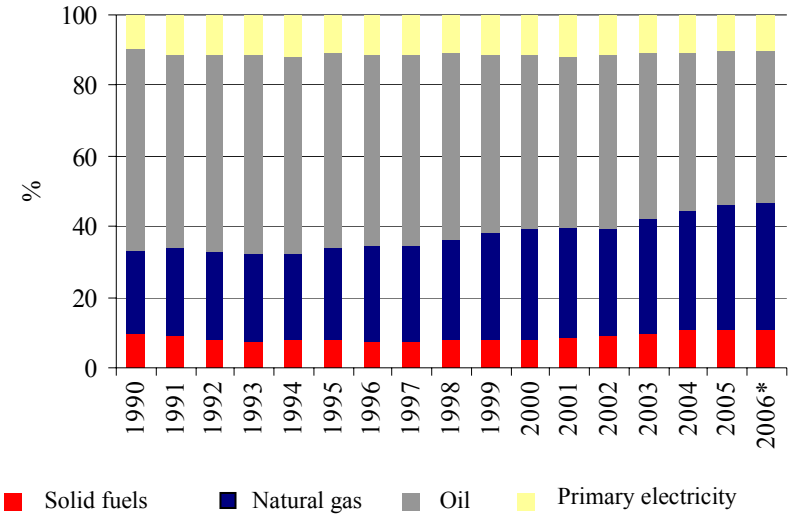
Within the European Union (EU15), the majority of the countries, including Italy, is not in line with the objectives set under the Kyoto Protocol. Germany has met the objectives, while Great Britain, Finland, France and Sweden reduced their emissions in 2005 beyond the objectives set for 2008-2012.

Figure 1.6: Comparison of the levels of greenhouse gas emissions in 2005, compared to the benchmark year of 1990, and the Kyoto objective for the period 2008-2012 in the European countries (EU27)[24]

The most recent data on the energy sector, in addition to confirming a number of the inherent characteristics of the national energy system, such as the performance levels above the European averages in terms of energy intensity and the ratio between final consumption and total consumption of energy, also point to a series of changes underway in the way in which energy is procured, such as the growing role of natural gas compared to petroleum products, as well as an upward trend in the contribution of renewable sources and cogeneration, plus, starting from 2001, renewed consumption of solid fuels, whose contribution to primary sources of energy (including primary electric energy) went from 8.57% in 2001 to 11.02% in 2006.

The national energy system is characterised by performance above the average European levels in terms of energy intensity and the ratio between final consumption and total consumption of energy, as well as a series of changes currently underway in the procurement of supplies.

[24] Source: APAT processing of UNFCCC data.

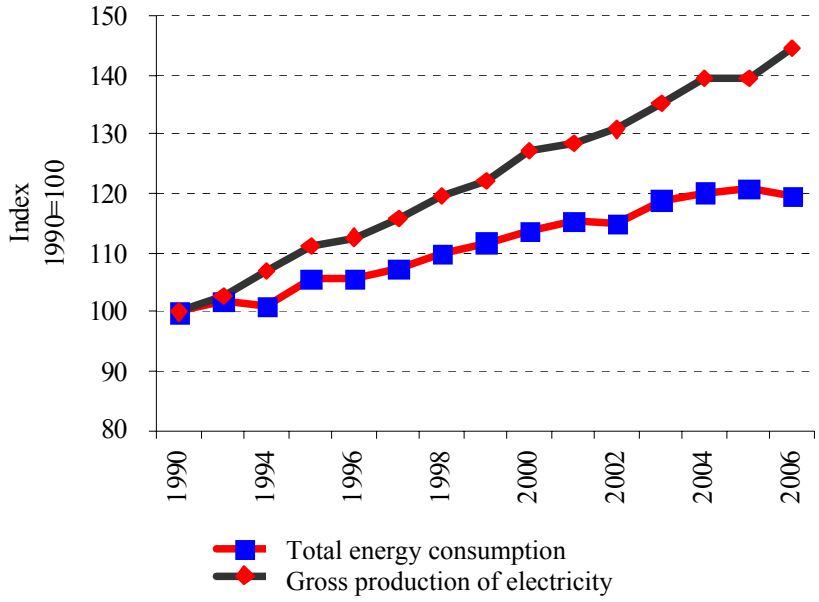


A series of changes are underway within the energy sector, in terms of the procurement of supplies, with growth in the consumption of natural gas compared to petroleum products, as well as in the contribution of renewable sources and cogeneration, plus, since 2001, in the consumption of solid fuels.

Legend: *Provisional figure
Figure 1.7: Total energy consumption by primary sources[25]

Results in the energy sector are influenced not only by fuel prices on the international market, but also by legislative and regulatory changes, such as the liberalisation of energy markets and the introduction of new forms of incentives for the production of electricity from renewable sources, in the form of a minimum quota of renewable sources for each electricity producer. As for final consumption of energy, between 2002 and 2005, a noteworthy increase was registered in consumption by the services and residential sectors (from 39.9 Mtoe in 2002 to 45.8 Mtoe in 2005), essentially on account of climatic factors, followed by a decrease in 2006, with final consumption falling to 44.4 Mtoe. These figures, combined with the limited growth in the GDP registered in recent years, underlie the increase in total energy intensity between 2002 and 2005 (+3.8%), which was followed by a significant reduction in 2006 (-2.9% between 2005 and 2006; +0.7% between 2002 and 2006). Between 1994 and 2006, the rate of growth for the production of electric energy was significantly higher than that for total energy consumption; especially worthy of note, from this perspective, are the figures for 2006. This result, if confirmed, points to a growing role for electricity as an energy carrier within the national energy system.

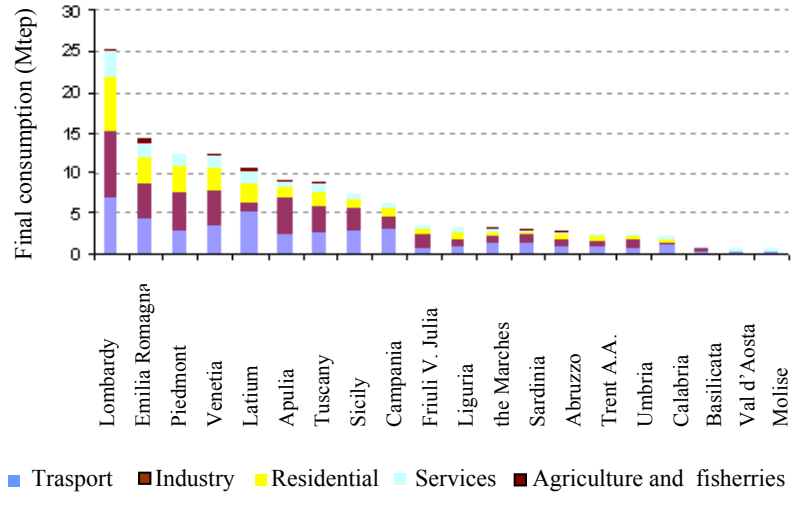
[25] Source: ENEA analysis of data from the Ministry of Economic Development



Between 1994 and 2006, the growth rate for the production of electricity was considerably higher than that for total energy consumption. Should this trend continue, it would point to a growing role for electricity as an energy carrier within the national energy system.

Figure 1.8: Trends in total energy consumption and production of electricity (1990 = 100)[26]

Figures for final energy consumption on the regional level point to an extremely varied structure within the national territory. Preliminary estimates for 2004 show that Lombardy consumes 19.3% of the national total; Emilia-Romagna, Piedmont and Venetia rank at an average figure of 9.8%; other regions, such as Latium, Apulia and Tuscany, register averages of around 7.2%. Taken as a whole, these seven regions account for 70.4% of total Italian consumption. Noteworthy shares of the total are also consumed by Sicily (5.8%) and Campania (4.9%)



Regional energy-consumption figures show an extremely varied structure within the national territory. Lombardy consumes 19% of the national total.
More than 70% of total Italian energy consumption is accounted for by only seven regions: Lombardy, Emilia Romagna, Piedmont, Venetia, Latium, Apulia and Tuscany.

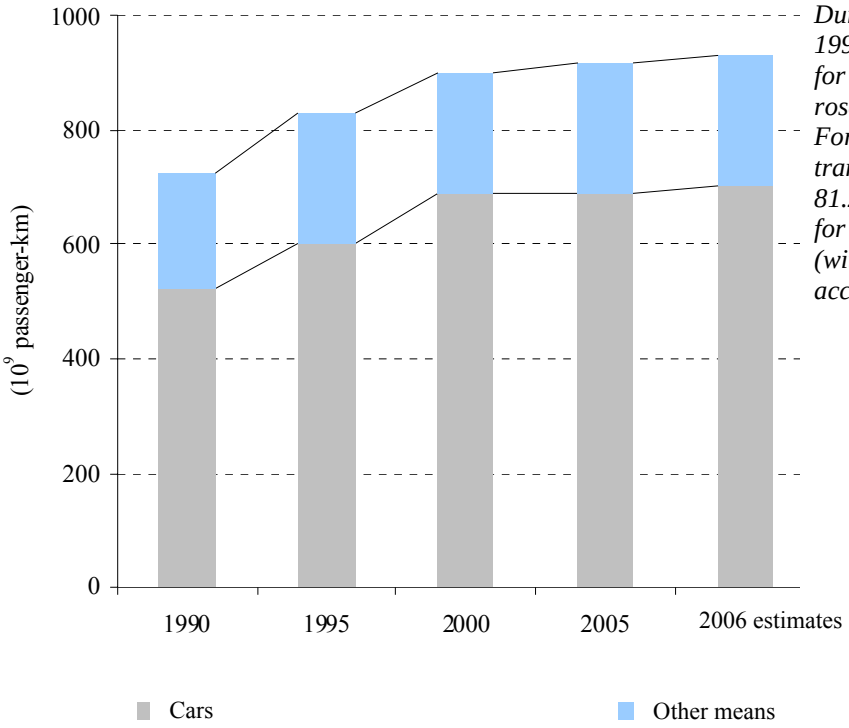
Figure 1.9: Final consumption of energy at the regional level by economic sector - Year 2004 (preliminary estimate)[27]

[26] Source: APAT analysis of data from the Ministry of Economic Development and TERNA

The transport system shows a trend pointing in the opposite direction from environmental sustainability. The demand for mobility continues to grow: during the period 1990-2006, the demand for passenger transport rose by 28.6%, while the demand for cargo transport rose by 31.9% during the same period.

During the period 1990-2006, the demand for passenger transport rose by nearly 29% and the demand for cargo transport by 32%.

The passenger demand continues to be satisfied primarily by the roadway mode of transport, the least efficient from an economic and environmental point of view. Private roadway transport alone (cars, motorcycles and scooters) accounts for 81.2% of the demand for passenger transport.



During the period 1990-2006, the demand for passenger transport rose by almost 29%. For 2006, roadway transport constitutes 81.2% of the demand for passenger transport (with automobiles alone accounting for 75.3%).

Figure 1.10: Trend of the demand for passenger transport [28]

[27] Source: APAT analysis of ENEA data

Cargo transport within the national territory takes place primarily on trucks (54.9% in 2006), with a noteworthy portion being handled by foreign carriers (14.7%). This last figure appears especially significant, in light of the constant growth registered since 1995, when the share of cargo transported by foreign carriers was 3.8%. Transport of cargo by sea and by railway account for respective shares of 16.1% and 9.9% of the total, while air cargo transport stands at a negligible 0.4%.
The demand for cargo transport shows especially rapid growth in the period 2003-2005, followed by a decrease in 2006.

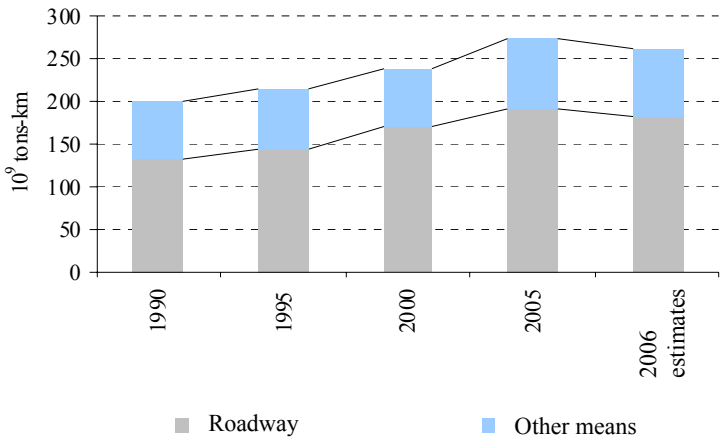


Figure 1.11: Trend of the demand for cargo transport[29]

Between 1990 and 2005, demand for cargo transport showed growth of more than 30% , while the figures for 2006 point to a decrease.
Estimates for 2006 further reveal that most cargo transport within the national territory travels by roadway (69.6%), while other modes, such as cargo transport by sea or by rail, account for respective shares of 16% and 10% of total transport.

Italy ranks second in Europe, coming after Luxemburg, in terms of the ratio of registered automobiles to the resident population, though it ranks first when motorcycles, scooters and commercial vehicles are included; worldwide, only the USA has a higher rate of motorisation, meaning the ratio of vehicles to inhabitants.

1.4 Response measures

The main response measures involve mitigation (meaning the reduction of greenhouse gas emissions) and adaptation to the

The main response measures involve mitigation (meaning the

[28] Source: Time series recalculated by the APAT, under uniform criteria, from data provided by CNT and Federtrasporti; the time series for the transport of cargo are influenced by variations in the data-collection method used by the ISTAT
[29] Source: time series recalculated by APAT under uniform criteria using data provided by CNT and Federtrasporti; the time series for cargo transport are influenced by changes in the ISTAT data-collection method

climate changes underway. Mitigation and adaptation measures can be complementary, interchangeable or independent. Recent evaluations of the IPCC make it clear that: "Under current policies for the mitigation of climate change and the related practices of sustainable development, global emissions of greenhouse gases shall continue to increase in the next few decades"[30]. Therefore, regardless of whatever measures of mitigation are implemented, adaptation measures shall be required as well, on account of the inertia of the climate system, as well as the changes already underway. It should also be considered that, on account of this inertia, the benefits of the mitigation measures taken today may manifest themselves only over the medium to long term, though the future potential of such measures is higher than that of the adaptation measures which we can implement today[31].

reduction of greenhouse-gas emissions) and adjustment to the climate changes underway.

Mitigation

Within Europe, the measures already taken to reduce atmospheric emissions by the energy sector, as well as those to be taken, should be considered within the policy framework recently defined by the European Council of 8-9 March 2007, which set the following objectives to be reached by the European Union by 2020:

a) reduction of greenhouse-gas emissions by 20% compared to 1990;
b) 20% of total energy consumption to be contributed by renewable sources;
c) reduction of energy consumption by 20% compared to forecasts;
d) 10% of total transport energy consumption to be contributed by bio-fuels.

The political framework defined by the European Council sets the following objectives for the EU by 2020:

- *reduction of greenhouse-gas emissions by 20% compared to 1990;*
- *20% of total energy consumption to be contributed by renewable sources;*
- *20% reduction in energy consumption compared to forecasts;*
- *10% of transport energy consumption to be contributed by bio-fuels.*

This approach, together with the objective of contrasting climate change, is meant to:
1) increase the security of energy sources;
2) ensure that the European economy is competitive;
3) promote an economy based on low carbon content.
Furthermore, the conclusions of the European Council lay down the commitment of limiting the increase in the average global temperature to a maximum of 2°C, as compared to pre-industrial levels.

[30] IPCC (2007). *Climate Change 2007* – WG-III, *Summary for Policymakers*
[31] IPCC (2007). *Climate Change 2007* – WG-III, *Technical Summary*

Of note nationally is the growing role of cogeneration, which increases the efficiency of the conversion of the energy available in primary sources. Since 1997, the figures for the portion of net thermoelectric energy produced through cogeneration run parallel to total thermoelectric production: between 1997 and 2006, the average annual increases for thermoelectric production through cogeneration and total thermoelectric production were approximately 6,480 GWh/year and 6,697 GWh/year respectively. The figure for overall production of electricity has remained essentially unchanged during the period considered, meaning that, since 1997, practically the entire supply of new electricity from thermoelectric plants has been produced through cogeneration.

Of note on the national level is the growing role of cogeneration, which makes possible greater efficiency in the conversion of the energy available from primary sources.

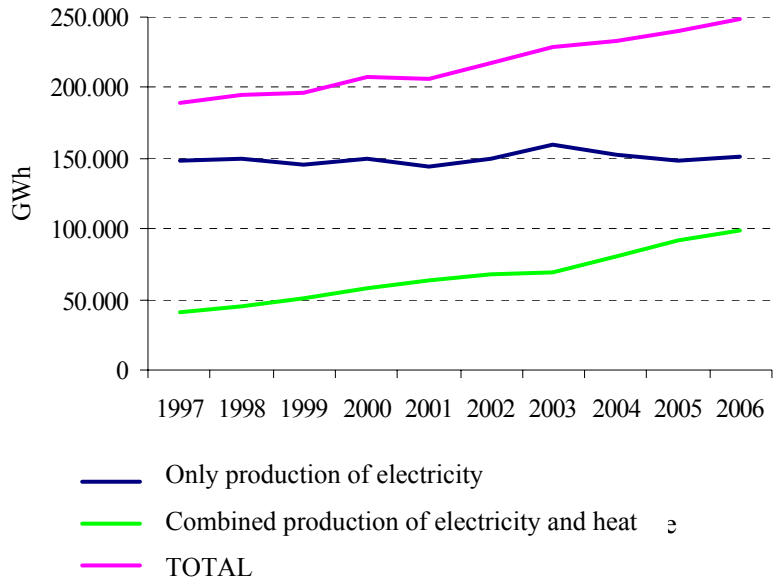


Figure 1.12: Net production of thermoelectric energy[32]

The average annual increase in the production of electricity between 1997 and 2006 was approximately 6,480 GWh/year for thermoelectric production through cogeneration and 6.697 GWh/year for total thermoelectric production, while overall production of electricity remained practically unchanged during the period in question.
These figures show that, since 1997, nearly the entire supply of new electricity has been produced through cogeneration.

A regulatory development of note in this sector is the recent transposition into Italian law of Directive 2004/8/EC, which promotes cogeneration through Legislative Decree no. 20 of 8 February 2007.

[32] Source: APAT analysis of TERNA data

In terms of the mix of primary sources, it should be noted that the growing role of natural gas in thermoelectric production has a positive influence on the trend of greenhouse-gas emissions. This is due not only to the lower emission factor of natural gas as compared to other primary sources, but also to the greater efficiency of combined cycles fuelled with natural gas, as compared to traditional steam cycles. During the period 1996 – 2006, a decrease of 18.7% was registered in the average specific consumption of natural gas for the net production of electric energy. Derivative gases also showed a noteworthy decrease in specific consumption for 2006, falling 15.2% compared to 1996. Looking at all the fuels used for the production of electricity, average specific consumption decreased by 10.6% (-1.8% between 2005 and 2006). The average specific consumption for the production of electricity relating to all fuels is influenced by the use of petroleum products and solid fuels, which have lower levels of efficiency than combustible gases. In fact, during the period under consideration, the figures for specific average consumption of petroleum products and solid fuels registered respective increases of 8.2% and 6.1%.

The growing role of natural gas in thermoelectric production has a positive influence of the trend of greenhouse-gas emissions.

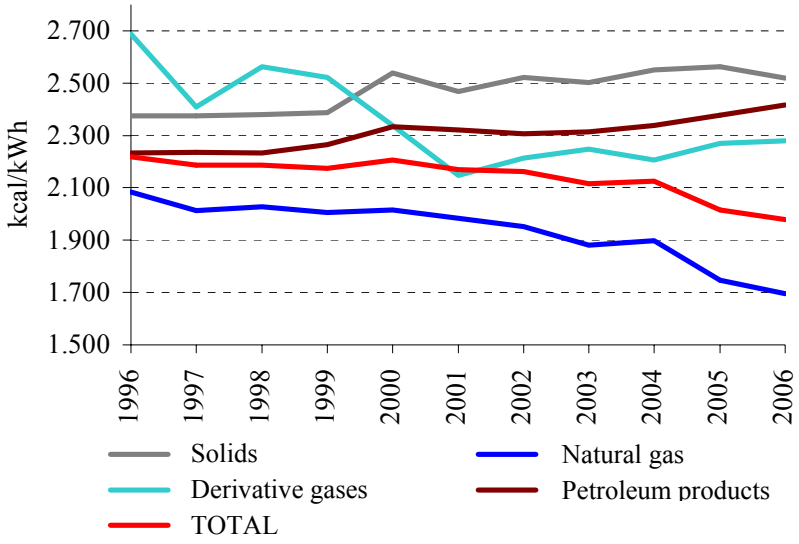


Figure 1.13: Average specific fuel consumption in the net production of electricity from fossil sources[33]

During the period between 1996 and 2006 there was a decrease of 18.7% in the average specific consumption of natural gas and a decrease of 15.2% in that of derivative gases. In terms of the overall production of electricity, average specific consumption decreased by 10.6%, compared to respective increases of 8.2% and 6.1% in petroleum products and solid fuels.

[33] Source: APAT analysis of TERNA data

In terms of energy efficiency of final uses, Directive 2006/32/EC sets the objectives for the efficiency of final energy uses and energy services for the member nations. The rough national objective for overall energy savings is 9% by the ninth year of the application of the Directory (2016). Under the provisions of art. 4, the member nations must implement effective measures designed to achieve this objective. In compliance with the directive, the Ministry of Economic Development presented the Action Plan for Energy Efficiency in July of 2007, identifying a series of actions that will make possible energy savings of 9.6% in 2016, based on average energy consumption between 2001 and 2005.

Based on Directive 2006/32/EC, the rough national objective for overall energy savings is 9% by 2016.

The production of electricity from renewable sources registered approximately 52.2 TWh in 2006, out of total electricity production of 313.1 TWh. The portion of total electric energy production generated by renewable sources is thus 16.7%. Production figures are characterised by annual fluctuations in the contribution of hydroelectric energy, tied to meteorological conditions, as well as growth in the contribution of non-traditional sources (wind, geothermal, biomasses and waste). In recent years (1997-2006), there has been a particularly noteworthy increase in the production of electricity from wind power (from 117.8 to 2,970.7 GWh during the period 1997-2006) and from biomasses/waste (from 820.3 to 6,744.6 GWh), as well as, though to a lesser degree, in energy of geothermic origin (from 3,905.2 to 5,527.4 GWh). The contribution of photovoltaic plants remains negligible (2.3 GWh in 2006, though this result should also take into account the production of electricity by photovoltaic roofs, which were not included in the statistics on the electricity sector, but produced 31 GWh in 2005). Despite the increase in the use of renewable sources in recent years, the figures on the production of electric energy from these sources do not appear sufficient for reaching the objective of approximately 75 TWh by 2010, as contemplated under Directive 2001/77/EC.

Production from renewable sources accounts for 16.7% of total production of electricity.
Despite the increase in the use of non-traditional renewable sources in recent years, the figures for the production of electricity from renewable sources are not sufficient for reaching the objective of approximately 75 TWh by 2010, as stipulated under Directive 2001/77/EC.
In the last few years (1997-2006), there has been a noteworthy increase in the production of electricity from wind power (from 117.8 to 2,970.7 GWh) and from biomasses/waste (from 820.3 to 6,744.6 GWh), as well as, though to a lesser degree, in energy of geothermic origin (from 3,905.2 to 5,527.4 GWh), while the contribution of photovoltaic energy remains negligible (2.3 GWh in 2006).

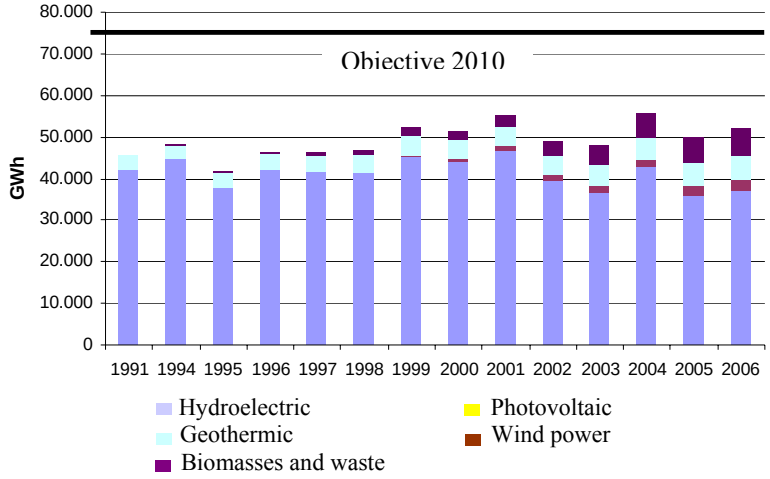


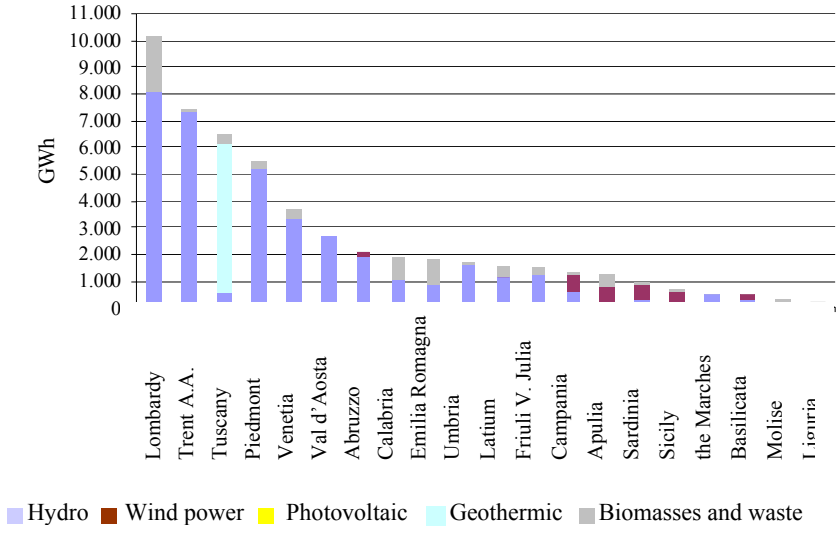
Figure 1.14: Overall production of electricity from renewable sources of energy[34]

Production from renewable sources constitutes 16.7% of total production of electricity. Since '97 there has been a noteworthy increase in the production of electricity from wind power (from 117.8 to 2,970.7 GWh during the period 1997-2006) and from biomasses/waste (from 820.3 to 6,744,6 GWh), as well as, though to a lesser extent, energy of geothermic origin (from 3,905.2 to 5,527.4 GWh).
But despite the increase registered in recent years, the figures on the production of electricity from these sources are not sufficient for achieving the objective of approximately 75 TWh by 2010, as contemplated under Directive 2001/77/EC.

There are noteworthy differences in the energy sources used in the various regions. Hydroelectric energy, concentrated in the regions of the Alpine arc, accounts for 70.8% of the electric energy produced by renewable sources. The use of geothermal energy is limited to Tuscany, which, on its own, accounts for 10.6% of the electric energy produced from renewable sources. Biomasses produce 12.9% of total production of electricity from renewable sources, while the portion generated by wind and photovoltaic plants is 5.7%, with almost all such production activities (99.1%) occurring the southern regions and on the major islands.

On the regional level, there are noteworthy differences in the renewable energy sources used. Hydroelectric energy, concentrated in the regions of the Alpine arc, accounts for almost 71% of the electric energy produced by renewable sources.

[34] Source: APAT analysis of TERNA data



On the regional level, there are noteworthy differences in the renewable energy sources used. The primary renewable source of electric energy, hydroelectric power, is concentrated along the Alpine arc (70.8%), while wind-powered and photovoltaic production are located in the southern regions and the islands (99.1%).

Figure 1.15: Overall production of electric energy from renewable sources on the regional level (2006)[35]

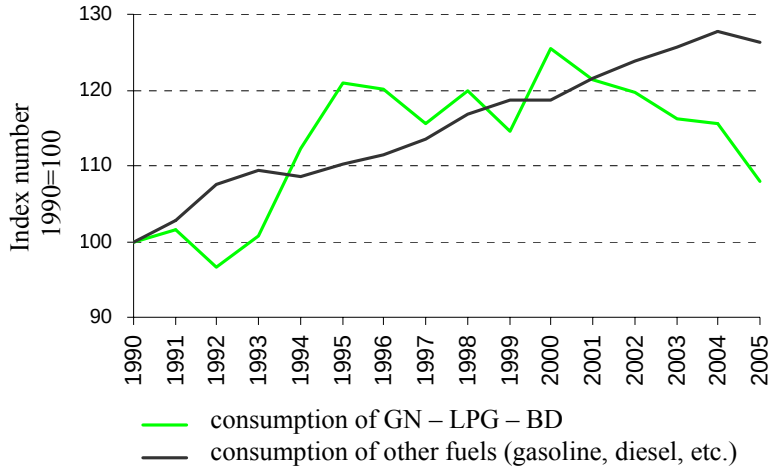
Of particular interest in terms of recent regulatory developments regarding renewable sources, and especially with respect to photovoltaic energy, is the Ministerial Decree of 19 February 2007, which lays down new criteria and procedures designed as incentives for the production of electric energy from photovoltaic solar plants. The measure will allow Italy to join the other European countries in the forefront of the sector by eliminating a portion of the lengthy bureaucratic procedures that weighed down the old "Energy Account".

The effects of technological measures regarding transport are offset by the growth in demand, especially for roadway transport.

The transport sector registered a constant increase in fuel consumption from 1990 to 2004 (+27.0% compared to 1990), followed by a slight decrease in 2005 (-1.5% compared to 2004). The percentage of fuels of low environmental impact (natural gas, LPG, bio-diesel) out of total fuels fluctuated, going from 5.6% in 1990 to 4.8% in 2005, with a peak of 6.1% in 1995.
The variation in the percentage consumption of fuels shows that, while the increase in classic fuels (gasoline, diesel etc.) has been constant, the levels of consumption of natural gas, LPG and bio-diesel have been irregular. Overall, the quantity of lower-impact fuels consumed in 2005 was 7.9% higher than the quantity consumed in 1990.
The available data show that, in the transport sector, the limited progress made through the enactment of technological measures regarding engine efficiency is offset - and to a greater degree in Italy than in the other European countries - by growth in the demand for transport, and especially the roadway mode, with the result that the environmental impact of the transport sector continues to grow. As for the quality of the fuels, it should be

[35] Source: APAT analysis of TERNA data

observed that the use of lower-impact fuels, in addition to being of marginal importance, follows a highly irregular pattern, with a constant decrease, since 2000, in the ratio of such fuels to total fuels consumed: a change in trend traceable primarily to reduced sales of LPG.



Use of lower-impact fuels has been highly irregular, with a constant decrease in their percentage of total fuel consumption since 2000.

Figure 1.16: Levels of consumption of fuels for transport (1990=100). (NG: natural gas; LPG: liquefied petroleum gas; BD: bio-diesel)[36]

In contrast to the increase in emissions of greenhouse gases resulting from various production activities and processes of deforestation, a noteworthy quantity of carbon dioxide has been removed from the atmosphere by vegetation, and especially by forests: on the order of 0.2 billion tons of carbon during the period 1980-1989 and 0.7 billion tons of carbon during the period 1989-1998, considered globally[37]. In Italy, the different forest reservoirs (epigeal and hypogeal biomass, necro-mass, forest bed and soil) were responsible for capturing 15.6 million tons of carbon in 1990 and 24.7 million tons of carbon in 2005, after accounting for losses from fires, natural uses and the mortality of the vegetation.

Between 1990 and 2005, the stock of carbon in Italian forests grew by 58%, due primarily to the expansion of forest surface area.

[36] Source: APAT analysis of data from the Ministry of Economic Development
[37] IPCC (2000). *Land-use, Land-use Change and Forestry*, IPCC *Special Report*

Adaptation

The Green Paper of the European Commission (COM(2007)354) stresses the global dimension of climate change, considering possible damage to Europe, together with the need to implement measures of adaptation. The Green Paper states that: "*Adaptation actions are taken to cope with a changing climate, e.g. increased rainfall, higher temperatures, scarcer water resources or more frequent storms, at present or anticipating such changesfuture. Adaptation aims at reducing the risk and damage from current and future harmful impacts cost-effectively or exploiting potential benefits. Examples of actions include using scarce water more efficiently, adapting existing building codes to stand future climate conditions and extreme weather events, construction offlood walls and raising levels of dykes against sea level rise, development of drought tolerant crops, selection offorestry species and practices less vulnerable to storms and fires development of spatial plans and corridors to help species migrate*".

The risks connected with climate change call for a series of timely actions, in order to avoid or reduce the costs that will be incurred if nothing is done. The recent Stern report on economic considerations tied to climate change[38], commissioned by the British Government, stressed that the economic impact of timely initiatives taken to limit climate change is estimable at around 1% of the global GDP per year, as compared to a figure of from 5% to 20% of the annual global GDP, should action not be taken.

The Stern report estimates the annual cost of initiatives to limit climate change at roughly 1% of the global GDP, compared to a cost of from 5% to 20% of the annual global GDP, if nothing is done.

Given this scenario, the EU plans to take a series of priority actions of adaptation, so as to avoid "*Unplanned measures of adaptation, possibly stop-gap actions to deal with the increasingly frequent crises and catastrophes, at extremely high costs and with possible risks for the social and economic systems of Europe, as well as its very security.*"

At the end of the National Conference on Climate Change, the Ministry of Environment, Land and Sea committed itself to drawing up a national strategy for sustainable adaptation to climate change and for the security of the territory by the end of 2008.

The Manifesto on the Climate[39], which summarises the proceedings of the Conference, sets a five-point program. The five points confirm Italy's commitment to comply with international agreements, and especially with the Kyoto Protocol, as well as the commitment to proceed with the additional reductions in greenhouse gases indicated by the

The Manifesto on the Climate and Sustainable Adaptation includes a commitment to the immediate formulation of a

[38] Stern N. (2006). *STERN REVIEW*: *The Economics of Climate Change*

[39] National Conference on Climate Change (2007), *Manifesto per il clima – Un new deal per l'adattamento sostenibile e la sicurezza ambientale*, http://www.conferenzacambiamenticlimatici2007.it/site/it-IT/Sezioni/Approfondimenti/manifesto.html, Rome 12-13 September 2007

European Union, equal to 20% by the end of 2020 and 60% by the end of 2050. Emphasis is also placed on the need to "coordinate measures of mitigation with those of adaptation to climatic change, immediately making the latter a part of sector-wide policies of economic development, as well as legislation and funding programs for major works".

National Plan for Adaptation, as well as the implementation of 13 priority actions.

Of particular importance is the commitment to "Immediately formulating a national plan for adaptation to climate change", involving institutions on all levels, together with the social partners, in a process that, taking into account international conventions (the Convention on Biological Diversity and the Convention on the Fight against Desertification, both dating from 1994), weighs the best strategies for initiatives in defence of the soil, the integrated management of coastlines, adaptations in tourism in Italy and the management of water resources.

Looking at the 13 priority actions for sustainable adaptation identified at the conclusion of the Conference, a number of these regard procedures for the production and consumption of energy, as well as the efficient use of water resources and the territory. Particular importance is placed on the need to provide incentives for saving energy and water resources, and on undertaking actions of sustainable management of the territory regarding climate change, urging that efforts be made to ensure the safety of Italy's coastline. Steps must also be taken in terms of healthcare policy, modifying healthcare strategies to include climate-related risks. Another factor of particular importance would appear to be the need to obtain greater knowledge of the critical problems connected with climate change.

Any response to climate change entails overcoming a series of obstacles tied to knowledge and outlook. The inherent uncertainty of any complex system, such as the climate system, is rendered even more acute by the scarce availability of many environmental parameters. Furthermore, an effort must be made to shift perceptions of the timeline for the effects of development decisions, which must be given a framework of decades in which to manifest themselves.

A number of adaptation measures (for example, the construction of defences against flooding and the raising of artificial embankments against the increase in the sea level) involve direct interventions on the environmental matrixes, the consequences of which must be carefully evaluated. Furthermore, adaptation efforts must compete with mitigation initiatives for resources; in actual fact, adaptation and mitigation are complementary, and should be viewed as two parts of a single, integrated response to the threat of climate change. The optimal mix of adaptation and mitigation must be determined on the basis of economic factors, such as cost-benefit analyses, though there can be no ignoring considerations of sustainable development and the ethical issues tied to this topic, especially as they effect future generations.

Adaptation and mitigation are complementary and should be considered as two parts of a single, integrated response to the threat of climate change.

In any event, there are measures of mitigation available for each

production and economic sector. By combining elements of mitigation and adaptation, these initiatives will not only contribute to reducing greenhouse-gas emissions, but they will also increase the resiliency of natural and human systems to the consequences of climate change, in addition to protecting natural assets, preventing damage to human systems and favouring sustainable development.

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].

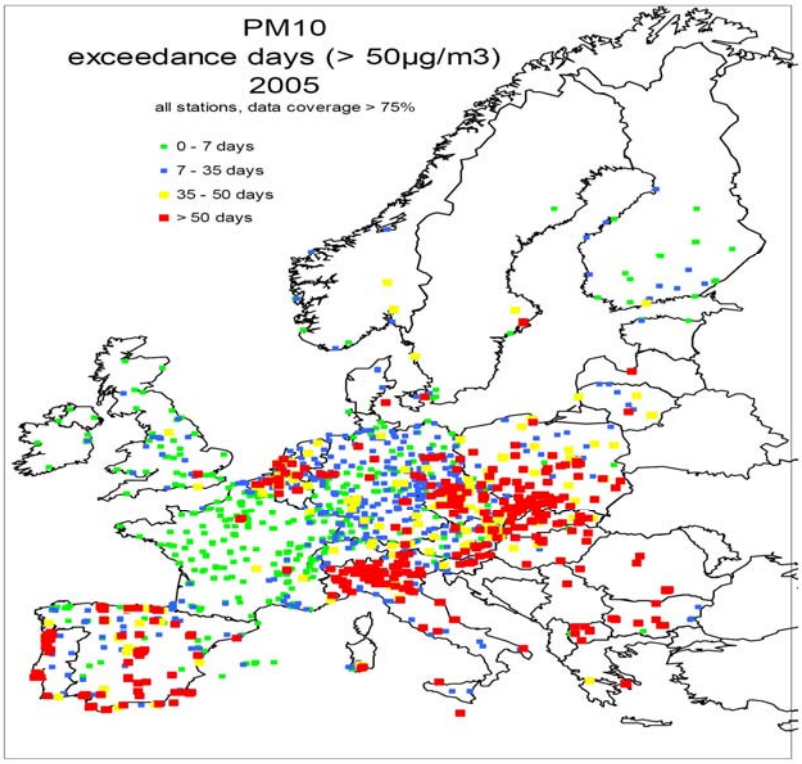
Exposure to PM_{10} in Europe causes an average loss of 9 months in life expectancy.

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.

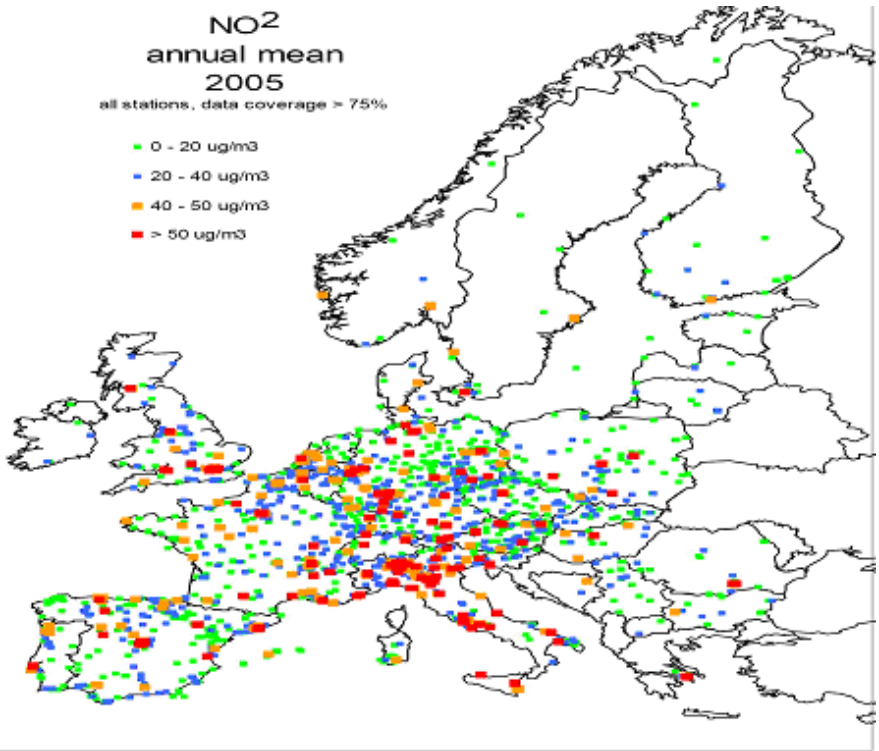
The following charts on PM_{10}, nitrogen dioxide and ozone show the situation of Italy within the European context, in particular the widely known critical situation in the Po Valley area (Figures 2.1, 2.2, 2.3).

[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.

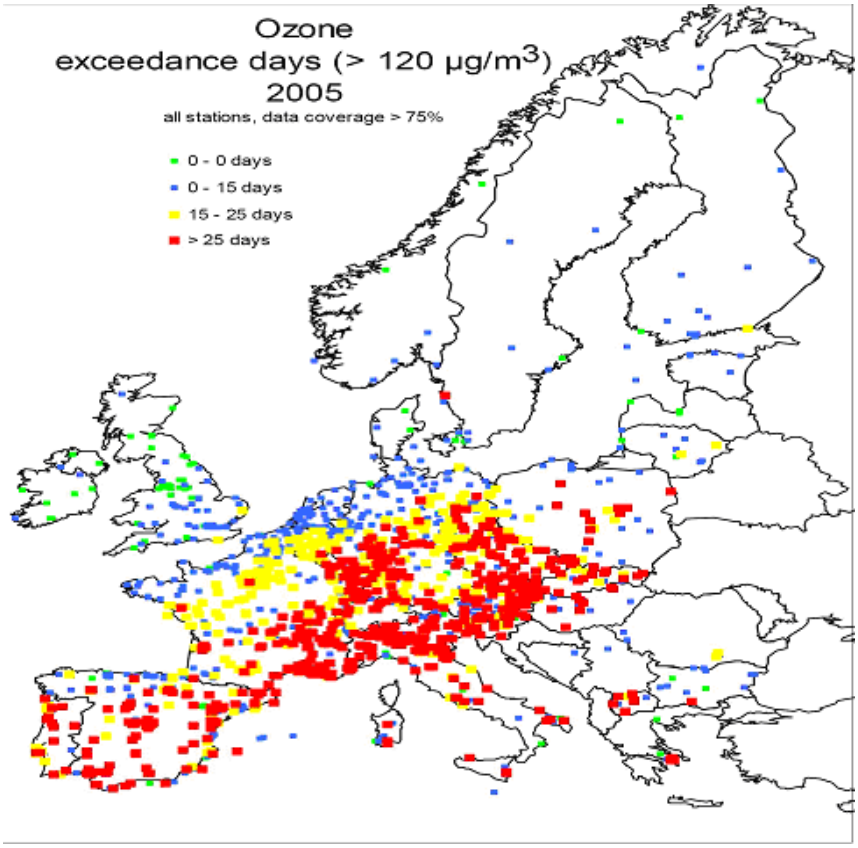
Figure 2.1: PM_{10}, - number of days in which the daily limit for the protection of human health is exceeded (50 µg/m^3, not to be exceeded more than 35 times in a calendar year) [2]



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*

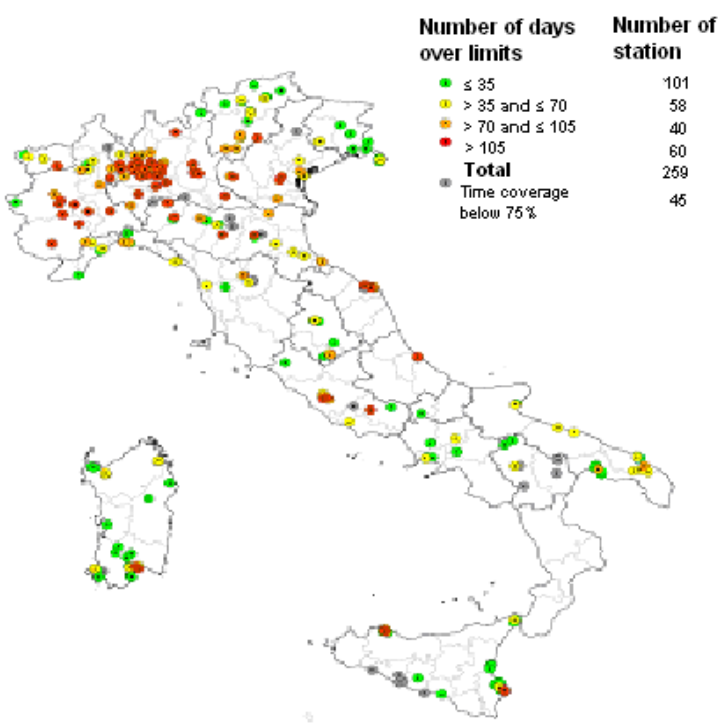
predominant secondary component that forms directly in the atmosphere, starting from other substances referred to as precursors (nitrogen oxides, volatile organic compounds, sulphur dioxide, ammonia).

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).



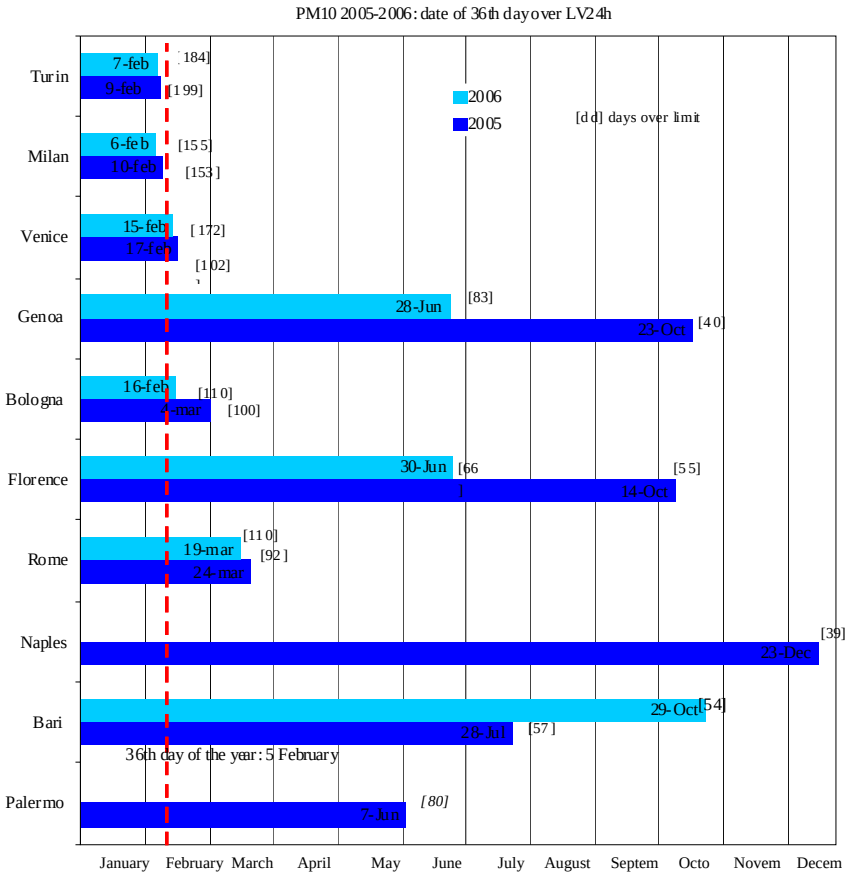
In Italy, in 2006, the daily limit (50 $\mu g/m^3$, not to be exceeded more than 35 times a year) was broken by 61% of the monitoring stations. The most critical situation is in Northern Italy. The monitoring stations are not uniformly distributed throughout the national territory.

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.

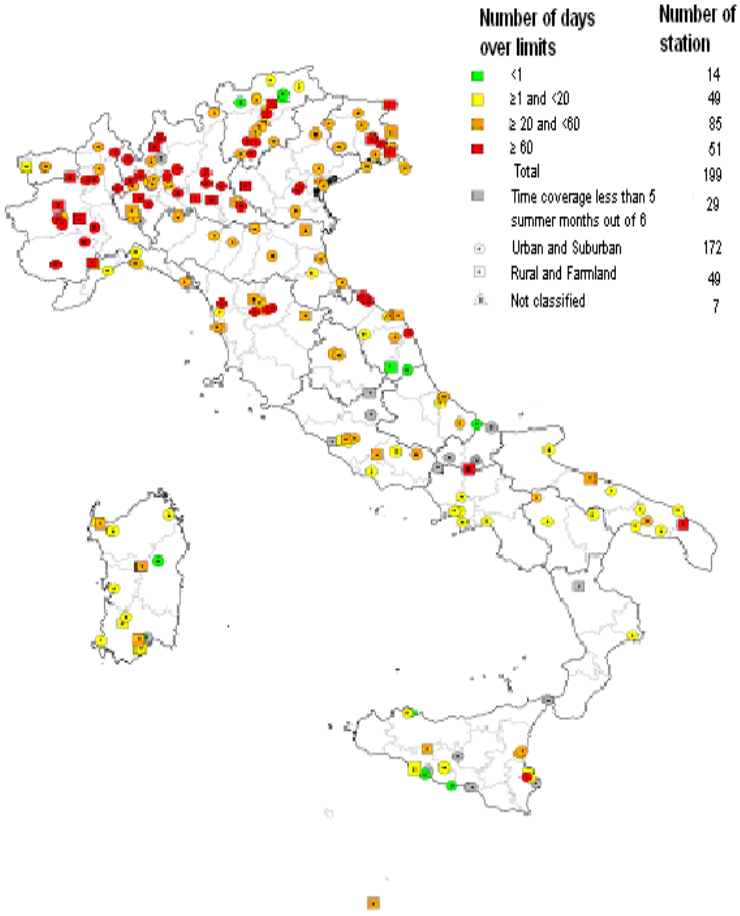
WHO: 8,000 deaths a year attributable to average PM_{10} concentrations > 20 μg/m^3.

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]

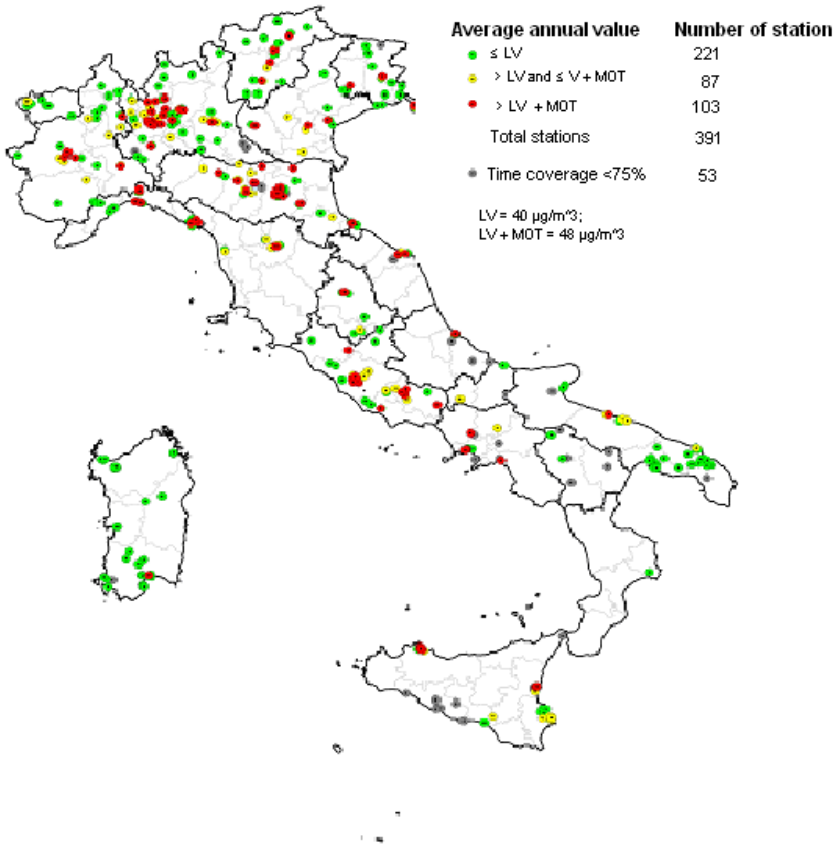
Even considering the undeniable difference in monitoring density between Northern and Southern Italy, the areas with the most critical ozone situations, as was the case for PM_{10}, are the regions of Northern Italy.

[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%.

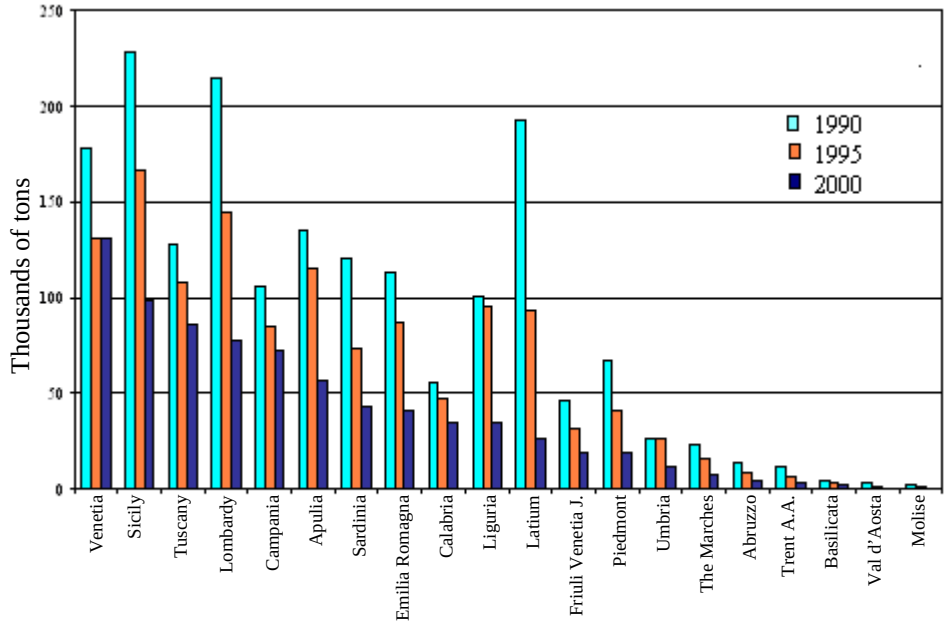
As for volatile organic compounds, but solely with regard to the non-methane ones (NMVOC), transport is responsible for 43%, while 39% come from the use of solvents, and the remainder from the industrial sector and other minor sectors.

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%).

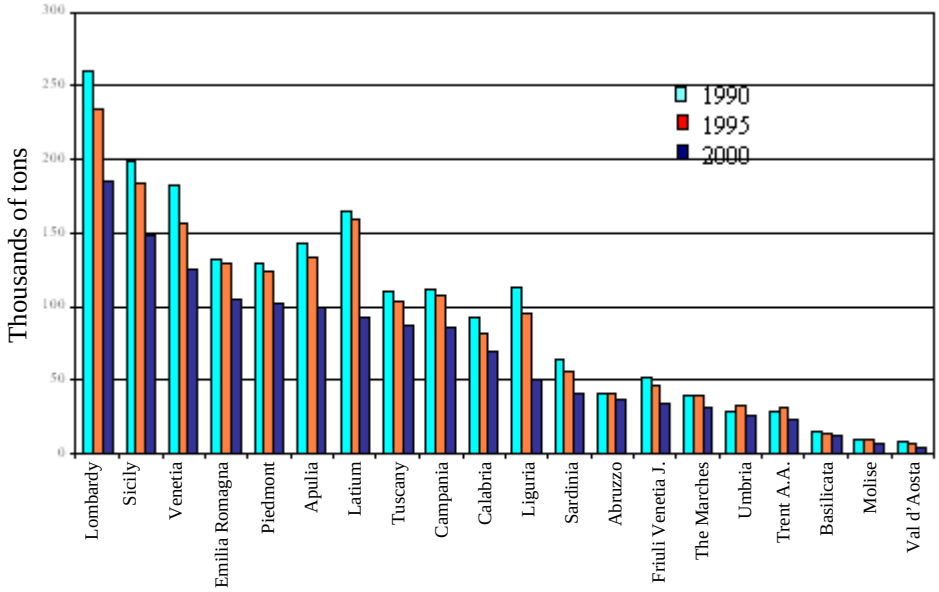
Emissions of PM10, SO_x and NO_x fell in all the regions, and especially those where large-scale combustion plants are found.

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%).

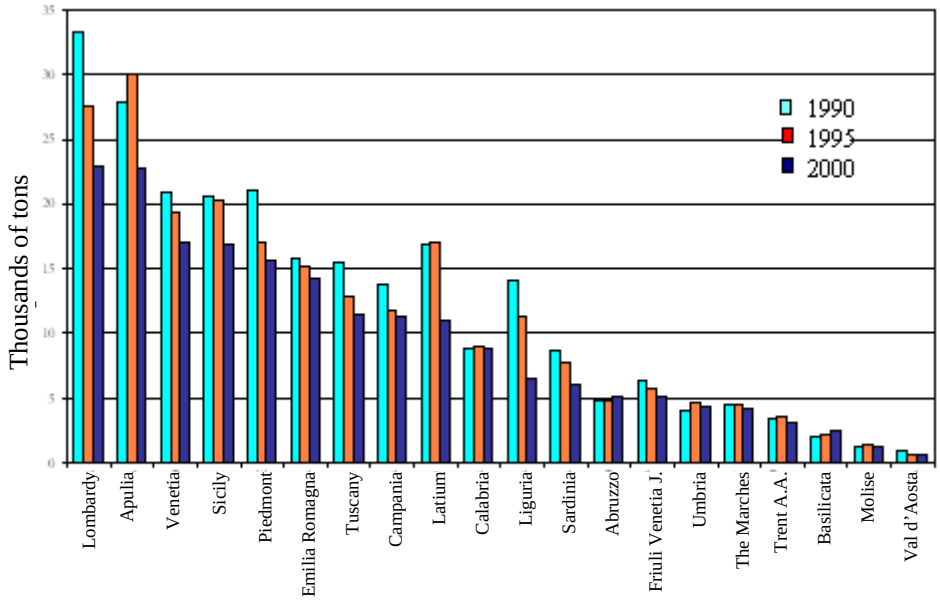
Figure 2.8: Regional emissions of SO_x[11]



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.

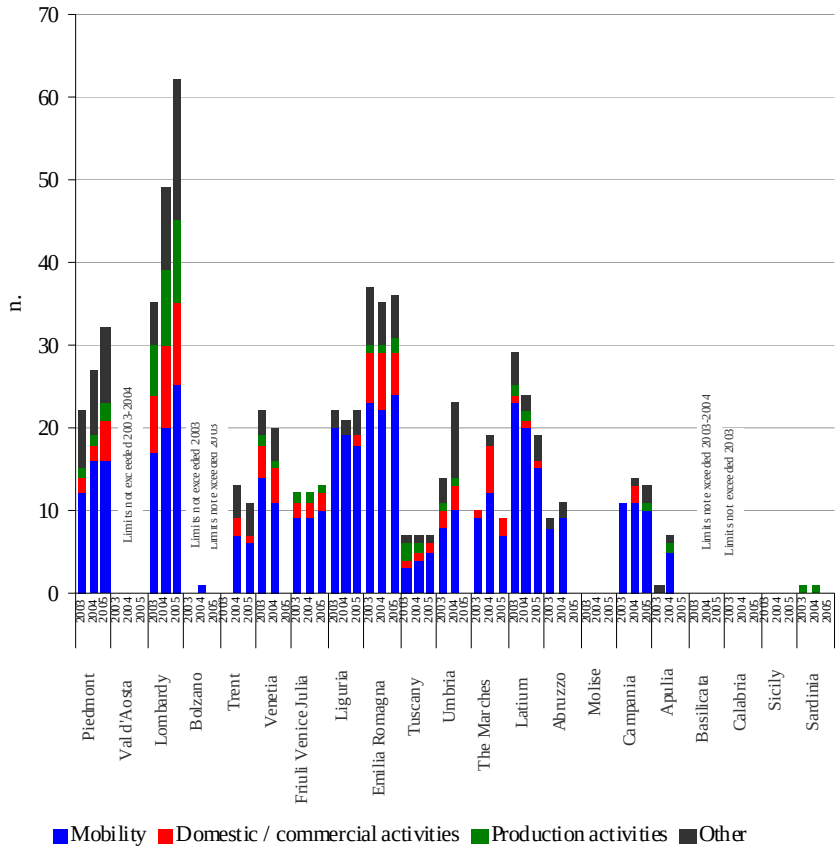
Moving on to an analysis of the additional actions selected, there are four main sectors of intervention in which the measures identified by the regions can be classified: Mobility, Domestic/Commercial

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,

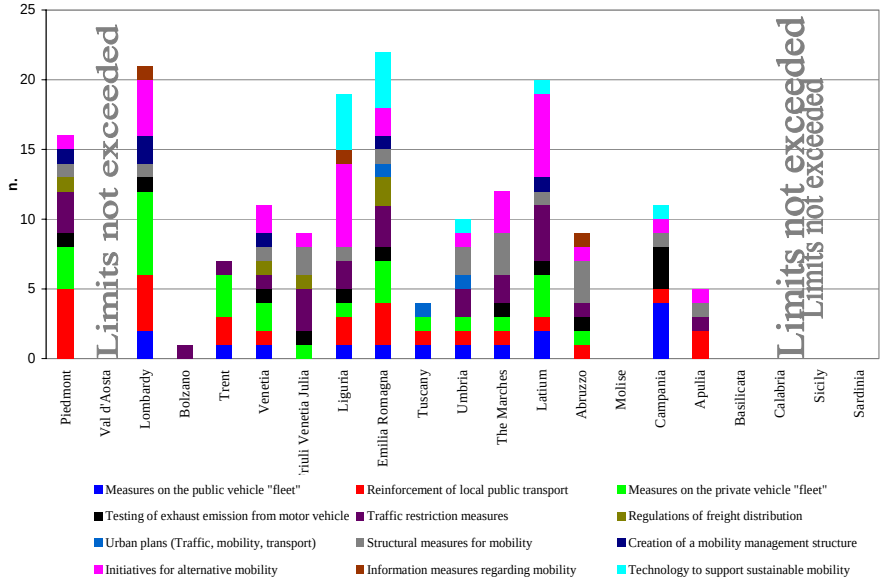
[21] The category "Other" includes: accessory measures in urban centres; studies and projects and initiatives for restructuring or expansion of air quality monitoring networks
[22] Source: APAT analysis of data from the regions and the autonomous provinces
[23] The expression *sustainable mobility* means "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).

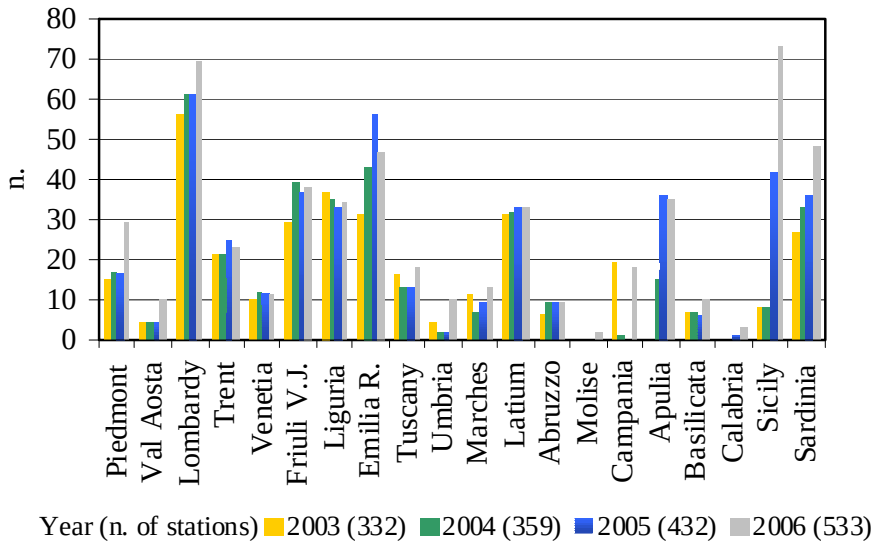
In terms of actions for the restoration of air quality, investigative initiatives, an area in which the APAT plays a major role, should not be neglected. At present, the prevalent and most reliable source of information on air in Italy consists of the monitoring stations distributed throughout the national 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.

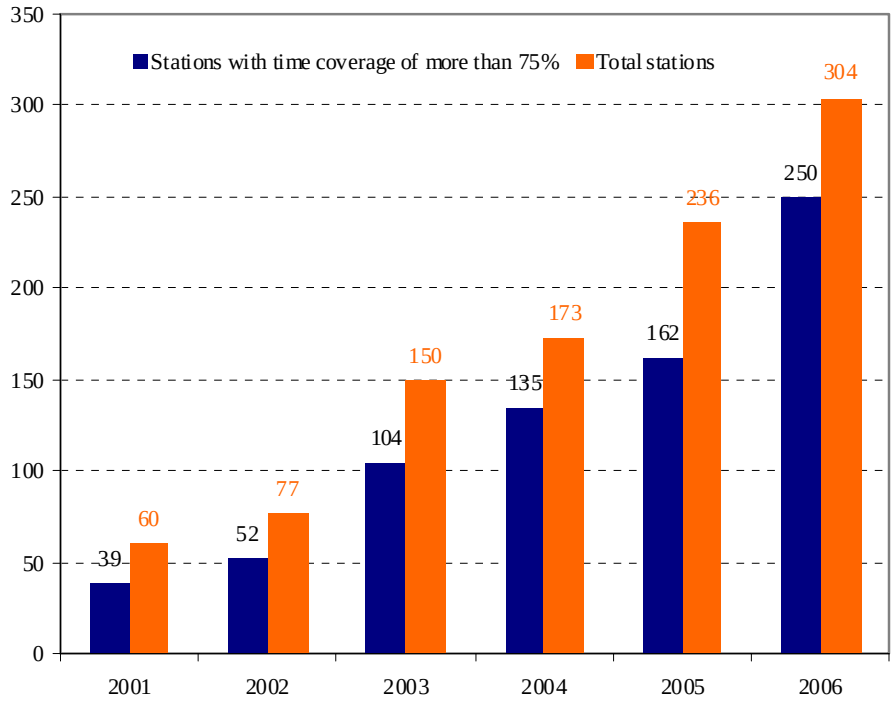
Figure 2.13: Number of monitoring stations per region (2003-2006)[27]

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.

---

[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".

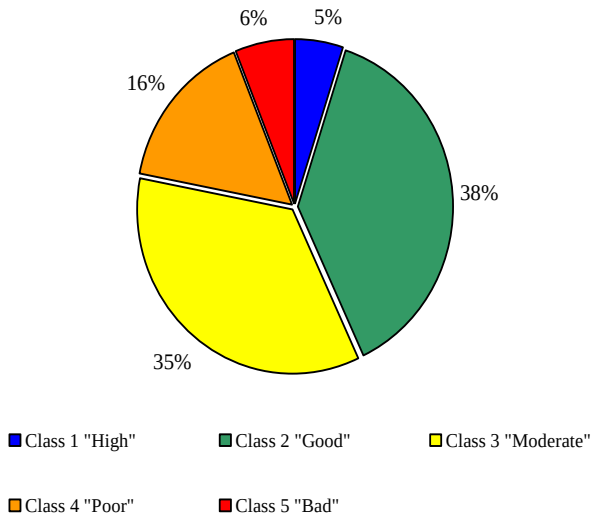


Figure 2.15: Percentage distribution of the classes of the SECA quality index (2006)[5]

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.

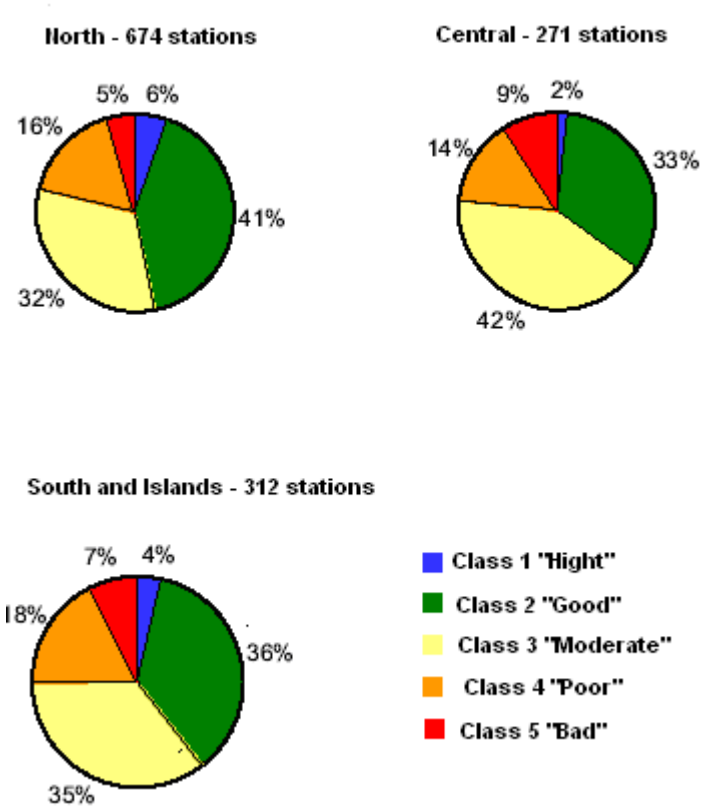
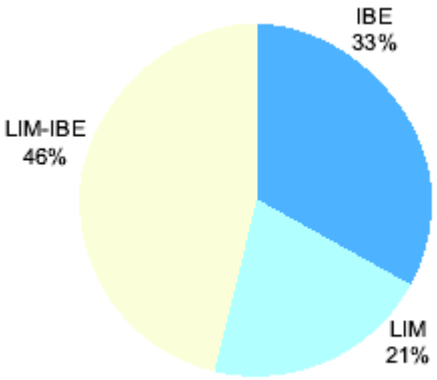


Figure 2.16: Percentage distribution of the SECA index quality classes by macro-region (2006)[6]

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

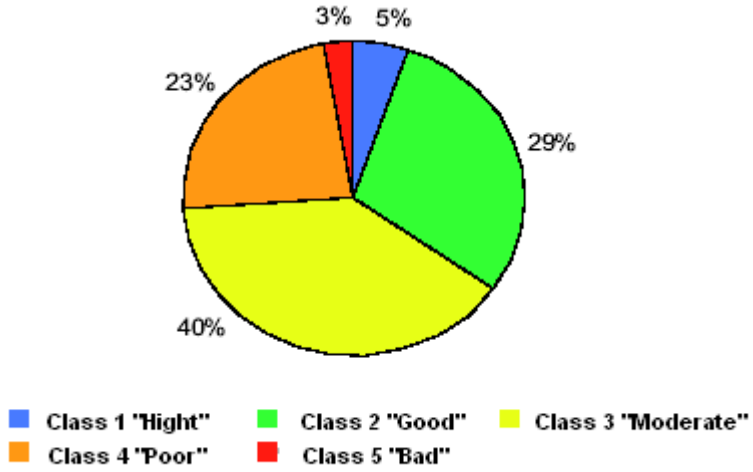


In 2006, as in previous years, the macrobenthic community played a greater role in determining the SECA than did the chemical-physical macro-descriptors.

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.

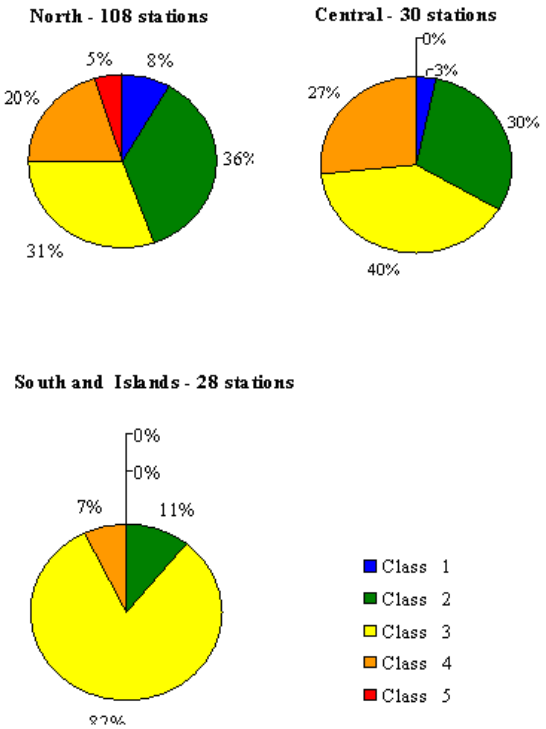


Figure 2.19: Percentage distribution of the SEL quality classes by macro-region (2006)[9]
Legend:
Class 1 = High; Class 2 = Good; Class 3 = Moderate; Class 4 = Poor; Class 5 = Bad

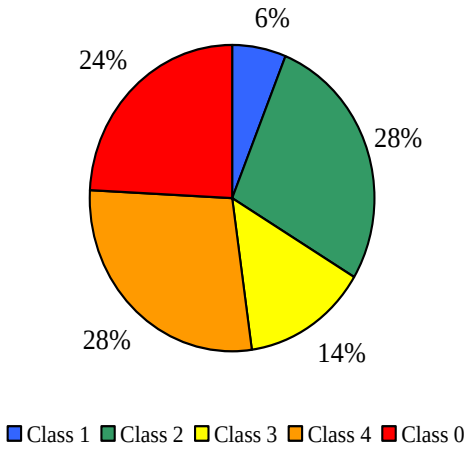
[9] Source: APAT analysis of ARPA/APPA data

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.



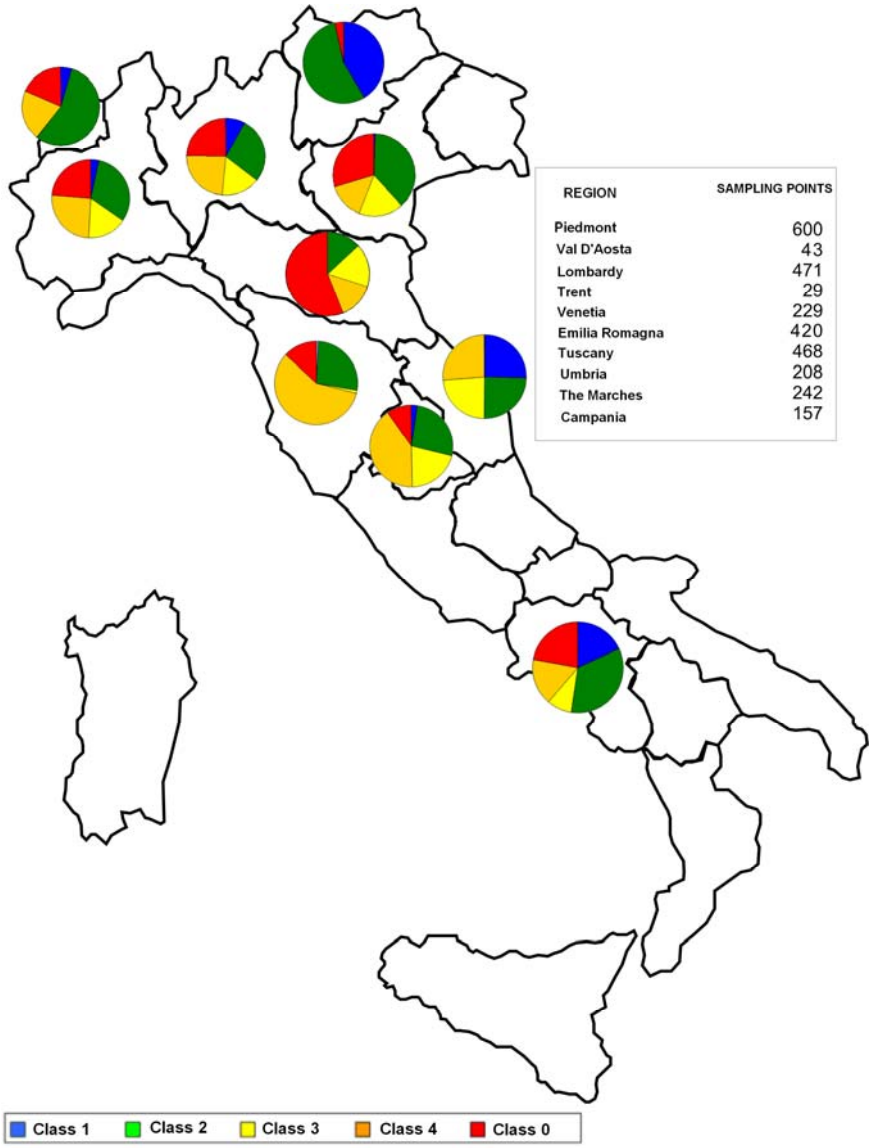
In 2006, at the national level, out of 2,863 sampling stations distributed in 10 regions, 48% present a chemical status ranked between classes 1 and 3, while a significant percentage (24%) is characterised by water of poor chemical quality, due to natural causes.

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.

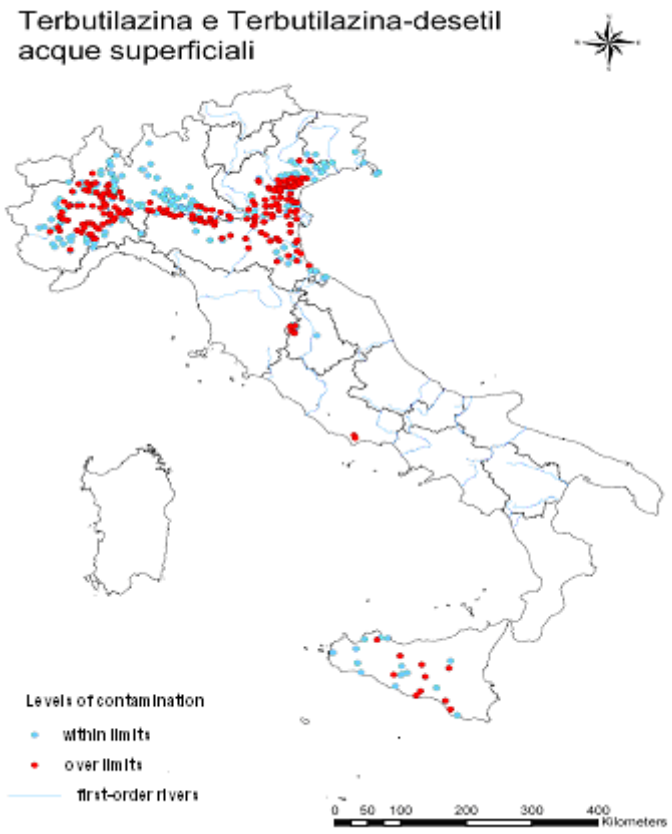
Plant care products placed on the market in 2005 showed an increase of 1.3% over 2004. During the period of 1997-2005, there was a 6.4% drop in distribution. To varying degrees, the decrease affected all the different categories, with the exception of "miscellaneous", which rose by 26.7%. There was also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

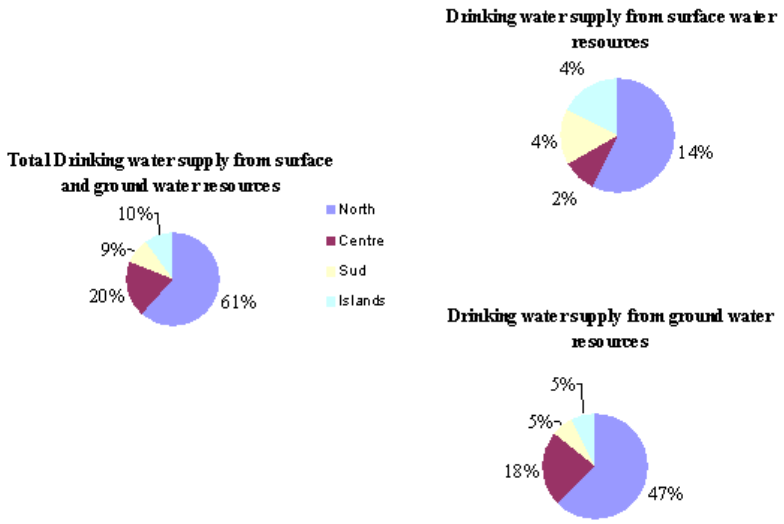
The primary civil use is the consumption of water for domestic purposes (water invoiced). Based on a survey carried out by the ISTAT and by the Environmental Observatory of Cities and Towns, in 111 municipalities that are provincial seats, with data aggregated on the municipal level, it was found that 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.)

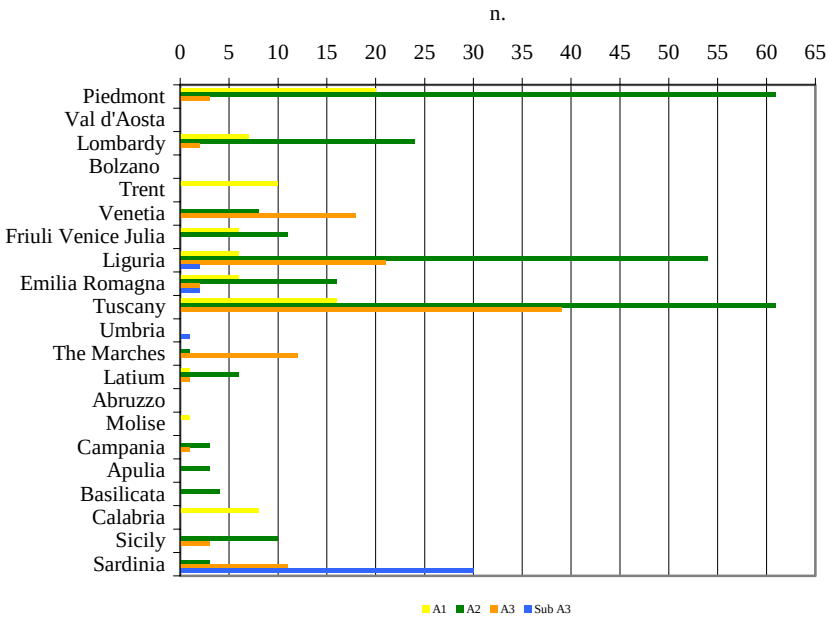
With the publication of Legislative Decree 152/06 (art. 121), the deadline for implementation of the defence plans by the regions was extended to December 31, 2007, and the deadline for approval to December 31, 2008.

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.

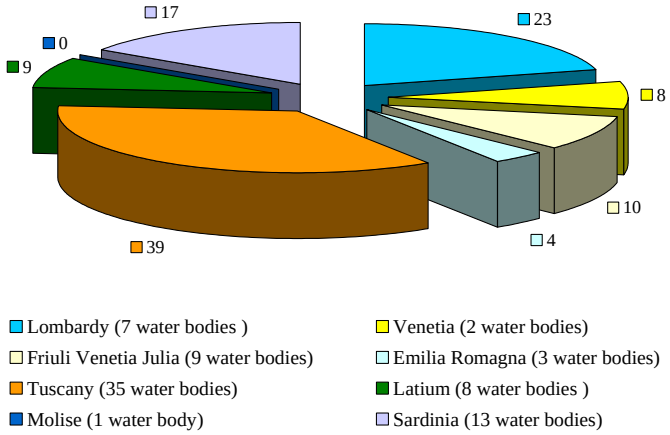


Figure 2.25: Actions programs presented and the number of water bodies requiring improvement[23]

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

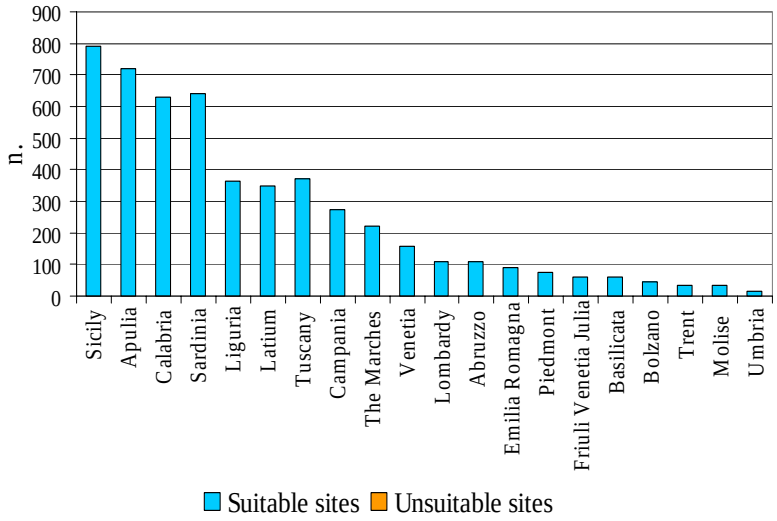


Figure 2.26: Sites unsuitable for swimming out of the total sites monitored[24]

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.

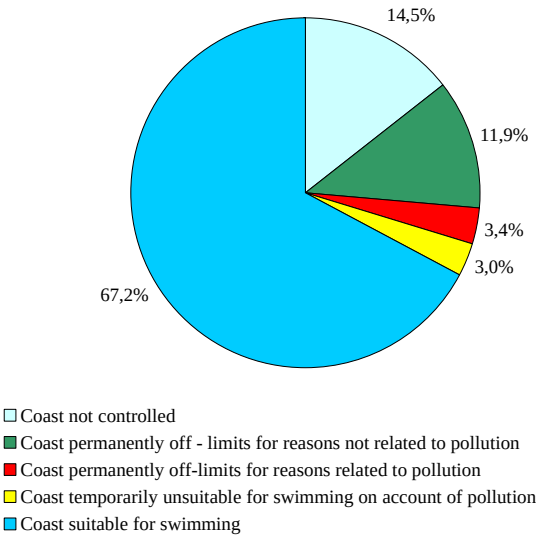
In 2005 the programs presented by the regional governments increased by 23%, and 219 sites were restored for swimming.

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.

Control of the coast.

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).

[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.

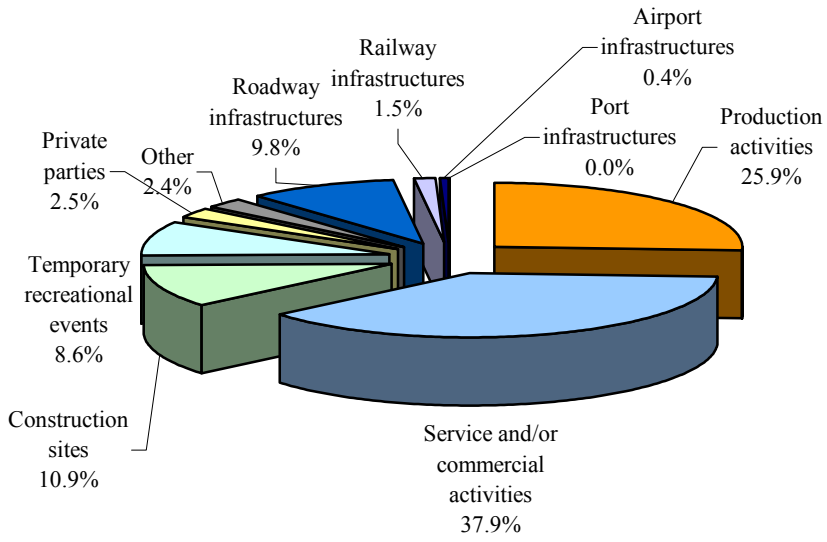
The data are collected from individual local settings, with evident limits due to discontinuity and the use of methodologies and acoustic parameters not yet in line with the European Directive on assessment and management of environmental noise, but suitable to describing existing conditions.

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.

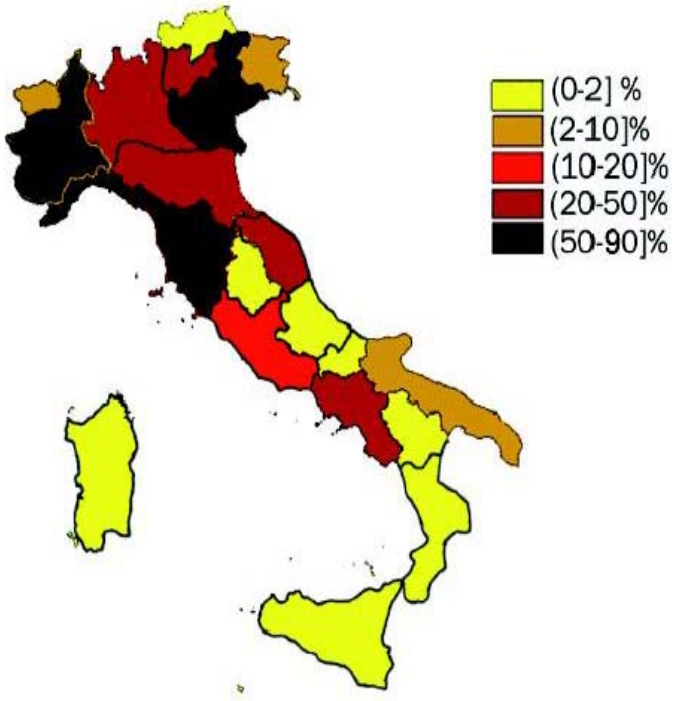
Initiatives have been undertaken to heighten the awareness of local government bodies, so as to favour activities of prevention.

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

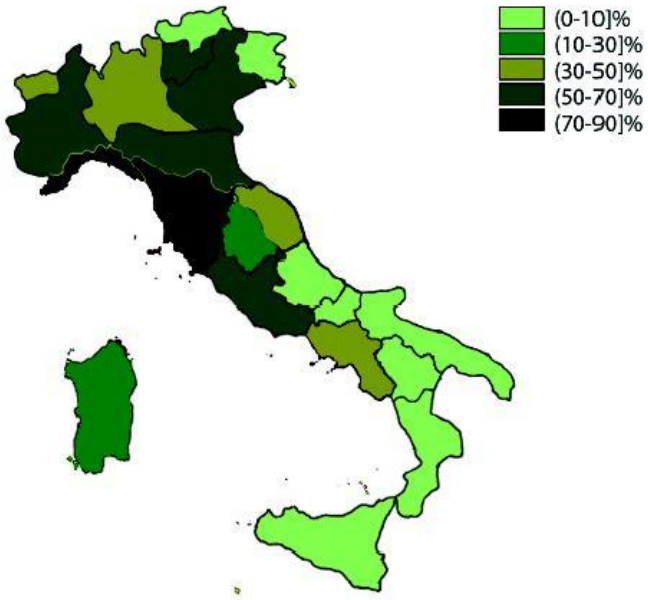
approved this classification, as of 2006, was equal to 31.5%, compared to the figure of 17.4% for 2003, while the percentage of the resident population in municipalities that have approved such zoning was 40.8%, compared to 31% in 2003. There were noteworthy differences between the situations in the 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%).

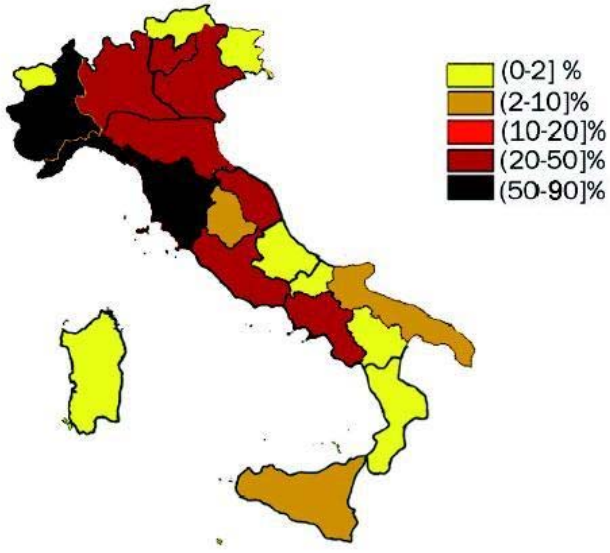
Figure 2.29: Percentage of municipalities that have approved acoustical classifications, out of the total number of municipalities for each region/autonomous province (2006)[2]

[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

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.

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

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.

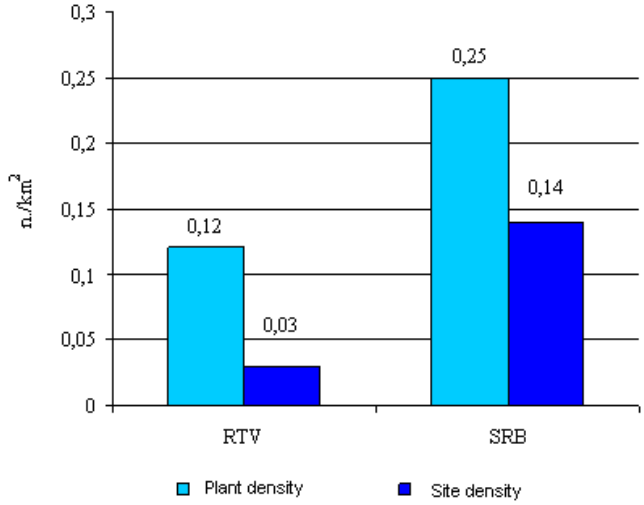
The main EMF sources

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).

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.

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

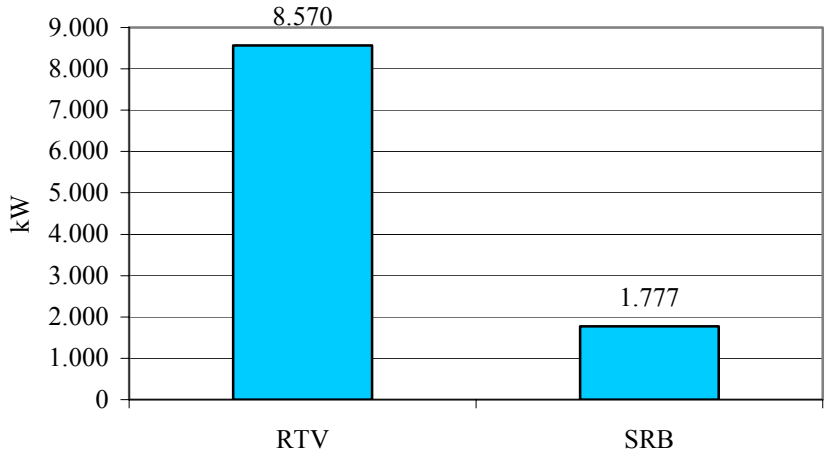
Analysis of the data on the density of RTV and RBS plants (Figure 2.32) shows that the density of the radio base stations is roughly double that of the radio-television systems (respectively 0.12 and 0.25 plants per km^2), while the density of the latter type of site (0.03 sites per km^2) is roughly 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.

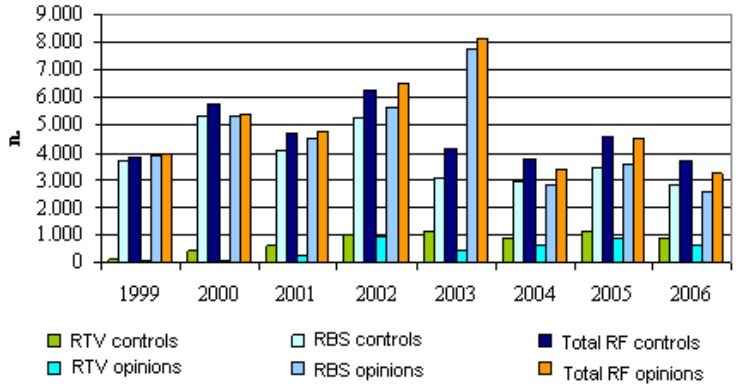
Figure 2.33: Total power, comparison between RTV and RBS for regions for which complete results are available (2006)[6]

[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).



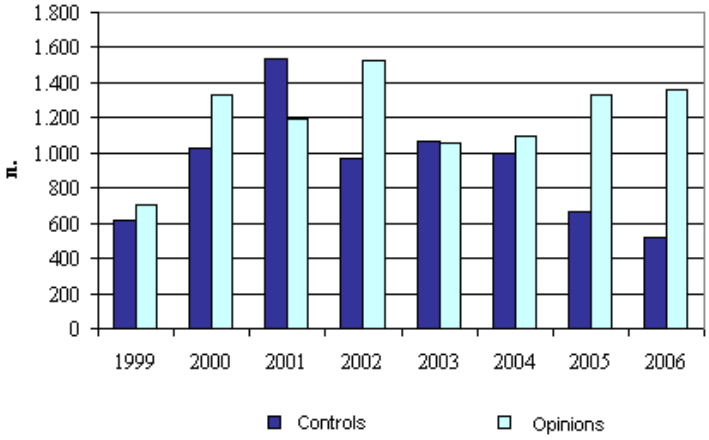
Between 2004 and 2006 there was a decrease in preliminary opinions for RBS (-8.9%), an increase in the number of opinions for RTV (+4.2%), a decrease in the number of controls for RBS (-2.8%) and a slight increase for RTV (+0.8%).

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.

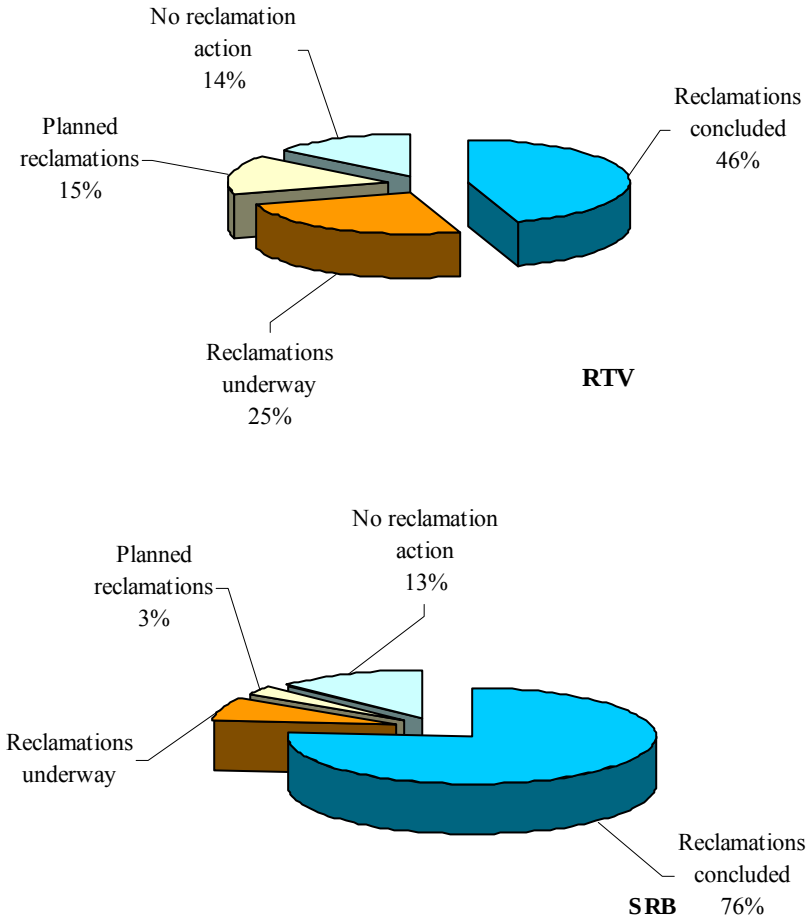
The current Italian legislative scenario has as its guideline the concept of "prudent avoidance", which underlines the importance of avoiding or reducing exposure to an external agent, to the greatest extent possible, should doubts arise as to its potential threat to human health. In fact, even in the 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.

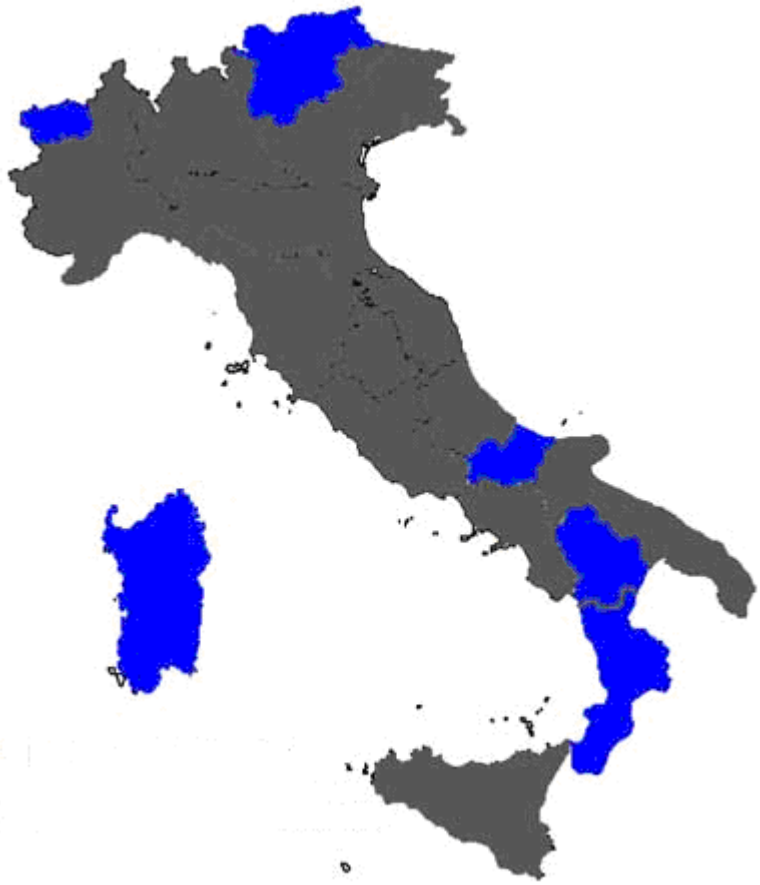
Light pollution is an alteration of the natural quantity of light present in the night-time environment, on account of the addition of artificial light. The night is not completely dark, on account of a number of sources of natural light, such as starlight, the light of the Sun spread by interplanetary 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.

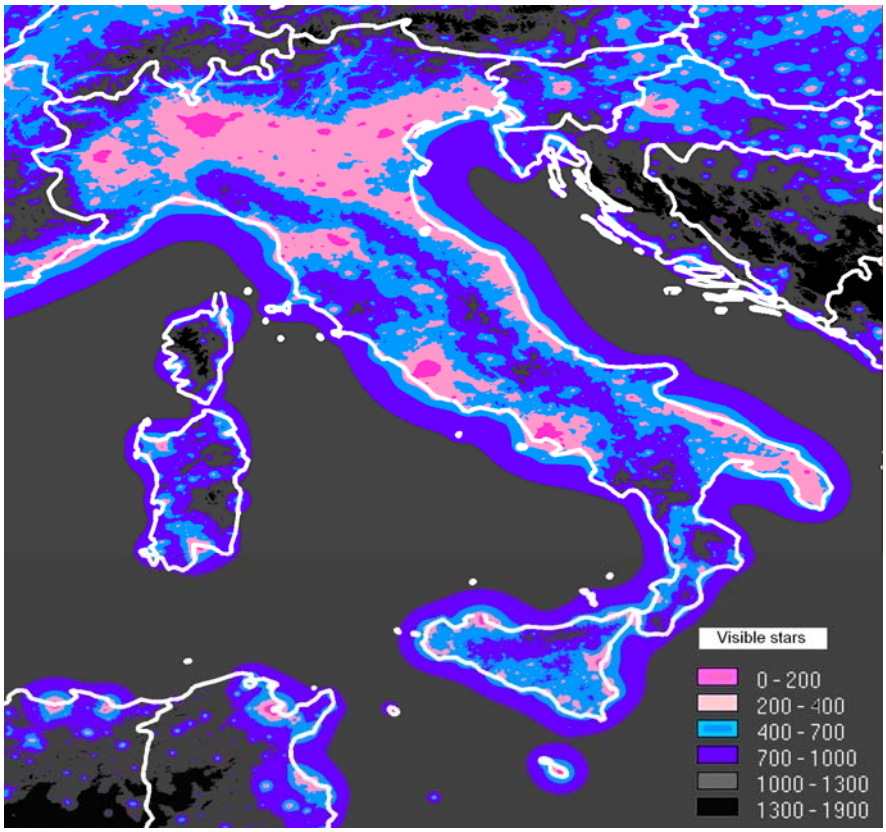


The regions highlighted in blue are those where the less luminous stars are still visible from more than 60% of the regional territory.

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.

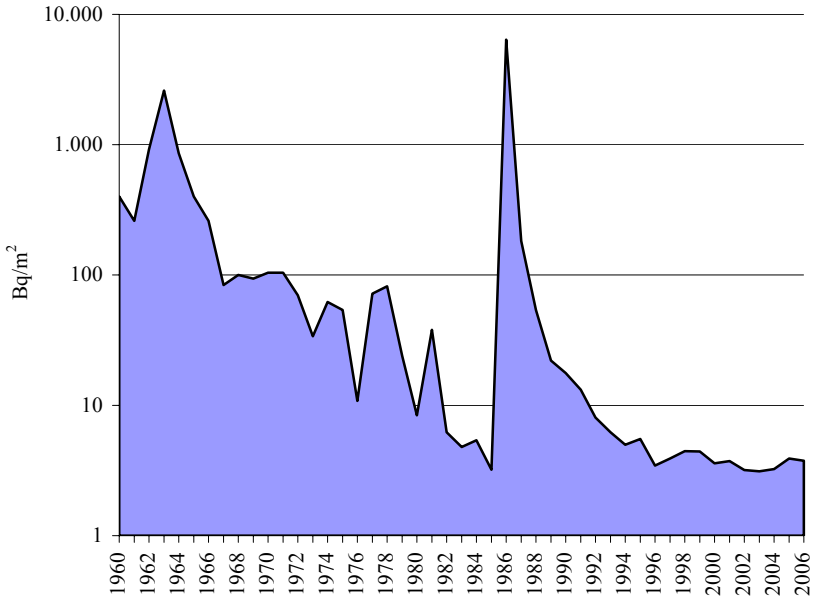
2.3.4 Ionising Radiation

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.

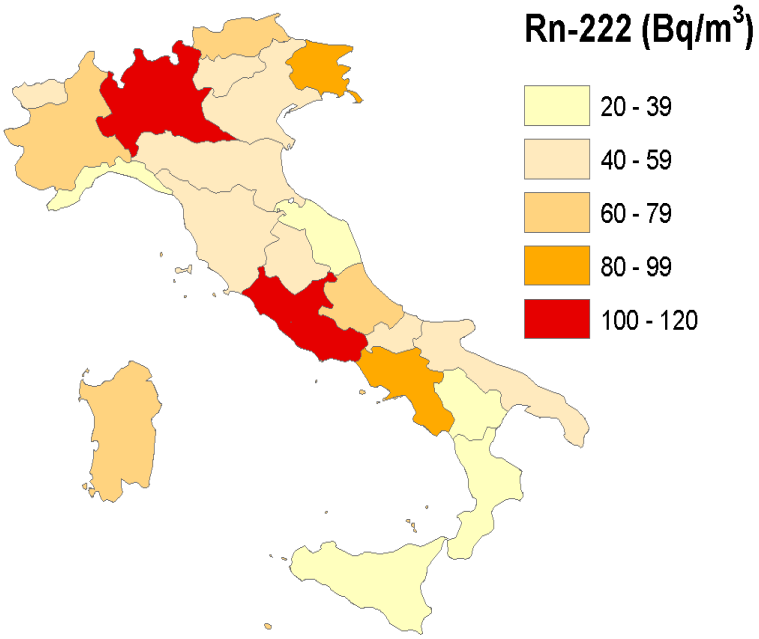


The graph shows the instances of fallout associated with the tests carried out in the atmosphere in the 50's – 60's, plus the peek tied to the accident at the Chernobyl plant in 1986, after which the contamination levels systematically decreased.

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.

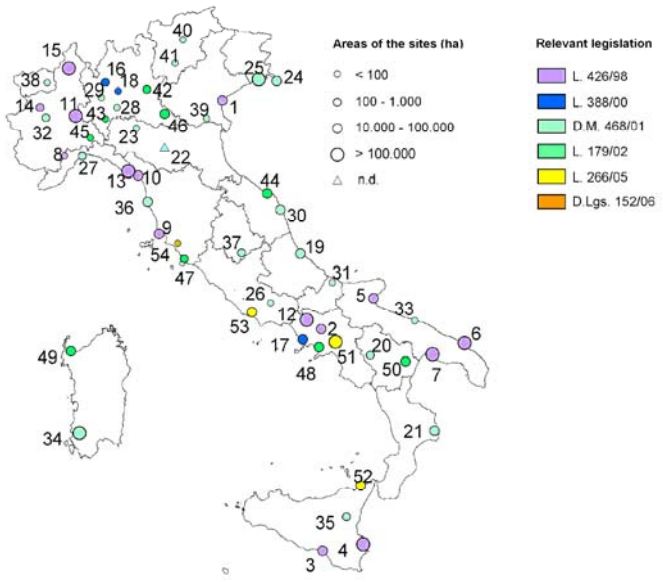
Impacts of soil contamination on surface and ground waters, on air and the food chain, may generate risks to human health.

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

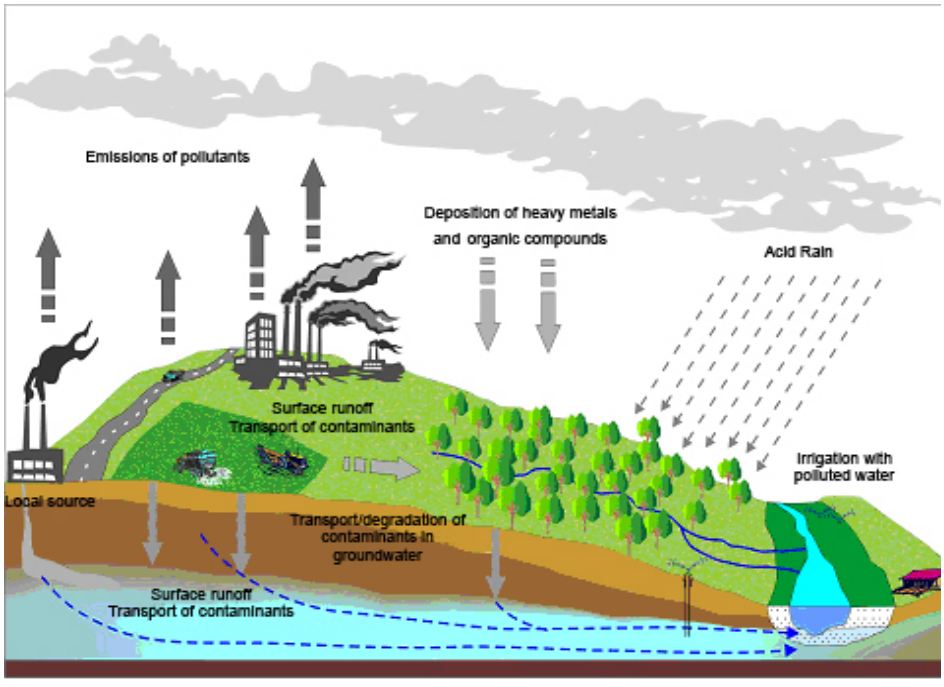
considered a relevant problem. In terms of pollution from nitrates, available data show a surplus of nitrogen and phosphorus in almost all Italian regions, with the highest levels in regions with large agricultural areas, and especially in certain districts of the Po Valley.

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

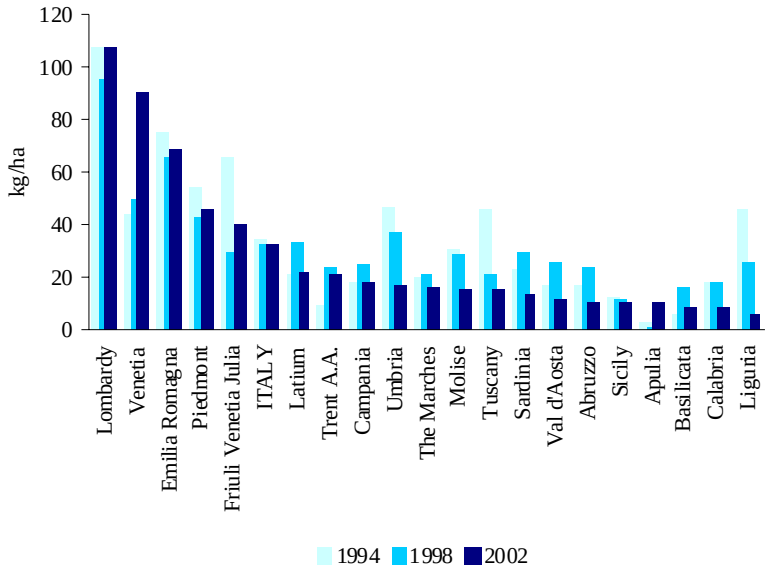
Industrial and urban activities release acidifying substances, heavy metals and

[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]

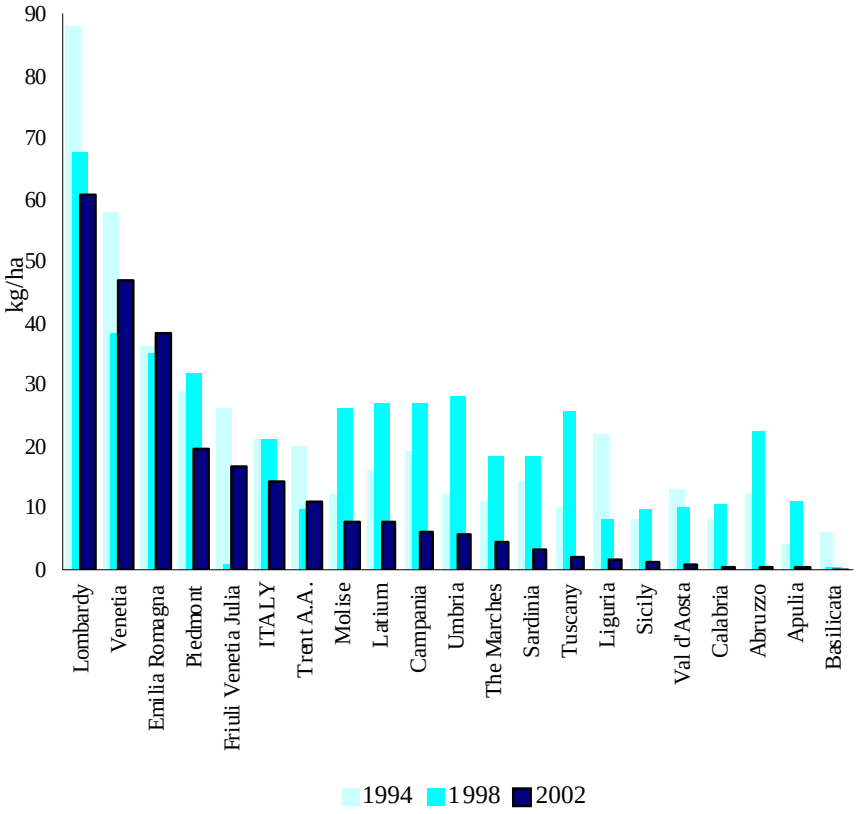
The analyses performed by APAT (2005) on a limited number of samples taken from a large portion of the Italian regions indicate an accumulation of Zn, Cu, Pb and Cd in the top 30 cm of soil, demonstrating the presence

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).

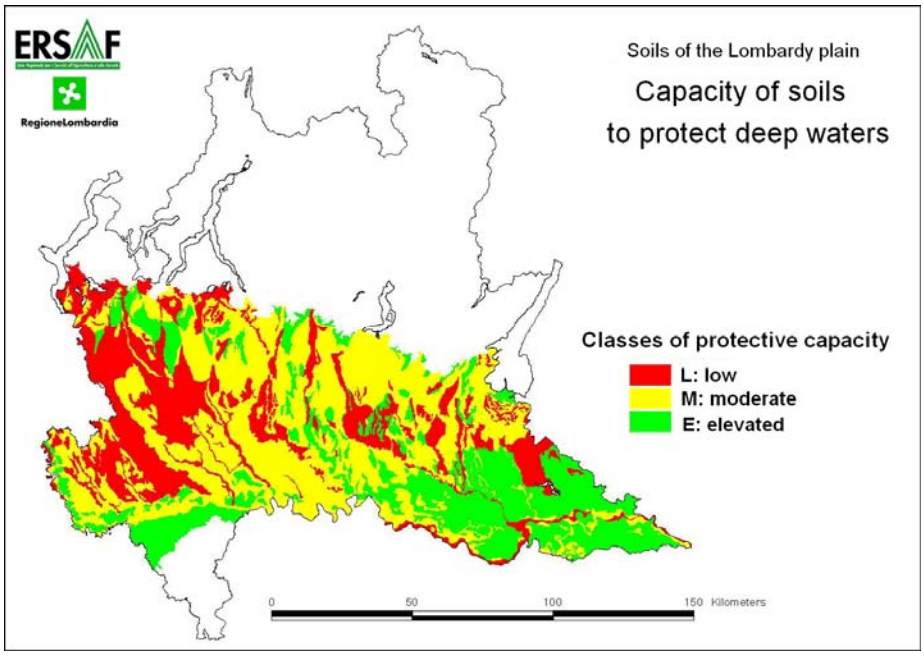


Figure 2.47: Map of the capacity of soils of the Lombardy plain to protect groundwater (2005)[5]

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.

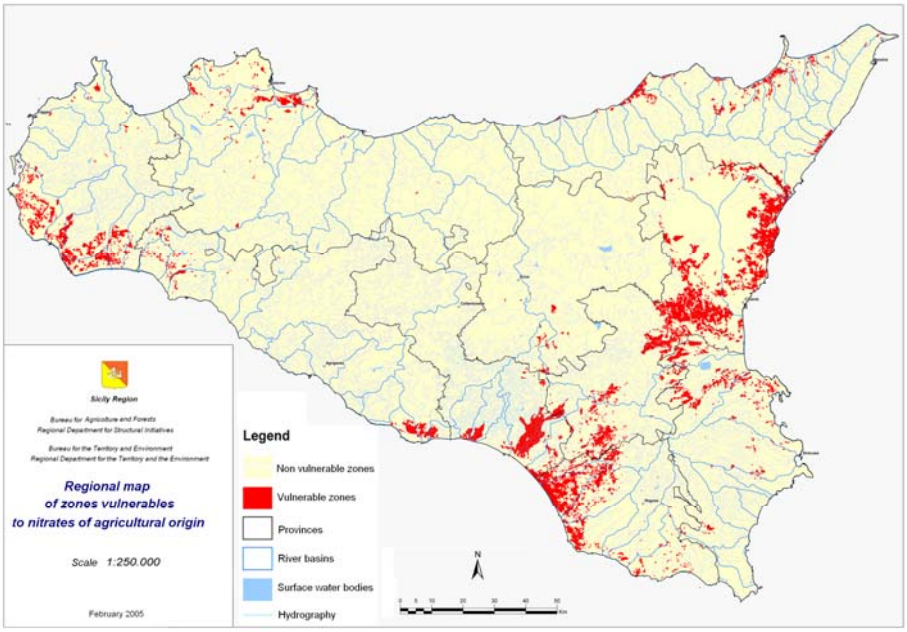


Figure 2.48: Regional map of zones vulnerable to nitrates of agricultural origin (2005)[6]

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.

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

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

[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.

3. BIODIVERSITY AND NATURAL, AGRICULTURAL AND FOREST AREAS

3.1 The state of natural and semi-natural environments in Italy

Italy is one of Europe's richest countries, in terms of biodiversity, essentially on account of its favourable geographic position, as well as its extensive geo-morphological, microclimatic and vegetative variety, plus the additional influence of factors of history and culture. Italy possesses fully one half of all the vegetal species currently found in European territory, together with a third of the animal species.

Italy is one of Europe's richest countries in terms of biodiversity, possessing half of the European vegetal species and a third of the animal species.

According to recent figures (*GIS Nature*, Ministry of the Environment, Land and Sea, 2005), the number of species of Italian fauna are estimated at more than 57,000, of which 1,265 belong to the *subphylum* of the Vertebrates, meaning Agnates (5), Fishes (568), Amphibians (37), Reptiles (55), Birds (473) and Mammals (127). Roughly 55,000 species are Invertebrates, the majority falling under the Insect class. Italy also holds third place among European countries in terms of the number of endemic Vertebrate species belonging to the classes of Amphibians, Reptiles, Birds and Mammals.

There are more than 57,000 animal species in Italy.
Italy ranks third in Europe in terms of the number of endemic vertebrate species.

According to the most recent publications[1], Italy's vascular flora includes 6,711 species, divided into 196 families and 1,267 genera, and with a contingent of endemic species that account for 15.6% of the total flora. The great number of flora are found in the regions with the most extensive environmental variations and the largest territories, such as Piedmont (3,304 species), Tuscany (3,249), Venetia (3,111), Friuli Venetia Julia (3,094), Latium (3,041) and Abruzzo (2,989). Looking at the flora species that are most rare, and found in small areas, the regions that possess the greatest number of endemic species and exclusive species, meaning those found in that region alone, are Sicily (322 endemic species and 344 exclusive ones) and Sardinia (256 endemic species and 277 exclusive ones).

There are more than 6,700 species of higher plants in Italy, and 15.6% of the flora consists of endemic species.

Italy also possesses an especially rich stock of forests, whose quantity, depending on the type of specifications adopted for the statistics, can be estimated at approximately 6,860,000 hectares (ISTAT, 2005) and 8,760,000 hectares (CFS-INFC, 2005), in addition to which there are 1,710,000 hectares of sparse or low forest formations, as well as bushes and shrubs (CFS-INFC, 2005). Taking the most restrictive approach, the national forest area index is equal to 22.8%, with the figure increasing in a gradual but constant manner, based on a trend tied to forestation activities and, in recent years, and to an even greater extent, to natural forest expansion in marginal farming areas in hilly and mountainous zones (Figure 3.1).

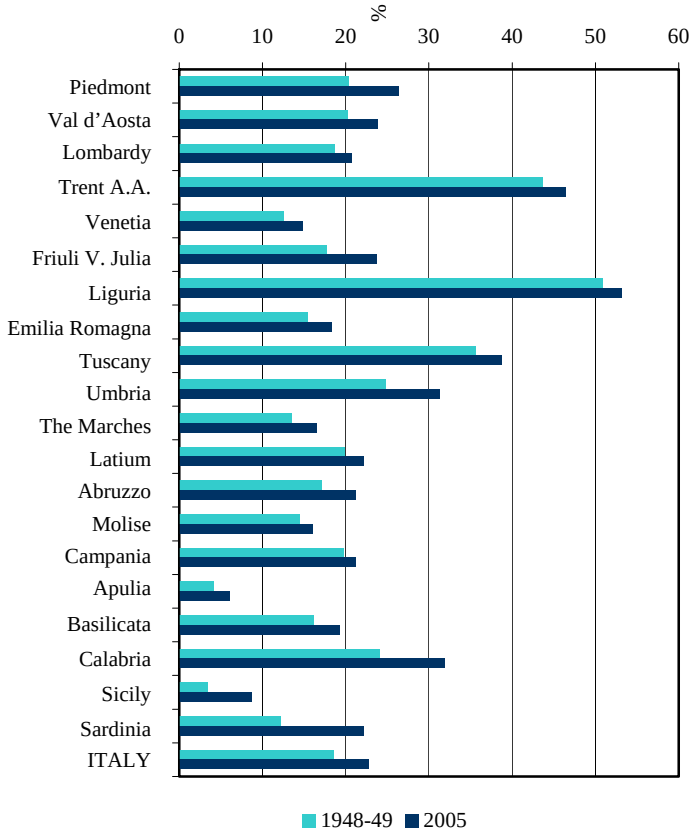
The national forestation index is 22,8%, and it is constantly growing.

A negative factor offsetting this expansion is the occurrence of forest fires, regarding which an especially critical period was recorded in the mid 80's, followed by years in which the level of such fires remained high, on the whole, though there was a gradual mitigation until 2006. Unfortunately, a new rise in the incidence of forest fires was recorded

In the first eight months of 2007, a resurgence of forest fires was recorded.

[1] *An annotated checklist of the Italian vascular flora*, Conti *et al*., 2005

during the first eight months of 2007, with 7,000 events affecting more than 110,000 hectares, of which approximately 54,000 hectares are part of the forest area in a strict sense (CFS, 2007).



Italy has an especially rich stock of forests, and its forest area index is constantly on the rise, thanks to activities of reforestation and the natural expansion of forests.
Running counter to this trend, however, are forest fires, which registered a resurgence in the first eight months of 2007, after having gradually declined through 2006.

Figure 3.1: Regional forest area index[2]

In addition to natural and semi-natural environments in the strict sense of the terms, Italy also possesses urban vegetation that constitutes an important component of its natural assets. Green areas within cities serve a variety of functions: in addition to improving appearances and setting the stage for recreational activities, they also mitigate pollution in the different environmental matrices (air, water, soil), in addition to improving the micro-climate and contributing to the preservation and enrichment of biodiversity. In 24 cities that are provincial seats, and that have populations of more than 150,000 inhabitants, the quantity of urban greenery showed a positive trend between 2000 and 2005, in terms of both percentage of municipal surface area and per capita availability (ISTAT, 2007). In the 24 cities in question, an average increase of 2.1% was observed in the percentage of greenery as a ratio of the municipal surface area, with especially high growth recorded in the cities of Turin, Naples and Cagliari. Per capita availability also rose, by an average of

In cities with more than 150,000 inhabitants, urban greenery increased by an average of 2.1% between 2000 and 2005.

[2] Source: APAT analysis of ISTAT data

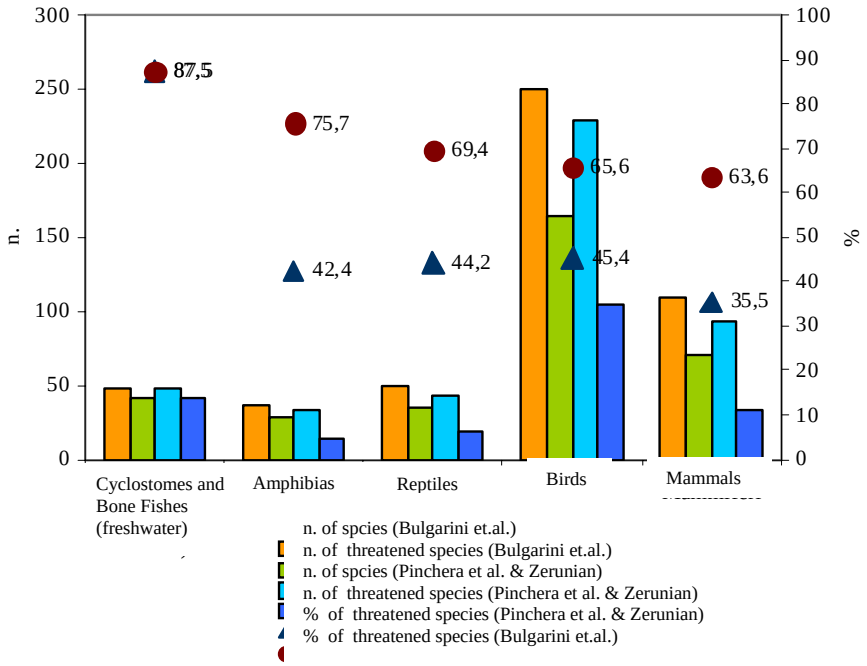
6.4 m^2/inhabitant, especially in the cities of Naples, Palermo and Cagliari.

The percentage of Vertebrate species at risk fluctuates, depending on which author is consulted, from 47.5% to 68.4%.

This wealth of biodiversity, however, is seriously threatened, with the risk of it being lost forever. The outlook in terms of threats to animal species within the national territory has been illustrated by a number of different authors in specific Red Lists, especially with regard to autochthonous Vertebrate species. In evaluating the different categories and levels of threats, the authors make reference to the IUCN categories[3]. An analysis shows that the percentage of Vertebrate species at risk fluctuates, depending on which author is consulted, from 47.5 % to 68.4%[4] (Figure 3.2). In the specific cases of Cyclostomes and Fishes in inland waters, more than 40% of the threatened species were found to be in an especially critical condition (the IUCN categories of CR – *critically endangered* and EN – *endangered*), while, with regard to Birds and Mammals, respective percentages of 23% and 15% of the threatened species were in serious danger of extinction. A further analysis, carried out on endemic and sub-endemic species, confirmed the overview just formulated. A third of the threatened Fishes species, and a sixth of the Reptiles species at risk, are endemic. But the most critical situation is that of the Amphibians, which show the highest percentage of all for endemic species in danger, at more than 66%. As of today, for obvious reasons, there exists no similar evaluation for the levels of threat faced by Invertebrates. Nevertheless, considering the elevated number of species, plus the fact that the percentage of endemic species is higher than in the case of Vertebrates, being equal to more than 10% of the total, as well as the elevated niche specialisation and the limited areas of distribution of many species, it can reasonably be assumed that, when faced with the same conditions as the Vertebrates, in terms of threats, the level of danger for the Invertebrates, and thus the threat of extinction, will prove decidedly higher.

[3] *The World Conservation Union*, 1994

[4] *Libro rosso degli Animali d'Italia*, Bulgarini *et al*., 1998; *Application to the terrestrial Vertebrates of Italy of a system proposed by IUCN for a new classification of national Red List categories*, Pinchera *et al*., 1997; *Condannati all'estinzione? Biodiversità, biologia, minacce e strategie di conservazione dei Pesci d'acqua dolce indigeni in Italia*, Zerunian, 2002



The percentage of Vertebrate species at risk fluctuates, depending on the author consulted, from 47.5 % to 68.4%. The situation is especially critical for freshwater Fishes, Amphibians and Reptiles.

Figure 3.2: Vertebrate species found in Italy and placed on Red Lists[5]

15% of the higher plants are at risk and 40% of the lower plants.

The statistics on the threat faced by vegetal species in Italy are also taken from Red Lists published by specialists. In 1992 the number held to be in risk of extinction was 458[6], a figure that rose to 1,011 in 1997, with publication of the Regional Red Lists on Plants in Italy[7], to which the IUCN categories of threat (version 2.3) were applied. This list was subsequently reviewed and combined with the Atlas of Species at Risk of Extinction[8], resulting in the identification of 1,020 specie, whose precise distribution is also indicated. At present, therefore, 15.2% of Italy's vascular flora are threatened with extinction, a situation that proves even more acute for lower plants, approximately 40% of which, out of all the known species, were found to be in danger (Figure 3.3).

[5] Source: APAT analysis of data taken from:
Zerunian S., 2002, *Condannati all'estinzione? Biodiversità, biologia, minacce e strategie di conservazione dei Pesci d'acqua dolce indigeni in Italia*; Bulgarini F.,Calvario E., Fraticelli F., Petretti F., Sarrocco S., (Editors), 1998, *Libro rosso degli Animali d'Italia*; Pinchera F., L. Boitani & F. Corsi, 1997, *Application to the terrestrial Vertebrates of Italy of a system proposed by IUCN for a new classification of national Red List categories.* Biodiversity and Conservation 6, 959-978
[6] *Libro Rosso delle Piante d'Italia*, Conti *et al.*, 1992
[7] Conti *et al.*, 1997
[8] Scoppola and Spampinato, 2005

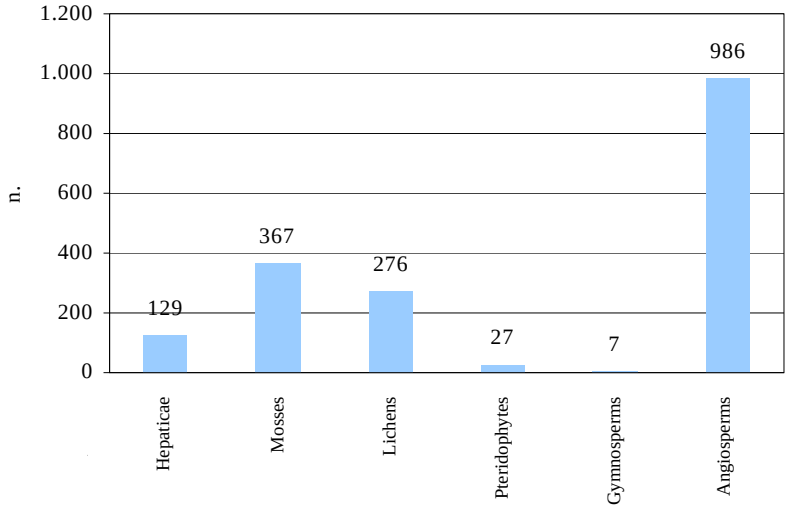


Figure 3.3: Threatened vegetal species in Italy, distributed by system groups (2005)[9]

15% of the vascular flora in Italy are threatened with extinction, while the situation is even more critical for the lower plants, with approximately 40% of all known species found to be in danger.
In detail, the Italian vegetal units at risk include 772 species of Hepaticae, Mosses and Lichens, plus 1,020 vascular plants.

It should be noted that current knowledge of Italian vegetal units at risk is far from complete, both because the species need to be examined anew using the most recent IUCN criteria and because the lists could be supplemented and revised following the resolution of taxonomic problems that remain suspended, the control of reports from stations requiring corroboration and surveys carried out on territories for which information is lacking.

Based on the Habitat Directive, over 50% of the European habitats to be protected are found in Italy.

Closely connected with the state of preservation of the different species is the state of preservation of habitats. As we shall see further on, in applying the "Habitat Directory" (92/43/EEC), which constitutes one of the most important regulatory instruments for preserving habitats and biodiversity, Italy plays a role of noteworthy importance. In fact, the country's geographic characteristics place it within three different bio-geographic zones (Alpine, Continental and Mediterranean), while, according to the Directive, 50% of the habitats to be protected are found in Italy. Of these, 33 habitats - 15 of them given top priority - are found only in Italy within their bio-geographic region of reference[10]. As a rule, the habitats at risk in Italy are uniformly distributed throughout the national territory, with this being true for the quantities of the different types of habitats as well[11]. Worthy of separate mention are the marine habitats protected under the Directive: though 8 out of the 9 habitats indicated are found in Italy, the only marine habitat, in the strict sense of the term, is that of the Prairie of Posidonia, regarding which, for that matter, the European Commission holds that the 2000 Nature Network is

[9] Sources: Conti, Manzi, Pedrotti, 1992 - *Libro Rosso delle Piante d'Italia*. Ministry of the Environment, WWF Italy. Conti, Manzi, Pedrotti, 1997 - *Liste Rosse Regionali delle Piante d'Italia*. WWF Italy, Italian Botanical Society, University of Camerino. Scoppola, Spampinato, 2005 - *Atlante delle specie a rischio di estinzione (CD-ROM).* Ministry of the Environment, D.P.N., Italian Botanical Society, University of the Tuscia, the La Sapienza University

[10] *Reference list of habitat type, EU Commission and EEA*, 2001

[11] *Libro rosso degli Habitat d'Italia*, WWF, 2005

not complete, meaning that the regulatory instrument for evaluating and preserving the biodiversity of this environment is rendered insufficient.

Almost 44% of the national territory is devoted to agricultural activity, and approximately 21% of the UAA (Utilised Agricultural Area) presents characteristics of noteworthy naturalistic value.

In addition to natural environments, agricultural areas also play an important role. In addition to supporting the production of food and fibres, they are closely tied to the environment, giving rise to extremely complex relations, at times in contradiction the one with the other. In demonstration of the importance of agriculture with regard to natural resources, it should be remembered that almost 44% of the national territory is earmarked for agriculture (ISTAT, 2003), and that a portion of this area, the equivalent of approximately 21% of the UAA (Utilised Agricultural Area) (EEA, 2004), presents characteristics of noteworthy naturalistic value, in terms of genetic and species biodiversity, as well as that of the landscape, serving as zones of connection with natural spaces. Italy, together with Spain, Greece, northern Great Britain and Scandinavia, preserves an elevated percentage of agricultural areas of significant natural worth, such as Alpine meadows and pastures.

Between 1990 and 2005 the UAA fell by 2.3 million hectares, a decrease that frequently corresponded to the operational abandonment of agricultural soil, following which processes of vegetative renewal were possible, though also processes of soil deterioration.

Over the last ten years, running parallel to the stagnation in demographic growth and in the demand for agricultural products, as well as to the exodus from rural areas and the rise in productivity per unit of surface area, Italy has registered a noteworthy decrease in the number of farming enterprises and in the UAA. This last measure fell by 2.3 million hectares between 1990 and 2005, meaning a loss of more than 15% (ISTAT). It is important to note, however, that this decrease has been accompanied by a gradual rise in the UAA of the average enterprise, which went from 6.1 hectares in 2000 to a figure of 7.4 hectares in 2005, making for an increase of 21.2%. The reduction in the overall UAA frequently corresponds to an operational abandonment of farmlands, which can then undergo processes of renewed colonisation on the part of tree, bush and herbal vegetation (re-vegetation), though they can also be subject to processes of soil deterioration, erosion and desertification. The process of vegetative renewal can be sharply limited by a loss of natural qualities caused by agricultural activities, with the extent of the loss depending of the characteristics of the agricultural activities and their duration. The fertility of the soil in abandoned farmland always proves to be impoverished, while the composition of the original seed bank of the soil is totally compromised. These factors, together with the situations of deterioration and fragmentation typical of the agricultural areas of industrialised countries, block or slow the natural dynamics of vegetative succession.

3.2 The main causes of threats to biodiversity in Italy

The primary threats to biodiversity are human activities and the growing

The main threats to the natural heritage are tied to the impact of human activities and to the growing demand for natural resources and ecosystem services. In Western and Central Europe, and throughout the

Mediterranean basin, the presence of man from ancient times has led to alterations in the natural ecosystems and habitats, which today, in the majority of cases, appear fragmented and subject to various types of disturbances. Five main causes for the loss of biodiversity are particularly worthy of note[12]: fragmentation, deterioration and destruction of habitats, the introduction of exotic species and the excessive exploitation of resources and species. This last factor is traceable, first and foremost, to a lack of adequate regulation for governing, according to ecological criteria, the procurement of supplies of resources, plus, as a secondary consideration, the collection and sale of wild species. These threats lead to a reduction in biodiversity, as a result of the deterioration and impoverishment of ecosystems, together with the local extinction of many species, primarily the most sensitive, the endemic species, the rare ones and those that prove most vulnerable. At times there is a turnover involving different types of species, with the often irreversible disappearance of many species typical of a natural habitat being accompanied by the entry of species that are exotic, competitive, generalist, ruderal or connected to human phenomena.

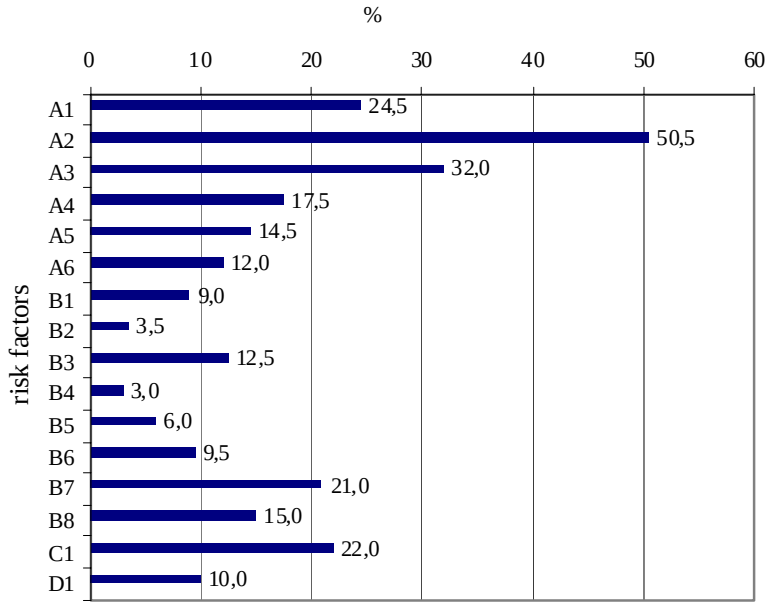
demand for natural resources and ecosystem services.

With respect to Vertebrate animal species, Figure 3.4 shows the overall outlook for the various factors of risk and their relative incidence on the state of preservation, determined on the basis of the Red Lists published to date on the different categories of threats by the IUCN. Generally speaking, the analysis shows that the most frequent threat (50.5% of the species at risk) of all the indirect influences of human origin consists of the transformation and modification of natural habitats (A2), while poaching and illegal fishing (B7) constitute the predominant threat among direct influences of human origin.[13]

The transformation and modification of natural habitats constitutes a threat for 50.5% of the Vertebrate animal species.

[12] *Conservazione della natura*, Primack and Carotenuto, 2007

[13] *Libro rosso degli Animali d'Italia*, Bulgarini *et al*., 1998; *Application to the terrestrial Vertebrates of Italy of a system proposed by IUCN for a new classification of national Red List categories*, Pinchera *et al*., 1997; *Condannati all'estinzione? Biodiversità, biologia, minacce e strategie di conservazione dei Pesci d'acqua dolce indigeni in Italia*, Zerunian, 2002



Legend:

Indirect influences of human origin:
A1 Reclamation of wetlands
A2 Modifications and transformations of habitats (construction, buildings, roads, ports, lining of riverbanks with concrete, variations in climate tied to influences of human origin, barriers blocking water ways, intakes of water supplies, modifications of flow)
A3 Use of pesticides and water pollution
A4 Fires and cutting of forests
A5 Changes in farming, livestock and fishing activities
A6 Leisure time activities (tourism, bathing, excursions, nautical sports, sport fishing, photographic hunting, mountaineering or free climbing)

Direct influences of human origin:
B1 Hunting
B2 Suppression of pests
B3 Harvesting of eggs, chicks, larva and adults for the purpose of sale or collecting
B4 Vandalism
B5 Genetic pollution
B6 Excessive fishing
B7 Poaching and illegal fishing
B8 Competition of predatory behaviour on the part of outside species and/or populations
C1 Natural causes
D1 Unknown causes
The figure refers only to threatened species for which confirmed chorological information is available.

Figure 3.4: Incidence of the risk factors for Vertebrates out of the total species threatened[14]

In Italy the primary threats to biodiversity are human activities and the growing demand for natural resources.
Of all the indirect influences of human origin, the most frequent types of threats (50.5% of the species at risk) involve the transformation or modification of natural habitats (A2), while poaching and illegal fishing (B7) constitute the primary type of threat among the direct influences of human origin.

Moving on to a more detailed analysis of the causes of impact, mention can be made of those tied to hunting, an activity that, it should be noted, can be practiced in more than 83% of the national territory (ISTAT, 2005 and the Ministry of the Environment, Land and Sea, 2003). Pressure from hunting is not uniformly distributed throughout the country: in certain regions, such as Liguria, Tuscany and Umbria, the level is definitely higher than in others. The greatest levels of pressure are to be found both in large-size regions (Tuscany, Lombardy,

Worth mentioning among the causes of impact are those tied to hunting, which can be practiced in more than 83% of the national territory, though hunting

[14] Sources: APAT analysis of data taken from: Zerunian S., 2002, *Condannati all'estinzione? Biodiversità, biologia, minacce e strategie di conservazione dei Pesci d'acqua dolce indigeni in Italia*; Bulgarini F.,Calvario E., Fraticelli F., Petretti F., Sarrocco S., (Editors), 1998, *Libro rosso degli Animali d'Italia*. Pinchera F., L. Boitani & F. Corsi, 1997, *Application to the terrestrial vertebrates of Italy of a system proposed by IUCN for a new classification of national Red List categories*. Biodiversity and Conservation 6, 959-978

Campania) and in those of limited extension (Liguria, Umbria and the Marches). Assuming that the number of hunters constitutes the primary factor of hunting pressure within a given territory, a decrease in this pressure was observed between 2000 and 2005, due to a drop of 1.2 percent in the number of hunters on the national level. This result was the final outcome of varying trends in different regions of Italy, with the region of Trent Alto Adige seeing the number of its hunters more than double, and the Calabria region registering an increase of 28.7% in the number of hunters in its territory, while other regions experienced decreases, such as the 22.1 percent drop in Umbria.

pressure differs from one region to the next.

As shown by Figure 3.4, one threat connected with hunting, though it occurs through different modes and has different impacts, is poaching, meaning the voluntary or accidental killing of a species not authorised to be hunted under Law no. 157 of 1992. The connection of poaching to hunting is documented beyond any reasonable doubt by the peak in statistics for animals treated at wildlife recovery centres during the hunting season. What is more, poaching activities intensify during the migratory season, especially in Springtime, in valleys and coastal area and on the smaller islands.

As far as fishing is concerned, it has a major impact on the marine environment. Italy accounts for approximately 5% of the total European catch, though, together with the other countries of the Union, it takes part in the efforts to limit the impact of fishing pursued for some time now by the EU and forcefully confirmed in the new Common Fisheries Policy (CFP), which went into effect on 1 January 2003. During the period 2000-2006, the Italian fishing sector was indeed characterised by a noteworthy scaling down of the fishing fleet, with fishing capacity reduced in terms of both overall engine power and tonnage (Ministry of Agricultural, Food and Forestry Policies-IREPA, 2006), a development accompanied by a general modernisation of the sector (Fishing Operating Program, Ministry of Agricultural, Food and Forestry Policies, 2007). As a rule, the Italian fishing fleet consists of modest and medium-size vessels, with non-industrial-scale fishing in many regions accounting for 80% of the entire fleet (Ministry of Agricultural, Food and Forestry Policies -IREPA, 2006). Naturally, the stations differ throughout the national territory, with the greatest number of vessels registered in the year 2006 found in Sicily (3,330), followed by Apulia, Sardinia and Campania (1,200-1,800). Campania, Latium and Apulia, on the other hand, are the regions whose average number of fishing days is higher than the national average. The most frequently used fishing systems are trawling and small-scale coastal fishing, confirming the general tendency of the Mediterranean to favour non-industrial modes of fishing. In the case of small-scale coastal fishing, it is common for different systems to be used in different periods of the year. Despite the generally small size of the vessels and the limitation of fishing efforts achieved in Italy in recent years, the fact that 99% of the vessels (84% of the overall tonnage and more than 92% of the engine power) operate in the coastal zone subjects that area, where a large portion of the resources of the entire marine system is located, to the greatest pressure.

Fishing is an important factor of impact in marine environments. Italy accounts for approximately 5% of the total European catch, but, as do the other countries of the Union, it takes part in efforts pursued by the EU for some time now to limit fishing.

The procurement of supplies of wood and non-wood materials (cork, pine seeds with shells, strawberries, raspberries, blackberries, chestnuts, mushrooms and acorns) constitutes a factor of pressure specific to forest ecosystems. It should be noted, however, that the expansion of forest area mentioned earlier has corresponded, in recent years, to a reduction in the rate of procurement (the ratio between the supplies of wood materials taken and the forest area), with the trend reversing between the year 2000 (when a level of 1.7 m^3/ha was reached) and 2005 (when the amount of supplies procured was 1.2 m^3/ha). This reduction was especially pronounced for roundwood (-40% compared to 2000 - ISTAT, 2006) and, though to a lesser extent, for wood used as fuel, which still accounts for more than 60% of overall wood production. Another noteworthy factor is the decrease of the average surface area of forest cuttings. In 2005, non-wood forest products showed a decrease compared to 2000 (ISTAT, 2006), probably on account of processes of urbanisation and the loss of local traditions. As a rule, these trends can be interpreted as a lessening of pressure on forest ecosystems, though consideration should also be given to the fact that a renewal of production activities, if properly managed, can end the state of abandonment of forests and improve the manner in which they are managed, with positive fallout in terms of conservation as well.

There has been a reduction in recent years in the rate of procurement of wood supplies, which registered 1.2 m^3/ha in 2005, while, at the same time, the average surface area of cuttings decreased.

The introduction of potentially invasive alien species constitutes another threat to biodiversity. The presence of exotic species in nature can essentially be traced to three modes of introduction: intentional or voluntary (through raising, cultivation, as a hobby etc.), secondary (*taxa* originally introduced in areas outside Italy's borders, only to enter our country, at a later point in time, on their own) and accidental (through the transport of cargo, the bilge water in ships, fouling etc.).

The introduction of potentially invasive alien species constitutes another threat to biodiversity.

Based on the data currently available on terrestrial fauna, and especially Nematodes, Gastropod Molluscs, Arthropods and Vertebrates, it is estimated that there are currently 450 alien or non-indigenous species present in Italy, having been introduced intentionally or accidentally, with the majority belonging to the Insect classes. Of the phytophage Insects of interest to agrarian and forestry activities, at least 115 species have been introduced through trade, and roughly 80% have become acclimated. There are fewer alien terrestrial species among the Vertebrates (36 species), but they have an equally significant impact on the autochthonous biocenosis, often with noteworthy economic consequences as well, as in the case of the nutria. In inland Italian waters, at least 29 species of fish have been introduced, with no fewer than 12 becoming acclimated[15]. As far as the marine environment is concerned, at least 79 alien species of Invertebrates and 18 alien species of Fishes have been reported in Italian territorial waters, favoured in

As regards terrestrial fauna, it has been estimated that there are at least 450 alien or non-indigenous species in Italy, introduced intentionally or accidentally, with the largest portion belonging to the Insect classes.

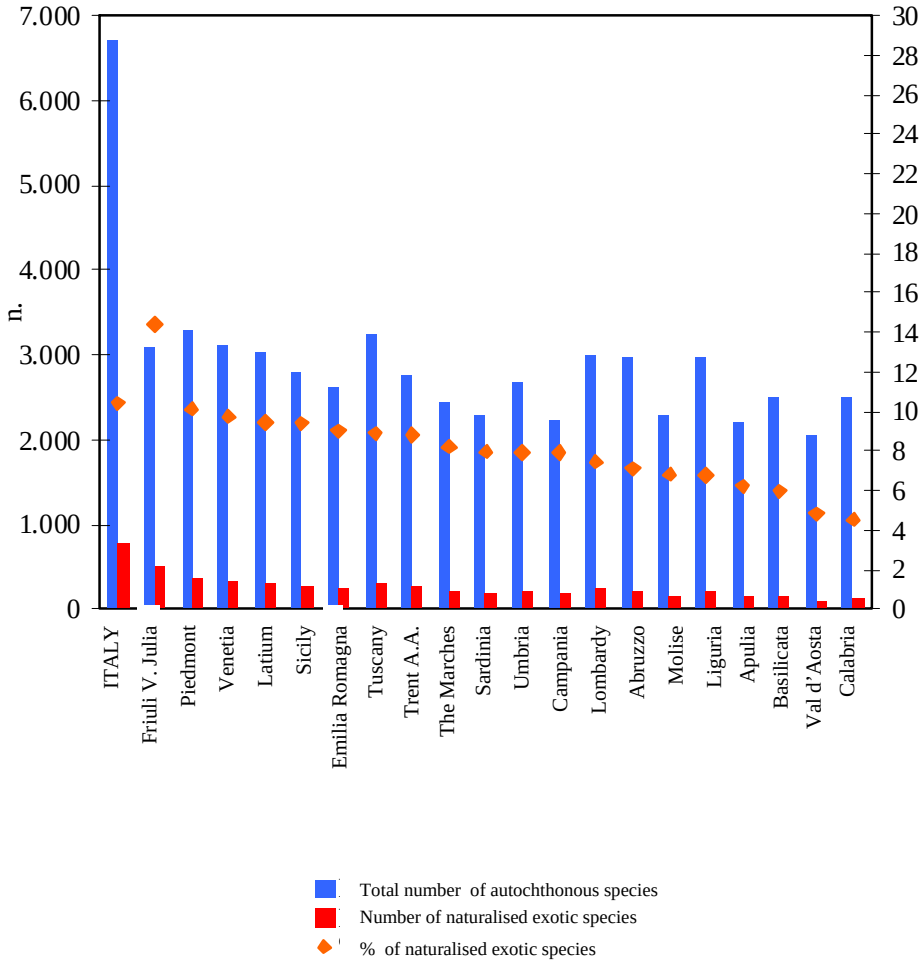
[15] *Condannati all'estinzione? Biodiversità, biologia, minacce e strategie di conservazione dei Pesci d'acqua dolce indigeni in Italia*, Zerunian, 2002

part by climate changes which, with the warming of the waters, can facilitate the naturalisation of outside Fish species with an elevated affinity for the warm waters of the Mediterranean Basin. At least 20 species of Molluscs living along Italian coasts are external, with some being cultivated in lagoon environments on account of their excellent commercial value (*Tapes philippinarum*).

As far as flora are concerned, the increasingly massive entry of exotic vegetal species from distant countries, often due to human activities, is causing "floral pollution". A recent census in Italy recorded 782 naturalised exotic species[16] that manage to survive and successfully reproduce, to the point where they currently account for 10.4% of our flora (Figure 3.5). This process, still studied and known only in part, is taking on sizeable proportions in Italy, considering that roughly 30 years ago 527 exotic species that had managed to become a stable part of Italian flora were registered[17]. At the same time, however, the Mediterranean vegetal communities have shown themselves to be more resistant to invasions of external species than those of Central Europe or the New World, and especially the communities of Australia, New Zealand and the Oceania islands. In our country, the great majority of exotic vegetal species remain confined in agricultural areas and in environments attuned to human activity (along transportation routes, in population centres, in industrial areas etc.), while it is rare that they pose serious threats to the diversity of natural habitats. Only a small number of external species (such as *Robinia pseudoacacia*, *Prunus serotina*) manage to spread in natural environments, showing a preference for invading lowlands, wetlands and coastal habitats.

A recent census in Italy recorded 782 naturalised exotic vegetal species that managed to survive and reproduce themselves with success; for the most part, however, these species remain confined to agricultural environments and those heavily influenced by man, only rarely posing serious threats to natural habitats.

[16] *An Annotated Checklist of the Italian Vascular Flora*, Conti *et al*., 2005
[17] *Flora esotica d'Italia*, Viegi *et al*., 1974



In Italy the naturalised exotic vegetal species represent 10.4% of our flora. A recent census recorded no fewer than 782 species capable of surviving and successfully reproducing; however, these remain confined within agricultural areas and environments heavily influenced by man, rarely becoming serious threats to the diversity of natural habitats.

Figure 3.5: Autochthonous and naturalised exotic vascular plants (2005)[18]

Climate changes underway interfere with the physiology, phenology and distribution of species.

Mention should be made of the indirect effects of actions of human origin, and especially those traceable to climate changes, already referred to and noted in numerous studies and reports. The climate changes underway interfere with the physiology of the species (for example, photosynthesis, respiration, the growth of plants, efficient use of water, composition of tissues, metabolism and decomposition), as well as their phenology (events in the life cycle that occur in advance or after a delay) and distribution (as in the case of shifting towards the poles and higher altitudes), and thus their adaptation *in situ*. All these factors can result in modifications in the interactions between species (in terms of competition, predatory actions, infection from parasites, mutualism etc.), causing a further shifting in distribution and ultimately, in certain cases, arriving at extinction. In the final analysis, there can be modifications in the structures and compositions of communities, with a gradual impoverishment of certain communities and a related increase in opportunistic species.

[18] Source: APAT analysis of data taken from Conti, Abbate, Alessandrini, Blasi, 2005 - *An Annotated Checklist of the Italian Vascular Flora*. Ministry of the Environment, D.P.N.; Department of Vegetal Biology, University of Rome, "La Sapienza" Campus

Infrastructure works are also a major cause of loss of biodiversity, when they result in the fragmentation, alteration and destruction of habitats, in addition to rendering terrain impermeable and causing acoustical disturbances and damage to fauna, as in the case of roadway and railway infrastructures etc..

Infrastructures works are another cause of loss of biodiversity.

There is controversy over the role of activities tied to agriculture as causes of impact on the natural heritage. On the one hand, agricultural surface areas are subject to the negative impacts of other activities and other spheres of production, given that they frequently are affected by urbanisation, illicit dumping of waste and industrial pollution. At the same time, agricultural activities themselves are frequently identified as one of the main causes of water pollution, loss of stability of terrains and soil pollution, as well as of increases in the greenhouse effect, loss of biodiversity and simplification of the landscape.

Agricultural surface areas are subject to the negative impact of other economic activities, while, at the same time, they can cause pollution and loss of biodiversity.

In Italy, the available data and information show that the single largest environmental impacts directly traceable to agriculture are tied to the use of fertilisers and plant care products. The resulting pollution and deterioration of the soil, as well as surface and underground waters, can have repercussions on human health and on flora and fauna, plus the ecosystems to which they belong. On the subject of fertilisers, it should be noted that the quantity placed on the market in Italy, after a slow but continuous decrease that began in the 70's, returned to an upward trend in the period 1998-2006 (Figure 3.6), registering growth of more than 12% (ISTAT, 2007). The national figure for the year 2006 moved above the 5 million ton mark, with more than 3 million tons consisting of mineral fertiliser, of which the most widely used type are those based on nitrogen.

During the years 1998-2006, there was an increase of more than 12% in the quantity of fertilisers placed on the market.

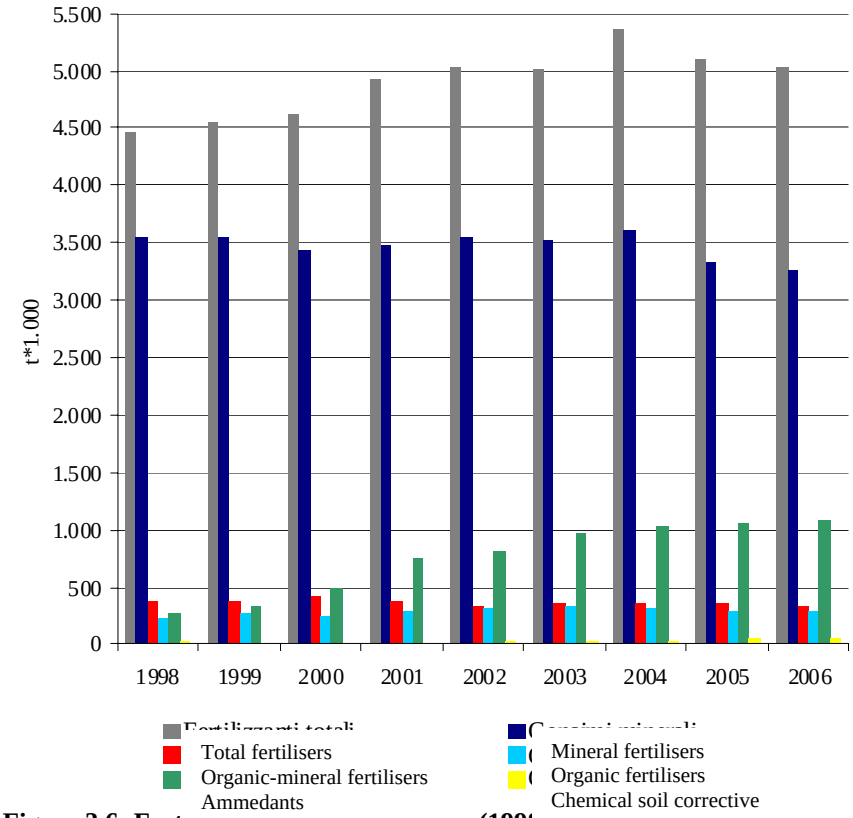


Figure 3.6: Fertilisers distributed by type (1998-2006)

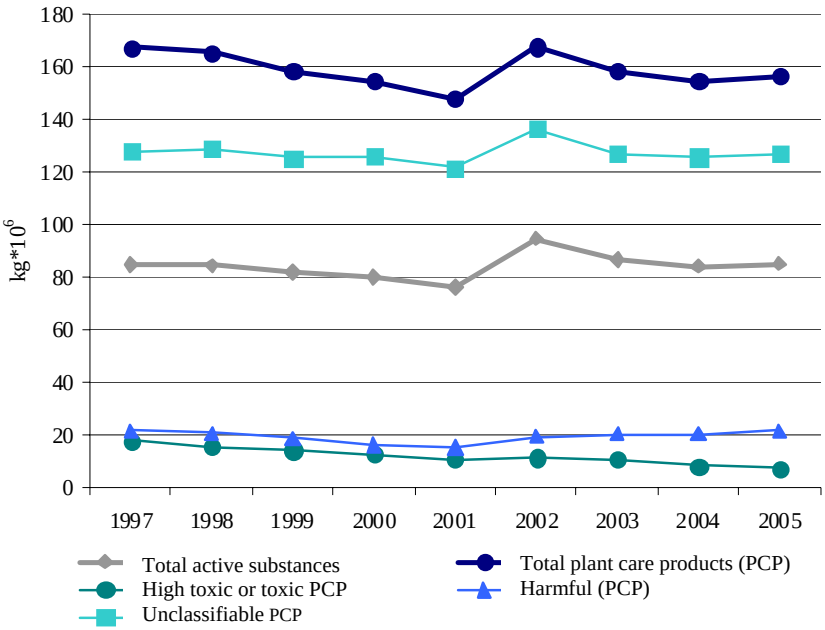
The most noteworthy environmental impacts traceable to agriculture are tied to the use of fertilisers.

In Italy, following a slow but continuous decrease in the quantities of fertilisers placed on the market, a trend that began in the 70's, growth resumed in the period 1998-2006, with an increase of more than 12%.

As far as plant care products are concerned, the quantities placed on the market in the period 1997-2005 shrank by 6.4% (Figure 3.7). In 2005 more than 156,000 tons were sold (for an increase of approximately 2,000 tons over 2004), with 81.4% of the total consisting of "unclassifiable" products. The remaining 18.6% include those products classified high toxic, toxic and harmful, which, being the most dangerous from a toxicological, eco-toxicological and chemical-physical point of view, are subject to special restrictions in terms of their sale and preservation. Compared to 2004, there was a noteworthy decrease in the level of very toxic and toxic products (approximately 1,000 tons less) and an increase in harmful products (approximately 1200 tons), whose impact on human health and the environment is naturally lower. Of note is the gradual increase in the distribution of organic fertilisers and biological products for defending crops, as alternatives to products made through chemical synthesis.

The quantities of plant care products placed on the market during the period 1997-2005 shrank by 6.4%.

[19] Source: ISTAT



The main environmental impacts traceable to agriculture are tied to the use of plant care products. In the period 1997-2005, the sale of plant care products registered a decrease of 6.4%. In 2005, however, more than 156,000 tons were sold (an increase of approximately 2,000 tons over 2004).

Figure 3.7: Total active substances, total plant care products and products divided by type (1997-2005)[20]

The agricultural areas of noteworthy naturalistic value referred to earlier on can be threatened by two contrasting situations: either the intensification of farming or the abandonment of extensive cultivation. Intensification occurs when the natural and economic conditions make it possible to increase the productivity and efficiency of agricultural activities. The abandonment of agricultural zones, on the other hand, is most frequent in regions with large surface areas of extensive agriculture, where productivity is fairly low and income reduced, with the difficult working conditions and the shortage of services making agriculture relatively unattractive, especially for the new generations of farmers[21].

Agricultural areas of noteworthy naturalistic value can be threatened by two contrasting scenarios: the intensification or the abandonment of extensive farming.

3.3 The main initiatives for protection

As already noted, the preservation of biodiversity often conflicts with the needs of man. Efforts to reconcile its defence as best as possible with the demands of society frequently result in agreements and legislative instruments, key elements that prove indispensable when it comes to combining the need for conservation with economic, social and cultural concerns, as well as those of local populations. Italy has endorsed numerous conventions and international agreements designed to safeguard biodiversity. Especially worthy of note, give its strategic importance on a global scale, is the Convention on Biological

Italy has endorsed numerous conventions and international agreements geared towards safeguarding biodiversity.

[20] Source: ISTAT

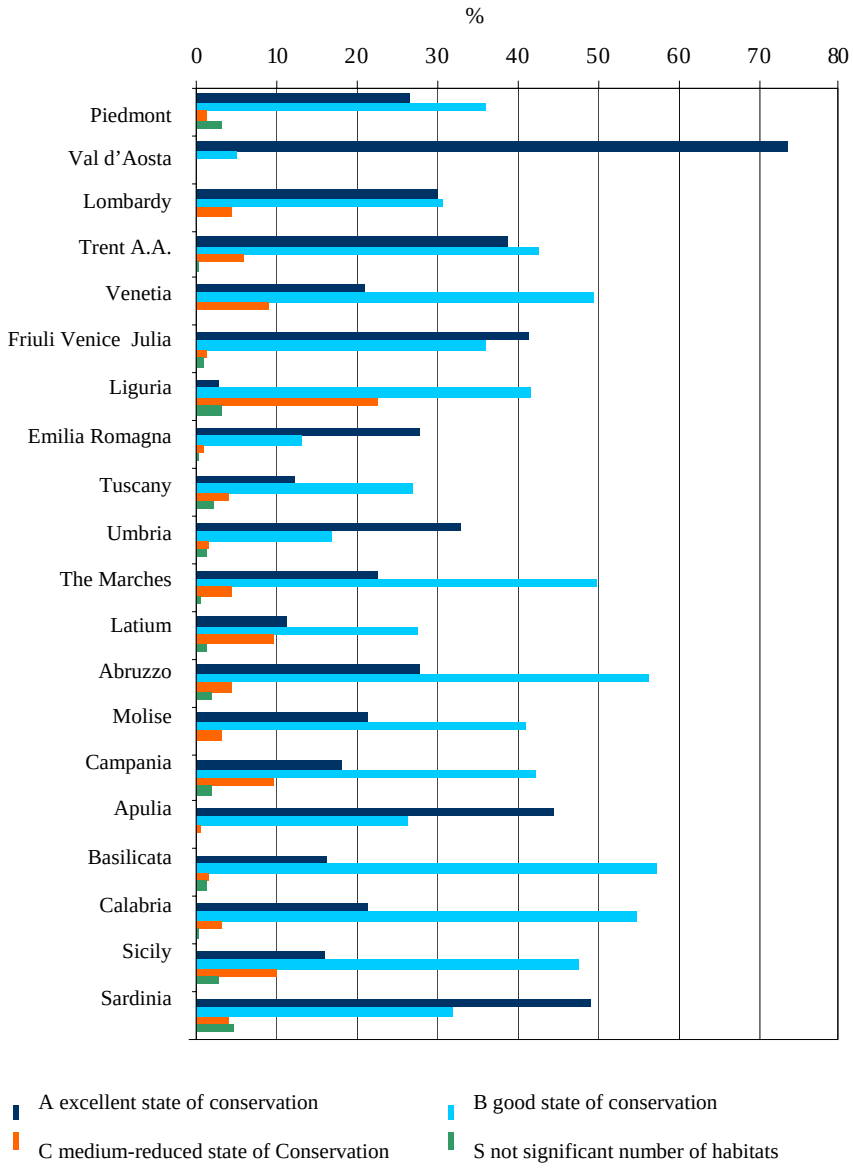
[21] *Stirbt der ländliche Raum? Zur Demographie ländlicher gebiete in Europa: Zahlen, Fakten, Schlussfolgerungen*, Heilig, 2002; *Demography of Europe - the extinction of the countryside?*, Heilig, 2002

Diversity[22] signed in Rio de Janeiro on 5 June 1992 during the United Nations World Summit on the Environment and Development[23]. The CBD sets three specific objectives: 1) the preservation *in situ* and *ex situ* of biological diversity; 2) the sustainable use of the components of biological diversity; 3) an equitable distribution of the benefits produced by the use of genetic resources.

On the European level, the EU has issued two key directives for the preservation of biodiversity: the Bird Directive (79/409/EEC) on the protection of wild birds and the Habitat Directive (92/43/EEC) on the preservation of the natural and semi-natural habitats of wild flora and fauna. The specific objectives of the Habitat Directive include the creation of a cohesive European ecological network entitled Nature 2000 and consisting of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), with these last being determined in accordance with the provisions of the Bird Directive. The Bird Directive was transposed into national legislation with Law 157 of 11 February 1992, while the list of Italy's SPAs was published as part of a Ministerial Decree issued on 25 March 2005. The Habitat Directive was fully transposed into Italian law under Presidential Decree no. 120 of 12 March 2003. Later the lists of the Sites of Community Importance (SCIs) were published for the Alpine Bio-geographic region (Ministerial Decree of 25 March 2004), for the Continental region (Ministerial Decree of 25 March 2005) and for the Mediterranean region (Ministerial Decree of 5 July 2007). At present, the Nature Network 2000 consists of 589 SPAs, with a surface area of 4,379,777 hectares, equal to 14.5% of the national territory, and of 2,283 SCIs, with a surface area of 4,507,325 hectares, equal to 15% of the national territory (*Databank of the Nature 2000*, Ministry of the Environment, Land and Sea, 2007). All the habitats indicated in the Directive and exclusive to Italy - meaning that the country bears a particular responsibility for their wellbeing - are placed in at least one SCI and cover 72.4% of the total surface area of Italy's SCIs. The state of preservation, in terms of structure, functional performance and possibility for restoration, of all the habitats indicated in the directive and placed inside the SCIs, is rated as good to excellent in approximately 65% of the cases (Figure 3.8).

In Italy, the Nature 2000 currently consists of 589 SPAs, with a surface area of 4,379,777 hectares, equal to 14.5% of the national territory, plus 2,283 SCIs, with a surface area of 4,507,325 hectares, equal to 15% of the national territory.

[22] *Convention on Biological Diversity* - CBD
[23] *United Nations Conference on Environment and Development* - UNCED



At present Italy contains 2,283 Sites of community Importance (SCIs), with a surface area equal to 15% of the national territory. The state of conservation, in terms of the structure, functional performance and possibility for reclamation, of all the habitats indicated in the Directive and found inside the SCIs is rated good or excellent in 65% of the cases.

Figure 3.8: Percentage of the surface area of the habitats found in SCIs, with respect to their total surface area, based on the state of conservation (updated to 31 August 2007)[24]

Another fundamental reference for the conservation of biodiversity in Italy is Framework Law no. 394 of 6 December 1991 on protected areas, an act that "lays down the underlying principles for the establishment and management of natural protected areas, in order to guarantee and promote, in a coordinated manner, the preservation and optimal use of the country's natural heritage". Accompanying the law are a series of measures meant to protect fauna and flora, regulate hunting, establish natural marine reserves, protect marine species and regulate fishing, in addition to safeguarding forest resources. Taken as a whole, the legislation approved has made it possible to carry out a number of different initiatives that attempt to safeguard and improve the conditions of our natural heritage. First of all, mention should be made

In Italy the protected areas established cover almost 3 million hectares of terrestrial areas (9.7% of the national territory), plus a slightly smaller surface area of marine zones, equal to 30% of national coastal waters.

[24] Source: APAT analysis of data from the Ministry of the Environment, Land and Sea

of the 772 protected areas established, equal to almost 3 million hectares of terrestrial areas (9.7% of the national territory), plus a slightly smaller surface area in terms of marine zones, equal to 30% of the national coastal areas[25].
Furthermore, thanks to Italy's endorsement of the Ramsar (Iran) Convention of 1971 on wetlands of international importance, 50 sites of major ecological importance, covering a total surface area of approximately 58,500 hectares, are protected.
Figure 3.9 shows the regional distribution of the protected areas, as per the provisions of the legislative instruments illustrated earlier.

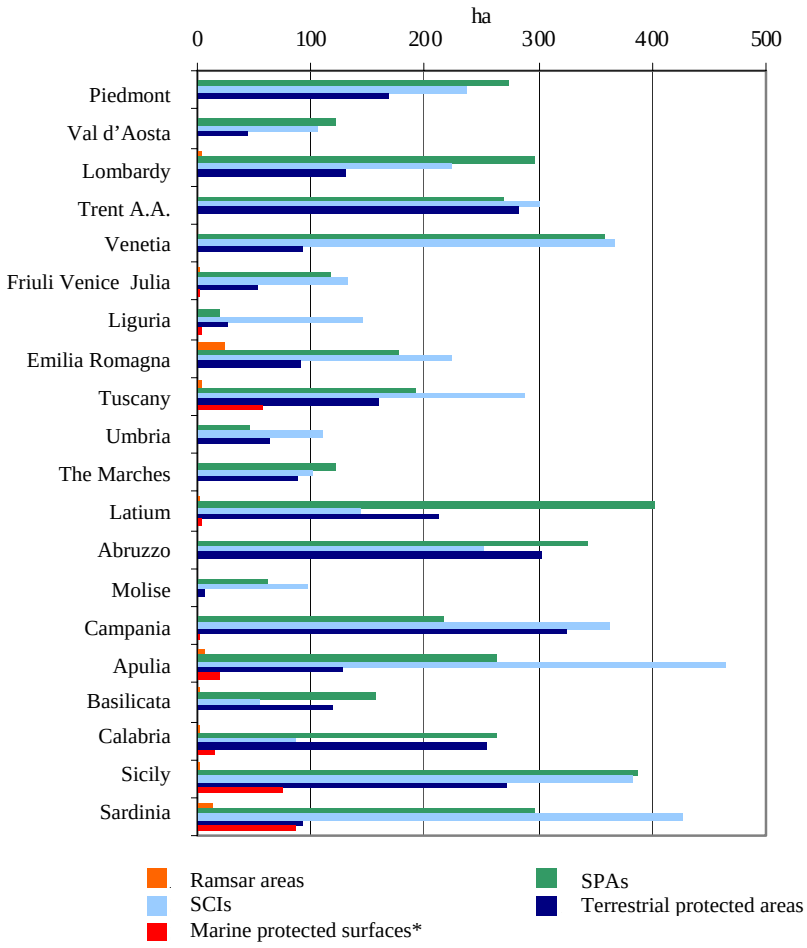


Figure 3.9: Regional distribution of protected areas[26]
* Marine Mammals Sanctuary not included

The natural heritage is currently protected as follows: 14.5% of the surface area of Italian territory holds SPAs, 15% holds SCIs (all approved by the European Commission) and 9.7% contains protected terrestrial areas, plus a slightly smaller surface area consisting of marine zones, equal to 30% of the national coastal waters. In addition, 50 Ramsar sites are protected.
The regional distribution of surface areas protected in different modes shows that the regions with the largest areas covered by conservation efforts are Venetia, Latium, Abruzzo, Campania, Apulia, Sicily and Sardinia.
The legislation establishes the principle that wild fauna are a resource of the State: safeguarding of this public

As mentioned earlier, other regulatory measures safeguard biodiversity by laying down rules for certain humans activities. Hunting in our country, for example, is governed by Law no. 157 of 11 February 1992, which sets rules for the protection of wild homeotherm fauna and the levels of hunting within the national territory, as well as by the laws for each region. The national legislation provides the framework within

[25] *V EUAP*, Ministry of the Environment, Land and Sea, 2003

which the regions must draft their legislation. The measures stipulate that wild fauna are resources belonging to the State: the defence of this public resource represents the norm, with hunting constituting an exception. The law also lays down a prohibition against the catching of birds while requiring that aspiring hunters take examinations and establishing that hunting licenses are valid throughout the national territory, in addition to setting the conditions for obtaining the license, together with the sanctions under the Criminal Code etc..

resource constitutes the rule, with hunting representing the exception.

As regards fishing, it should be noted that the reform of the CFP, referred to earlier, introduced a series of modifications meant to adjust the Policy, in the interests of protecting fish stocks and preserving the marine environment. The priority objectives include the sustainable use of fish resources through the implementation of strategies calling for, among other things, biological rest periods, the use of selective systems and the reduction of the level of fishing activities. The main changes in the CFP include a long-term approach that sets objectives for the achievement and/or maintenance of fishing stocks, together with a new policy for reducing the size of fishing fleets, uniform operating principles for systems of control and close involvement of the interested parties in the process of European-Community policy. Another step taken in support of the policy of involving the interested parties has been the formulation by the Ministry of Agricultural, Food and Forestry Policies of the Operational Program for Fishing FEP 2007/2013 (10 October 2007), with the organisation of a public consultation to obtain comments regarding the evaluation of the incidence of the Program. The objective of reducing the level of fishing operations is reached both by reducing the size of the fishing fleet and by placing limits on catches (Total Admissible Catch - TAC).

The priority objectives of Community Policy include the sustainable use of fishing resources, through strategies that include periods of biological rest, the use of selective systems and the reduction of the level of fishing operations.

Many other initiatives, some of them taken on the regional or local levels, focus on the study and monitoring of species and their habitats, as well as efforts of environmental restoration and restocking, plus the creation of ecological networks, the introduction of criteria of sustainability in the various production sectors, product certification and environmental education. Many of these efforts are directly or indirectly controlled by the numerous programs carried out on the local or national levels by public or private bodies, as well as by universities and other organisations. Monitoring plays an important role in the preservation of biodiversity, and it is approached as monitoring not only of the components of biodiversity, but also of the categories of activities that can prove detrimental to biodiversity. The Chart of Nature, the monitoring networks of the Environmental Agencies system and the reporting activities involving environmental data, such as the APAT Environmental Data Yearbook, are direct offshoots, or are closely tied

Many other initiatives, including some undertaken on the regional and local levels, are focussed on the monitoring of the species and habitats, on environmental reclamation and restocking, on the creation of ecological networks, on the implementation of criteria of sustainability in the

[26] Sources: for the protected terrestrial and marine areas: the Ministry of the Environment, Land and Sea: see the Official List of Natural Protected Areas for 2003; for the Ramsar Sites: the Ministry of the Environment, Land and Sea, 2007; for the SCIs and the SPAs: APAT analysis of data from the Ministry of the Environment, Land and Sea (updated to 31 August 2007)

to, the objectives found under art. 7 of the CBD. Efforts of preservation *in situ* include not only the establishment of protected areas, as illustrated above, but also the identification of areas for the implementation of special measures of conservation. Falling under this objective are the measures of protection contemplated for areas adjoining the protected areas, as well as the various initiatives - noteworthy examples of which can be observed within the national territory - for the establishment of ecological networks, both terrestrial and marine. The Italian Network of Germoplasm Banks for the *ex situ* preservation of wild flora (RIBES) is another major initiative for the preservation of germoplasm, as well as an incentive for studies on the subject (art. 9 of the CBD). As for the objective of the long-term use of biological components (art. 10 of the CBD), it includes initiatives designed to encourage the habitual use of biological resources, in accordance with traditional cultural practices that prove compatible, with one option for their implementation being the involvement of the local populations in the planning of actions for the restoration of biodiversity, together with improved cooperation between government authorities and the private sector. Major steps in this direction are the enactment of the 21 Agendas, plus efforts focussed on participation and access to information, as well as environmental certification and seals of quality for local products, with various examples of the application of such efforts on the local level found throughout the national territory. The Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA) and the assessments of the incidence of plans and projects, as well as surveys meant to gauge environmental damage, are all actions contemplated under art. 14 of the CBD and designed to assess, and therefore minimise, impacts that can prove harmful to biodiversity. Last but not least are the activities of research and training in the environmental sector (art. 12 of the CBD), as well as those of instruction and dissemination to the public (art. 13 of the CBD). In the case of these last programs, the Ministry of the Environment, Land and Sea, together with the Ministry of Education, has carried out the program of the INFEA initiative on information, training and environmental education of 1995, a noteworthy effort of coordination meant to channel experiences and isolated initiatives on a local level in such a way that they can contribute to national programs and structures.

various production sectors, on the certification of products and on environmental education.

Finally, mention should also be made of initiatives involving the certification of forest activities and forest products. Forest certification is defined as a voluntary instrument issued by independent parties for the purpose of reconciling the requirements of sustainable forest management with the demands of the market. Internationally, two alternative systems of forest certification, both used in other European countries as well, can be identified: the PEFC (*Programme for Endorsement of Forest Certification Schemes*, 1999, promoted by owners of forests and the forest industry) and the FSC (*Forest Stewardship Council*, 1990, drawn up by environmentalist organisations and operative for a longer period of time). With the first forest certification having been awarded to the Magnificent Community of

At present, roughly 7% of the national forest surface area (equal to 675,845 hectares) is certified.

Fiemme (Province of Trent) in 1997, at present approximately 7% of the national forest area (equal to 675,845 hectares) has obtained this recognition. The majority of the forests certified are private property (approximately 54%), though the certification of public forests is also on the rise (46%). In addition to the Alpine regions, which hold the majority of Italy's certified forest areas, numerous zones in the central and southern Apennines have also been certified. A further development of note was the first certification of an Italian cork forest (FSC), in Tempio Pausania (Province of Sassari), in 2005.

In the field of nature conservation, the State Forestry Corps and the Environmental Defence Division of the Carabinieri Corps play an important role in terms of controls.

In terms of application of the measures described above, a number of different public bodies, on both the central government and the local government levels, carry out activities of oversight. Considering only the specific field of nature conservation, mention can be made of the activities of the State Forestry Corps (which carried out more than 66,000 controls in 2004, resulting in over 2,300 legal measures regarding violations and/or administrative sanctions, a clear-cut increase over the 863 such measures of 2003) and the Environmental Defence Division of the Carabinieri Corps (which performed more than 2,000 controls in 2004, resulting in over 1,200 legal measures regarding violations and/or administrative sanctions, a clear-cut increase over the 18 such measures of 2003).

During the period 2001-2004, an average of roughly 21.9% of the total spending by the various ministries on environmental protection was allocated to the protection of biodiversity and the landscape.

The various actions outlined up to this point to safeguard nature and biodiversity can be effectively applied only if they are supported with adequate funding. In this respect, an examination of the data available for the period 2001-2004[27] shows that, on the average, roughly 21.9% of overall spending by the various ministries on the protection of the environment has been allocated for the defence of biodiversity and the countryside. The decrease of 4.3% registered during the period in question in the sum total of the available resources has not resulted in a reduction in the funds allocated to the sector, which, on the contrary, have registered an overall increase of 42%. In terms of the amounts paid out, the protection of biodiversity and the countryside again proved to be one of the most important sectors during the four-year period under examination, accounting for 57% of the total amounts spent.

The reform of Community Agricultural Policy is meant to replace traditional methods of production with an agricultural system based on the sustainable use of resources and protection of the environment.

As for relations between agriculture and the environment, it should be noted that, while policies of rural development in the past, on both the national and extra-national levels, were primarily geared towards increasing the productivity of forestry and farming operations, for a number of decades now their priority objective has been efficiency and sustainability. Starting in the nineties, a thoroughgoing change in Community Agricultural Policy (CAP) has occurred, oriented towards supporting farmers in their efforts to take preventive action against risks of environmental deterioration and to play a positive role in the defence of the countryside. Specifically, the reform of the CAP over

[27] *Spending on environmental protection by the administrative organs of the national government. Years 2001-2004.* ISTAT

the middle term (2003) has established a system for the awarding of European-Community subsidies and bonuses that is no longer based on the types of crops grown and the quantities produced, but rather on the exercise of agricultural activities and on the awarding of a "single payment for each enterprise", on the condition that a number of obligatory operating criteria are met in the areas of environmental defence, food security and the wellbeing of animals. The EU also implements measures involving farming and food to support agricultural practices specifically geared towards defending the agricultural environment, biodiversity and the countryside. These modifications, referred as the "greening" of the CAP, are meant to supersede traditional methods of farming, in order to arrive at a production system based on the sustainable use of resources and protection of the environment.

European-Community policies on agriculture and the environment call for incentives promoting production activities of low environmental impact. National guidelines promote generational turnover, economic and social development and the reconstitution of farmlands and farming enterprises.

In terms of maintaining or increasing the dimensions of the UAA nationwide, it should be noted that no specific objectives are set under either international or national legislation, though the last two European Action Programs in the field of the environment, as well as the 21 Agenda, set a number of general objectives, such as the sustainable use of the territory, the protection of Nature and biodiversity and the maintenance of the levels of production. These objectives are reiterated in the resulting thematic strategies, in the associated legislative proposals and in the numerous existing legislative measures. Community policies for agriculture and the environment call for incentives promoting production systems featuring low environmental impact, such as integrated and biological agriculture, as well as increased extensive production, safeguarding of habitats of elevated naturalistic value, maintenance of biodiversity and the low-intensity management of pasturelands. Equally important are the national guidelines, geared towards promoting a generational turnover, together with economic and social development of agriculture, in addition to providing incentives for the reconstitution of farmlands and farming enterprises.

In Italy the surface areas involved in, or being converted to, biological agriculture in 2006 were equal to 1,148,162 hectares (+2.42% compared to 2005),representing 9% of the national UAA.

Within this framework of measures and facilitations, particular attention is focussed on biological agriculture. This is a method of agricultural production, animal husbandry and industrial processing and transformation of foodstuffs whose purpose is to promote methods for the production of raw materials and foods that respect natural cycles, safeguard biodiversity, contribute to the wellbeing of animals and defend the countryside, the fertility of the soil and non-renewable resources. In Italy the surface areas involved in or being converted to biological agriculture in 2006 were equal to 1,148,162 hectares (+2,42% compared to 2005), representing 9% of the national UAA. Italy leads the EU in terms of both the number of biological farming enterprises and the surface area involved (17% of the biological UAA of EU-25), followed by Germany and Spain (Figure 3.10).

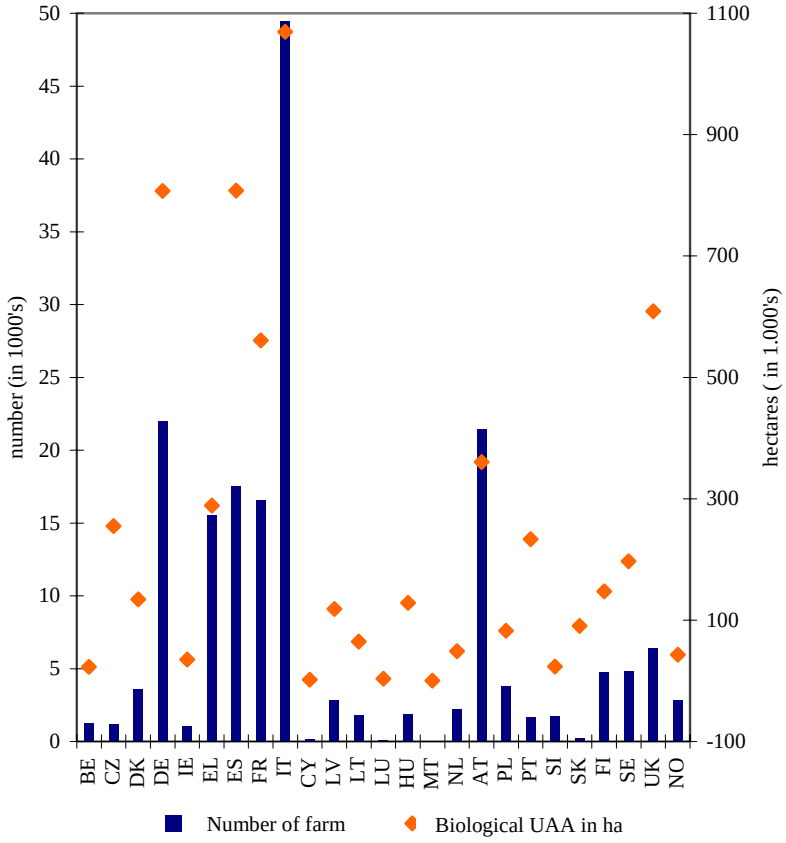


Figure 3.10: Number and UAA of farming enterprises run under the biological method in Europe (2005)[28]

European-Community policies, on farming and the environment contemplated incentives for production activities of low environmental impact; the national guidelines promote generational turnover, economic and social development and the reconstitution of farmland and farming enterprises. Italy leads Europe in terms of the number of biological farming enterprises and the surface area involved (17% of the biological UAA in the EU-25), followed by Germany and Spain.

[28] Source: SINAB

4. USE OF RESOURCES AND WASTE GENERATION

Introduction

The topic of "Sustainable Consumption and Production" (SCP) was recently addressed on the international level in the "Marrakech Process"**,** initiated during the 1st International Meeting of Experts, held in Marrakech in June of 2003, with the objective of following up on the "Recommendations of the Johannesburg Summit"**,** so as to involve governments, international organisations and civil society in the development of a *decade-long framework of programs in support of activities and initiatives meant to promote sustainable models of production and consumption*.

The link between education and consumption arises from the clear intention to consider changes in the behaviour patterns of citizens and the acquisition of a critical awareness as fundamental elements in the development of new models of production and consumption.

According to the definition drawn up at the symposium on "*Sustainable Consumption*" (Oslo, 19/20 January 1994), "Sustainable production and consumption are achieved through the use of goods and services that satisfy fundamental needs and that lead to a better quality of life, at the same time as they make it possible to minimise the use of natural resources, toxic materials, the production of waste and the emission of polluting agents throughout their entire life cycle, in this way ensuring that the needs of future generations are not jeopardised".

This concept contains three cornerstones of sustainability: the economy, society and the environment.

In this chapter, attention is focussed on the environmental factors and, in part, on the economic considerations tied to SCP, specifically examining the key concerns of SCP through the life cycle of the different materials: from resource extraction, through the phases of production and consumption, up to the production and management of waste (Figure 4.1).

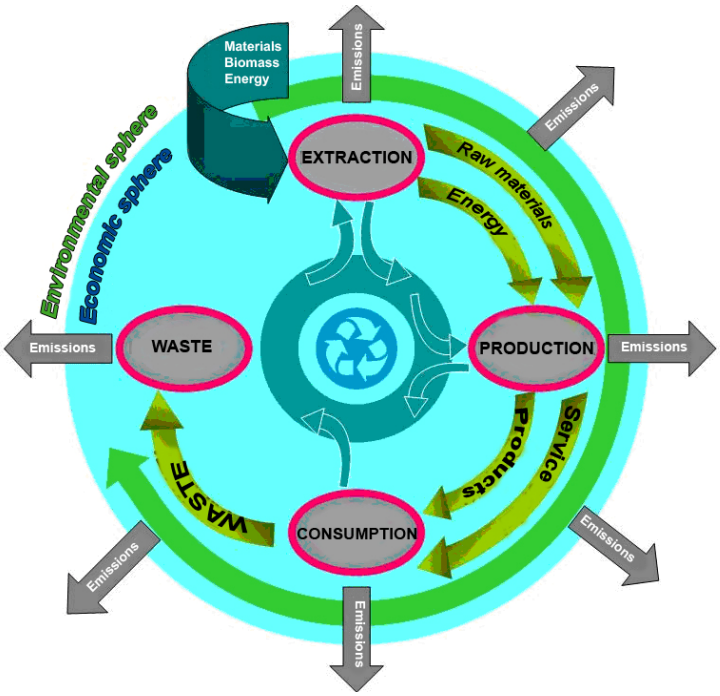


Figure 4.1: Life cycle from procurement - production- consumption- to waste[1]

Sustainable production and consumption are achieved through the use of goods and services that satisfy fundamental needs while leading to a better quality of life, at the same time as they make it possible to minimise the use of natural resources, toxic materials, the production of waste and the emission of polluting agents throughout their entire life cycle, so as to avoid jeopardising the needs of future generations.

[1] Source: APAT

4.1 Use of Materials Resources

4.1.1 Introduction

Knowledge of the quantities of materials used in a given socio-economic system – and, more in general, the quantities necessary for its operation – is extremely important when it comes to understanding, on both the general and macroscopic level, the interaction of the system with the natural environment. In fact, the use of material resources plays a crucial role in generating environmental pressures. This because it is the *demand* for virgin natural resources, the use of materials, that underlies the pressures generated at the moment in which the input of the materials enters the economic circuit, meaning the pressures directly attributable primary activities (the cultivation of agricultural biomasses, the procurement of wood from forests, the mining of minerals). In the same way, the *transformation*, or the use of the materials, underlies the pressures generated at the time the materials become output, meaning the moment in which they are returned to nature and to the territory in forms, and at times and in places, different from what was originally the case in nature (emission of pollutants in the atmosphere and in waters, the discharge and dumping of waste and the installation of buildings and infrastructures within the territory). A precondition to any pressure on the natural environment and human health is the movement and transformation of materials.

The use of material resources plays a key role in the generation of environmental pressures, in terms of both the demand for natural resources (input) and the transform of the same (output).

Aggregate measures regarding merely the quantities of the materials used cannot provide an exhaustive illustration of the pressures, seeing that they do not give adequate consideration to differences in quality. Still, knowledge of quality provides an idea of a system's potential for generating pressures through movements of materials, in preparation to carrying out more refined analyses of the specific flow over a more extensive period of time.

The quantities of the materials returned to the natural system, representing the potential pressures at the end of the cycle, may be measured indirectly, by calculating the apparent consumption of the materials. The indicators produced by this calculation, though lacking a qualitative disaggregation able to prove immediately meaningful in terms of the actual pressures generated during the output phase of the materials, owe their relevance to the observation that nothing can be returned to Nature unless it has first been taken from Nature. In technical terms, calculation of the indicators proves to be simpler than taking the sum total of the outputs, making it possible to control that the available information is correct and complete, based on these same indicators.

The main indicators regarding the material flows of the Italian economy, calculated by the ISTAT for the period 1980-2004[2], show that the

Material Flow analysis of the Italian

[2] These indicators are calculated according to the EW-MFA (Economy-Wide Material Flow Accounts) satellite count procedures developed by Eurostat. Cf. Eurostat (2001), *Economy-wide material flow accounts and derived indicators - A methodological guide*, Luxembourg

demand for material resources brought to bear against Nature by the Italian economy has not evolved, on the whole, in a direction favourable to ecological sustainability. In fact, the material flow indicators directly relevant to the national territory point to levels of both procurement of materials from nature and of potential restitutions that essentially remain constant over time, while the indicators for indirect flows, meaning those triggered abroad by the demand for goods generated by Italy, even show a rise in the potential pressures on the global environment attributable to the functional activities of our economy.

economy shows that, in the period 1980-2004, the demand for materials resources brought to bear against Nature by the Italian economy did not evolve in a direction favourable to ecological sustainability.

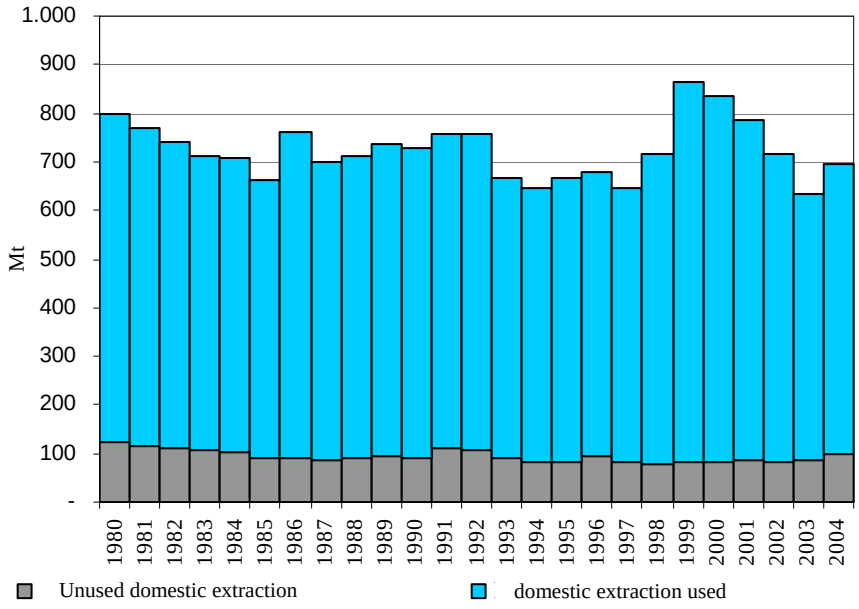
4.1.2 Direct domestic extraction

An immediate repercussion on the environment of the use of material goods by the socio-economic system is the demand for virgin natural resources that must be extracted from the natural environment, to the degree in which such material resources are not already procurable within the socio-economic system, as the outcome, for example, of activities of recovery and recycling.

Measurement of the quantities of virgin materials extracted from the national territory can be considered indicative of the potential pressures borne by this territory during the phases of extraction and production.

Measurement of the quantities of virgin materials extracted from the national territory can be considered indicative of the potential pressures borne by this same territory during the extraction activities, and in terms of minerals and biomasses not produced, as well as the pressures of the production phase, with respect to the biomasses produced.

The overall materials extracted from the national territory is measured by the *Domestic Total Material Requirement* indicator (Domestic TMR Figure 4.2).



It was found that the majority of the materials extracted from Italian territory are actually used, meaning that they are transformed into products, while the remainder, smaller in scale, consists of unused materials, meaning those whose removal is necessary in order to carry out the other activities.

Figure 4.2: Domestic Total Material Requirement (1980-2004)[3]

[3] Source: ISTAT

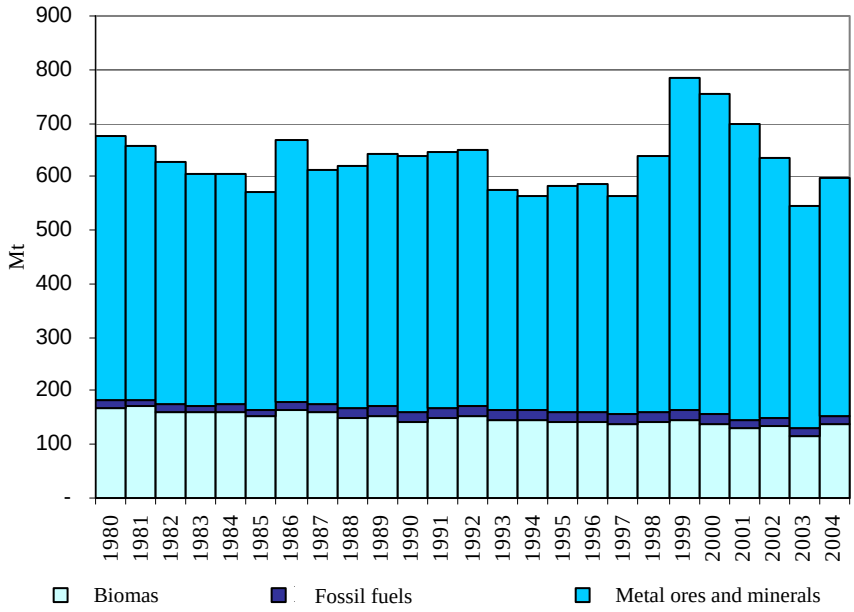
The majority of the materials extracted from Italian territory proved to have actually been *used*, meaning that they were transformed into products. These are materials endowed with an economic value whose introduction in the socio-economic circuit constitutes the main function of the primary activities. The remaining portion of the indicator refers to the *unused* materials, meaning those whose removal is necessary in order to carry out the other activities. Such materials include scrap generated in the course of the primary activities, in order to arrive at the materials endowed with economic value, as well as the excavation performed in constructing buildings and infrastructures (not including the earth that is part of the work, as well as the materials employed).

On the whole, this indicator points to the possibility of a slight decline over the long term. Nevertheless, this trend, while indeed present, is overshadowed by cyclical variations immediately traceable to the influence of the economic cycles on the demand for virgin natural resources.

The cyclical trend of the domestic total material requirement is due almost exclusively to the largest component, namely the domestic extraction of materials used.

The cyclical trend of the domestic total material requirement is due almost exclusively to the largest component, meaning the *domestic extraction of materials used* (Figure 4.3). This component does not present a clearly defined long-term trend, registering noteworthy fluctuations around an average value of approximately 630 million tons.

The most extensive of these fluctuations occurred during the last decade. In the two-year period 1998-1999, the extraction of materials used showed marked growth (+38.6%), reaching a peak of 783 million tons. The year 2000 marked the start of a new decline, leading to the minimum value of approximately 550 million tons, registered in 2003. The increase that took place in the years 1998-1999 was due primarily to the extraction of non-energy minerals (for the most part, construction materials), the most significant component of the used materials extracted in Italy. Between 1997 and 1999, this component grew to approximately 620 million tons, equal to 79% of the used materials extracted from the national territory in that year. During the period 2000-2004, a net decrease sent the figure for the domestic extraction of non-energy minerals back to approximately 440 million tons. The extraction of energy-related mineral also declined during the period in question (fossil fuels -15%), though this component constitutes an extremely limited percentage of the domestic extraction of minerals used: in fact, fossil fuels, after reaching their peak level of nearly 20 million tons in the mid-nineties, fell to less than 15 million tons in 2004. The downward trend in biomass flows appears fairly stable over the long term: in 2003 biomasses recorded their minimum level, at 116 million tons, compared to the more than 168 million tons reached in 1980.



The most marked fluctuation occurred during the last decade. During the two-year period of 1998-1999, the extraction of used materials rose sharply, (+38,6%, due primarily to the extraction of non-energy minerals), reaching a peak of 783 Mt. A new decline began in 2000, leading to the minimum level of 2003 (550 Mt).

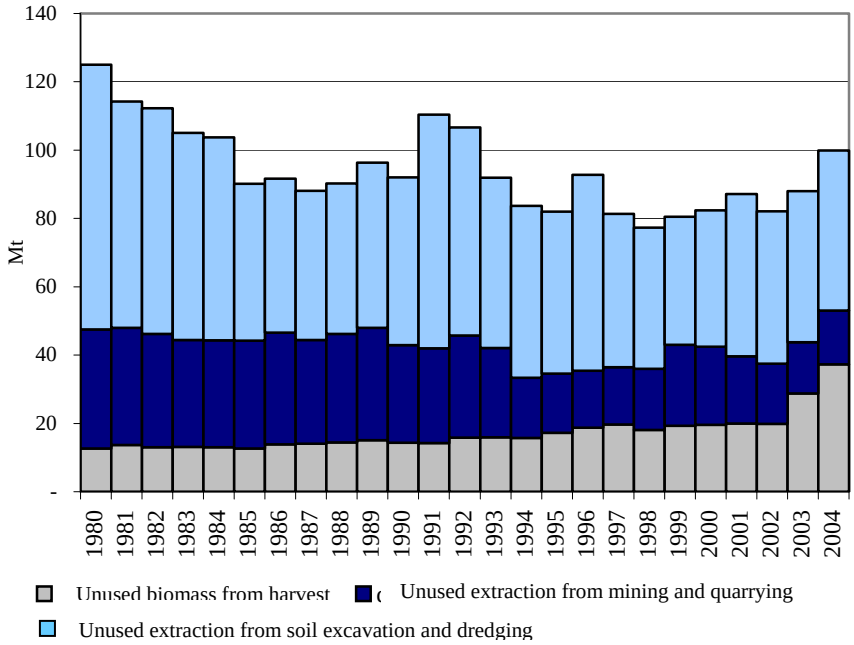
Figure 4.3: Domestic Extraction Used [4]

The figures for non-energy minerals – the largest single component of domestic extraction of used materials – can provide a useful, though admittedly very rough approximation of the annual accumulation of materials within the economy. In the majority of cases these are construction materials, most of which remain within the national territory, in the form of buildings, roads, railways etc..

Unused domestic extraction (Figure 4.4) consists of materials lacking in economic value and not subject to further transformation as a result of human activities; nevertheless, their removal from the natural sites constitutes a potential disturbance of the circulation of elements within the natural system (an example would be the possible effects on water tables of the excavation of tunnels). In addition, they become a form of waste to be managed at the very moment in which they are extracted.

The unused domestic extraction is lacking in any economic value and is not subject to any further transformation; nevertheless, its removal from natural sites constitutes a potential disturbance of the natural system, while, at the moment of its extraction, it becomes a form of waste to be managed.

[4] Source: ISTAT



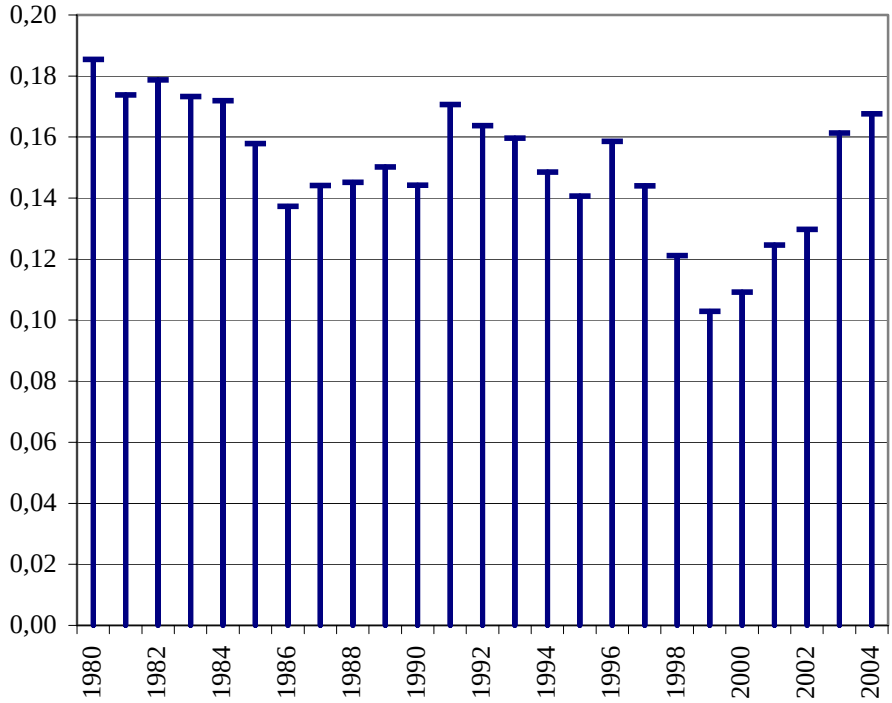
Unused domestic extraction presented an overall downward trend (-20% in the period 1980-2004), though there was an upward revival between 2000 and 2004 (+21%).

Figure 4.4: Unused Domestic Extraction [5]

The period under examination shows an overall downward trend in the quantities of unused domestic extraction (-20%), though there was a resumption of growth between 2000 and 2004 (+21%). Within this aggregate result, the quantities of unused residues from the activities involved in the collection of biomasses rose steadily; this growth took place despite a decrease in the quantities of the used materials that generate these residues.

Figure 4.5 illustrates the ratio between the overall quantities of used materials moved and the overall extraction of used materials within the national territory (domestic extraction of used materials). Despite the presence of short-term fluctuations, as well as the results observed above for biomasses, this ratio pointed to a downward trend for the period 1980-2004. The trend in question can be attributed to the excavation component, which is less closely related to the useful materials.

[5] Source: ISTAT



The ratio between the quantities of unused materials and the overall extraction of used materials from the national territory shows that, despite the fluctuations, the trend was downward (1980-2004).

Figure 4.5: Ratio between Unused Domestic Extraction and Domestic Extraction Used[6]

4.1.3 Imports and exports of materials

A country poor in natural resources, like Italy, which imports the metals and fuels needed to operate its economy, can transfer abroad the demand for materials, together with the potential pressures on the environment, of the extraction phase. A similar process, but in reverse, holds for exported goods.

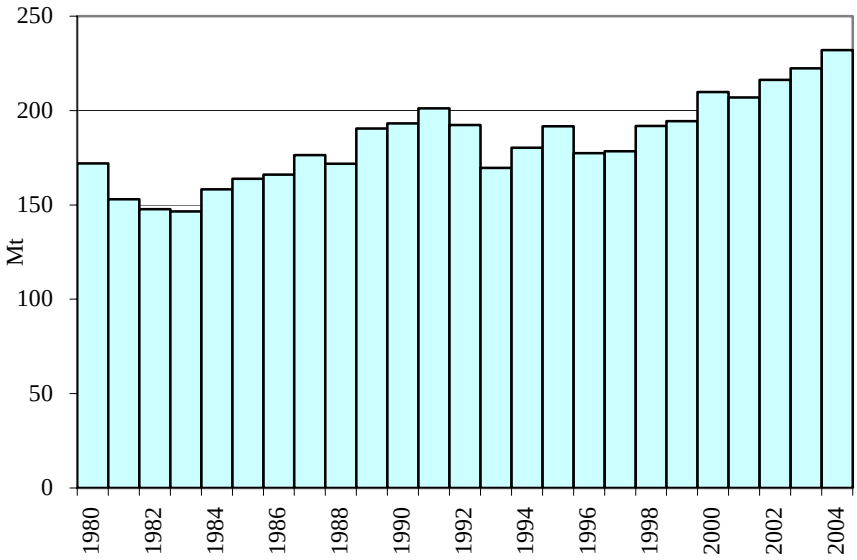
The supply of natural resources does not constitute an irremovable limit on economic growth, except on the planetary level. A country poor in natural resources, and especially in those of value, can import almost all the metals and fuels it needs to operate its economy, transferring abroad the demand for materials, together with the potential pressures on the environment tied to the extraction phase. To the extent in which the imported goods are not raw materials but transformed products (whose production has generated waste and emissions), the importing country also transfers abroad a portion of the pressures on the environment and the territory generated during the output of the materials. A similar observation, though framed in the opposite sense, holds for exported goods.

The balance between the total weight of imported goods and the total weight of exported goods – meaning the *Physical Trade Balance* (PTB – Figure 4.6) – provides an initial approximation of the role played by the country in the international distribution of the extraction of resources and their use, together with the related potential pressures on the natural environment.

The PTB grew by 35% during the period under examination, reflecting Italy's traditional dependence on imports and on foreign demand for transformed products. Short-term results are closely tied to the figures for imports; in the period between 2000 and 2004, the PTB registered

[6] Source: ISTAT

an increase of 10.7%, compared to respective growth rates of 7.5% and 9.5% in exports and imports.



The PTB, which provides an approximation of the role of the extraction of materials and their use, as well as the resulting potential pressures on the environment, grew by 35% during the period in question, reflecting Italy's dependence on imports and on foreign demand for transformed products.

Figure 4.6: Physical Trade Balance [7]

The comparison between the aggregate of the PTB and the monetary aggregate of the *Trade Balance* – which, during the period in question, shows the level of exports to be generally higher than that of imports - confirms the importance of the role of the transformation of materials to the Italian economy, whose task within the international division of labour is to add value to imported materials. Such materials enter the Italian economy as raw materials and semi-finished goods, and, at the very moment in which they receive the added value through production, they lose weight: in fact, a portion of the materials processed takes the form of waste, atmospheric emissions or other undesired sub-products. The resulting products have a unit value (per unit of weight) much higher than that of the imported goods.

A comparison of the aggregate PTB and the aggregate of the monetary trade balance confirms the major role played by the transformation of materials in the Italian economy, whose assigned function is to add value to imported products.

4.1.4 Materials processed by the national economic system

The *Direct Material Input* (DMI – Figure 4.7) registers the materials that enter the national economic system during a given accounting period. This indicator takes into account both the used materials procured from the national soil and all types of imports from abroad, regardless of the final destination (domestic or foreign) of their component materials.

[7] Source: ISTAT

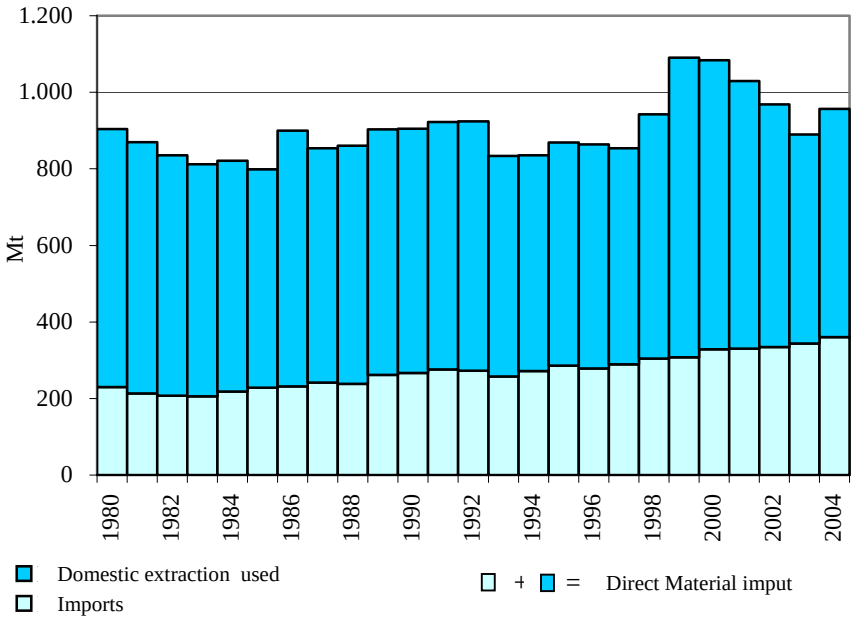


Figure 4.7: Direct Material Input of Materials [8]

The DMI, which registers the materials that enter the national economic system during the accounting period, rose by 5.8% in 2004, compared to 1980, meaning that it did not show marked growth.

The overall level of the DMI as of 2004 had risen by 5.8% compared to 1980. Thus there would not appear to be a decisive growth trend over the long term, with the key factor in the growth registered being the sudden increase recorded in the two-year period 1998-1999, when, as a result of the increase in the domestic extraction of non-energy minerals, the DMI reached a peak of almost one billion and 100 thousand tons.

The dynamics of the flows appear in a different light when the domestic component and imports are considered distinctly. The latter show a clear growth trend, reflected, as seen above, in the growth of the physical trade balance.

The results for the DMI are characterised by fluctuations that reflect similar changes in the level of the foreign extraction used :
A rise of 25.5% in the period 1995-1999; a reduction of 11.7% in the years 2000-2004.

The performance of the DMI is characterised by fluctuations, some of them of noteworthy extent, reflecting the fluctuating results for the domestic extraction used. During the period 1995-1999, the DMI rose to a considerable extent (+25.5%), while the dynamic for the years 2000-2004 was downward (-11.7%).
As a result of the growth in imports, the break-down of the various components of the Italian DMI has gradually shifted in their favour, with imports going from a percentage weight of 25.4% of the DMI in 1980 to 37.7% in 2004, registering the peak value in 2003 (38.6%).

While international trade transfers input pressures abroad, in terms of output, the quantities of materials that remain in the natural environment prove to be higher than would be possible based on

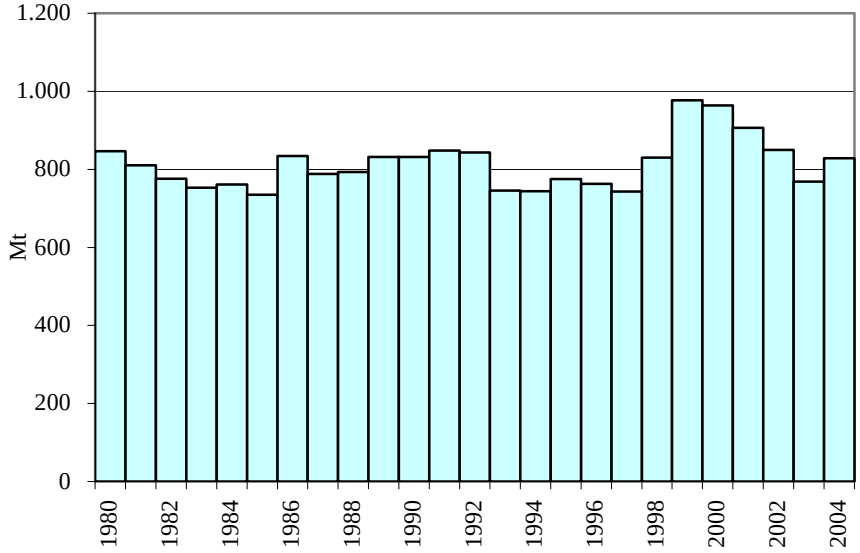
While foreign trade is able to lift the constraint represented by scarce resources and transfer the input pressures abroad, looking at the output, the quantity of materials that remains in the national natural environment proves greater than what would be possible as a result of domestic resources alone. These quantities are measured in the aggregate for *Domestic Material Consumption* (DMC), which is determined by subtracting the mass of exported materials from the

[8] Source: ISTAT

DMI, as shown in Figure 4.8.

domestic resources alone (as measured by the DMC).

Under the law of preservation of materials, the DMC, being equal to the sum of all the materials extracted domestically or abroad, and that remain in the country, represents all the materials that accumulate in the form of physical capital (buildings, infrastructures, machinery, durable goods, livestock) or that are transformed into waste, emissions in the air and the water, dissipated uses etc.. In other words, the indicator provides an overall measure of the potential pressures generated by our socio-economic system in terms of the output of materials that are to be borne by our natural environment.



No clear-cut trend emerges for the DMC over the long term. After having decreased by 12% in 1997, as compared to 1980, its growth resumed, peaking in 1999 (at approximately 1 billion tons).

Figure 4.8: Domestic Material Consumption [9]

The short-term dynamics of the DMC are in every way similar to those of the DMI. For the DMC as well, no clear-cut long-term trend can be observed: after a decrease that brought it to 87.8% of the initial level by 1997, the DMC grew in the course of the next two years, coming close to the mark of a billion tons in 1999 (the peak figure registered during the period considered). After a subsequent phase of settling, by 2004 the aggregate had returned to a level of roughly 830 million tons, equal to 98% of the value registered in 1980. Meanwhile regular growth had been recorded in the level of exports, in physical terms, with the figure more than doubling between 1980 and 2004 (+121%), so that, by the end of the period, it had reached nearly 15.5% of the DMC. The growth in exports highlights how the stress on the natural environment tied (in terms of both input and output) to the use of natural resources (both domestic and foreign) generated by Italian production activities is traceable, to an increasing extent, to the satisfaction of foreign demand.

[9] Source: ISTAT

4.1.5 The contribution of indirect flows

The Physical Trade Balance Including Indirect Flows (PTBIF) is a balance that takes into account not only physical imports and exports (direct flows) – meaning the subject of the PTB – but also the indirect flows associated with both imports (the natural resources mobilised abroad to support the country's activities) and exports (the natural resources mobilised to satisfy foreign demand[10]).
The PTBIF shows Italy's position in the international distribution of the use of material resources, taking into account the country's role not only as a net importer, but also as a user of indirect flows of materials attributable to the trade transactions in which it engages. From this perspective, the past results for the indicator point to the extent and the ongoing development of what ultimately amounts to an "ecological deficit" for the Italian economy (Figure 4.9).

The PTBIF illustrates Italy's position as a "user" of indirect flows of materials within the international distribution of the use of material resources. Thus the set of results from the past points to an overall "ecological deficit" on the part of the Italian economy.

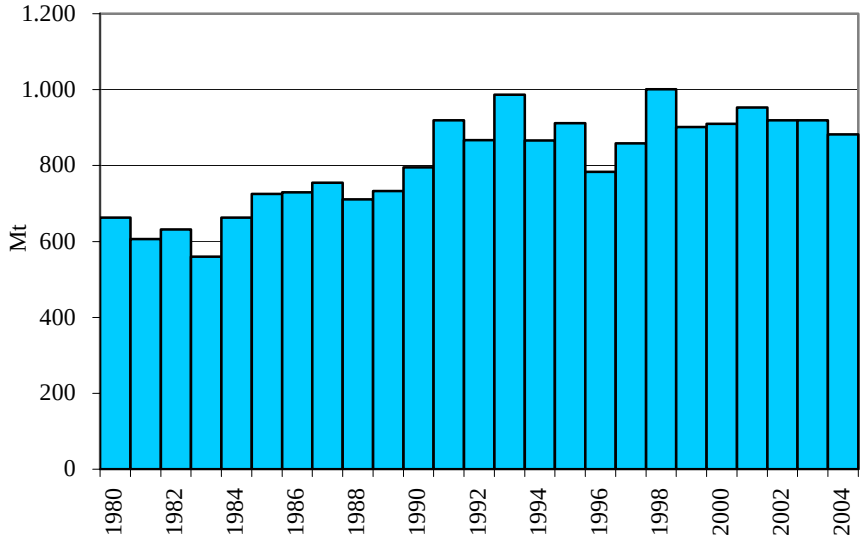


Figure 4.9: The Physical Trade Balance including Indirect Flows[11]

Between 1980 and 2004 the PTBIF rose by 33%, pointing to a growing gap, in terms of materials, between the natural resources requested by Italy from the rest of the world and those needed by the country to produce the goods it exports.

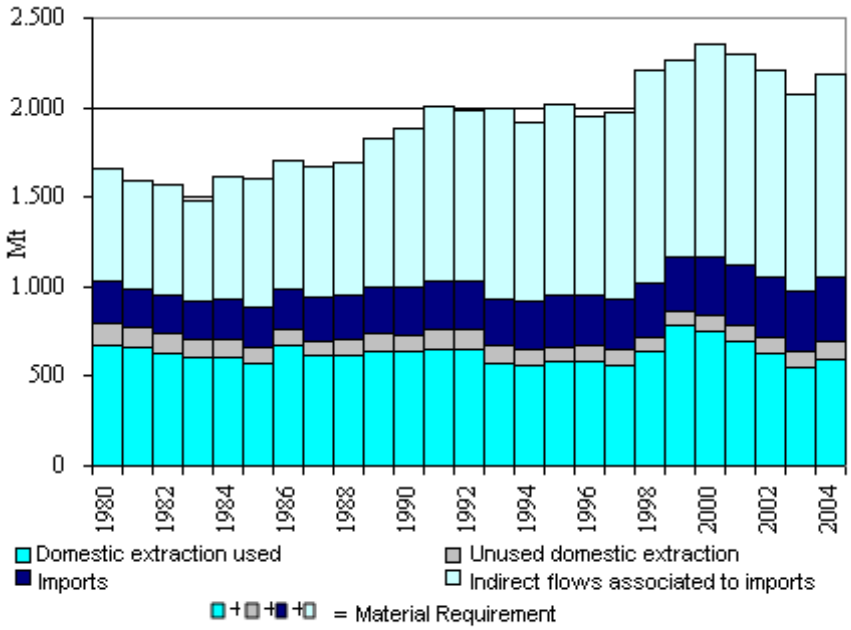
During the period under examination, the value of the indicator remained positive to a noteworthy extent, increasing by 33% and pointing to an increasing gap, in terms of materials, between the natural resources requested by Italy, both directly and indirectly, from the rest of the world and the resources needed by the country to produce the goods it exports. The total physical flows for imports rose by 73.4%, while those for exports grew by 210.8%. Though the growth of the total flows tied to exports was rapid in relative terms, in absolute terms it was decidedly lower than that of the total flows tied to imports, given the much lower starting point. It is interesting to note that, between 2000 and 2004 the PTB_{IF} registered a decrease of 3%, falling from approximately 910 million to 880 million tons, a result mainly

[10] The accounting approach is a modified version of that recommended in the Eurostat Methodological Guide, in that it includes, unlike the Guide, the direct flows
[11] Source: ISTAT

attributable to a decrease in imports, as well as to lower indirect flows connected to imports (-2%).

4.1.6 The total material requirement and consumption

In calculating the *Total Material Requirement* (TMR Figure 4.10) – the most extensive of the aggregates found in the EW-MFA system of accounts on flows of materials – consideration is given to the sum total of all the flows of materials, used and unused, that have made possible the functional operations of the Italian economy, directly or indirectly, during the accounting period in question.

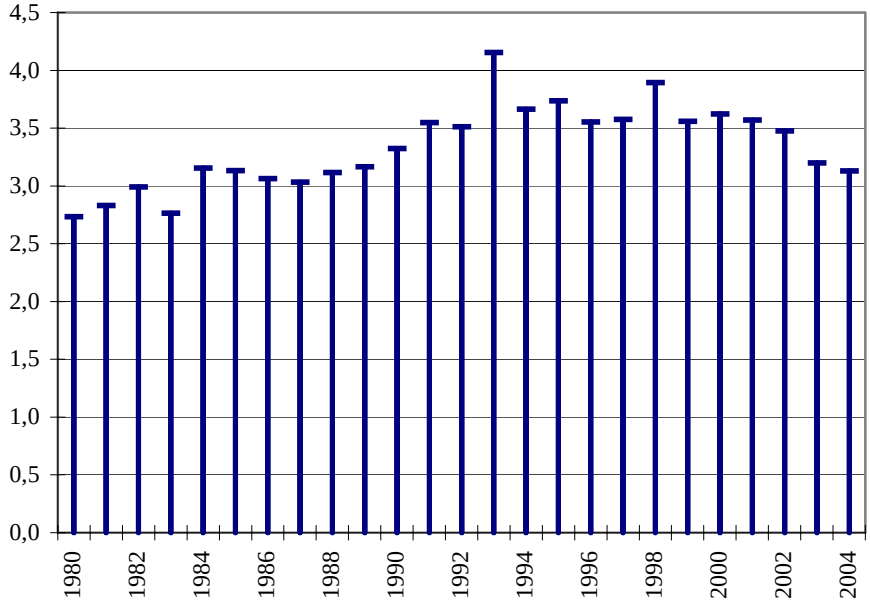


Between 1980 and 2004 the TMR rose by 31.8%; this growth was due to the indirect flows associated with imports (+79.5%). This shows that the country's economic activities have called for increasing supplies of virgin materials from the natural system of the rest of the world.

Figure 4.10: Total Material Requirement [12]

During the period in question, the Italian TMR grew by 31.8%; this growth is due to the flows tied to imports: as of 2004, domestic extractions of both used and unused materials showed a decrease of 13% compared to 1980. The growth in the TMR was traceable, first and foremost, to the indirect flows associated with imports, which rose by 79.5%, going from 38% of the TMR to approximately 52%. This shows that the country's economic activities, though they have not directly involved a growing quantity of materials, have called for the procurement of increasing quantities of virgin materials from the natural system of the rest of the world. The increase in the quantity of imported products (+56.7%) provides only a partial explanation for the rise in the indirect flows associated with imports: the remainder is due to growth in the average indirect flow tied to each unit of material imported.

[12] Source: ISTAT



In 1980, for each ton of goods imported by Italy, flows of materials equal to 2.73 tons were moved abroad, while the figure for these flows was more than 3.13 tons in 2004. This points to a change in the make-up of Italian imports in favour of types of goods whose production calls for relatively high flows of materials.

Figure 4.11: Indirect flows associated with imports as a percentage of imports [13]

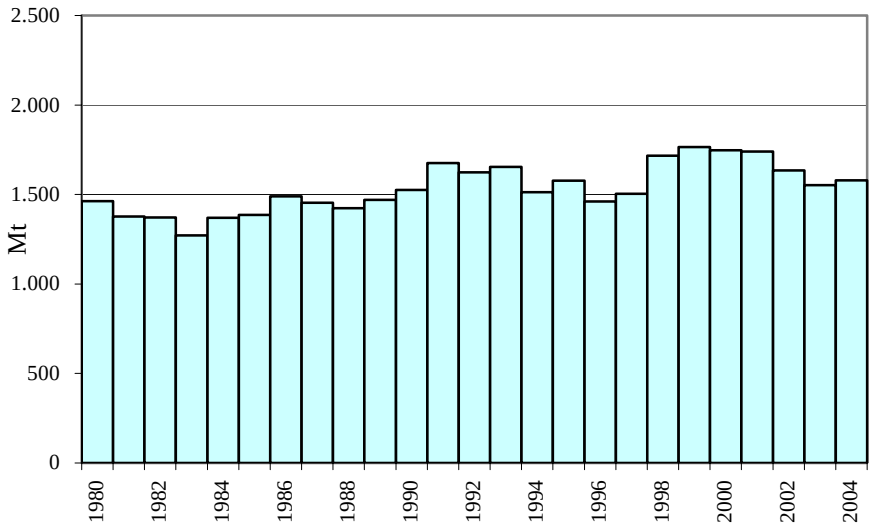
As shown in Figure 4.11, in 1980 material flows of 2.73 million tons were moved abroad for each ton of goods imported by Italy, whereas these indirect flows totalled more than 3.13 million tons by 2004. This points to a change in the make-up of Italian imports in favour of types of goods whose production calls for relatively high flows of materials in the early stages of the process. The indirect flows triggered per unit of imported goods was especially high in the last decade of the past century, during which the ratio in question was constantly above 3.5.

The chief reason for the decrease in the TMR registered in the last few years (-7.3% between 2000 and 2004) is less the downward trend observed during the same period for indirect flows associated with imports (-5.4%) than the noteworthy decrease in the foreign extractions of used materials (-21%).

The decrease in the TMR between 2000 and 2004 (-7.3%) can be tied less to the decrease registered during the same period in the indirect flows associated with imports (-5.4%) than to the noteworthy drop in domestic extraction of materials used (-21%).

Total Material Consumption (TMC), obtained by subtracting the indirect flows associated with the TMR from the TMR itself, takes into account movements of materials on a global level (and, therefore, production of scrap as well) traceable to the internal demand for goods and services.
The evolutionary development of the aggregate result during the period of 1980-2004 is shown in Figure 4.12.

[13] Source: ISTAT



During the period under examination, the TMC showed a certain growth trend (+7.9%), though it recorded a gradual decrease of 9.7% between 2000 and 2004, reaching a level of 1,578 million tons in 2004.

Figure 4.12: Total Material Consumption [14]

During the period under examination, the TMC showed a certain growth trend (+7.9%), though it recorded a gradual decrease between 2000 and 2004, a period during which it fell by 9.7%, reaching a level of 1,578 million tons in 2004. The rise in global stress on the environment tied to the demand for goods for consumption and investment by Italians has been accompanied by a slight decrease in the quantity of materials which, having been directly transformed, remained in the country (in 2004 Domestic Material Consumption was 2% less than 1980).

4.1.7 Has economic growth in Italy been decoupled from the use of resources?

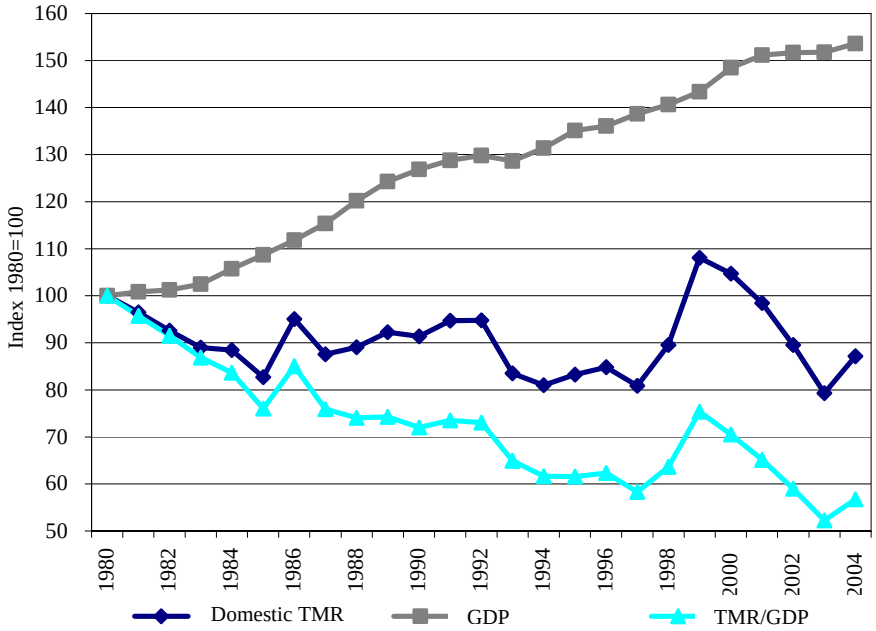
The indicators of the flows of materials of the national socio-economic system provide a response to the need of public decision-makers and citizens for concise information on the use of natural resources and on environmental pressure.

The indicators on the flows of materials of the national socio-economic system respond to the need of public decision-makers and citizens for concise information on the use of natural resources and on environmental pressure, to be cross-referenced with monetary indicators on economic activities in order to carry out the relevant decoupling analyses. To this end, it should be kept in mind that the indicators in question provide information of a holistic nature on the potential for the generation of pressure on the natural environment.
The indicators used herein are especially well suited to comparisons with the monetary indicators produced by the national central accounting unit; in fact, the latter are based on a methodology (the accounting of flows of materials on the level of the entire economy) that shares the conceptual underpinnings of the national accounting approach based on satellite counts.

Domestic Total Material Requirement (Domestic TMR) provides information on the use of the resources found inside the national territory, as well as on the pressure potentially applied to the territory

[14] Source: ISTAT

through the removal of the resources. The indicator takes into consideration, therefore, only the stress on the national natural environment directly tied to the input of materials.



During the period 1980-2004, the Domestic TMR showed an overall downward trend, unlike the GDP, which grew (+53%). In absolute terms, therefore, a decoupling took place. Still, the trend in question shows little stability.

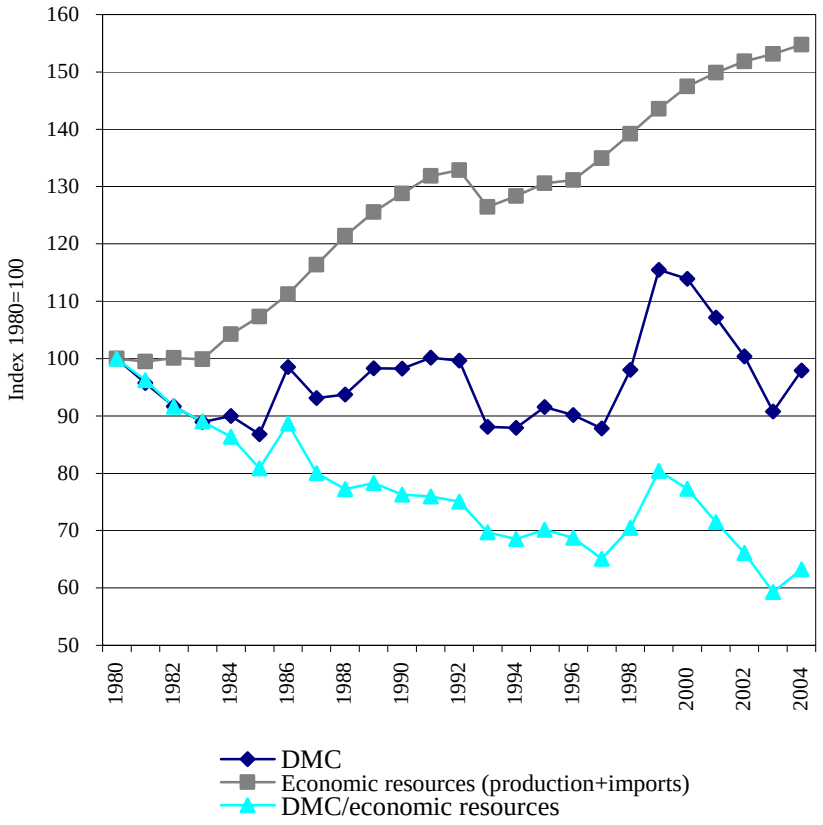
Figure 4.13: Domestic Total Material Requirement, GDP and their ratio[15]

During the period 1980-2004, the Domestic TMR showed a downward trend overall (Figure 4.13). This stood in contrast with the growth of the GDP (+53%). Based on the picture provided by this indicator, therefore, a decoupling did occur in absolute terms. It should be noted, however, that the trend in question shows little stability.
The relationship between the Domestic TMR and the GDP provides an indicator of the *intensity* of the use of national natural resources per product unit. The direction taken by this ratio (-43%) demonstrates the strength of our economy's push to increasingly free itself from the limit placed on growth by the scarce domestic availability of natural resources; the trend in question can be traced to the structural evolution of the economy rather than to increased efficiency in the use of resources within the different sectors.

Domestic Material Consumption (DMC) provides information not only on the quantity of materials needed to satisfy domestic demand, but also on the potential of the Italian economy to generate direct pressure in terms of outlet materials[16].
The time series 1980-2004 do not show a well defined trend for the DMC over the long term (Figure 4.14). Specifically, it cannot be held

[15] Source: ISTAT
[16] Under the law on the conservation of materials, at the end of the accounting year, the materials covered by the index (national resource of domestic origin and products from abroad), not having left the country as exports, are considered to have been transformed into emissions or to have been accumulated inside the national territory as stocks of products or as waste

that there is decoupling in absolute terms, seeing that no noteworthy decrease in the indicator has been observed. It can be noted, however, that, in the course of the same period, while the DMC essentially remained unchanged, the economic resources for domestic use grew by 55%[17]. This points to a noteworthy decoupling in relative terms, meaning a tendency for the values of the goods purchased and the services used in our country not to depend on the quantities of materials used domestically, emitted into the natural environment or accumulated in Italian territory. A further point of note is that the increased ecological efficiency demonstrated by the results for the ratio between the two indicators (-37%) regards only direct flows of materials.



The time series 1980-2004 do not provide a well defined, long-term trend for the DMC. Decoupling in absolute terms cannot be said to exist, given that there was no noteworthy decline in the indicator.

Figure 4.14: Domestic Material Consumption, Economic resources (GDP + imports - exports) and their ratio [18]

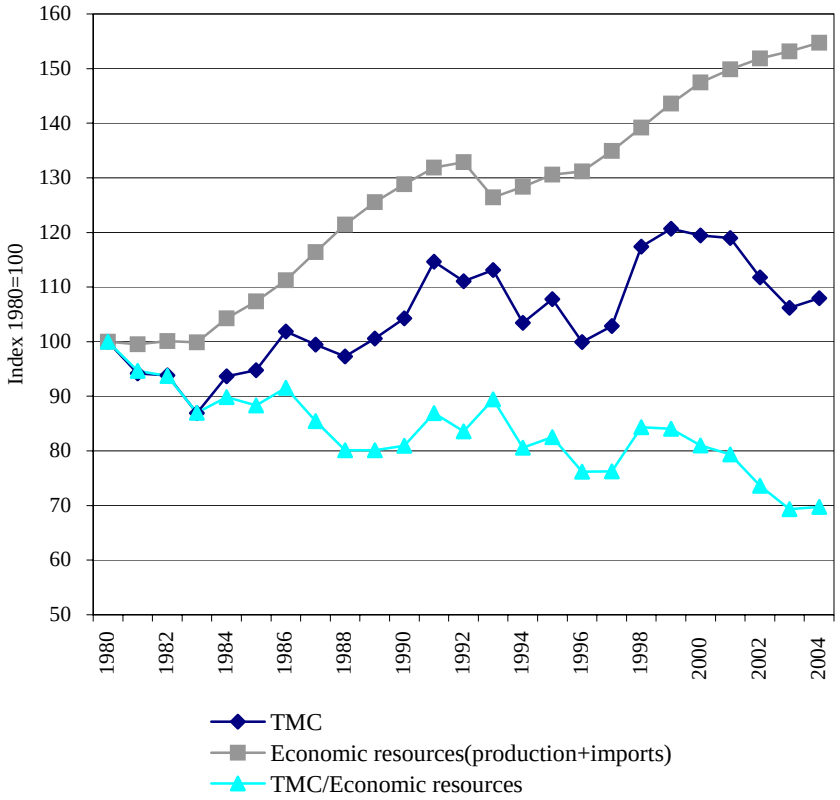
Total Materials Consumption (TMC) serves as a reference for evaluating a contribution made by a country to the procurement of resources on a global scale, as well as to the potential pressure tied to the output side of the use of materials, triggered directly or indirectly by the country in question.

The ratio between the TMC and the total economic resources for domestic use points to a major improvement in efficiency, a sign of a *relative decoupling*: for each unit of value of the resources available in

[17] This is a monetary aggregate similar to the DMC, arrived at by taking GDP + Imports - Exports

[18] Source: ISTAT

our system, a lesser quantity of extractions from and restitutions to the natural environment has been enacted globally (Figure 4.15). Still, the TMC does not show a trend towards decoupling in absolute terms (+8%).



The ratio between the TMC and the total economic resources available for domestic use shows a noteworthy improvement in efficiency, sign of a relative decoupling.

Figure 4.15: Total Material Consumption, Economic resources (GDP + imports - exports) and their ratio[19]

In short, while there has been an improvement in the efficiency of the use of the resources in the chain of global transformation at whose endpoint the needs of Italians are found (expressed by the ratio TMC/economic resources available for domestic use), and the quantity of materials procured directly from the national territory has decreased (as shown by the Domestic TMR), the potential pressures on the national territory (shown by the DMC) have remained essentially unchanged, while there has actually been an increase in the demand for natural resources and environmental services implicit in Italian practices of consumption and investment and borne by the global environment.

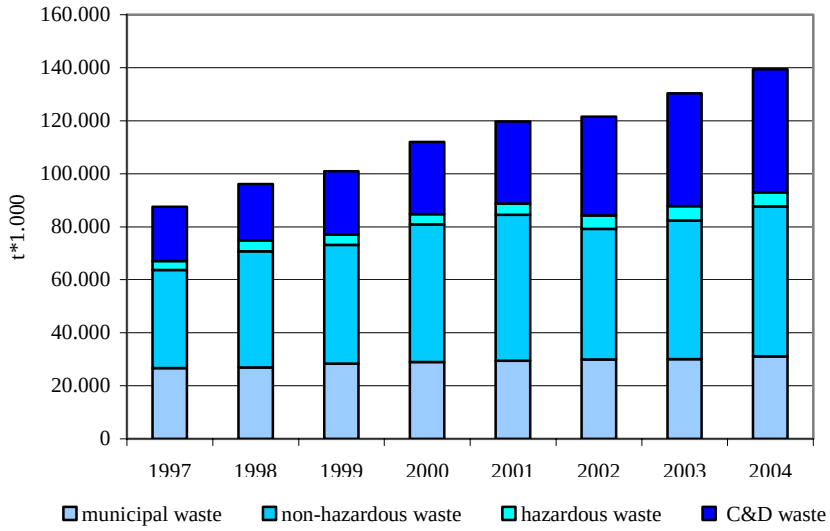
Though the use of resources has become more efficient, and the quantity of resources extracted directly from Italian territory has decreased, the potential pressures in Italy have remained essentially stable, while the demand for natural resources and environmental services borne by the environment has actually increased.

[19] Source: ISTAT

4.2 Waste Cycle

4.2.1 Waste Generation

During an eight-year period (1997-2004) in which the waste cycle was observed more completely and accurately (Figure 4.16), an increase of almost 60% was registered in total generation (municipal waste and hazardous and non-hazardous waste[20], which went from approximately 87.5 million tons in 1997 to slightly more than 140 million tons in 2004. The annual average growth rate was approximately 7%, and the latest figure available falls within the average, at roughly 6.9%.



Between 1997 and 2004 total waste generation grew by 60%, going from approximately 87.5 million tons in 1997 to slightly less than 140 million tons in 2004.

Figure 4.16: Break-down of total waste generation[21]

The above scenario stands in sharp contrast with the strategic and regulatory guidelines of the European Union, which place top priority on efforts of quantitative and qualitative prevention involving waste; this entails undertaking concrete initiatives that focus to an increasing degree on the source of the waste, addressing the planning of the products, the generation cycles and the promotion of sustainable consumption.

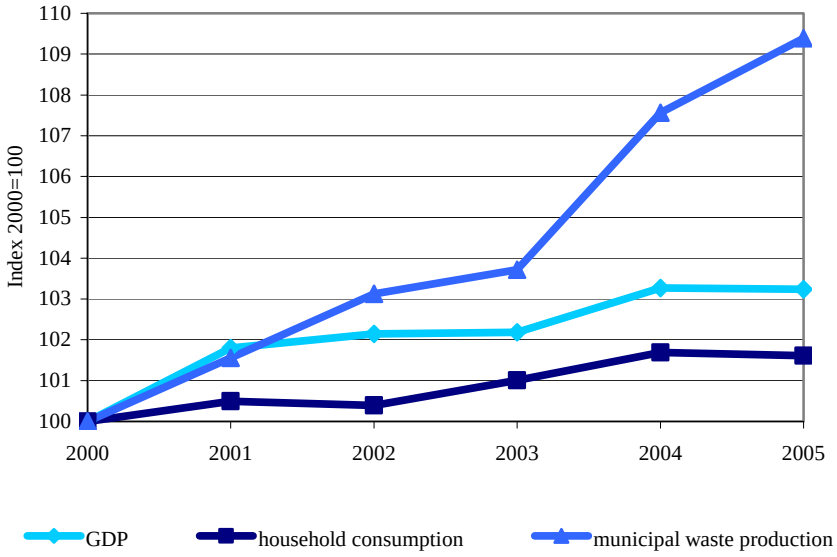
The situation stands in contrast with the strategic guidelines of the EU, which place priority on the quantitative and qualitative prevention of waste, and thus the need for initiatives focussing on generation cycles and sustainable consumption.

In the case of municipal waste as well, following a period of limited growth, generation has accelerated, with a percentage increase of 5.5% between 2003 and 2005, reaching a total amount of approximately 31.7 million tons. This increase is significantly higher than the one for the period 2001-2003 (2.1%). The growth appears more significant in the central regions, where generation registered a percentage increase of slightly less than 9% between 2003 and 2005, as compared to increases of 4.6% in the North and approximately 4.4% in the South. In 2005, overall municipal waste generation was equal to approximately 14.2 million tons in the north, 7.2 million tons in the central regions and

[20] Waste generated by economic activities
[21] Source: APAT

approximately 10.3 million tons in the South.

As shown in Figure 4.17, the correlation between municipal waste generation and the socio-economic indicators, such as the GDP and household consumption, documents the lack of alignment between economic growth and waste generation and confirms the failure of prevention policies. Though the GDP grew by 1% between 2003 and 2005, and household consumption by 0.6%, municipal waste generation rose by 5.5%.



A lack of alignment can be observed between economic growth and the quantities of waste generated, confirming the failure of prevention policies. Though the gross domestic product grew by 1% between 2003 and 2005, and household consumption by 0.6%, municipal waste generation rose by 5.5%.

Figure 4.17: Municipal waste generation and the main socio-economic indicators[22]

At the national level, the per capita generation growth is significantly lower than the total generation increase (in tons). The national per capita growth between 2003 and 2005 was approximately 2.9%, with decidedly limited increases in the North. In fact, the increase in this area was only slightly higher than 1%, primarily as a result of a parallel increase (+2.2% between 2003 and 2005) in the resident population. During the same period, a different situation were observed in the central and south regions, which registered respective growth rates of 5.5% and 3.3%.

An analysis of the per capita data, meant to evaluate the waste generation without taking into consideration the level of the resident population, shows that, as in previous years, the highest levels for 2005 were recorded in the central regions, with approximately 633 kg of waste per inhabitant per year, while the lowest amounts were found in the south, which stood at 496 kg/habitant per year; as for the north, it turned in a figure of approximately 533 kg/habitant year, very close to the national average of 539 kg/inhabitant per year.

Analysing the per capita data,, the highest levels of generation for 2005 were found in the central regions, at approximately 633 kg/inhabitant, while the lowest levels were recorded in the south (496 kg/inhabitant),with the

In this case the north/central difference could be attributable to the greater likelihood, in the central regions, of waste from small-scale

[22] Source: APAT

industries and commercial enterprises being classified as municipal waste.

north turning in a figure of approximately 533 kg/inhabitant.

An analysis of the regional data shows that, as of 2005, the regions with per capita generation of more than 620 kg/inhabitant were Tuscany (697), Emilia Romagna (666) and Liguria (620), while those that presented the lowest levels of per capita generation were Molise (414) and Basilicata (451). Despite these figures, the regions that showed noteworthy growth between 2004 and 2005, in line with the figure for absolute generation, were Basilicata (+13.5%) and Molise (+8.8%).

To establish comparisons with the rest of Europe, reference must be made to the data for 2004: in this year, Italy registered per capita generation of municipal waste of 533 kg/habitant, lower than the EU/(25) European average, which was roughly 537 kg/habitant, as well as the EU(15) average, equal to approximately 580 kg/inhabitant per year.

The generation of hazardous and non-hazardous waste, not including waste generated by construction and demolition activities (C&D), continues to grow, having risen from slightly more than 40 million tons in 1997 to approximately 62 million tons in 2004. The increase of 7% registered between 2003 and 2004 is in line with the annual yearly growth rate registered during the period 1997-2004, which was roughly 6.5%.

In 2004 Italy registered per capita generation of urban waste of 533 kg/inhabitant, lower than the EU(25) European average of approximately 537 kg/habitant, as well as the EU(15) average, equal to roughly 580 kg/inhabitant.

A similar increase was recorded for inert waste generated by construction and demolition activities. Generation of this type of waste went from approximately 21 million tons in 1997 to more than 46 million in 2004.

4.2.2 Waste management (Response)

The general objective of waste management must be the rational and sustainable use of resources, and activities must be structured in accordance with a precise ranking of priorities, listed in detail in the recent framework directive on waste:

The general objective of waste management should be the rational and sustainable use of resources; nevertheless, the situation observed is not comforting.

- quantitative and qualitative waste prevention measures through a reduction of the hazardous substances contained in the products;
- preparation for the reutilisation of products that have become waste;
- recovery of waste as products, materials or substances, eventually through an increase in separate collection of municipal waste
- other recovery operations, such as energy recovery;
- disposal operations.

In light of the above objectives, the picture that emerges from an analysis of the data is not comforting.

In 2005 separate collection, which plays a priority role in the municipal waste management system, accounted for slightly less than 7.7 million tons, equal to 24.3% of total municipal waste generation, a figure significantly lower than the target of 35% set for 2003 by Legislative Decree 22/97 (in force at the time).

Separate collection, which plays a priority role in the municipal waste management system, stood at slightly less than 7.7 million tons in 2005, equal to 24.3% of the

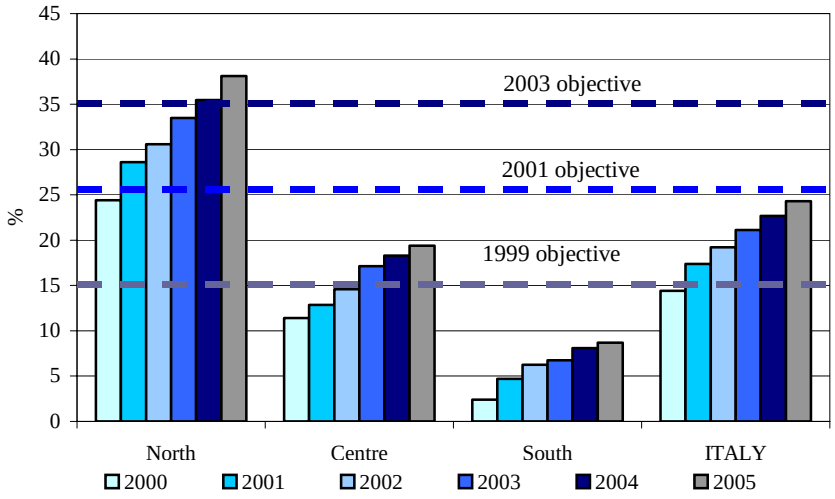
Between 2001 and 2005, separate collection showed an increase of approximately 2.6 million tons, corresponding to percentage growth of

roughly 50% (Figure 4.18). During the same period of time, overall municipal waste generation registered an increase of approximately 2.3 million tons, meaning that the positive effect of the separate collection increase was partially offset by a simultaneous rise in waste generation; nevertheless, the levels of separate collection reached nationally are still low. However, significant differences can be noted in the three macro-areas: the North, with a percentage of 38.1%, exceeds the target of 35% (the target had already been met in 2004), while the percentages for the central and south regions, respectively 19.4% and 8.7%, still fall far short of this target. Between 2001 and 2005, separate collection increased by 9.5 percentage points in the North, 6.6 percent in the central regions and 4 percent in the South.

total municipal waste generation, a figure significantly lower than the target of 35% set for 2003.

At the regional level, high percentages of separate collection were recorded for 2005 in Venetia, Trent Alto Adige, Lombardy and Piedmont. Venetia, in particular, with a percentage of 47.7%, ranks well above the targets set for 2003. The most sizeable increase, however, was recorded by Trent Alto Adige, whose percentage of separate collection went from 37.8% in 2004 to 44.2% in 2005. The growth achieved in this region appears even more significant when one considers that, in 2001, the rate of separate collection still stood below 25%.

Three regions - Emilia Romagna, Tuscany and Friuli Venetia Julia, present percentages of more than 30%, while two other regions, Val d'Aosta and Umbria, show percentages of more than 20%. The regions with a separate collection percentage of between 15% and 20% were, in 2005, Liguria (18.3%), the Marches (17.6%) and Abruzzo (15.6%). All the other regions turned in 2005 levels that were still extremely low (far short of the objective of 15% called for under Legislative Decree 22/97 for the year 1999), without showing significant progress since 2004, except in the case of Sardinia, which, following a percentage improvement of approximately 4.6 points, came close to the 10% mark in terms of differentiated collection.



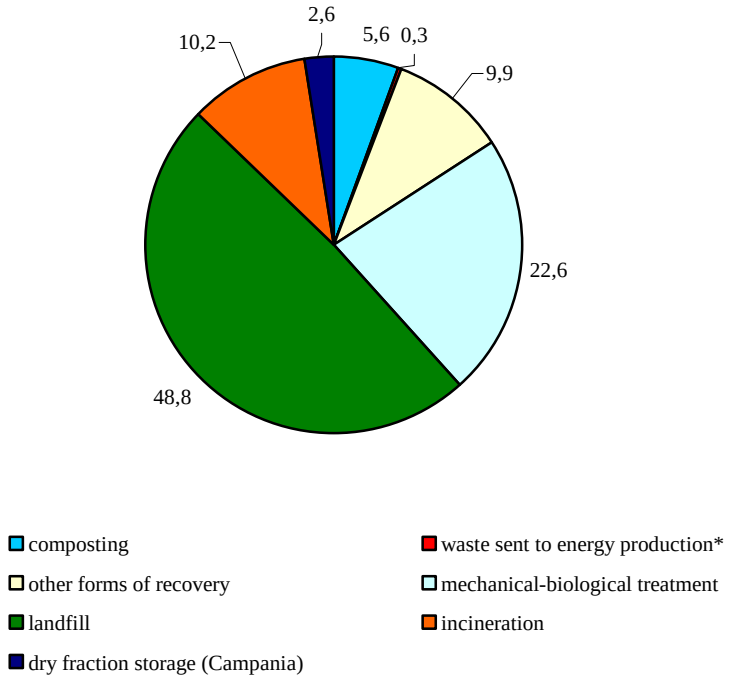
The situation appears different from one geographic macro-area to another: the North, with a rate of 38.1%, is well above the objective of 35%, while the central regions (19.4%) and the south (8.7%) are still far removed from the goal.

Figure 4.18: Percentage of separate collection of municipal waste [23]

In terms of the management of municipal waste (Figure 4.19), an analysis of the data for 2005 points to a decrease in landfilling and a rise on other types of management. Compared to 2004, the use of landfill has decreased by 2.7 percentage points, falling at a greater rate than was observed in previous years. Nevertheless, it remains the most widely practiced form of management.
The other forms of management register increases that are relatively limited, in the case of incineration (+7.4%) and other forms of material recovery (+5.0%), while the results are higher for mechanical-biological treatment (+13.6%) and composting from select matrixes (+12.9).
Incineration went from 8.8% in 2001 to 10.2% in 2005, for a per capita figure of 65 kg/inhabitant.

In recent years, mechanical-biological treatment has taken on an increasingly important role, contributing to ensuring more correct management of mixed waste. After a phase of essential stability (2003-2004), an increase of 13.6% was registered in this form of treatment in 2005; the amount of mixed waste treated went from 7.4 million tons to 8.5 million (from 20.4% to 22.6% of the total managed).
As a rule, an integrated management system, in accordance with the European-Community guidelines, should include ample use of biological treatments. This approach makes it possible to achieve material recovery of biowaste, while, at the same time, reducing landfilling of biowaste, in accordance with art. 5 of Legislative Decree 36/2003.
Another important contribution to such efforts is made by composting treatment, which went from 1.96 millions tons to 2.1 million tons (from 5.4% to 5.6% of the total waste managed), registering growth of approximately 13%, following the disappointing results of the three-year period 2002-2004.

[23] Source: APAT



An analysis of the data for 2005 point to a reduction in municipal waste landfilling (-2.7%) and an increase in other types of management. Specifically: incineration (+7.4%), other forms of materials recovery (+5.0%), mechanical-biological treatment (+13.6%) and composting from select matrixes (+12.9).

Legend: * Estimated figure
Figure 4.19: Municipal waste management (%) 2005[24]

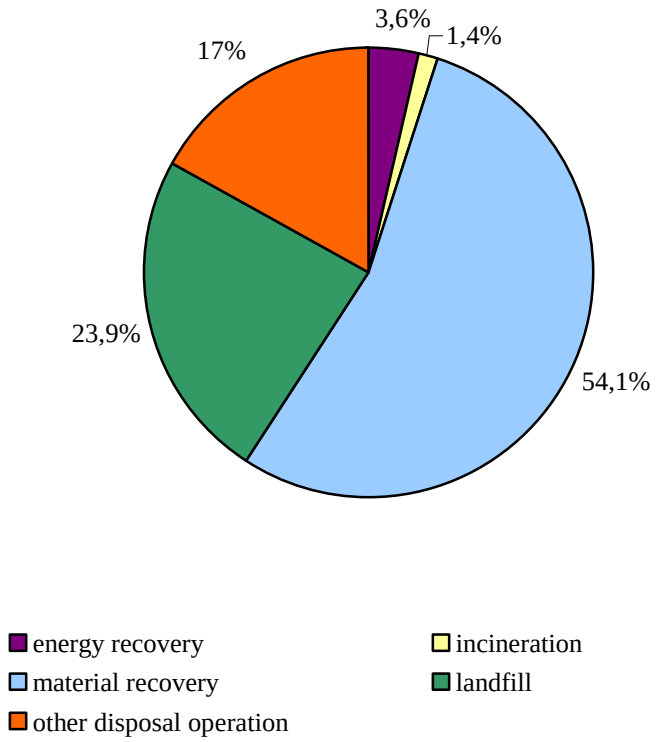
The total amount of hazardous and non-hazardous waste managed in 2004 (Figure 4.20) stood at slightly less than 95 million tons, of which 46.7 were sent to be recovered, 34.8 were earmarked for disposal and nearly 12.8 were placed in storage.
An analysis of the data, excluding the quantities placed in storage, shows that the most widely used form of management is material recovery (54.1%), which works out to approximately 44.6 million tons in absolute terms.

Data on hazardous and non-hazardous waste management, not including the quantities sent off to storage, shows that the most widely used form of management is materials recovery (54.1%).

As for disposal operations, it should be noted that, unfortunately, landfilling remains the most widely used form of disposal, accounting for 23.9% of all waste managed and approximately 59% percent of the total sent off for disposal operations, for an increase, in absolute values, of approximately 700 thousand tons. The overall amount of hazardous and non-hazardous waste landfilled in 2004 was approximately 19.7 million tons.

Landfillig remains the most widely used disposal method, accounting for 23.9% of the total managed.

[24] Source: APAT



The total amount of hazardous and non-hazardous waste managed in 2004 stood at slightly less than 95 million tons, of which 46.7 were sent on for recovery, 34.8 designated for disposal operations and almost 12.8 placed in storage

Figure 4.20: Management of hazardous and non-hazardous waste, excluding storage (2004)[25]

[25] Source: APAT.

5. ENVIRONMENTAL RISK

Introduction

Risk consists of the expected number of human losses and injuries, property damage and shutdowns of services or economic activities resulting from a given event of natural or anthropic origin.

The term risk is often used as a synonym of the likelihood of a loss or a hazard. In technical terms, risk represents the expected number of human losses and injuries, damage to property, shutdowns of services and economic activities, as a result of a specific event of natural origin or one caused by human activity. As a rule, risk is expressed as the product of three parameters: R = P x V x E, where P indicates the level of hazard, V the vulnerability and E the value exposed. The level of hazard is the probability that a given event will occur at a certain intensity in a given area and within a certain interval of time. Vulnerability expresses the capability of manmade works and environmental resources to resist a given calamitous event. Exposure expresses the value of the full set of elements at risk (human lives, infrastructures, historic, architectonic, cultural and environmental resources) inside of the area exposed.

In the present analysis of the problems tied to Risk, it has been decided to subdivide the topic into two parts: Natural Risk and Anthropogenic Risk. This approach is taken because, though there exist connections between natural risk and that caused by human activity, the topics treated herein present distinctive characteristics that deserve to be addressed separately. It should be noted that this chapter shall address the components of natural risk that directly involve the geo-sphere and the components of anthropogenic risk that regard industrial activity.

5.1 Risk of Natural Origin

The natural evolutionary processes of the territory, the soil and subsoil, interacting with human components (population, inhabited zones, infrastructures, etc.) frequently give rise to conditions of risk. Natural risk is the expected damage to man and the environment following the occurrence of certain events that can be subdivided into two main categories of underlying causes: events of endogenous origin, meaning those set off by forces within the earth, and those of exogenous origin, traceable to the action of forces that act on the external surface of the planet. Endogenous processes manifest themselves through volcanic and tectonic activity, while exogenous processes, often not necessarily tied to extreme meteorological events, operate on the terrestrial surface, tending to level the landscape through the erosion of elevations and the sedimentation of low-lying zones. Such actions (both endogenous and exogenous in nature), which include volcanic eruptions, earthquakes, landslides, floods (along riverbanks and coastlines), avalanches and accelerated erosion (of beaches and riverbeds), place the safety of individuals at risk, in addition to causing noteworthy damage to human infrastructures and settlements. The interaction between the natural events referred to above and activities of human origin is reciprocal, with the consequence that inappropriate modes of use and management of the territory frequently result in an amplification of the disturbances underway or in the triggering of new ones. This is especially apparent in the case of the deterioration of pedological coverings (soil, subsoil), which can compromise the functional efficiency of the soil (i.e. erosion from water, transformation to an impermeable state, compacting, salinisation, contamination) to the point of desertification, in addition to causing coastal erosion.

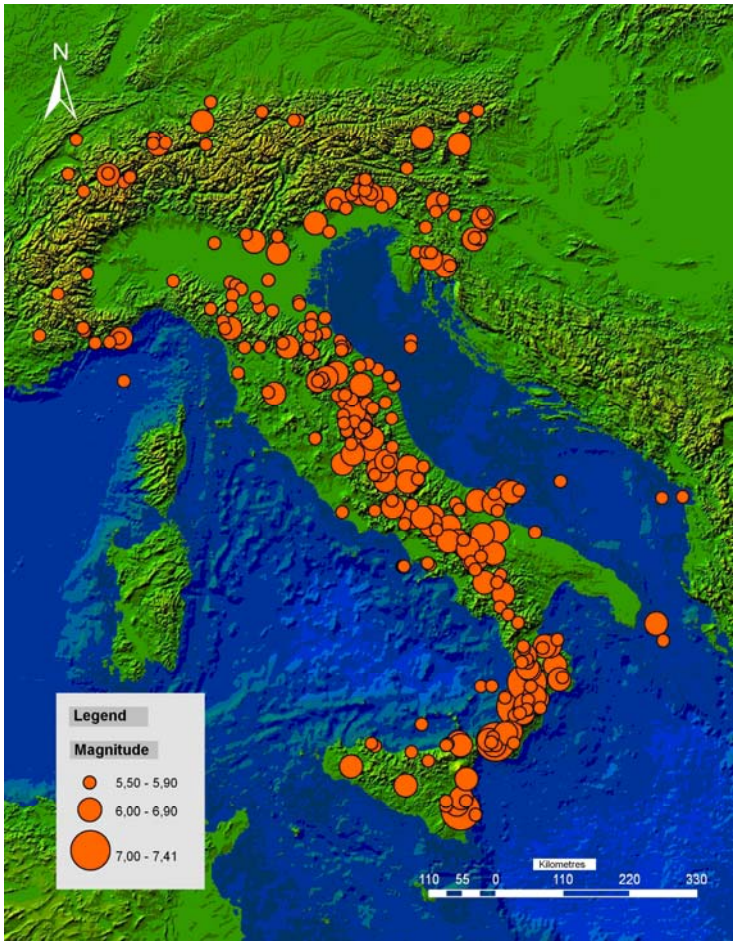
Natural risk manifests itself through the occurrence of events of endogenous origin (volcanic and tectonic activities) and of exogenous origin (erosion of elevations and sedimentation of low-lying areas), which events interfere with anthropogenic activities.

An inappropriate use of the territory by man may amplify disturbances underway or trigger new ones.

5.1.1 The situation

The specific location of Italian territory within the Mediterranean geodynamic setting (convergence of the European and African plates, interposition of the Adriatic micro-plate, opening of the Tyrrhenian basin) and the distinctive modes of surface response to dynamics deep underground make Italy one of the countries facing the greatest seismic and volcanic danger in the area. The elevated seismic and volcanic hazard, combined with the widespread presence of exposed elements, (population centres, infrastructures, the architectonic, artistic and environmental heritage) and the noteworthy vulnerability of the same, creates conditions of high to very high risk for extensive sectors of Italian territory. The areas facing the greatest seismic risk are found in the Friuli sector, along the central-southern spine of the Apennine range, and especially in the sectors of the inter-Apennine basin, along the Calabrian edge of the Tyrrhenian and in southeast Sicily (Figure 5.1).

Italy faces one of highest levels of seismic and volcanic hazard of any European country.

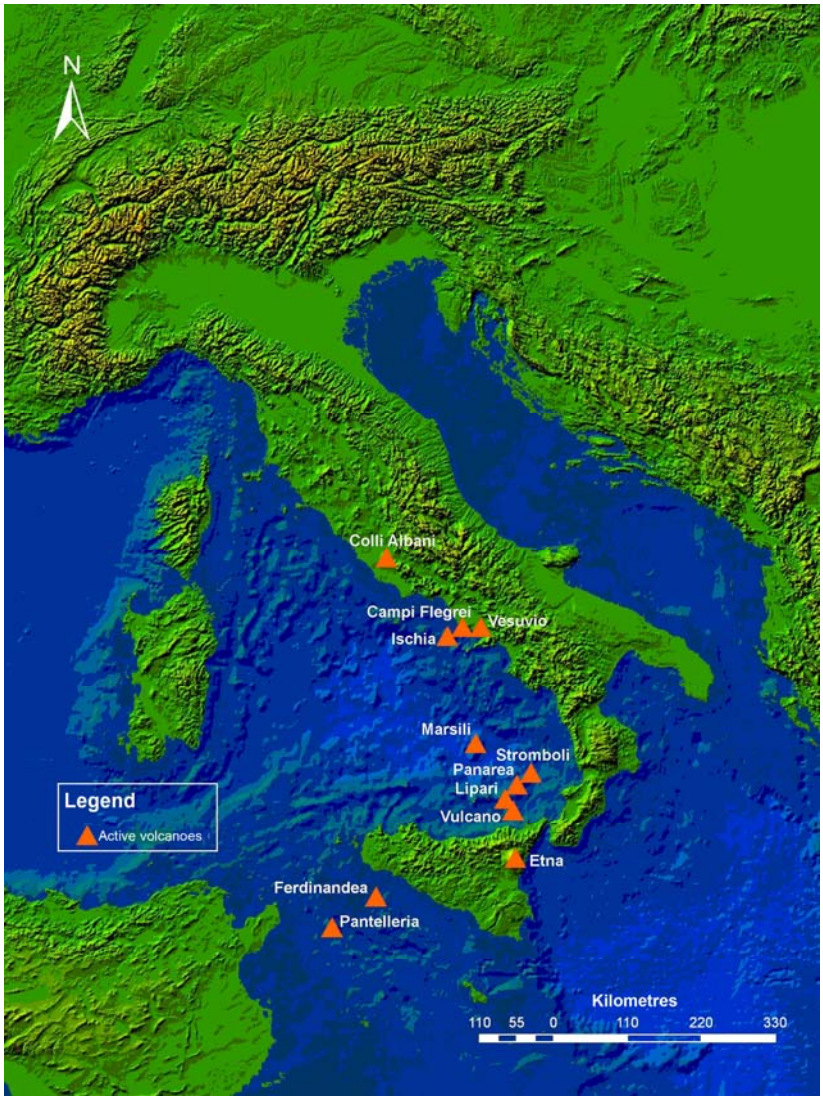


Italy faces one of the highest levels of seismic hazard in Europe.
The areas at the greatest seismic risk are those in the Friuli sector, along the central-southern Apennine spine (intra-Apennine basins), the Calabrian edge of the Tyrrhenian zone and southeast Sicily.

Figure 5.1: Distribution throughout the national territory of the major seismic events (magnitude ≥ 5.5)[1]

The conditions of greatest volcanic risk are naturally tied to the proximity of Italy's active volcanoes, meaning that they regard the Vesuvius and Phlegraean area, the Island of Ischia, the Etna sector, the Aeolian Islands and, in all probability, the Alban Hills (Figure 5.2). A decidedly lower level of risk, though not one entirely to be ignored, is connected with the underwater volcanoes, found in both the Tyrrhenian Sea and the Canal of Sicily. In the Tyrrhenian basin it would appear to be confirmed that the Marsili is active, while data are not available on the possible activity of the other underwater volcanic edifices in both the Tyrrhenian area and the Aeolian arc. In any event, the danger of such volcanoes is tied not only to their possible activity, but also to the probable activation of gravity slides resulting in tidal waves.

[1] Source: Data taken from the Parametric Catalogue of Italian Earthquakes – INGV



Italy is one of the countries presenting the greatest volcanic risk, with the highest levels found in the Vesuvius and Phlegraean areas, the Island of Ischia, the Etna sector, the Aeolian Islands and the Alban Hills.

Figure 5.2: Distribution of the main active volcanoes in Italian territory[2]

Seismic and volcanic events can often manifest themselves in tandem, as frequently occurs in the Etna area. Furthermore, in addition to the damage tied solely to the seismic quake (and at times exceeding that damage), further harm is done by natural events brought about by or related to the earthquake, such as landslides and falling rock, liquefaction, consolidation, tsunami and surface faulting. Quite frequently volcanic events also present related phenomena, such as: activation of mud and/or debris slides (*lahars*); instability and subsequent collapse of the flanks or top portions of the volcanic edifice (which can generate tsunami in the case of volcanoes that develop directly on the sea bottom, as occurred at Stromboli in 2002); instances of secondary quakes (typical of the Phlegraean fields).

There were no extreme examples of seismic or volcanic activity during the year 2006.

Though there were no massive manifestations during 2006,

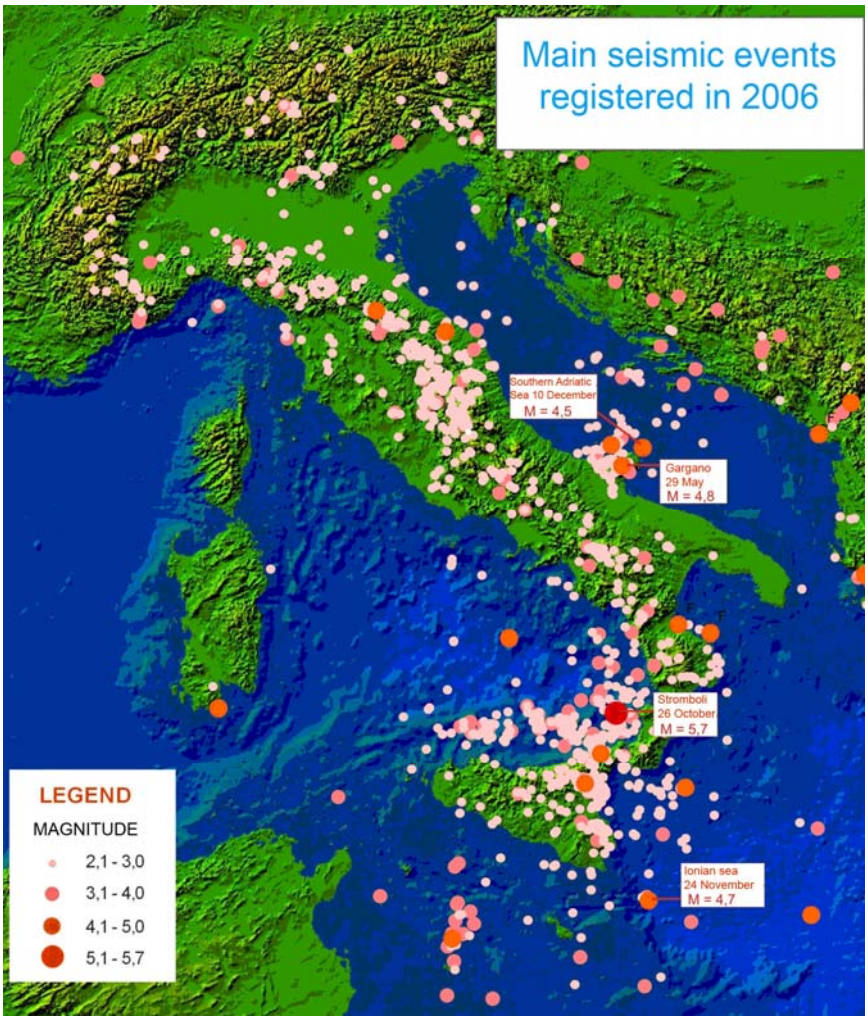
During the year 2006, only 4 seismic events reached or exceeded the

[2] Source: Data taken from the Parametric Catalogue of Italian Earthquakes – INGV

threshold magnitude of 4.5 (Figure 5.3). The strongest event occurred at Stromboli on 26 October, with a magnitude of 5.7, even though, on account of the noteworthy depth of the epicentre, no significant damage occurred.

seismic and volcanic events remain sources of elevated risk in Italy.

The events in the Ionian Sea (24 November, M=4.7) and in the southern Adriatic (10 December, M=4.5) did nothing more than frighten the local population; the lone damage of note caused by the Gargano seism (29 May, M=4.8) was the collapse of the Castelvenere tower in the Province of Benevento.



Though there were no massive manifestations during 2006, seismic and volcanic activities remained sources of elevated risk in Italy.
In 2006 there were four seismic events of a magnitude greater than or equal to 4.5. The most intense event was that of Stromboli on 26 October, at a magnitude of 5.7.

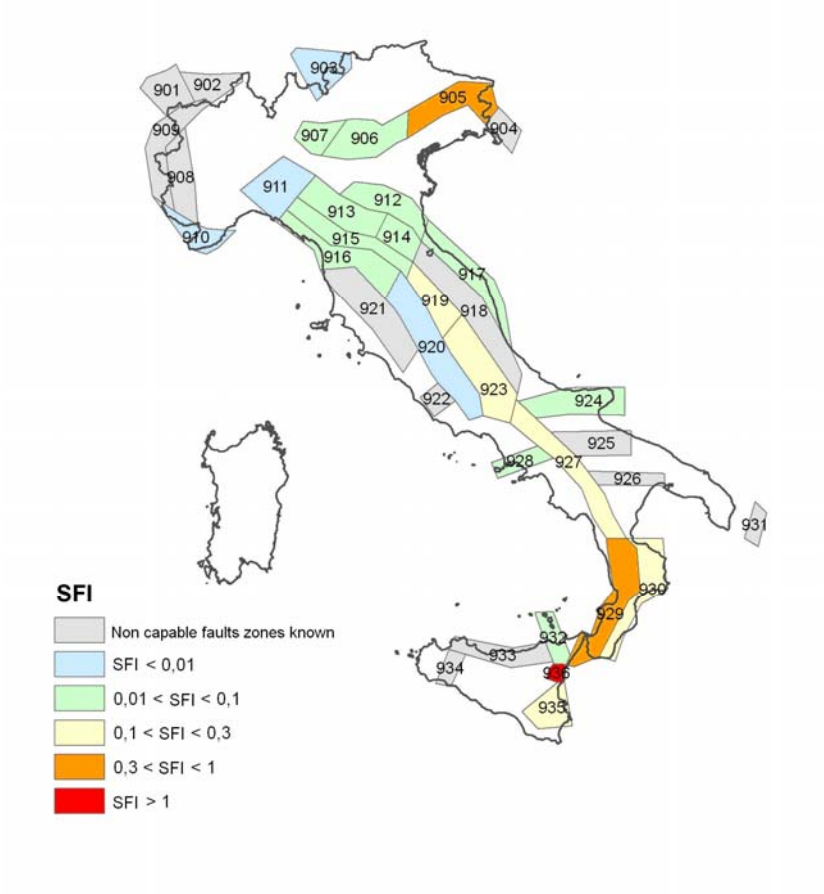
Figure 5.3: Main seismic events registered during 2006, with indication of the 4 earthquakes of elevated magnitude[3]

In the absence of earthquakes of a magnitude at least approaching 6, no effects of surface faulting have been registered.

It should be noted, however, that Italian territory presents number of capable faults (active faults able to produce noteworthy dislocations/deformations of the topographic surface). An analysis of the distribution of urban areas with respect to the aforementioned faults clearly demonstrates that, in many sectors of Italian territory, critical

[3] Source: APAT processing of INGV data

levels of exposure to surface faulting are reached (Figure 5.4).



Italian territory is characterised by the presence of numerous active faults capable of producing noteworthy fracturing of the terrain, at times with displacements of more than a metre.

The most critical zones are found in southeast Sicily, the Tyrrhenian side of Calabria and the Venetia-Friuli Alpine foothills.

Figure 5.4: Classes of the Surface Faulting Index (SFI) for each of the seismogenetic ZS9 zoning areas[4]

The SFI index (Surface Faulting Index), determined by using as input data on the capable faults taken from the ITHACA (*ITaly HAzard from CApable faulting*) dataset, the distribution of the urban areas mapped by the *CORINE Land Cover 2000* and the ZS9 Seismo-genetic Zoning show that the most critical zones are located in eastern Sicily, the Tyrrhenian portion of Calabria and the pre-Alpine sector of Venetia-Friuli (Figure 5.4).

As for "hydrogeological disarrays" (or, better yet, "geological-hydraulic" disarrays), the data on flooding tied with the main weather events that have occurred in Italy from the post-war period to the present (1951-2006) show that, despite the recent calamitous events in Sarno (1998), Soverato and Piedmont/Val d'Aosta (2000), there has been a certain downward trend in the damage and the victims produced by flooding over time. The average number of victims caused by flood events has gone from roughly a hundred per year in the 60's to a few dozen a year during the last three decades, though some of the results

Hydro-geological disarrays: in recent years there has been a downward trend in victims and damage produced by extreme events.

[4] Source: APAT

registered can be ascribed to individual meteorological events (1954, Salerno; 1998, Sarno) of an extreme nature. Of the events considered, there were many that caused more than 5 victims, while the threshold of a hundred victims was exceeded by 4 events (Figure 5.5).
In terms of estimated economic damage, information taken from the assessments carried out by the regions and the provinces points to damage of no less than 5 billion euro during the period 2001 – 2006.

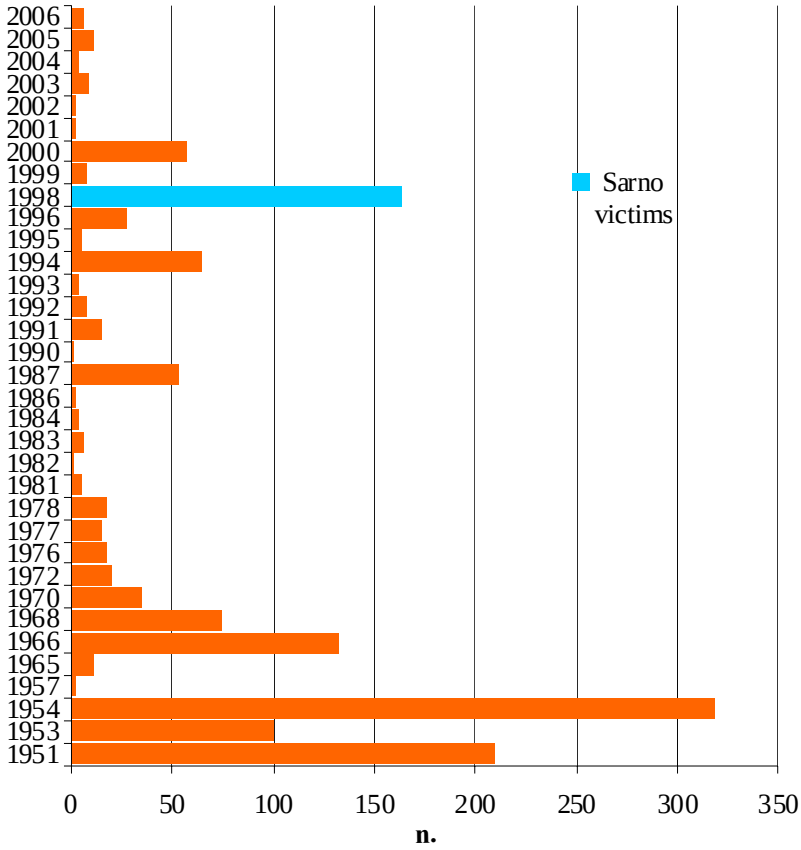


Figure 5.5: Victims of the principal floods in Italy from 1951 to 2006[5]

Landslides and flooding continue to be major causes of natural risk in large portions of the territory.
In recent years there has been a decrease in the damage and victims produced by extreme events.
Only 4 events exceeded the threshold of a hundred victims, taking place in 1998, 1966, 1954, 1951.

The decrease observed in the number of victims and the amount of damage resulting from flood events could be the result not only of improvements in the systems for safeguarding the territory and mitigating risk, but also of a natural fluctuation in the intensity and duration of the events. The extent of the damage has also been influenced to a significant extent by parameters tied to the management of the territory by man, such as the adaptation to human activities and the modification of riverbeds, variations in the use of the soil and practices for managing farmland.
In the decade 1990-2000, urbanised areas increased by approximately 6%, meaning that the areas involved lost their capacity for absorption and retention of water by the soil, with a consequent increase in surface runoff and a heightened possibility of flash flooding. Similar effects are produced by instances of compacting, which definitely involve - though there is still no overview with information drawn up on a uniform basis -

The decrease in damages is probably due to the onset of a variety of factors, such as improvements in the systems for defending the territory and mitigating risk, plus the natural fluctuation in the intensity and duration of the events.

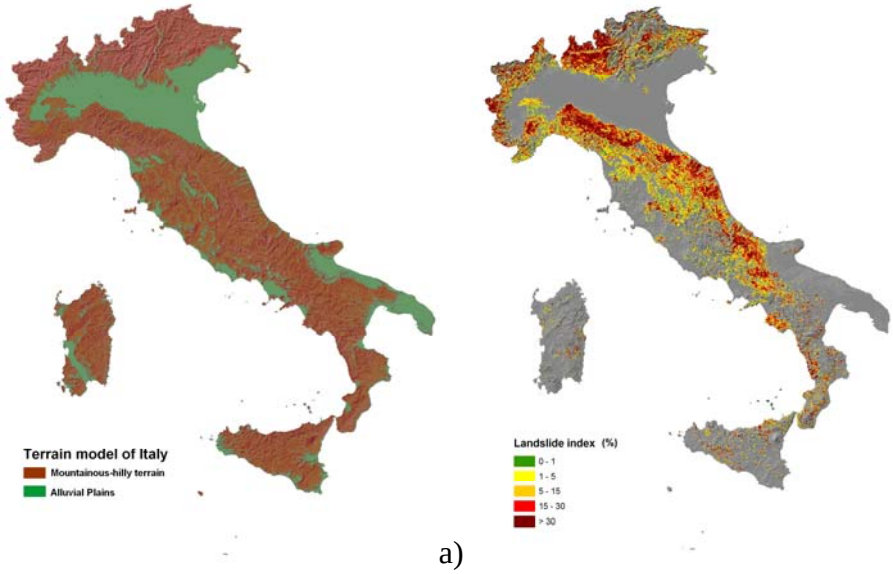
[5] Source: APAT

a large portion of the national farmland used for intensive growing.

In terms of hillside and mountainside disturbances, Italy presents an especially high risk of landslides (Figure 5.6), on account of its morphological characteristics (75% of the territory is mountainous-hilly).

Landslides are the natural disasters that occur with the greatest frequency and, after earthquakes, cause the greatest number of victims and the most damage to urban areas, infrastructures and environmental, historical and cultural resources. In the last twenty years alone, memorable catastrophic events have occurred in the Val Pola (1987), in Piedmont (1994), in Versilia (1996), in Sarno and Quindici (1998), in northwest Italy (2000) and in Val Canale - Friuli Venetia Julia (2003). As of December 2006, almost 470,000 landslide events has occurred and been recorded in Italy, involving an area of approximately 20,000 km^2, equal to 6.6% of the national territory. This census was carried out under the IFFI Project (Inventory of Landslide Events in Italy) undertaken by the APAT and the regions and the autonomous provinces, for the purpose of identifying and mapping landslides on the basis of a standardised and widely accepted approach. The landslide index, equal to the ratio between the area subject to landslides and the total surface area calculated using a grid size of 1 km, provides an overview of the distribution of landslides in Italy (Figure 5.6b).

Landslides, in addition to being the most frequent natural disaster, are also, after earthquakes, the ones that cause the most victims. Almost 470,000 landslides were catalogued in Italy until 2006, involving an area of approximately 20,000 km^2.



The risk of landslides in Italy is especially high, on account of the country's morphology (75% of the territory is mountainous-hilly). As of December 2006, the landslides identified covered 6.6% of the national territory.

Figure 5.6: a) Terrain contour model of Italy; b) Landslide index (%)[6]

The data gathered by IFFI show that the most frequent types of movement (classified on the basis of the prevalent component of the movement) are rotational/translational slide, at approximately 33%, slow earth flow, at 15.5%, rapid debris flow, at almost 15%, and complex landslides, at 11.6%. A large portion of landslide events are reactivated

[6] Source: APAT

over time; quite often, dormant periods lasting a number of years, or even centuries, alternate, on the occasion of extreme meteorological events, with periods of renewed mobilisation, as is the case for almost all the landslides in the Apennine zones of the Emilia Romagna Region, characterised by slow paced movements. In contrast, newly formed scenarios most frequently feature rapid kinetics, such as rockfalls or mud/debris flows

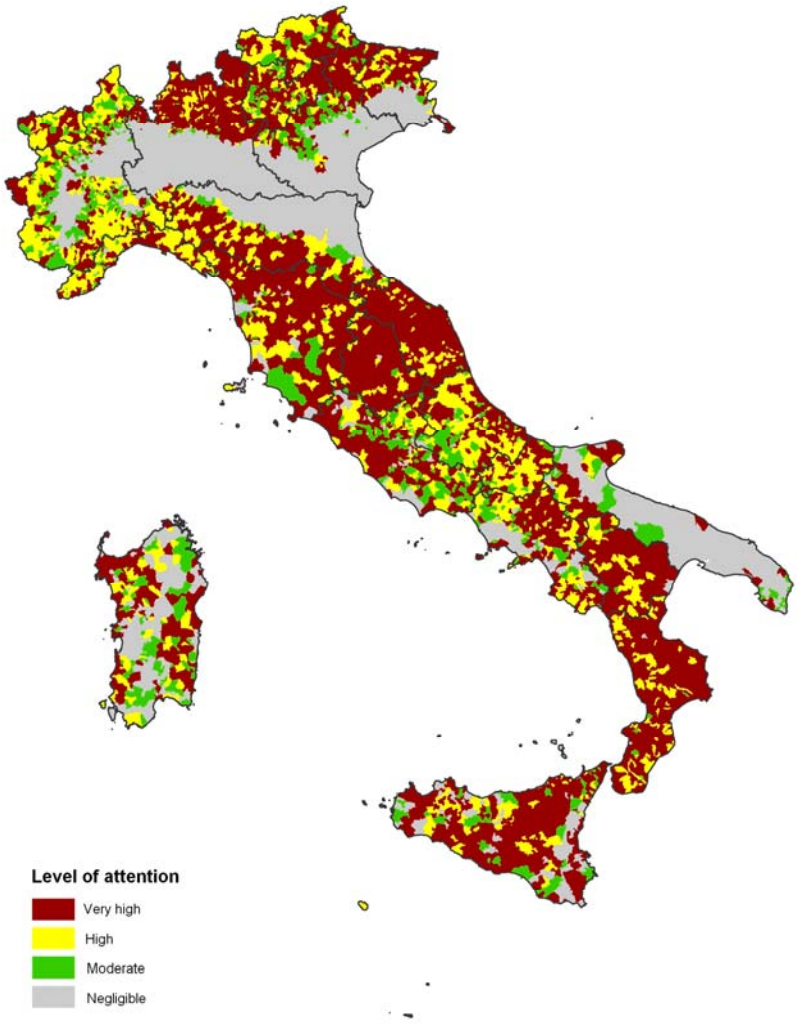
Italian municipalities affected by landslides currently number 5,596, equal to 69% of the total.

The Italian municipalities affected by landslides currently number 5,596, or 69% of the total. In order to obtain a preliminary landslide risk assessment of Italian territory, landslide features of the IFFI Project have been overlaid with the exposed elements by GIS processing (Figure 5.7). A total of 2,839 municipalities were classified at very high levels of attention (with intersections between landslides and the continuous and discontinuous urban texture, as well as industrial or commercial areas), 1,691 municipalities call for high levels of attention (intersections between landslides and the highway, railway and road networks, areas used for mining, dumping and worksites), 1,066 present a moderate level of attention (intersection between landslides and wooded territories and arable lands, green urban areas and sports and recreation areas), and 2,505 call for negligible levels of attention (municipalities in which no landslides have been registered).

Not all landslides present the same level of hazard, with those involving high-speed movement (rock falls and rapid mud and debris flows) and noteworthy volumes of rock or soil causing the greatest damage.

Italy is a fragile territory, with approximately 10% classified as being at high risk of flooding, landslides and avalanches, and with more than 2/3 of the areas at risk consisting of urban centres, infrastructures and production areas.

At present, roughly 10% of our country is classified as facing a high risk of flooding, landslides or avalanches, with involvement of all or a portion of the territories of more than 6,600 Italian municipalities. The census updated to January 2006 shows that, out of approximately 30,000 km^2 of areas in a highly critical situation, 58% are found in landslide zones and 42% in areas prone to flooding. These results point to a situation of extreme fragility in Italian territory, exacerbated by the fact that more than 2/3 of the areas at risk consist of urban centres, infrastructures or production areas closely tied to the country's economic and social development.



Italy is a fragile territory, with approximately 10% classified as being at high risk of flooding, landslides and avalanches, and with more than 2/3 of the areas at risk consisting of urban centres, infrastructures and production areas.

A total of 2,839 municipalities are classified as requiring extremely high levels of attention, 1,691 municipalities high levels of attention, 1,066 municipalities average levels and 2,505 negligible levels.

Figure 5.7: Level of landslide alert on the municipal level[7]

Erosion of soil by water has major economic repercussions.

A factor of noteworthy economic importance is the erosion of soil caused by water. The damage occasioned by erosion, which can take the form of loss of soil, fertility and biodiversity, frequently makes necessary corrective action, especially in the case of prized agricultural land of significant economic value. The analyses show that roughly 30% of Italian land presents a risk of erosion above the threshold of tolerability. These estimates, derived from nationwide models, are weakened by the approximate nature of the data utilised. An overview that more accurately reflects the actual situation is currently being drawn up under the projects for harmonising the regional information coordinated by the APAT, with the participation of the CRA, the JRC and the Italian regions (SIAS Project).

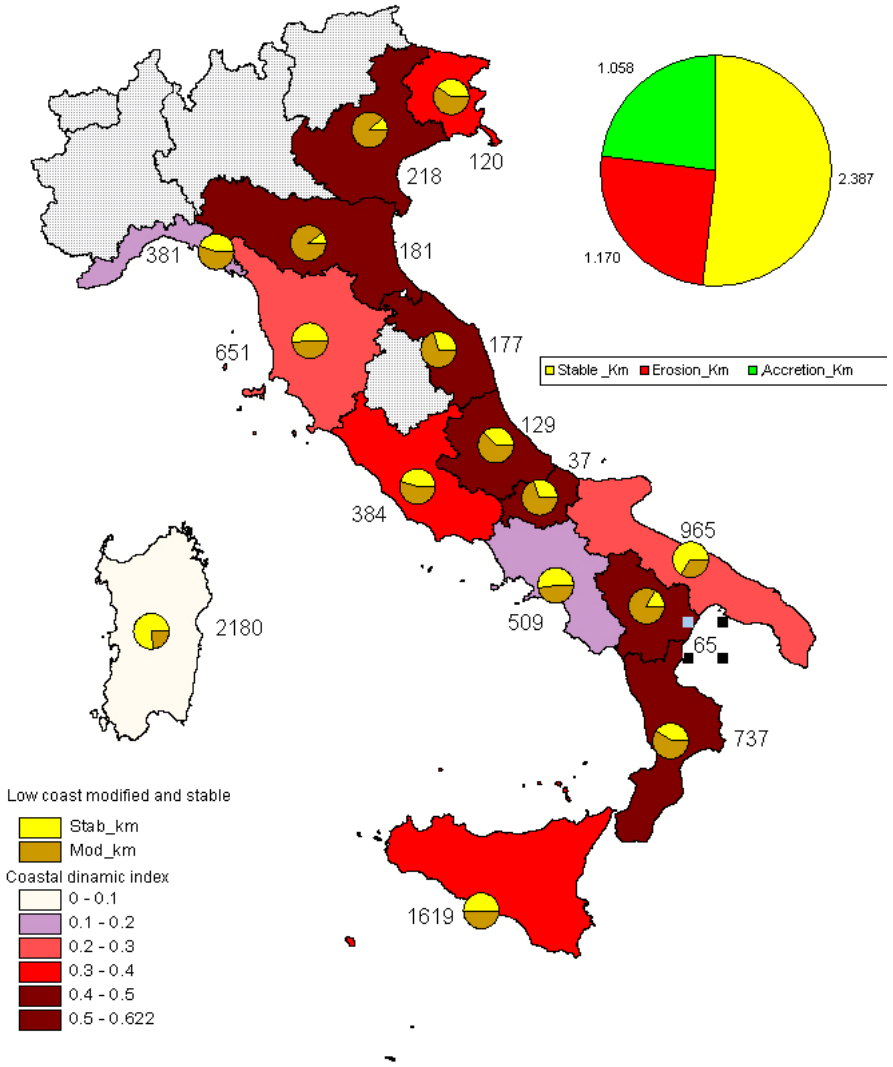
20% of the total Italian coastline (8,350 km) suffers from an evident state

The data on the erosion and flooding of coastal areas, events present to a significant degree within our territory, point to a general retreat of Italy's sandy coastlines from the 70's to the present. Today, approximately

[7] Source: APAT

1,500 km of Italy's roughly 4,600 km of low-lying coastline, including coastal plains, already suffers from an evident state of erosion and is at risk of flooding, meaning nearly 20% of the total of approximately 8,350 km of Italian coastline.

of erosion and is at risk of flooding.



Erosion and flooding of coastal areas has a noteworthy effect on our territory.

From the 70's to the present, the trend has been for Italy's sandy coasts to retreat.

20% of Italy's total coastline (8,350 km) suffers from an evident state of erosion and is at risk of flooding.

Figure 5.8: Variation > 25m of the low-lying coastline and the index of coastal dynamic[8]

The need for wide-scale, integrated management of coastal areas, with the taking of appropriate steps to contrast coastal erosion, has led to the formulation of numerical indexes for the evaluation of conditions of risk in coastal zones, through application to Italy's coasts of the methods proposed under the EUROSION Project.

First of all, the coastal area indicated as RICE[9], a zone potentially

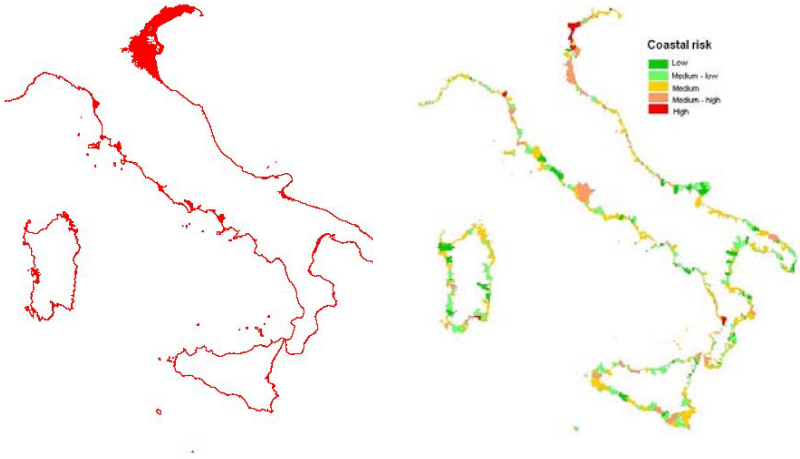
The integrated management of coastal areas calls for the formulation of numerical indexes for assessment of the conditions of risk.

[8] Source: APAT

[9] *Radium of Influence of Coastal Erosion* is the geometric site of points that satisfy at least one of the following two conditions: distance of no more than 500 metres from the coast; altitude of no more than 5 metres above sea level. In order to take into consideration errors connected with the definition of the DTM (Digital Terrain Model), and avoid underestimating areas with altitudes of no more than 5 metres, the curve taken for the limit level was that corresponding to 10 m

subject to erosion and flooding within the next 100 years (Figure 5.9a) was identified. Of note is the fact that the area potentially at risk occupies 954,379 ha, equal to 3.17% of the entire national surface area, and houses 5,276,535 of the country's inhabitants, or 9.12% of the entire population. Within this zone, it is estimated that a surface area of 336,746 ha (1.12% of the national surface area) and a population of 2,133,041 (3.69% of the total population) are exposed to a moderate-high or high risk (Figure 5.9b).

The area potentially subject to erosion and flooding within the next 100 years occupies 954,379 ha, equal to 3.17% of the entire national surface area, and holds approximately 5.3 million inhabitants, equal to 9.12% of the entire population. Out of this area, it is estimated that a surface area of 336,746 ha (1.12% of the national surface area) and a population of 2,133,041 (3.69% of the total population) is exposed to a moderate-high or high risk.



a) b)

Figure 5.9: a) RICE area in Italy and b) Map of coastal risk by municipality[10]

5.1.2 The causes

As noted earlier, events such as earthquakes and volcanic activity are due to the specific geological context of our country. These phenomena, being tied to natural processes, present a risk connected with their occurrence, as well as with interaction involving factors tied to human activities.

The evolution of the primary examples of land instability on the Italian peninsula is influenced by both natural and anthropic factors.

The evolution of the main instances of land instability on the Italian peninsula, whether caused by gravity or the action of water, is also influenced by both natural and anthropogenic factors. The natural considerations include, apart from the morphological conformation of the territory, which depends on the geological-structural layout and on the lithological characteristics, the type and extension of the vegetative coverage and conditions of weather and climate. The precipitation monitored over the last few decades, which has shown an average reduction, as well as a variation in the distribution of precipitation over time (with a heightened occurrence of intensive events of brief duration,

The physical mechanisms that regulate the onset and the evolution of critical hydro-geological events

[10] Source: APAT

referred to as “extreme”), while it may have reduced the number of flood events of average intensity in certain areas, could also have favoured an increase in the instability of mountainsides and hillsides. The physical mechanisms that govern the onset and evolution of critical hydro-geological events are often highly complex and extremely non-linear. The extent to which levels of rain correspond to landslides or flooding is influenced by a number of factors, which can set off different effects from one place to the next, even in situations that would appear to be similar.

are very complex and highly non-linear. Anthropogenic causes are taking on increasing weight.

Among the causes of “hydrogeological disarrays”, those of anthropogenic nature are playing an increasingly important role, being tied to a use of the territory that does not pay sufficient attention to the characteristics and the delicate hydro-geological balances of Italian terrain. The demands arising from socio-economic and demographic development have resulted in a use of the territory that does not always respect its natural tendencies. An unmistakable example is the marked expansion, in the post-war period, of population centres and industrial areas in flood plain areas. Such development, together with undeniable socio-economic benefits, has also placed what amounts to a “plaster cast” on the territory, on account of increasingly invasive works (such as embankments, dikes, canals, reclamation works and retaining walls), that have prevented evolution according to natural dynamics. Similar projects, which show varying levels of effectiveness over the brief-medium period, also call for increasingly costly and large-scale maintenance work.

Use of the territory that pays insufficient attention to the characteristics and the delicate geological-hydraulic balances of Italian terrain can currently be considered one of the primary causes of hydro-geological disturbances.

In mountain areas, on the other hand, gradual depopulation has led to the abandonment of traditional crops, with negative effects on the defence of the soil as well.

In hill areas and plains, the development of growing practices tied to intensive farming underlies the significant increase in loss of soil as a result of water-based erosion, with consequences that include a decrease in fertility, as well as an increase in the transport of solids in waterways and problems involving the silting-up of artificial basins.

Such farming practices are also responsible for the onset of compacting on the surface and in-depth (ploughing level), which limits/prevents the infiltration of water from precipitation, resulting in frequent submersions of the soil, with serious damage done to crops on account of root suffocation, at the same time as it increases surface runoff, reducing the retention time of the watershed.

Abandonment of traditional crops, together with the use of intensive techniques, has had a negative effect on the soil in terms of reduced fertility and increased compacting.

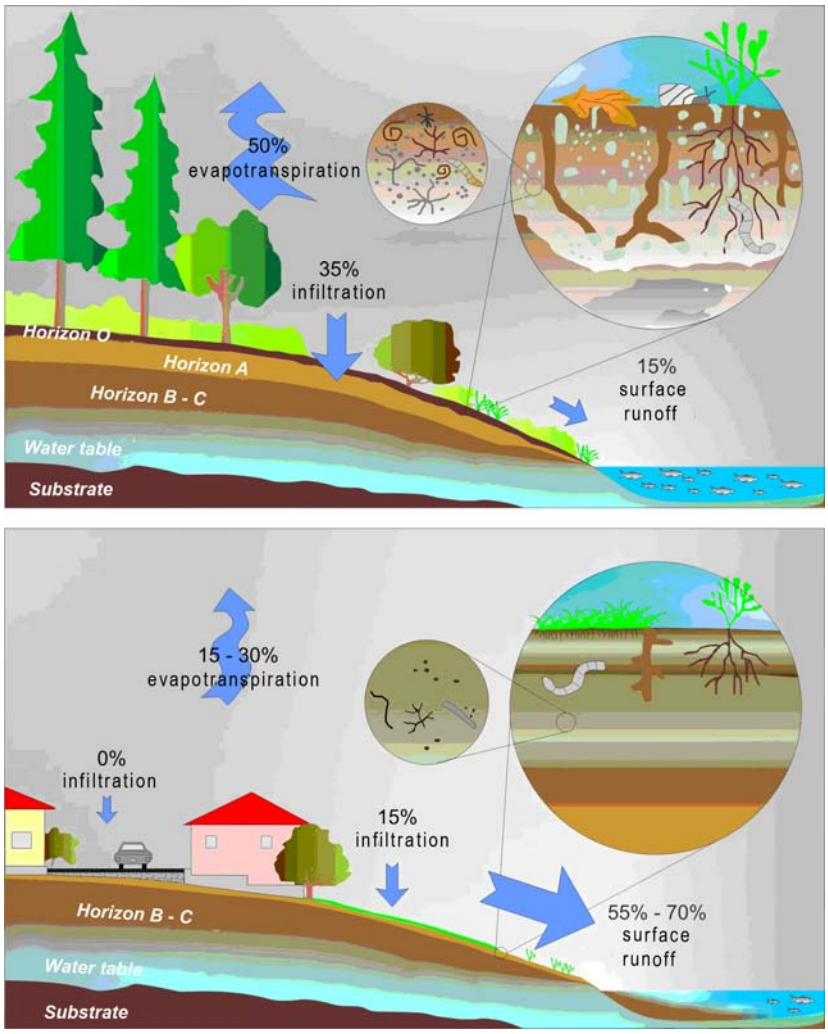


Figure 5.10: Chart illustrating a natural terrain and an anthropised one

Soil in its natural condition is capable, thanks to its porosity, permeability and humidity, of retaining a large quantity of water from atmospheric precipitation, contributing to the regulation of surface runoff.
In an anthropised environment, on the other hand, the presence of surfaces rendered impermeable, the reduction in the vegetation, the removal of the surface layer, which is rich in organic substances, and the onset of compacting result in a serious deterioration of the soil's functional efficiency.
The decrease in evapotranspiration, and in the soil's capacity to absorb water, result in an increase in surface runoff and in the transport of large quantities of sediment in natural collectors.
The values shown in the figure are nothing more than rough estimates. They can vary, and to a significant degree, depending on a variety of parameters (the physical-chemical characteristics of the soil, the topography and geology, as well as the duration and intensity of precipitation etc.).

The actions of man also have noteworthy effects on coasts and watersheds.

Coastal environments and the watersheds underneath them (subdivided into physiographic units) also present a setting that is the end result of a complex interaction among numerous factors, the largest part of which are anthropic. The parameters in question include processes of erosion, transport and deposition, as well as the construction of rigid works for the defence of coastal areas from erosion and the instability of mountainsides and hillsides.

The causes of increased processes of coastal erosion and marine flooding also include, apart from increased urbanisation in the coastal sector:

- reduced supply of solid river materials to beaches, due to works for the stabilisation of hillsides and mountainsides, the control of rivers and dams, as well as the extraction of materials from riverbeds (primarily anthropic, as opposed to natural);
- the combined effects of tides and flood events, which cause heightened erosion at river mouths when the large volumes of

river water reach the sea;
- the rise of the sea level resulting from a lowering of the terrain caused by the simultaneous effects of natural and anthropic subsidence, as well as eustatic movements.

Though knowledge of the state of the coastal system is still insufficient, in terms of both uniformity on the national level and detail of scale, the data collected point to an ongoing loss of terrain at the seashore.

5.1.3 Solutions

To limit risk situations, attentive planning and the introduction of adequate regulatory instruments are called for.

Seismic and volcanic activities, flooding, landslides and coastal erosion are outcomes of the natural dynamics of the planet, meaning that there is little that man can do to control them. Nevertheless, risk conditions can be significantly reduced through careful territorial planning and the introduction of legislative instruments that place limitations on the use of the soil and/or establish technical-engineering standards. In order to arrive at effective risk mitigation, therefore, it is indispensable that the emergency approach, based on after-the-fact responses, be replaced with initiatives combining forecasting and prevention.

Forecasting can be carried out through specific studies of zones at risk. Prevention should take the form of decisions regarding the application of technical procedures designed on the basis of the knowledge obtained. Unfortunately, the decisions made in this field have not always been the right ones.

Forecasting can be carried out through specific studies of the zones subject to risk, in order to determine the probability of events recurring over time, whereas prevention entails selecting and applying technical procedures designed on the basis of the knowledge obtained. Unfortunately, the choices made in this field are not always the right ones: a large part of the buildings in our country do not comply with anti-seismic standards, both because the stock of structures from the past has only rarely been upgraded to meet the current anti-seismic measures and because the marked urban expansion from the post-war period to the present suffers from a lack of attentive territorial planning, as well as the all too frequent, and deplorable, tendency to build in violation of the regulations. The seismic classification of the national territory, whose evolution made significant progress following the 1980 earthquake in Irpinia, reflects the state of the art as far as knowledge of seismic risk in Italy is concerned (Figure 5.11). The classification provides a detailed presentation of the maximum horizontal acceleration values at ground level, making it possible to set adequate anti-seismic design criteria, the problem being that these standards are obligatory only for new structures, while no measures have been taken for the anti-seismic upgrading of existing buildings.

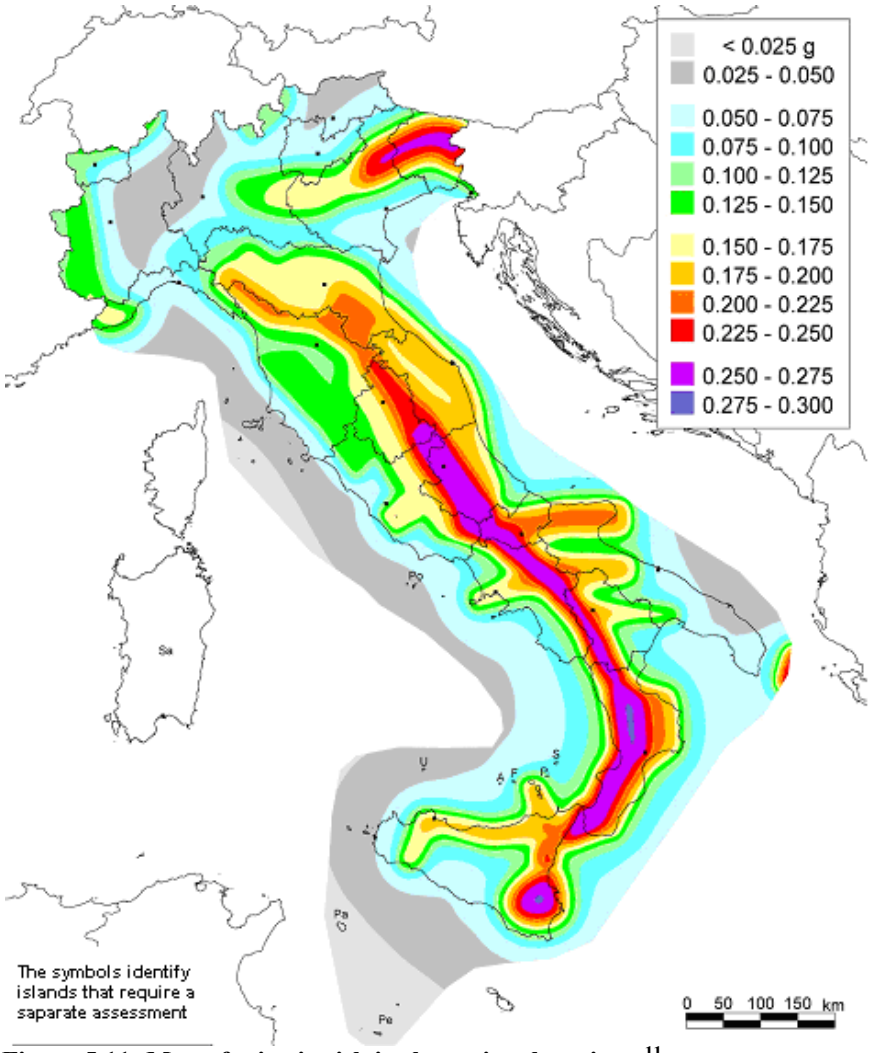


Figure 5.11: Map of seismic risk in the national territory[11]

The seismic classification of the national territory, which has made significant advances since the 1980 earthquake in Irpinia, reflects the state of the art in terms of knowledge of seismic threats in Italy.

The map illustrates the seismic threat in terms of maximum acceleration at the ground level, with a probability of exceedance of 10% in 50 years for rigid terrain (Vs_{30} > 800 m/s; cat. A, point 3.2.1 of the Ministerial Decree of 14 Sept. '05).

At the same time, uncontrolled urban development in areas of elevated volcanic risk, such as the Phlegraean Fields, Ischia and Vesuvius, places these zones among the most risk-prone in the world. In the case of Vesuvius and the Phlegraean Fields, the Italian Civil Defence Department has drawn up specific emergency plans, currently under revision, for the purpose of managing the emergency phases of any eruptions, eventually through the evacuation of the areas held to be at risk, based on the reference eruption standards. What is necessary, and should be aimed at, is a combination of planning and initiatives to arrive at the decongestion of an urban situation that is simply unfeasible in an area containing active volcanic structures, as well as efforts to instil in the general public a correct awareness of the inevitability of the event, of the possibility of lengthy waiting times and false alarms, as well as the possibility that the eruption could occur with an intensity and in a mode different from what has been forecast. It should also be noted that, in many sectors of Italian territory, urban development has taken place on active tectonic structures capable of producing significant

[11] Source: INGV

dislocations/deformations of the topographic surface (capable faults). In such cases, assessment of the seismic risk, traditionally based on the effects of the quake, proves to be underestimated, seeing that it does not take into account the effects of surface faulting.

The regulatory and planning framework for land preservation is still essentially governed in Italy, in an all-encompassing manner, by Law 183/89 (currently being modified/abrogated by Legislative Decree 152/06). This legislative measure has thoroughly innovated the defence of the soil, called for the special institutes established under earlier legislation to be combined within a new organisational-institutional structure. Based on this approach, planning for risk-mitigation initiatives has been drafted in accordance with the contents of the Basin Plan, which constitutes a territorial plan for the sector, as well as an instrument of research, regulation and technical-operative considerations used to plan and program actions and standards of use for the conservation, protection and optimisation of the land. In the interests of improved territorial planning, Law 183/89 contemplates the possibility of drawing up separate plans for individual functional sectors, correlated to the contents of the Basin Plan, though the latter remains the general, all-encompassing tool for planning.

As of September 2006, the state of implementation of the PAI (Individual Plans for the Hydro-Geological System) on the national level had reached the conclusive phase, with the approval of 27 PAI and the implementation of 8 PAI projects, while, in 3 cases, the planning was still underway.

As of September 2006, 27 PAI have been approved and 8 PAI projects have been implemented. In three cases, the planning is still underway.

A key contribution to application of the regulations and standards of land preservation was made by Legislative Decree 180/98 (referred to as the "Sarno Decree", converted into Law 267/98), issued in 1998 following the tragedy in Sarno (Campania Region), in order to accelerate application of Law 183/89 (largely unfulfilled at that point), with absolute priority given to areas at "high and very high hydro-geological risk". This Legislative Decree resulted not only in immediate identification of the most critical zones (Extraordinary Plans), but also in the introduction and formulation of "programs of urgent measures for the reduction of hydro-geological risk".

Within this regulatory context, the priority phases for the forecasting and prevention of disturbances are the preparatory research involved in collecting information on possible events (i.e. the IFFI Project, the AVI Project etc.), monitoring with instrument networks and the simulation of event scenarios. Proper territorial planning is carried out through the programming of both non-structural initiatives (the implementation of safeguards, the application of constraints regarding the use of the territory and activities of civil defence, with the formulation of emergency plans) and structural efforts (performance of various types of reclamation interventions, maintenance of riverbeds and protective works, plus delocalisation activities or, in more general terms, active modification of the dynamics and disturbances currently underway). To this end, the Ministry of the Environment, Land and Sea, starting from 1998, and in accordance with Legislative Decree 180/98, plus subsequent modifications and additions, has financed 2,270 urgent

For the forecasting and prevention of disturbances, the research phases have been formulated, together with the monitoring actions, utilising instrument networks and event scenarios, plus appropriate territorial planning.

The Ministry of the Environment, Land and Sea has financed 2,270

initiatives for the reduction of hydro-geological risk, largely of a structural type, at a total cost of more than 1.7 billion euro. The majority of the initiatives financed regard gravity slides (47%), followed by floods (21%) and mixed or avalanche events (in the case of 29% of the initiatives, the main type of disturbance is not indicated in the decree of approval).

initiatives for reducing hydro-geological risk.

A further contribution to the planning of initiatives to mitigate hydro-geological risk was made by the enactment of the ReNDiS Project (Repertory of Measures and Works for the Mitigation of Hydrogeological Risk in Italy), formulated by APAT for the purpose of providing a unified, systematically updated overview of the works and resources committed to land preservation, to be shared by all the administrative bodies active in the planning and implementation of such initiatives. ReNDiS is meant to be used as a tool for obtaining knowledge, potentially capable of improving coordination and thus optimising national spending on the defence of the soil. In publishing the data, the Repertory is designed to satisfy the need for "transparency" in the operations of the Public Administration regarding land preservation. The end goal is to contribute to heightening awareness of the problems involved in protecting the soil, and the close connection between such problems and a correct use of the land.

The ReNDiS project contributes to the planning of initiatives for the mitigation of hydro-geological risk, providing an updated overview to be shared with the administrative bodies.

The dissemination of information on landslide events among the central and local bodies of the Public Administration, as well as the general population, also plays a highly important role in the prevention of risk. The Italian Landslide Inventory (IFFI project) constitutes an important tool for gathering the basic knowledge needed for correct territorial planning. Heightening the awareness of citizens also provides them with increased knowledge of the risks involving their own territory, as well as the forms of conduct to be followed before, during and after the event. For this purpose, APAT has created an on-line cartographic consultation service for the IFFI project (www.sinanet.apat.it/progettoiffi), making it possible to query the database and obtain information on landslides, in addition to visualising documents, photographs and filmed pieces.

A valid instrument for the prevention of risk is the dissemination of information on landslide events among the general population and the bodies of the Public Administration, making possible a heightened awareness of the risks found in their territories.

Initiatives meant to mitigate the degradation of farmland have been undertaken, both nationally, through the new PSN (National Strategic Plan for Rural Development) and on the European level, based on the new CAP (Common Agricultural Policy), which requires that farmland be kept in good agronomic and environmental condition. In 2006 the European Commission implemented the "*Soil Thematic Strategy*", which includes a proposal for a "Framework Directive on the Protection of the Soil" (COM(2006)232). The proposal identifies the main threats that could compromise the functional efficiency of the soil (including erosion, transformation into an impermeable state, compacting and landslides), making it necessary to identify the areas at risk and prepare appropriate measures of mitigation. In the case of floods, which were originally covered by the strategy (COM(2002)179), a separate directive is currently being drawn up.

Tools such as the PSN and the CAP constitute valid initiatives for mitigating the deterioration of farmland.

The dissemination of data is also a factor of noteworthy importance when it comes to analysing coastal erosion. It is held to be highly necessary to make the best possible use of existing databases on a national scale (which are extremely accurate and, in theory, provide more cartographic information than is the case in other countries), in order to offset the major shortcoming represented by the lack of uniformity of the knowledge and the difficulty in obtaining access to it. What is missing at present is an established process for accessing and sharing these data. It is of fundamental importance, therefore, that the techniques and products used to collect data be coordinated, and that there be unconditional sharing of cartographic bases and "strategic" thematic write-ups between the various bodies and branches of the central, regional and local administrations.

The risk of coastal erosion makes necessary attentive planning and programming of actions, given their high cost.

The options for reducing the vulnerability of Italy's coastal areas all start from the assumption that it is not economically sustainable to undertake initiatives of protection regarding all of the more than 4,600 km of Italy's low sandy coasts. Even limiting efforts to the approximately 1,500 km where erosion, as of today, has already set in would call for enormous initial investments (on the order of 2 billion Euro) needing to be repeated over time, plus the use of quantities of sediment for replenishing on the order of 150-200 million cubic metres, only at the start, not to mention the quantities needed to maintain the actions. Moreover, these quantities of sediment must present physical characteristics and factors of quality that would prove difficult to find in all the zones affected by erosion, given the need to comply with current regulations in the sector as well.

There are a variety of possible approaches to enacting strategies of adaptation, entailing different expenditures of resources.

Possible solutions for enacting strategies of adaptation include:

- abandoning areas to their natural course of evolution;
- preserving and/or reconstructing natural zones that serve as "soft" interfaces between the land and the sea;
- preserving and/or reconstructing coastal dunes;
- the implementation of strategies of territorial planning, in order to avoid further deterioration, in terms of vulnerability, with one option being planning constraints;
- protection of land-sea positions through soft works (replenishing) rather than rigid ones;
- increased morphological resilience of the above-water beach (dunes) and the below-water portion (sandbars etc.);
- regulatory initiatives meant to establish the recommendations of the coastal management plans as a form of oversight for the Municipal Regulatory Plans (MRP) while introducing the Strategic Environmental Assessment (SEA) into the process for assessing coastal plains. In addition, the system of assessment should be independent of the subject that formulates the plan.

The risk of erosion makes necessary a balance between residential/productive

The first and second strategies are based on the principle of abandoning the struggle for position between land and sea by taking into consideration options that call for different approaches to coexistence in

coastal areas, establishing a new balance between populated and productive areas, on the one hand, and the values and dynamics of nature, on the other. This implies planning activities of a vast scope (at least regional, and possibly encompassing entire seacoasts), so as to take into account not only the impact of the work in the immediate vicinity, but also its interaction with the coastal system as a whole, all based on the principle that "projects which lead to erosion shall no longer be financed".

areas and natural values/dynamics. Consideration must be given not only to the immediate impact of the work, but also to its medium/long-term interaction with the coastal system.

The courage must also be found to remove, wherever possible, those traditional protective measures whose effectiveness has decreased on account of climate changes.

In light of the above, an increasingly urgent priority is the implementation of the EC recommendations on ICZM *(*Recommendations of 30 May 2002 of the European Parliament and Council concerning the implementation of Integrated Coastal Zone Management in Europe) through the formulation of national guidelines endorsed by the administrative organs and the authorities which currently hold responsibility for planning. Equally urgent is the need for a regulatory definition of the concept of "Coastal Plain", establishing the minimum extension of such areas on the basis of criteria of coastal dynamics (such as physiographic units), as opposed to administrative considerations, and placing them on a level that overrides municipal regulatory plans and other instruments of planning.

Given the size of the investments that will prove necessary for coastal planning, it is indispensable that a synergy be established between public and private investments, through legislative instruments that favour private investments which also contribute to satisfying the need for adaptation to climate change.

The actions necessary in the area of coastal planning call for: synergy between public and private investments; coordination between initiatives on the local and national levels.

There must also be a form of national collaboration on the topic of coasts (research, monitoring, methodologies, planning criteria etc.), so that those operating on the local level are not isolated from the general context, with the experiences currently limited to certain areas effectively becoming a collective resource and with optimal use being made of the results of research projects. The contribution of the inter-regional EU projects has not eliminated this shortcoming. It is proposed, therefore, that approaches be found for grouping initiatives, projects and programs to be undertaken in coastal zones on a central level, with one possibility being a national committee on the coasts, with the participation of representatives of institutions, the regional governments and the academic world.

5.2 Anthropogenic Risk

The term “anthropogenic risk” refers to the risk (direct or indirect) tied to human activities that pose a hazard to the environment and to human life. This broad definition includes so-called “industrial risk”, meaning that resulting from activities carried out inside of industrial establishments.

“Anthropogenic risk” is that which arises (directly or indirectly) from human activities that are potentially hazardous to the environment and to human life.

The definition “Major-Accident Hazards establishments” (MAH establishment) refers to an establishment that contains (using them in its production cycle or simply in storage) potentially hazardous facilities, at quantities that exceed the thresholds established under the “Seveso” regulations (Directive 82/501/EEC, plus subsequent modifications).

The storage and/or use of large quantities of substances classified as toxic, inflammable, explosive, combustible or hazardous for the environment can lead to the possible uncontrolled evolution of an accident that poses a serious threat, either immediately or after a certain delay, to man (inside or outside the establishments) and to the surrounding environment, on account of:

- the emission and/or dispersion of substances that are toxic for man and/or for
- the environment;
- fire;
- explosion.

In the 80’s, the European Community took this type of establishment into consideration for the first time, in order to reduce the incidence of major accidents in industry while increasing protection of local populations and the environment as a whole, doing so by issuing a specific directive (the aforementioned 82/501/EEC, also known as the “Seveso Directive”).

The purpose of the Seveso Directive, plus subsequent modifications and additions, is to reduce the possibility of the occurrence of accidents, together with their potential impact on man and the environment.

Operative application by the member states of the European Community brought to the fore the need for adjustments and modifications, with the result that the Seveso Directive has been updated twice over the years, in the form of Directives 96/82/EC and 2003/105/EC, which were transposed into Italian law under Legislative Decree 334/99 and Legislative Decree 238/05.

The purpose of these measures is to reduce the possibility of the occurrence of accidents, along with their subsequent impact on man and the environment. To this end, the operators of industrial establishments where a major accident may occur are required to meet specific obligations, including: mandatory production of technical documentation and specific information, plus the installation of specific systems for the safe management of the facility; in addition, they are subject to specific controls and inspections by the authorities.

5.2.1 The situation

The information on facilities at risk for accidents, sent by the operators to the competent authorities (including the Ministry of the Environment, Land and Sea, under the specific obligations contemplated in Legislative Decree 334/99, which calls for administrative or criminal sanctions for notifications that are not made or prove incomplete), is collected by APAT, in accordance with the Ministry of the Environment, Land and Sea, through the taking and updating of the National Inventory of Major-Accident Hazard establishments (MAH establishments), as stipulated under Legislative Decree 334/99 (art. 15, paragraph 4), at which point it is further confirmed through comparison with the information held by the regions and the regional environmental agencies competent in the area where the establishments are located.

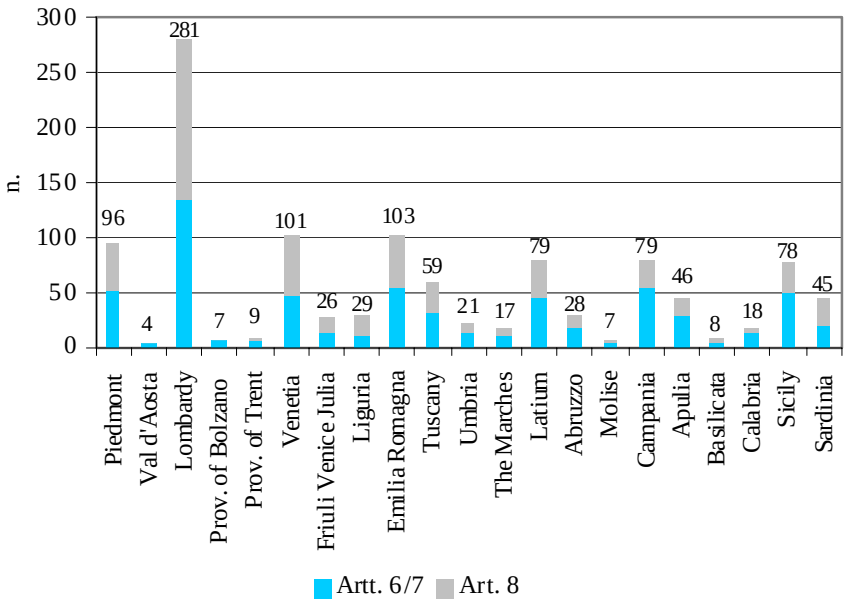
APAT, in accordance with the Ministry of the Environment, Land and Sea, collects the information on Major-Accident Hazard establishments provided by the operators to the competent authorities.

Thanks to the information stored in the aforementioned Inventory, a general overview of the pressures placed on Italian territory by the Major-Accident Hazard establishments can be drawn up.

This means knowing, for example:

- the “number of Major-Accident Hazard establishments in each region” (Figure 5.12);
- the “number of Major-Accident Hazard establishments in each province” (Figure 5.13);
- the “municipalities with 4 or more Major-Accident Hazard establishments” (Figure 5.14); the areas where an especially large number of MAH establishments are concentrated can be highlighted, making it possible to implement controls and precautionary measures which ensure that an accident in an individual facility does not spread to the others (domino or knock-on effect), with enormous consequences for both man and the environment.

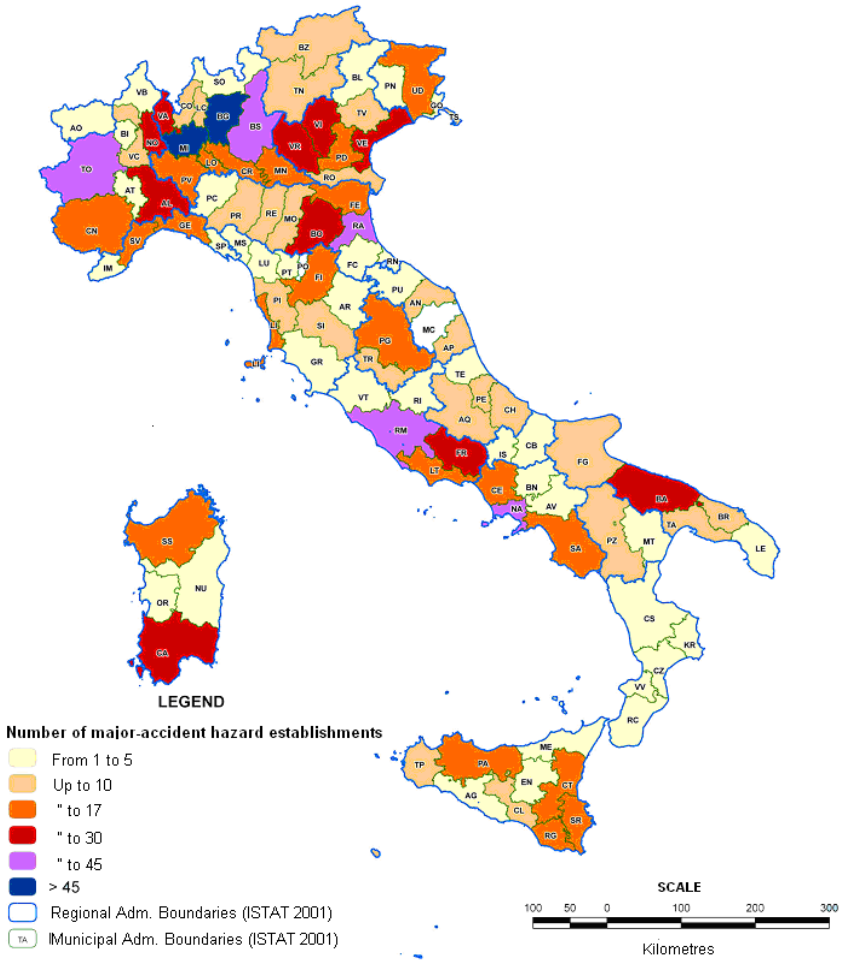
Knowledge of the number and the distribution throughout the territory of the Major Accident Hazard establishments makes it possible to draw up risk maps.



The regions with the greatest concentration of facilities at risk of serious accidents are: Lombardy, Emilia Romagna, Venetia and Piedmont. Next come Latium, Campania and Sicily.

Figure 5.12: Regional distribution of the establishments subject to Legislative Decree 334/99, plus subsequent modifications and additions[1]

[1] Source: APAT analysis of data from the Ministry of the Environment, Land and Sea



The largest number of Major Accident Hazard establishments are concentrated in the central-northern provinces, and especially in Turin, Milan, Bergamo, Brescia and Ravenna, in the north, plus Rome and Naples in the central-southern zone.

Figure 5.13: Number of Major-Accident Hazard establishments – provincial distribution[2]

[2] Source: APAT analysis of data from the Ministry of the Environment, Land and Sea

Of particular note among municipalities with 4 or more Major Accident Hazard establishments are Venice, Ravenna, Rome and Naples.

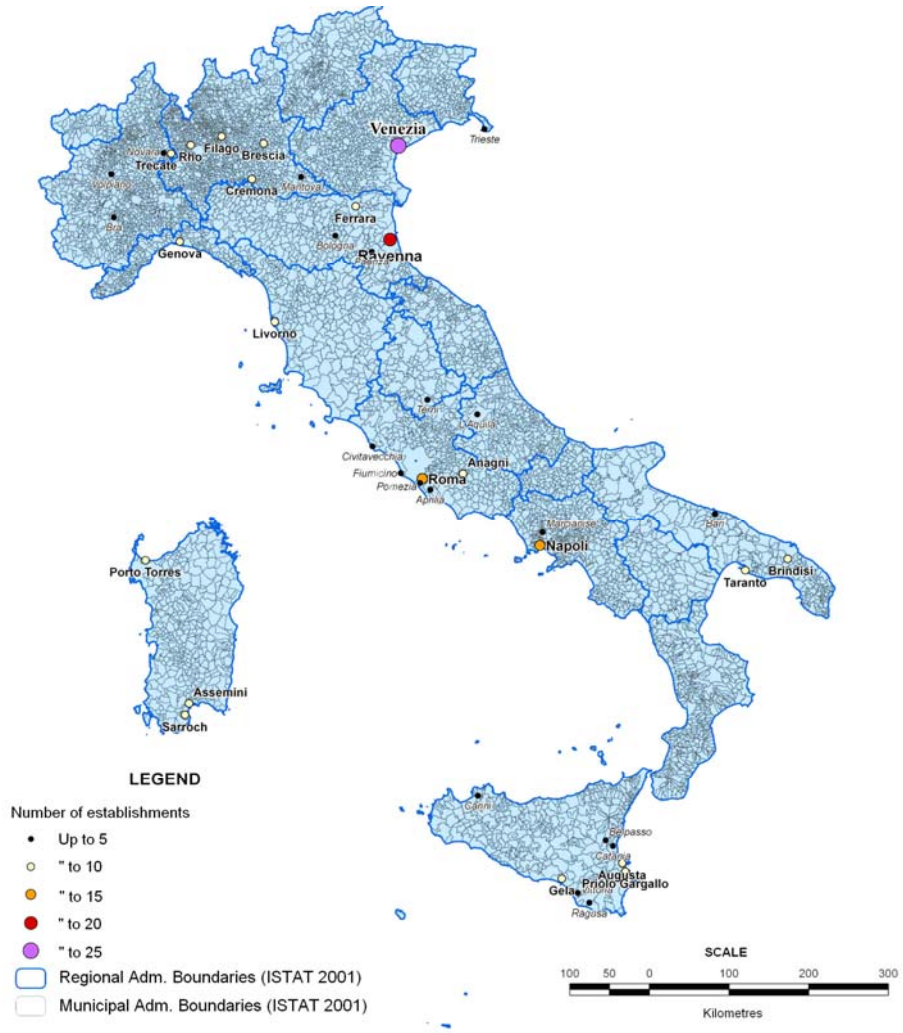


Figure 5.14: Municipalities with 4 or more Major-Accident Hazard establishments[3]

An analysis of the types of establishments involved (Figure 5.15) makes it possible to formulate further considerations regarding the map of industrial risk in our country. Using this information, the types of industrial activities most widespread among the Major-Accident Hazard establishments can be identified, together with their distribution throughout the national territory.

Knowledge of the activities of a plant makes it possible to identify the associated hazard.

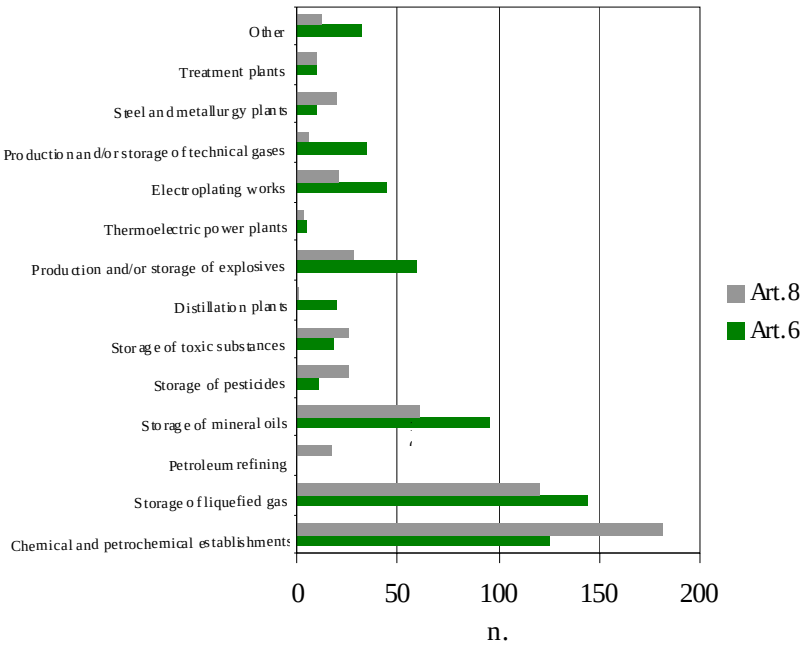
Knowledge of the activities of a given establishment makes it possible to determine in advance, albeit in general terms, the potential associated hazards. For example, storage depots of LPG and explosives, as well as distilleries and plants for the production and/or deposit of technical gases, present a predominant hazard of fire and/or explosion, with effects attributable, in the case of an accident, to irradiation or overpressure of varying extents, with the possibility of structural damage to the plants and buildings, as well as damage to man. Chemical factories, refineries, depots of toxic materials and pesticide products

[3]Source: APAT analysis supplied by the Ministry of the Environment, Land and Sea

entail, in addition to the risk of fire and/or explosion, as in the above cases, the risk of the spread of toxic or eco-toxic substances, eventually over significant distances, and thus the possibility of immediate and/or delayed threat to both man and the environment.

In terms of the types of activities located throughout the national territory, a predominance of chemical and/or petrochemical establishments was observed, together with depots of liquefied gas (essentially LPG), which, taken together, account for approximately 50% of all the establishments. Chemical and petrochemical establishments were found to be concentrated in Lombardy, Piedmont, Emilia Romagna and Venetia. The refining industry (17 plants in Italy), on the other hand, is spread more or less throughout the national territory, with especially high concentrations in Sicily and Lombardy, where the respective numbers of plants are 5 and 3. A similar observation can be made for storage depots of mineral oils, which are concentrated in the vicinity of the country's major urban areas. As for depots of LPG, they are widespread in the southern regions, and especially Campania and Sicily, in addition to Lombardy, Tuscany, Venetia and Emilia Romagna. These establishments are often found in urban areas with noteworthy concentrations in the provinces of Naples, Salerno, Brescia, Venice and Catania.

In Italy, the prevalent types of MAH establishments are chemical and/or petrochemical factories and LPG depots (approximately 50%). The first category is essentially concentrated in the northern regions, while the second is also widespread in the south.



The main types of establishments are chemical and/or petrochemical plants, plus depots of liquefied gas (mainly LPG), which, taken altogether, account for approximately 50% of all the facilities.

Figure 5.15: National distribution of establishments subject to Legislative Decree 334/99, plus subsequent modifications and additions, by type of activity[4]

[4] Source: APAT analysis of data from the Ministry of the Environment, Land and Sea

5.2.2 The causes

Distinguishing characteristics of Italy include the extensive network of LPG depots, designed to supply zones not reached by the methane network …

The pressure from Major-Accident Hazard establishments in Italy is comparable to that of Europe's other leading industrial countries, though there are undoubtedly distinguishing characteristics tied to the history and development of Italian industry, as well as to the choices made in the past, as in the case of energy supplies.

Examples are the high concentration of refineries found in Sicily and Lombardy, the major petrochemical complexes developed in the post-war years in the Po River valley (Ravenna, Ferrara) and in the Venice Lagoon (Marghera), as well as in Southern Italy (Brindisi, Priolo, Gela, Porto Torres etc.), starting in the 60's and 70's. A distinguishing characteristic of Italy, within the European framework of facilities at risk, is the noteworthy growth of the network of LPG depots, meant to supply areas of the country not reached by the methane distribution network.

…plus the presence of industrial districts with high concentrations of small and medium-size industries whose production activities are similar to, or connected with, a single production sector.

A further national characteristic is the presence of industrial districts containing a concentration of small and medium-size industries whose production activities are similar to or connected with a single sector, such as chemicals and pharmaceuticals in certain areas of Lombardy (25% of the Major-Accident Hazard establishments are found in Lombardy) and in the Pontine area, or electroplating works in Venetia, Piedmont and Lombardy. These operations are often found in congested territorial contexts, closely connected with urban settings or in densely inhabited areas characterised by the presence of population centres highly sensitive to potential accidents.

5.2.3 The solutions

The activities of response implemented in Italy are in line with those implemented in the other EU countries.

The regulatory framework for the control of the Major-Accident Hazard establishments on the European and national levels is well defined and fully developed, thanks to the three successive Community directives, together with the national legislation transposing their contents. The actions of response implemented in Italy are in line with those undertaken in other EU countries, demonstrating an essential compliance with European standards, though there is room for improvement through:

- a streamlining and acceleration of the procedure for assessing safety reports and increasing inspection controls;
- heightened awareness on the part of municipal administrations regarding problems of industrial risk, with a resulting increase in activities of control within the territory and in the supply of information to the population;
- improvement in both the quality and quantity of the activities connected with the planning of external emergencies in the event of an accident.

The improvements indicated above can be achieved when the following are present:

- definite allocations of resources for the branches of the Public Administration and the technical bodies involved, eventually through the introduction, under the Seveso regulations, of a system of fees charged to the operators of Major-Accident Hazard establishments, based on the controls performed by the P.A.;
- gradual decentralisation of the controls on the regional level, in keeping with the provisions of the Bassanini Act, following confirmation of the presence of local capacities and/or guarantees that the controls will be increased, especially in the southern regions, plus the formulation and maintenance of monitoring procedures by the Ministry of the Environment, Land and Sea;
- precise and timely definition, on the central government level, of detailed criteria and technical references meant serve as guidelines for the authorities and the local technical bodies responsible for the controls.

The agency system can make a valuable contribution to the problems connected with anthropogenic risk.

Within the above scenario, an element of key importance would appear to be reinforcement of the System of Environmental Agencies, which, given their role, as well as the know-how and experiences matured, can make a significant contribution, together with other subjects, to solving the problems highlighted.

6. INSTRUMENTS FOR ENVIRONMENTAL KNOWLEDGE AND AWARENESS

Introduction

This closing chapter of the volume is meant to present an overview – concise and definitely not exhaustive – of the different instruments that can be utilised to ensure that the various components of society are able to obtain more in-depth knowledge regarding an ever increasing number of environmental matrixes and factors, while, at the same time, the general level of knowledge regarding environmental issues is raised, making it easier to engage in styles of living that prove eco-compatible.

Instruments available to society for the formulation of a strategy of response to the environmental problems that it is called on to address.

According to the DPSIR model, an effective action of response, as indicated in numerous documents on both the national and international level, consists of "environmental education", meaning a form of activity not limited to school but extending into adulthood, in the field of continuing education and professional training.

The definition and objectives of environmental education have changed over time. In the broader sense of the term, environmental education can be defined as a tool for inducing citizens to take responsibility for, and to modify, their environmental behaviour.

The definition and objectives of environmental education have changed over time.

As is the case with other spheres of individual civic training, environmental education, together with its distinguishing characteristics and objectives, must be viewed within its specific context: it has evolved in response to changes in both global and local scenarios, as well as the uprooting of environmental givens, often characterised by full-fledged emergencies, that has occurred throughout the Planet, and especially in recent decades.

Environmental education first takes the form of the defence and conservation of nature (1970 – Conference of the International Nature Conservation Union). Then, during the 70's, its scope expands to include anthropic activities, the causal relationship between health and the quality of the environment and technological progress: the environment consists not only of the natural environment, but also the constructed and social environments. During this period, the ongoing advances in scientific research create a situation in which information and training are the main objectives of environmental education. "Using the discoveries of science and technology, education must take a leading role in establishing a clear-cut awareness and an improved comprehension of environmental issues. It must give rise to positive forms of behaviour towards the environment and the use of the nation's resources."[1]

In 1970 the International Nature Conservation Union established the first definition of environmental education understood as education in the defence and conservation of nature.

During the 80's, environmental education, dominated by the underlying concept that correct information can lead individuals to make a

[1] 1977 – The Tbilisi Declaration of UNESCO

significant change in the way they approach the environment, becomes a major area of activity in quantitative terms. However attention is focussed on the individual disciplines, with many European countries tending to confine the scope of environmental education to biology-related disciplines.

The Earth Summit held in Rio de Janeiro in 1992, and the Global Forum of NGOs that took place at the same time, undoubtedly mark a moment in which the gravity of the environmental problem gains widespread awareness. The Summit's primary agreement, known as "Agenda 21", proposes a strategy of global action to guide policies worldwide. The document makes unequivocal reference to the right of citizens to receive ongoing environmental information and education.

As things currently stand, the objective of environmental education is the process through which citizens mature to the point of obtaining a new awareness that translates into a capacity to modify forms of behaviour.

The treaty approved by the Global Forum on *Environmental Education for a Sustainable Society and Global Responsibility* upholds "the central role of education in cultivating social values and actions", in addition to reiterating the need for formation of an active citizenry capable of understanding the complexity of relations between nature and the activities of man. There is an increasing awareness that knowledge of risks alone will not result in the modification of forms of behaviour and policies, and that the most widespread model of knowledge – one that reflects a mechanistic vision of the world, holding that man is able to control the effects of his actions and dominate nature – falls short when it comes to understanding the complexity of the man-nature relationship, as well as the entire system of existing relations. At present, as the European Union has repeatedly stated in acts and documents, the primary objective is not simply a transfer of knowledge, but the start-up of a process of maturation in which all citizens gain a new awareness that translates into a capacity to modify forms of environmental behaviour and to contribute to the identification of adequate solutions for specific environmental problems. The learning experience is no longer one that begins and ends during one's school years, but that extends into adult life as ongoing education, continuous learning, training and updating of professional know-how. "Environmental education forms an active citizenry, making it possible to understand the complexity of relations between nature and human activities, inherited resources and those to be saved and transmitted, together with the dynamics of production, consumption and solidarity. Environmental education is global, and it extends throughout one's entire existence, preparing the individual for life. Environmental education includes formal instruction, heightening of awareness and training".[2]

The tools selected for presentation in this chapter as examples of how to arrive at a broader and more in-depth environmental knowledge and awareness include the activities carried out by the Measurement Laboratories of the Environmental Agency System, the reporting

[2] "Charter of Principles of Environmental Education Geared towards Sustainable, Informed Development" Fiuggi 1997

activities and their products, the level of use of telematic equipment for accessing environmental data/information, library services and environmental training in the strict sense, plus the enactment of the European EMAS and Ecolabel regulations.
It is held that the topics listed provide an overview, approximate but meaningful, not only of the disparities between the different types of instruments that can be used to obtain the set objective, but also the variety of the sectors of society that can be involved in such efforts.

6.1 Dissemination of environmental information

One of the most important actions, when it comes to increasing the environmental awareness of citizens, is the correct transmission of data and information. It may be useful to state the definition of environmental information: "Any information available in any form, written, visual or audio, or contained in a database, regarding the state of waters, the soil, fauna, flora, the territory and natural spaces, as well as activities, including those that are harmful, or measures that have, or could have, a negative impact on the aforementioned environmental components, plus activities, administrative measures and programs for the management of the environment".[3]

In line with the Aarhus Convention, as well as the Community directives and the relevant national legislative measures, in particular Legislative Decree 195/2005, "Implementation of Directive 2003/4/EC on Public Access to Environmental Information", as is also emphasised in National Report I on the implementation of the Aarhus Convention, the Agency System (APAT-ARPA/APPA) disseminates environmental information and data through the channels of the web, reporting, library services and the mass communications media. The Agency System also promotes other activities of environmental communication geared towards presenting the general public with technical-scientific information through the organisation of conferences and conventions, the dissemination of informative documentation, access to available information and the creation of multimedia products.

The Environmental Agency System disseminates environmental information and data through the channels of the web, reporting, library services and the mass communications media.

The legislative framework outlined above confirms and acknowledges the importance of providing citizens with the knowledge in the possession of the public authorities. At the same time, increasing participation and attention on the part of public opinion has been observed with regard to environmental problems and their effects on day-to-day life. Information and communications on environmental topics and data thus constitute not only a fundamental support benefiting citizens, but also a key tool for the policies of national and extra-national governments.

The involvement and participation of citizens, plus, in more general terms, of whomever may hold an interest, whatever the reason, is of fundamental importance in improving the quality of public policies and decision-making processes, seeing that it contributes to the development and consolidation of a democratic policy, based on a dialogue between the institutional and social sectors.

The involvement and participation of citizens is of key importance when it comes to improving the quality of the public policies and decision-making processes.

The social demand, the legislative framework and the very nature of environmental protection make necessary actions designed to reinforce

[3] Legislative Decree. 39/1997, which transposed into Italian law Directive 90/313/EEC regarding freedom of access to information on the environment

and consolidate within society the culture of sustainability: to this end, the promotion and dissemination of environmental culture, in accordance with the DPSIR model, constitute an effective action of response, being geared towards increasing awareness of environmental issues among citizens while guiding them towards sustainable forms of behaviour.

6.1.1 Environmental information through reporting

For a number of years now, APAT, through publication of the Yearbook of Environmental Data, has made known the results of the monitoring of the reporting products of the Agency System, meaning reports on the state of the environment / yearbooks, manuals/guidelines, thematic reports and proceedings of technical-scientific events (conventions, seminars, study days etc.). It should be remembered that, on both the European-Community and international levels, the reporting activities are not the subject of a structured analysis based on widely shared indicators. In late 2007, the OECD asked its member countries to provide elements of information on the instruments they utilised for the dissemination of environmental data/information, both to the general public and among decision-makers. If the initiative started up a process of defining indicators for the systematic monitoring of reporting activities, then APAT should be credited with having had the foresight to promote – on the level of the Environmental Agency System - reflection on the methodological tools best suited to representing this form of response to the sum total of environmental demands.

The reporting product most widely used by the Environmental Agency System is the "thematic report".

Though no historic set of data on the monitoring of reporting products is yet available, in the strict sense of the term (on account of the lack of uniformity in the data-collection methods used in different years, the fact that there was only partial spatial coverage etc.), still – based on the information collected from 2002 onward – an attempt can be made to draw up, at least in general terms, and in a completely provisional manner, both a balance of what has been done to date and a forecast of future developments.
Among those referred to earlier, the most widely used reporting product of the Environmental Agency System is the "thematic report", roughly a hundred of which have been published, on the average, in each of the last few years. Among the individual Local Environmental Agencies, this proves to be the reporting product to which preference is given in policies for the dissemination of environmental data/information.

As for "manuals/guidelines" and "proceedings of conference", the number published each year has consistently stood in the dozens.

In the case of the product "reports on the state of the environment", it should be noted that, in many cases, these are actually "yearbooks" (lists of statistics on environmental components and factors) rather than "reports" in the full sense of the term (documents that contain not only

statistical data on environmental components and factors, but also information on the underlying assumptions of environmental policies). In the case of the combined "yearbook/report" type of product, the quantity published in any given year is in the dozens.
The figures for 2006 (Table 6.1) confirm what is stated above. And, in years to come, it can reasonably be foreseen that the results will differ little from those registered to date.

Table 6.1 : Environmental information by means of reports and publications – (2006)[4]

Agency	Environmental data yearbooks	State of the environment reports	Manuals and guidelines	Thematic reports	Conference proceedings
	n.				
Piedmont	1	1	0	0	0
Val d'Aosta	0	1	0	2	0
Lombardy	1	1	1	12	2
Bolzano-Bozen	1	1	3	2	4
Trent	0	0	0	0	1
Venetia	1	1	3	5	-
Friuli Venetia Julia	1	1	1	4	1
Liguria	0	1	2	7	1
Emilia Romagna	1	0	0	0	3
Tuscany	0	1	1	1	1
Umbria	0	0	0	0	1
The Marches	1	1	3	28	7
Latium	0	1	1	0	0
Abruzzo	0	1	0	3	4
Molise	0	0	0	0	5
Campania	0	0	1	1	1
Apulia	0	0	0	24	1
Basilicata	1	1	0	0	1
Calabria	0	0	0	0	0
Sicily	1	0	2	1	1
Sardinia	0	0	0	0	4
APAT	1 + 2cd	0	11	39 + 2cd	1

The reporting product most widely used by the Environmental Agency System is the "thematic report". In the case of the combined "yearbook/report" type of product, the annual number of publications stands in the dozens.

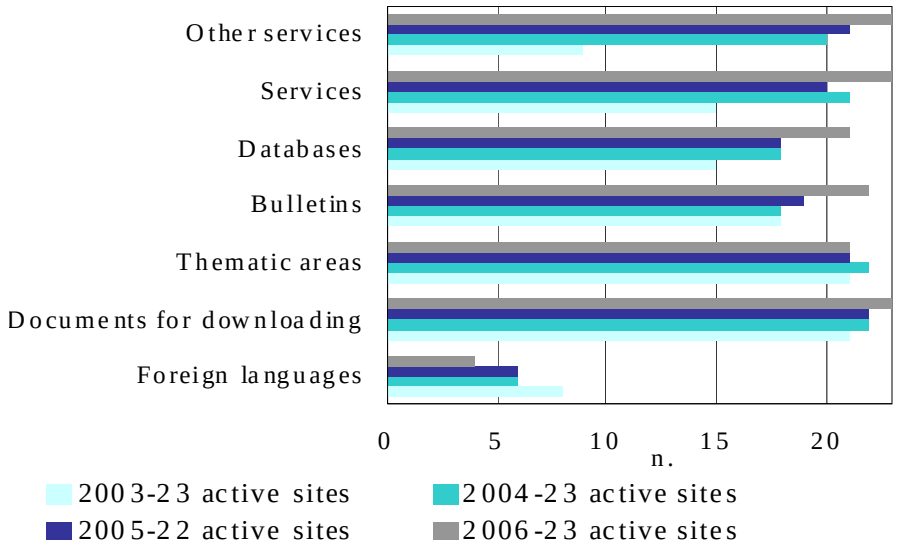
[4] Source: APAT analysis of ARPA/APPA data

6.1.2 Environmental information and communications on the web

The importance of Internet as an instrument of environmental information dissemination is constantly on the rise, due to its flexibility and dynamism. It also provides a way of overcoming the burden of paper document printing and distribution. Its relevance is further demonstrated by the increasing quantity of information provided on the state of the environment and by the possibility of dialoguing with users.

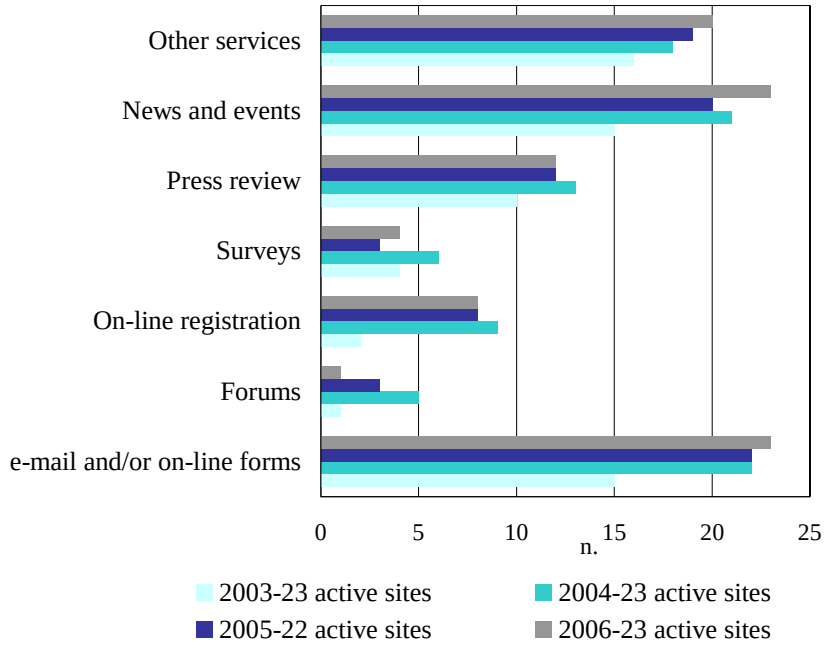
The research results show that the offer of environmental information available on the agencies' websites has increased. Growth was observed in several services, such as periodical bulletins, databases with connected cartography and general services, including information meant for businesses, other administrative bodies and users. The increase is only partially influenced by the number of active sites (22 in 2005 and 23 in 2006).

As Figure 6.1 shows, the Agency System generally meets users' requests for environmental information in a fairly satisfactory way. The research results show an increased presence of all the services, except for the translation of web pages in foreign languages. (only 4 sites out of 23 in 2006).
The analysis points out a general increase in the availability of the communication and interactive communication services (Figure 6.2), in order to maintain and increase direct relations between users and pertinent offices (e-mail, registration forms, news and events). On the other hand, the use of direct communication instruments, such as forums and surveys, has decreased over the years, probably as a result of a lack of adequate technology and properly trained personnel.



The supply of environmental data on the websites of APAT and the ARPA/APPA has been constant over time, with increases in bulletins, databases and services in general.

Figure 6.1: Statistics on environmental information on the web[5]



The Agency System's readiness to establish direct relations with users has increased. The preferred tools are: electronic mail, news and involvement in national and local events.

Figure 6.2: Statistics on environmental communications on the web[6]

[5] Source: APAT
[6] Source: APAT

6.1.3 Library services and resources for users

As for the libraries and/or documentation centres specialised in the Agency System's environmental topics, the research results show a clear connection between the assignment of economic and human resources and the offer of services and information to users. The trend is partially improving.

The organization, the offer of services and the territorial distribution of the libraries are not homogeneous (15 local agencies have a library). Increases in acquisitions and in services to users were registered in ARPA Lombardy, ARPA Venetia, ARPA Liguria, ARPA Tuscany, ARPA Latium, ARPA Campania and APAT. Worthy of note are new library start-up projects (ARPA Sardinia).

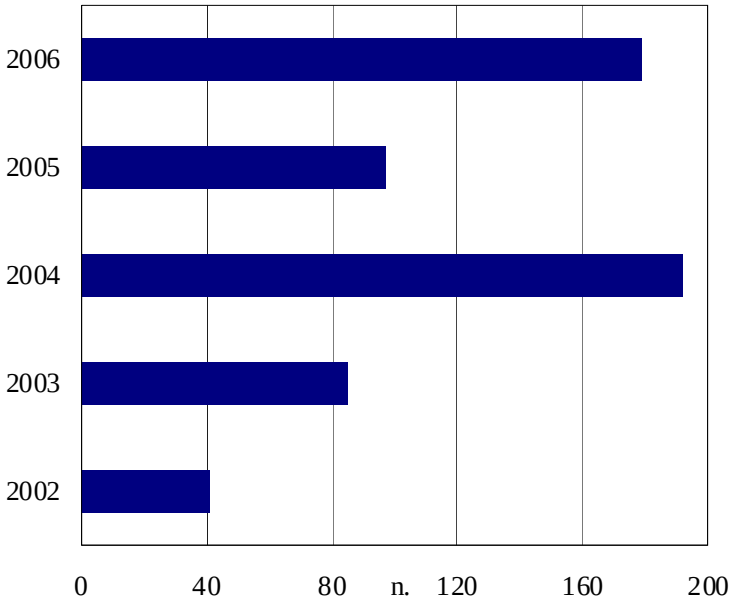
6.2 Instruments for Quality Environmental Information

Ensuring that the information disseminated is well founded in technical-scientific terms is of key importance when it comes to forming knowledgeable citizens capable of understanding the complexity of environmental issues.

The agency network has the task of arranging for environmental monitoring of the territory and ensuring the quality and the reliability of the environmental data collected. More specifically, the environmental regional agencies are responsible for the environmental monitoring of their territory, while APAT has the task of assuring the quality and comparability of the colleted data.
These objectives are commonly ensured by the use of standard methods, the implementation of quality control programs within the laboratories and participation in proficiency testing schemes (PTs). Within this framework, a key role is played by the (certified) reference materials (CRMs/RMs). The use of CRMs/RMs makes possible validation of measurement methods and the control of instruments and analysts' performances, while ensuring that the data obtained by the different laboratories are reliable and comparable. To this end, APAT established in 2002 a laboratory for the production of reference materials, to be used for inter-laboratory comparisons, proficiency tests and internal quality control within the laboratory. These activities were performed according to international rules and guidelines, such as ISO Guide 34 and 35 and ISO Guide 43-1.

The reliability and comparability of the data obtained by the different regional environmental laboratories is commonly guaranteed by standard methods for the implementation of quality control programs and the participation in circuits of contact and comparison.

In 2006, 179 laboratories participated in PTs and interlaboratory comparisons, confirming the interest of the Environmental Agencies in establishing a network of laboratories within the territory capable of guaranteeing a constantly improved quality of measurements (Figure 6.3).



There has been active participation by laboratories in PTs and interlaboratory comparisons organised by APAT free of charge.

Figure 6.3: Laboratories that have participated in PTs and interlaboratory comparisons[7]

[7] Source: APAT

6.3 Programs of Education and Training

As has been noted on a number of different occasions, in both international and national documents, environmental education constitutes an experience that does not begin and end in school, but that extends into adulthood, in the fields of continuing education and professional training.

The agency system has promoted a variety of environmental education initiatives and training courses, both face-to-face and remote, in accordance with the objectives of the "Decade of Education for Sustainable Development" proclaimed by the UN – UNESCO for the period 2005-2014.

The Decade, based on the recommendations found in the international implementation guidelines of UNESCO and the strategy for education for sustainable development of the UNECE, is developed in the member countries through a national coordinating body, which, in the case of Italy, is the Italian National UNESCO Commission. The Commission has promoted the establishment of a national network whose members include numerous subjects – both institutional and non-institutional – that deal not only with the environment, but also with different aspects of sustainable development (the Ministry of the Environment, Land and Sea and the Ministry of University Affairs and Research, APAT and the 21 ARPA/APPA, the regional scholastic offices, public sector organisations, networks and associations). The UNESCO Commission organises an annual National Week of Education for Sustainable Development and it recognises, by awarding the "DESS" logo (Decade of Education for Sustainable Development), all initiatives that contribute to achieving the objectives of the Decade.

The Italian UNESCO Commission organises an annual National Week for Education in Sustainable Development, and it recognises, by awarding the "DESS" logo, all initiatives that contribute to achieving the objectives of the Decade.

6.3.1 Environmental education and training offerings

The Agency System, as well as its individual components, has promoted, in recent years, a number of different initiatives meant to raise awareness and provide education on environmental sustainability as part of the Decade, or, at the very least, in keeping with its underlying goals. Initiatives involving environmental education can essentially be grouped in two categories: environmental education projects and specific activities for raising awareness and disseminating environmental information and education, with the term "projects" referring to integrated initiatives that extend over time, while "specific activities" are the other, individual educational initiatives promoted by the Agencies at the request of scholastic institutes or on the occasion of events regarding the topics in question. In the case of the interagency working group CIFE, whose members are the representatives for Communications, Information, Training and Environmental Education

The Junior Conference, organised by APAT, in collaboration with a number of environmental agencies and with the CTS for the Environment, as part of the National Conference on Climate Changes for 2007, has proposed use of a highly interactive methodology ("game simulation") to

of the Environmental Protection Agencies, and which is coordinated by APAT, the focus has been development of a course addressing some topics of education for sustainable development. The Course – an environmental education workshop started in September 2005 and held in the form of a series of teaching modules organised on each separate occasion by a different ARPA/APPA, is currently nearing conclusion. Another important education initiative that obtained official recognition from UNESCO is the Junior Conference organised by APAT, in collaboration with a number of regional environmental agencies, as well as the CTS Environment, as part of the 2007 National Conference on Climate Changes, an event that proposed the use of a highly interactive methodology ("game simulation") to introduce and involve young people in gaining an understanding of topics tied to environmental sustainability.

introduce and involve young people in gaining an understanding of topics tied to environmental sustainability.

The projects recorded for 2006 numbered 224, of which 16% are multiyear initiatives and 89% were developed as co-planning efforts. In terms of the target, the percentage of the projects aimed at the adult population has reached approximately 54%. Of particular note is a significant increase in recent years in education activities directed at adult citizens, in keeping with the principles of "life long learning", meaning learning that extends through every phase of life, by means of different methods and procedures.

Figures for 2006 show that there were 224 environmental education projects.

APAT and the agencies also run training programs designed to develop the skills and know-how of professionals who operate in the field of the environment. In addition to providing an opportunity for the dissemination of technical and scientific knowledge, training initiatives also allow technicians active in different environmental spheres to share their methodologies and instruments of application. Increasing use is made of innovative teaching approaches that offer higher levels of effectiveness, being based primarily on practical applications, as well as theoretical concepts. In a number of cases, the e-learning, mode is used, heightening the flexibility of the training procedure.

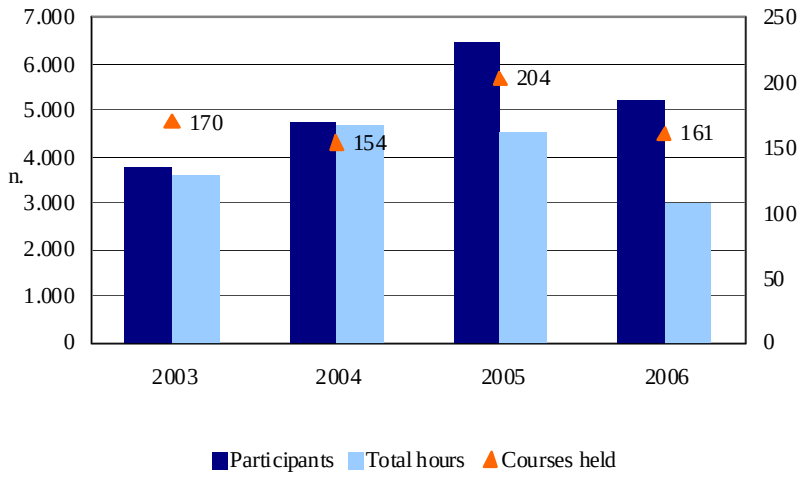
Training initiatives give technicians who operate in different environmental spheres the chance to share methodologies and instruments of application.

Thematic workgroups have organised a number of courses addressing elements of environmental emergencies, such as the "Blossoming of the *Ostreopsis ovata* algae along Italian coasts", organised in 2007, as well as topics of current interest, with an example being the course promoted in 2005 on "Eco-Compatible Design, Methodologies Instruments for the Innovation and Improvement of Production Cycles", plus topics pertinent to all sectors, such as the "Workshop Course on Environmental Education in Sustainable Development" described above.

Since 2003, APAT has promoted initiatives of environmental training, some in response to specific requests from the Ministry of the Environment, Land and Sea, aimed at the technicians of the environmental agencies and other public bodies. The courses have

addressed topics involving environmental defence and restoration, new methodologies and instruments for analysing the risk of contaminated sites, techniques of environmental reclamation and clean-up, environmental regulations and instruments for sustainable land management.

To increase the dissemination of technical knowledge on the environment, APAT has published the technical-scientific contents of the courses held on its website for environmental education and training (www.formeducambiente.apat.gov.it).



During the period 2003-2006 the Agency System promoted 689 training initiatives. There were more than 20,000 participants in the courses.

Figure 6.4: Environmental training offerings 2003-2006[8]

Environmental training activities have provided opportunities for contact and exchanges of experiences in the field of environmental protection, at times through initiatives of international cooperation. One such initiative, a cooperation project between APAT and the Egyptian Environmental Affairs Agency (a bilateral agreement between the Italian Ministry of the Environment, Land and Sea and the Egyptian Ministry of State for Environmental Affairs), initiated in 2005 and scheduled for completion in the first six months of 2008, involves the organisation of training workshops for the reinforcement of skills and know-how regarding technical and specialised aspects of environmental protection, as well as the publication of a yearbook of environmental data.
A similar effort has been undertaken as part of the working relationship formally established in 2005 between APAT and the Moroccan Ministry of the Environment, with specific training encounters organised for the development of technical skills meant to improve the management of environmental policies.

[8] Source: APAT

During the period 2003-2006 (Figure 6.4), 689 training initiatives (for a total of 15,838 hours) were organised by the Agency System, with more than 20,000 participants taking the courses. In the year 2006 more than 160 training initiatives were organised on specific topics involving environmental protection and sustainable development, with more than 5,000 participants attending the courses. An analysis of the statistics shows that the individual agencies promote training activities to varying degrees, based in part on the powers and responsibilities assigned to them under their legislative acts of foundation.

It is important to point out that a number of agencies have obtained regional/provincial accreditation, and/or accreditation from the Ministry of University Affairs and Research, such as the ARPAs of Venetia, Tuscany, the Marches, Latium and Apulia, meaning that they are authorised to issue training credits for the courses held. A number of agencies have obtained certification demonstrating compliance with the UNI EN ISO 9000-9001 standards, while others, such as APAT, have initiated the procedures for entering their environmental training activities in the quality certification process.

6.3.2 Operational performance of the local environmental education network

The participation of the Agencies in the reference network for environmental education in local systems and in educational networks consists primarily of coordination activities (or participation in coordination groups), carried out under an institutional mandate, as part of the regional/provincial educational systems (normally involving the INFEA network and/or the inter-agency group CIFE). Another area of activity where the ARPA/APPAs play a significant role, increasing their contribution over the years, concerns functions of support for the activation and performance of participatory processes of local sustainability (first and foremost local Agenda 21), including tasks of promotion, dissemination of information, raising of public awareness etc..

6.4 Instruments for Improving Environmental Services

Increasing importance has been placed on improving the environmental quality of businesses, organisations and products for the sake of protecting the environment.

The growing awareness that the protection of the environment must necessary involve all the pertinent subjects, in particular through the activation of new forms of collaboration with the leading market operators (firms and consumers), places increasing importance on improving the environmental quality of companies, organisations and products; the primary reference sources for this objective are the European EMAS and Ecolabel Regulations, together with the international standards of the ISO 14000 series.

EMAS (EC Regulation no. 761/01) and Ecolabel (EC Regulation no. 1980/2000) are representative of the environmental policy initiated by the European Union under the Fifth Action Program (1992-1999). The traditional mechanism of command and control has been supplemented with new instruments of voluntary participation aimed at improving resource management, plus the assumption of direct responsibility for the environment and the promotion of public information with regard to the environmental performance of processes and products.

The first years of application have confirmed the notable value of the above regulations as instruments of environmental prevention and improvement. The key underlying objective of the Sixth Action Program and Integrated Product Policy (IPP) can be considered the development and consolidation of a set of measures which, stressing forms of production that respect the environment, together with ecologically aware consumption, should lead to the creation, over the medium/long period, of a "green market", as well as activation of the principles of Sustainable Production and Consumption (SPC).

The tangible manifestations of this new approach are:

- the intent, as expressed in the Sixth Action Program of the EU, to increase the dissemination of EMAS and Ecolabel Regulations, to promote Green Procurement, in order to accelerate the growth of the "ecological market", and to improve business to business and business to consumers environmental information, in part by providing incentives for the formulation of Environmental Product Declarations (EPDs);
- the request for the development in each member state of strategies which, by combining the voluntary instruments available (EMAS, ECOLABEL, Product Declarations, ECO Design etc.) and the legislative measures, put into practice the environmental efficiency" principle;
- the innovations introduced on the occasion of the revision of the EMAS and Ecolabel schemes, and in particular: an approach based more on quantitative than qualitative considerations, in order to focus attention on indicators of environmental performance (EMAS III); the extension of EMAS from the industrial sector to all

activities; the introduction of the indirect environmental impact (EMAS II) concept and the extension of the field of application of Ecolabel from products to services;

- the strategic role assigned to the public sector and to citizens-consumers as subjects capable of developing the "demand for ecology".

The creation of the "green market" is a commitment that involves:

- companies, which can improve the environmental characteristics of their products and services during the phases of design and operation;
- consumers, who can give preference to ecologically certified offerings and make correct use of what they purchase;
- the Public Administration, which can provide environmentally adequate services, work towards a correct use of the territory, pay close attention to what it consumes, inform citizens and guide their awareness and behaviour, in addition to introducing bonus incentives, promoting research and harmonising development policies.

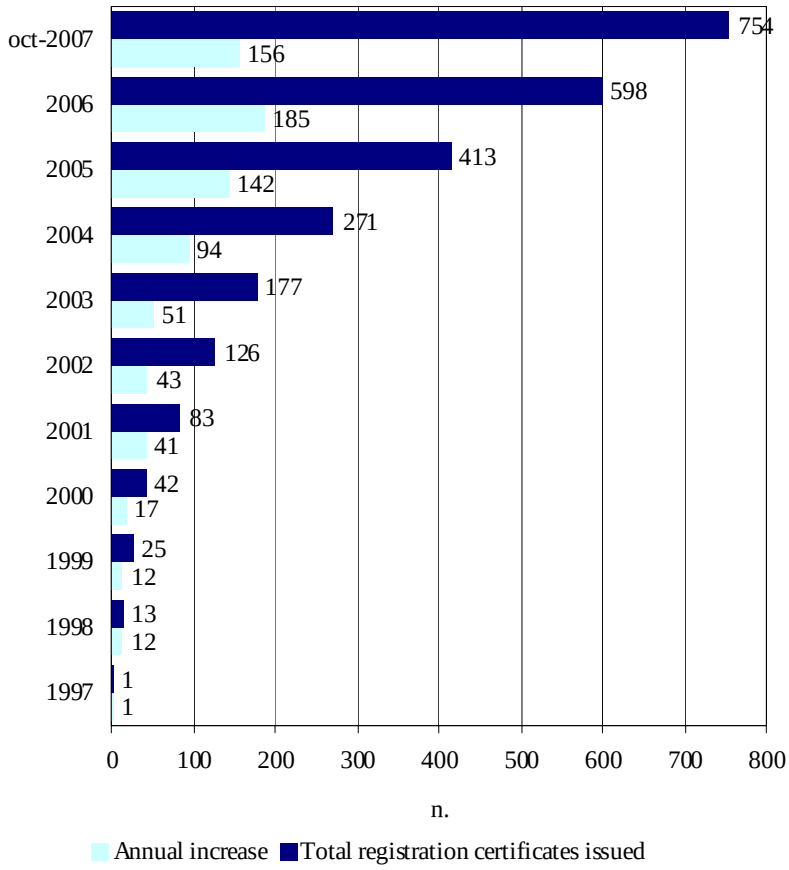
As is specified in the "Green Book" on IPP, "Ecological efficiency is an exercise in leadership", to be developed with the objective of working towards a new mode of production and consumption. Many instruments are now available (EMAS, Ecolabel, GPP, DAP etc.), and they are technically proven: the way these instruments are combined in their actual application must be the result of strategies formulated on the company level, based on market competitiveness, and within the Public Administration, in terms of decisions and programs regarding development.

To summarize as concisely as possible, the driving factors on which harmonised strategies should be based are:

- attention to economic interests, using taxes/subsidies to internalise external costs, so as to identify the "fair price" (introduction of the principles of "if you pollute, you pay" and of the "responsibility of the producer");
- development of instruments and incentives to promote a more ecological consumption, through initiatives regarding both demand and information, and through efforts aimed at heightening the awareness of the administrative bodies that manage public tenders;
- interaction with the offerings of ecological products and services, through the introduction of instruments for comparing information, plus encouragement of the transparency and dissemination of data, requesting that the regulatory sector take action to promote eco-compatible planning and design, plus compliance with environmental compatibility.

From 1997 (the year in which EMAS and Ecolabel Regulations became effectively operative in Italy) to the present, the penetration of the two

regulations has grown continuously, showing a significant annual increase (Figures 6.5 and 6.6).



The most virtuous regions, in terms of the number of EMAS registered organisations, are: Emilia Romagna, Tuscany, Lombardy, Piedmont and Venetia, with Campania holding sixth place, demonstrating a certain amount of attention on the part of Southern Italian regions. The lack of uniformity in development throughout the territory reflects the different levels of local awareness and/or incentives.

Figure 6.5: Number of EMAS registration certificates issued in Italy over time[9]

In Europe, Italy ranks third in terms of EMAS, coming after Germany, while Spain ranks first, followed by France and Denmark, in terms of Ecolabel. The most virtuous regions (Central/Northern Italy), in terms of the number of EMAS registered organisations, are: Emilia Romagna, Tuscany, Lombardy, Piedmont and Venetia, while Campania holds sixth place, showing a certain amount of attention on the part of Southern Italy. The largest number of Ecolabel licenses is registered in Trent Alto Adige, followed by Tuscany, Emilia Romagna, Piedmont and Lombardy.

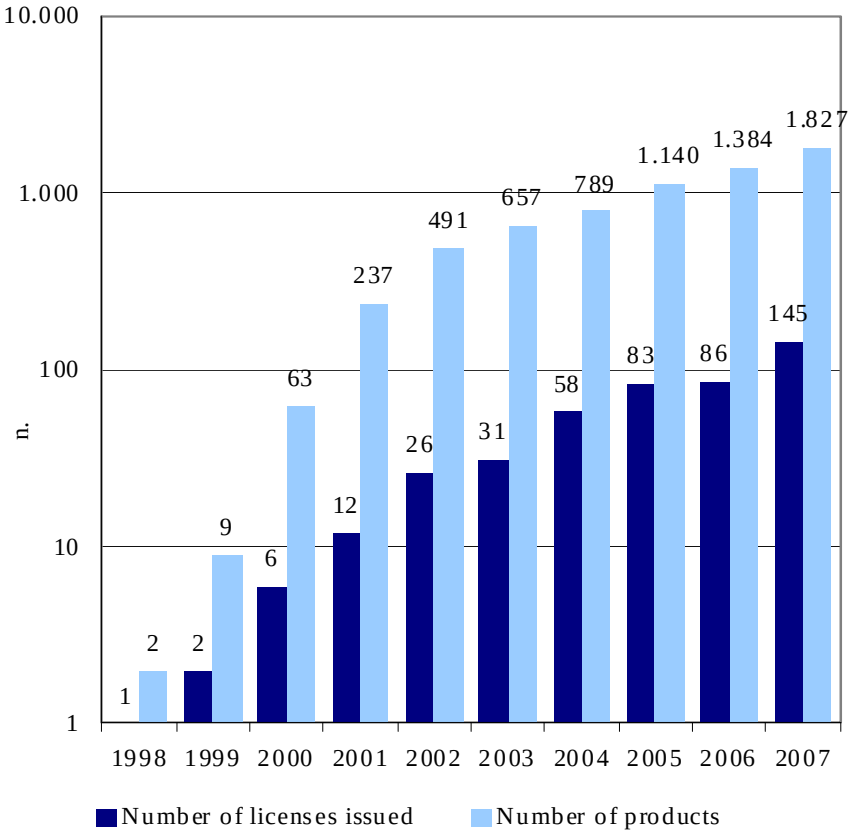
The increase in EMAS and Ecolabel has been favoured by, among other factors, the development of professional skills and know-how through attendance at local EMAS and Ecolabel schools, whose objective is to provide basic training to professional figures qualified to assist the organisations (EMAS environmental auditors and consultants and Ecolabel consultants), in addition to establishing, in agreement with the academic world, specific masters programs for advanced instruction.

[9] Source: APAT

Still, this growth, though it places Italy among the European leaders, is not yet structural in nature, with development being inconsistent through the national territory, as a result of levels of awareness and/or incentives that differ from one region to the next, or among the various local government bodies, production sectors, professional associations etc.. Despite the good intentions regarding EMAS shown by the provisions of art. 18 of Law 93 of 23 March 2001 (though without the support, it should be said, of subsequent measures of application), as well as the new Unified Act on the Environment (Legislative Decree 152/2006), an effective and incisive sponsorship of voluntary instruments by the pertinent administrative bodies and the interested parties is still lacking.

In the case of EMAS, the crucial problems would appear to be:

- the lack of systematic involvement of the interested parties in the formulation of strategies designed to integrate environmental needs and competitiveness on the market, as well as the lack of development of incentive proposals for subjects that participate in the procedure;
- the large number of public entities involved in the procedures of authorisation and control, plus the scarce propensity to place priority on policies of prevention;
- the continued shortage of adequate professional skills and know-how within the territory.



Between 1998 and 2007, a total of 145 Ecolabel licenses were issued, making for 1,827 products/services labelled. The trend was positive for both licenses and products/services. Last year, the largest increase was registered in the tourism accommodation sector.

Figure 6.6 : Number of Ecolabel licenses and products/services in Italy over time[10]

As for Ecolabel certification, the fact that environmental criteria have been included in the calls to tender of the Public Administration, and that companies whose products are certified have been awarded points, has led to a significant increase in the interest shown by business enterprises in this instrument. A concrete demonstration of this interest is provided by the increase in certified products and licenses in a number of product groups such as detergents, textiles and paper. Nevertheless, the largest increase during the last year occurred in the tourism accommodation sector, where a far-reaching promotional effort throughout the territory, plus incentives offered by a number local public administrations, have stimulated the demand for participation in the EU Ecolabel scheme, increasing the number of licenses more than three-fold.

It should be noted, however, that even though more than 1,800 certified products, goods and services are available on the Italian market, knowledge of the Ecolabel scheme on the part of the general public, as well as awareness of the EMAS logo, continues to be scarce, still falling below levels able to move the market in the direction of “green market”

[10] Source: APAT

status.

ACRONYMS

Listed below are the meanings of a number of the acronyms found in the publication

AAP	Other Protected Area
ACI	Italian Automobile Club
AE	Equivalent Inhabitants
AEA	European Environmental Agency (also see EEA)
AIE	International Energy Agency
AIEA	International Agency for Atomic Energy
AM	The Italian Air Force
ANCI	National Association of Italian Municipalities
ANMP	Natural Protected Marine Areas and Marine Natural Reserves
ANPA	National Environmental Protection Agency (now APAT)
APAT	Agency of the Environmental Protection and Technical Services
APPA	Provincial Environmental Protection Agency (only autonomous provinces)
ARPA	Regional Environmental Protection Agency
ASL	Local Healthcare Enterprise
BAT	Best Available Techniques
CARG	Geological Cartography
CBD	Convention on Biological Diversity
CCTA	Carabinieri Police Command for the Defence of the Environment
CE (EC)	European Commission
CECOM	Communication of the European Commission
CEE	European Economic Community
CFS	State Forest Corps
CIPE	Inter-Ministerial Committee for Economic Planning
CIRIAF	Interuniversity Centre for Research on Pollution from Physical Agents
CLC	CORINE Land Cover
CNLD	National Committee for the Fight against Desertification
CNR	National Research Council
CONACEM	National Coordination for Defence against Electromagnetic Fields
CONECOFOR	Control of Forest Ecosystems
CORINAIR	CooRdination InformatioN AIR
CRA	Agricultural Research Council
CTN	National Topic Centre
CTN-TES	National Topic Centre – Land and Soil
DBMS	Database Management System
DISMED	Desertification Information System for the Mediterranean
DPSIR	Determinants – Pressures – Status – Impact – Responses
EAP	European Action Programs in the Field of the Environment
EAP (EU)	Environmental Action Plan (also see PAA)
EEA	European Environment Agency
EIA	Environmental Impact Assessment
EMAS	Eco-Management and Audit Scheme
ENEA	Agency for New Technologies, Energy and the Environment
EPER	European Pollutant Emission Register
ESAs	Environmentally Sensitive Areas
ETC	European Topic Centres
EU	European Union
EUAP	Official list of Protected Areas

EUROSTAT	Statistical Office of the European Communities
FAO	Food and Agriculture Organization of the United Nations
FSC	Forest Stewardship Council
GDF	Italian Treasury Police
GDP	Gross Domestic Product
GFS	Sustainable Forestry Management
GIS	Geographic Information Systems
GMO	Genetically Modified Organisms
GNDT	National Earthquake Defence Group
GPP	Green Public Procurement
IBE	Extended Biotic Index
ICDM	Sea Defence Service of the Ministry of the Environment
ICRAM	Central Institute for Research on the Marine Environment
IFFI	Inventory of Landslide Events
INES	National Inventory of Emissions and their Sources
INFC	National Inventory of Forests and of Forest Reservoirs of Carbon
INGV	National Institute of Geophysics and Volcanology
IPCC	International (or Intergovernmental) Panel on Climatic Change
IPP	Integrated Product Policy
IPPC	Integrated Pollution Prevention and Control
IPR	Main Reference Institute
IQB	Index of Bacteriological Quality
IREPA	Institute of Economic Research for Fishing and Aquaculture
IRSA	Waster Research Institute
ISS	Italian National Health Institute
ISSDS	Experimental Institute for the Study and Defence of the Soil
ISTAT	National Statistics Institute
ISTIL	Institute of Science and Technology of Luminous Pollution
ITHACA	Italy Hazard from Capable Faults
IUCN	The World Conservation Union
JRC	Joint Research Centre
LCA	Life Cycle Assessment
LIM	Level of Pollution from Macro-Descriptors
MAP	Ministry of Production Activities
MATTM	Ministry of the Environment, Land and Sea
MAV	Waters Magistrate
MEDALUS	Mediterranean Desertification and Land Use
MGM	Genetically Modified Micro-Organisms
MIPAAF	Ministry of Agricultural, Food and Forestry Policies
MUD	Consolidated Environmental Declaration Form
NFP	National Focal Point
NIR	Non Ionising Radiation
NORM	Naturally Occurring Radioactive Materials
ODP	Ozone Depleting Potential
OECD	Organization for Economic Cooperation and Development
OPR	Oasis for the Protection and Refuge of Fauna
PAA	Environmental Action Program (of the EU)
PAC	Common Agricultural Policy
PAI	Plan of Hydrogeological Array
PAN	National Action Plan

PEFC	Programme for Endorsement of Forest Certification Schemes
PFR	Regional Focal Point
PGM	Genetically Modified Plants
PIFFI	Landslide Event Identifying Point
PMP	Multizone Prevention Facilities
PN	National Park
PNR	Regional Nature Park
POP	Multiyear Guidance Programs
PSR	Pressure-Status-Responses
PYL	Potential Years of Life Lost
R&S	Research and Development
RFI	Italian Railway System
RICE	Radium of Influence of Coastal Erosion
RID	Italian Dikes Register
RNR	Regional Nature Reserve
RNS	State Nature Reserve
ROD	Reporting Obligation Databases
RSA	Report on the State of the Environment
SAC	Special Area of Conservation
SCAS	Chemical State of Ground Waters
SCI	Site of Community Importance
SCN	Nature Preservation Service
SEA	Strategic Environmental Assessment
SECA	Ecological Status of Waterways
SEL	Ecological Status of Lakes
SCI	Sites of Community Importance
SIMN	National Service for Study of Waters and Seas
SINA	National Information System for Environmental Monitoring
SINAB	National Information System on Biological Agriculture
SINAL	National Laboratory Accreditation System
SINAnet	Network of the National System of Environmental Knowledge and Controls
SITAP	Information System on the Territory, Environment and Landscape
SNAP97	Selected Nomenclature Air Pollution
SNI	Site of National Interest
SPA	Special Protection Area
SSN	National Seismic Service
ST	Total Surface Area
TAF	Agrarian and Forestry Territory
TERM	Transport and Environment Reporting Mechanism
TOFP	Tropospheric Ozone Forming Potential
UAA	Utilised Agricultural Area
UMTS	Universal Mobile Telecommunications System
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNCDS	United Nations Committee on Sustainable Development
UNCED	United Nations Conference on Environment and Development
UNECE	United Nation Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework on Climatic Change

US-EPA	Environmental Protection Agency
USLE	Universal Soil Loss Equation
VVF	Fire Fighters Corps
WFD	Water Framework Directive
WHO	World Health Organisation
WMO	World Meteorological Organization
WWF	World Wildlife Fund
ZRC	Zones for Repopulation and Capture of Wildlife
ZUN	Zones Vulnerable to Nitrates

Appendix

Yearbook Indicators Database

Yearbook Indicators Database
(http://annuario.apat.it/)

Introduction
Together with the preparation of the 2007 Yearbook, a new release of the Environmental Indicators Database was drawn up, in order to achieve further improvement in the operating management of the indicators while streamlining their processing and making the information collected easier to consult.

Structure of the Yearbook Database

The *Yearbook Database* is a web-based application designed to support the preparation of the Yearbook of environmental data and available for consultation on the Internet site http://annuario.apat.it.
The site is a web application that can be used by non-privileged (or basic) users to consult the indicator fact-sheets, while privileged (or data entry) users can input data (updating of indicator fact-sheets already in the data base or insertion of new ones) and supervisors can coordinate the preparation of the Yearbook.
Basic users access the application with a browser, having first entered their username and password in the on-line login form. The privileges associated with these user profiles permit consultation of the indicator fact-sheets and the data, the formulation of customised reports and the downloading of such reports.
Data-entry users, on the other hand, are given the privileges necessary for annual management of the information on the indicator fact-sheet. The information can be divided into two sub-groups:
- *Meta-data on the indicator*
- *Data associated with the indicator*.

Support of the Yearbook production process

The database was created as a tool meant to supply aggregate data is the form closest to that required by the paper edition of the Yearbook and by other reporting products. It involves the loading, memorisation and subsequent consultation of not only the meta-data, but also the input data for the indicators, which is prepared and updated annually.
In preparing the new Yearbook, the indicator fact-sheets already found in the database are automatically precompiled and then updated by the authors, who also upload the input data.
Once the Yearbook has been published, the fact-sheets can be consulted and downloaded by all users.
At present, indicator fact-sheets from the 2003 edition of the Environmental Data Yearbook onward are available for consultation.

Consultation

The database may be accessed directly using the address http://annuario.apat.it
At present there are two different modes for consulting the Database: one focussed on searching for the indicator fact-sheet, containing both the meta-data and the data; the other designed solely for consultation of the input data of the indicator. Using the

first method, the consolidated indicators can be consulted through the following filters: Year of Publication of the Yearbook Sought, Topic Area and SINAnet Theme; the other approach, referred to as “Sistematizzazione” and still in a prototype version, makes possible visualisation of the time services from the different editions of the Yearbook, as well as individual extraction of the data that generated the series. The first method is described below.

Figure A.1 shows the application’s homepage.

Figure A.1: Yearbook Homepage

The application interface is easily understood, allowing basic users to register on-line by entering their usernames and passwords. The registration form, shown in figure A.2, calls for compilation of the obligatory items (username, first name, last name and e-mail, all indispensable for access and management of users), in addition to requesting optional information that can be of use in tracing the profiles of users who access the consultation function.

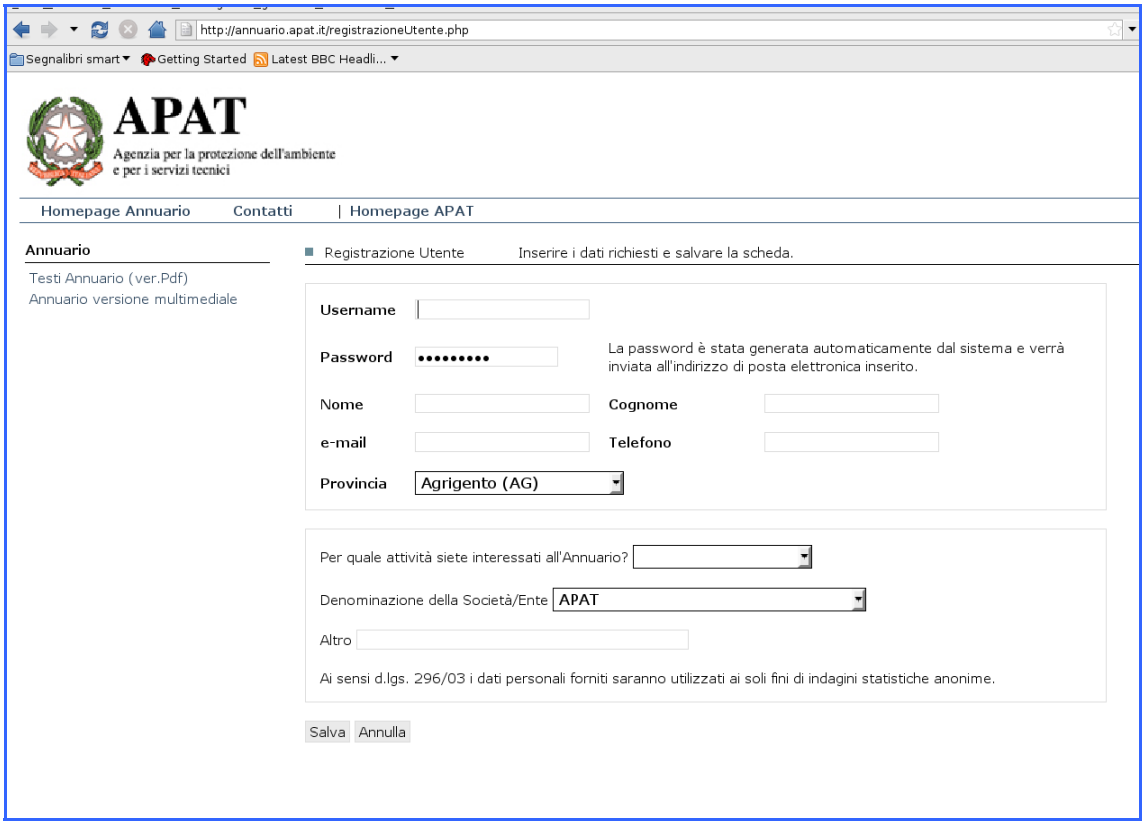


Figure A.2: "Registrazione utente" interface

Once registration has been completed, the user can start navigating by carrying out the login, which involves entering the username selected and the password automatically generated by the system and sent to the e-mail address entered during the registration phase.
Should the username or password be lost, the application includes a function (Figure A.3) that sends out the access credentials once again, after the e-mail address use for registration has been entered. This function is accessed from the menu on the right side of the homepage.

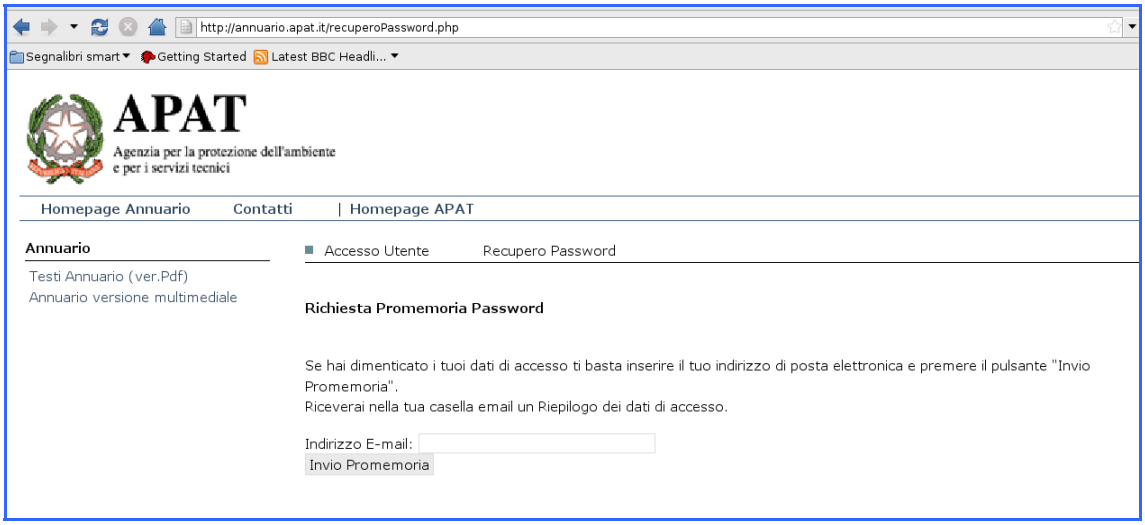


Figure A.3: The "Richiesta promemoria password" interface

Figure A.4 shows the initial page that appears to the basic user after the login.

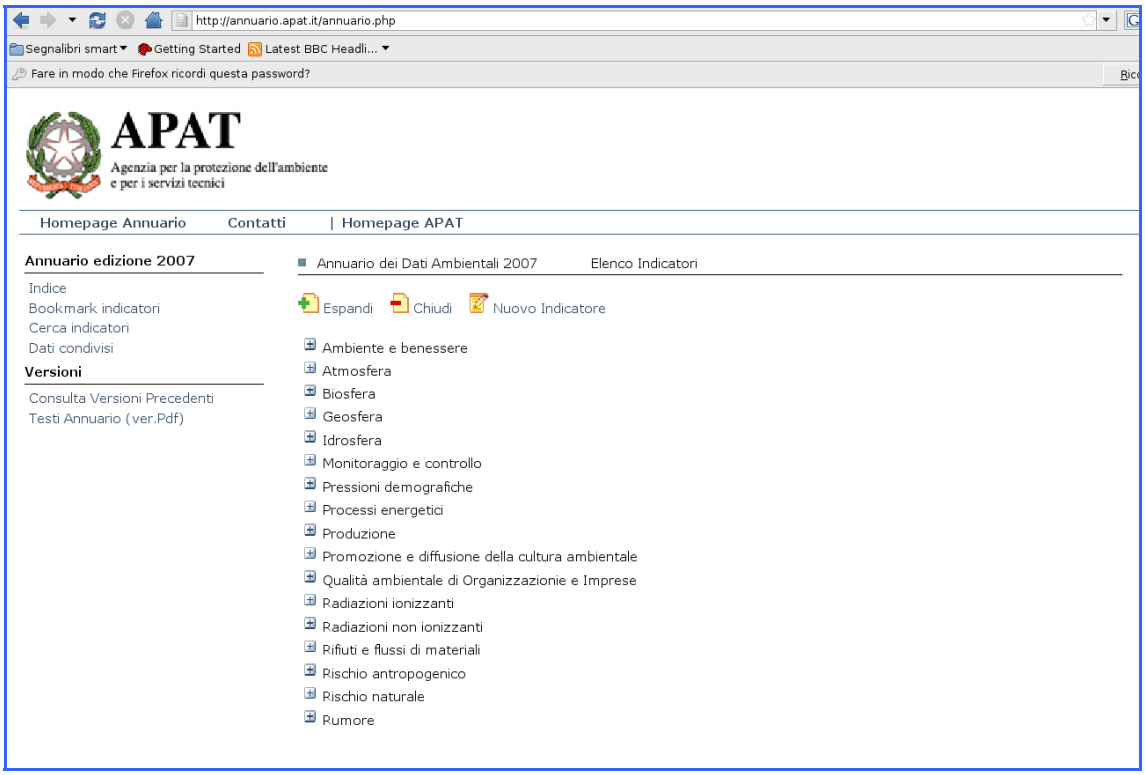


Figure A.4: The homepage of the basic user

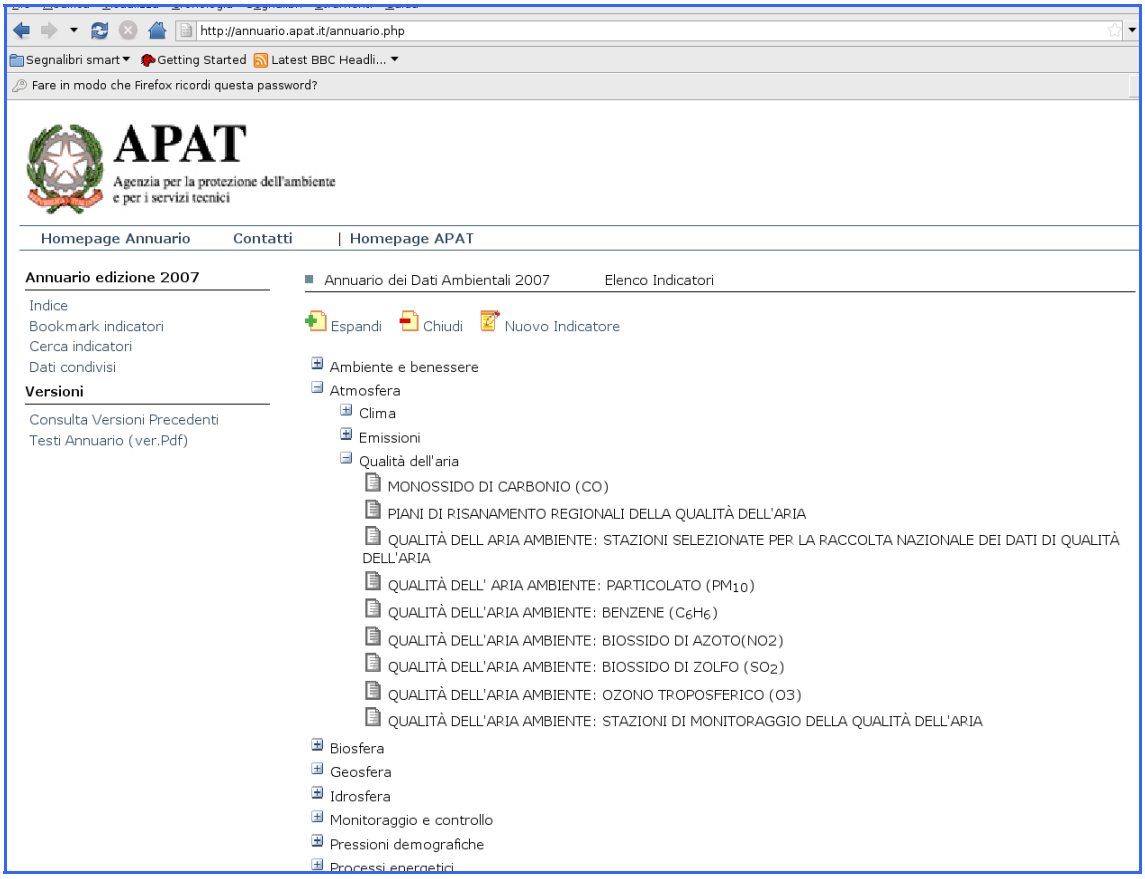


Figure A.5: The "Indicators List" interface

This screen can be used for both simple and advanced searches of indicators.
The simple search is carried out by:

- Entering the “descrittivo”, keywords or characters, in the proper space;
- Clicking on the topic area and the related subsections.

Advance searches are performed by filling out one or more of the spaces found on the indicator fact-sheet, based on:

- the name of the indicator, or words or characters that are part of the name;
- words or characters that are part of the **“**descrizione” entry;
- words or characters that are part of the **“**scopo**”** entry.

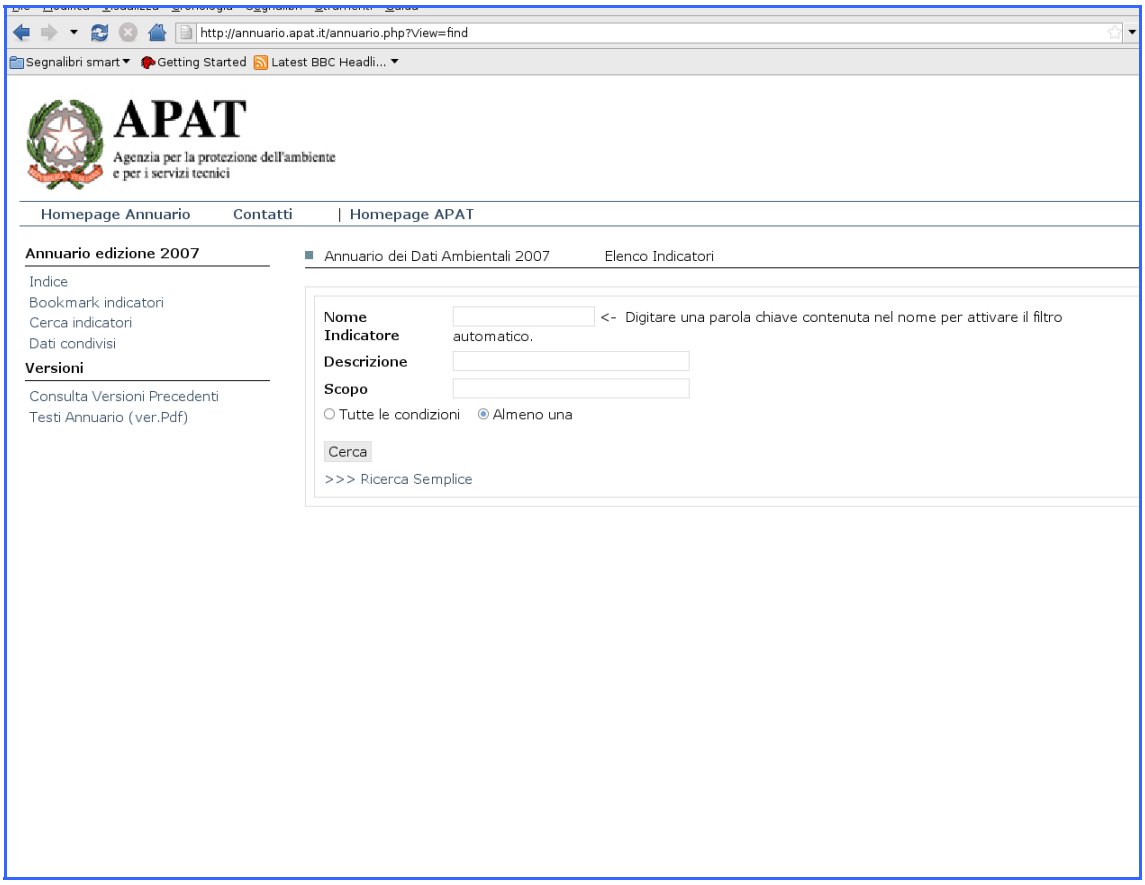


Figure A.6: The “Search” interface

The outcome of the search is a list of indicators meeting the prerequisites specified in advance by the user.
The fact-sheet for each indicator (meta-data and data) can be viewed (figures A.7 and A.8).

Figure A.7: "Meta-Data Section" interface

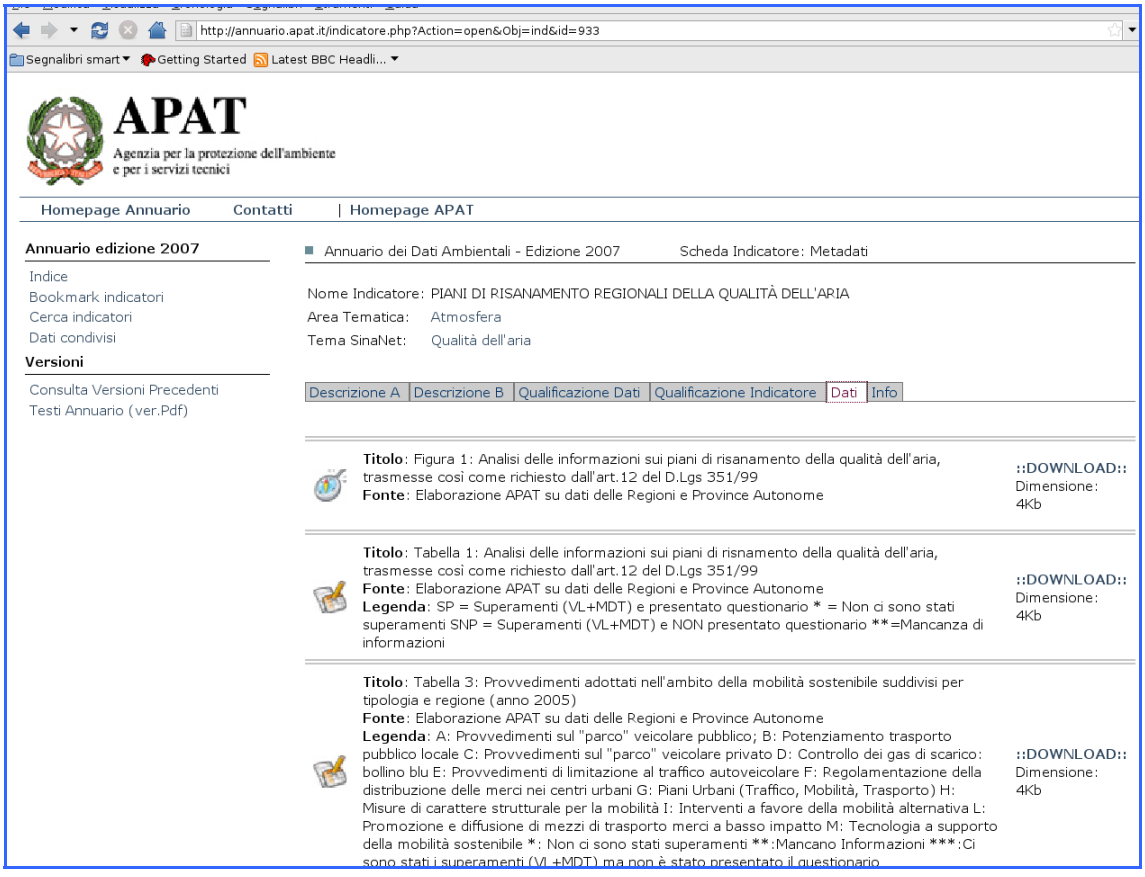


Figure A.8: "Data Section" interface

The indicators can be selected using the “Aggiungi al Bookmark” function, which makes it possible to create a report (in Pdf or Html versions) with the same structure and information found on the indicator fact-sheets of the Yearbook.

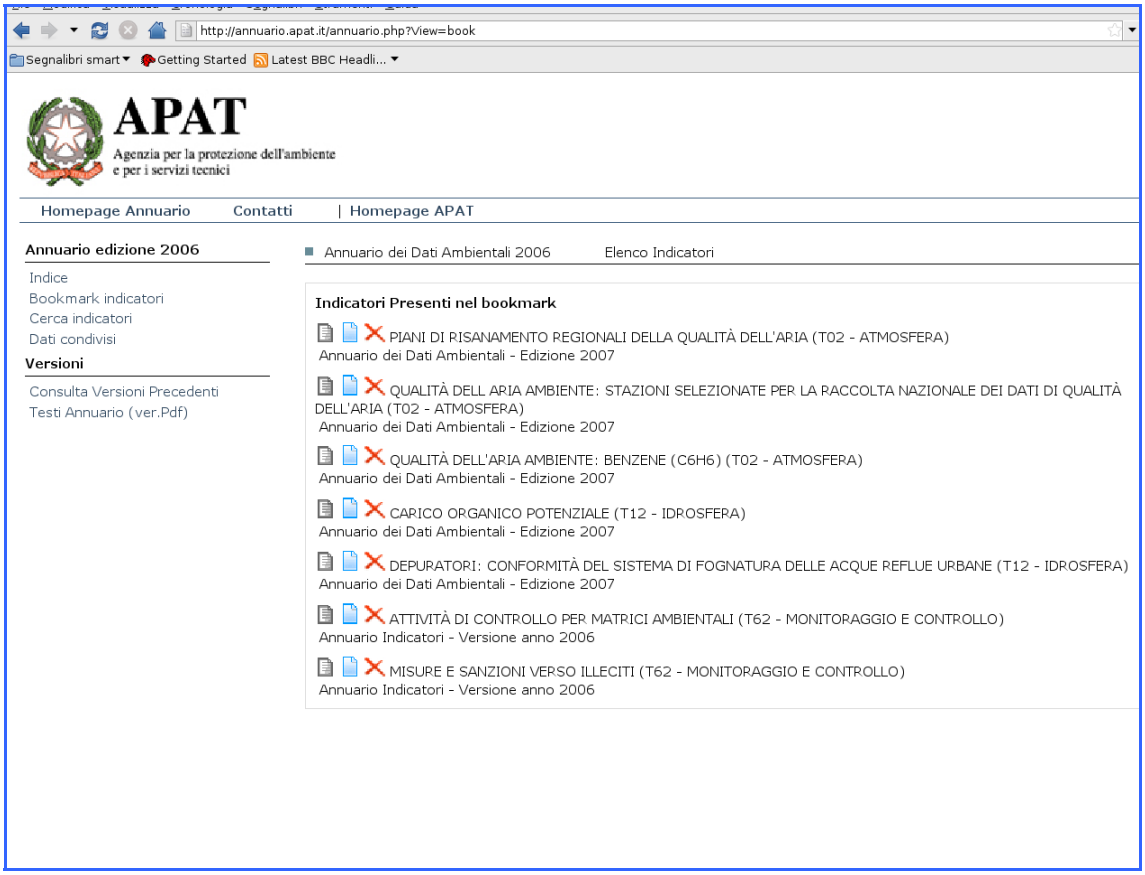


Figure A.9: “Bookmark indicatori” interface