ISPRA
Institute for Environmental
Protection and Research

KEY TOPICS

Italian Environmental Data Yearbook

2008

DISTRIBUTION FOR THE G8 ENVIROMENT

MINISTERO DELL'AMBIENTE
E DELLA TUTELA DEL TERRITORIO E DEL MARE

G8
SIRACUSA
22-23-24 Aprile 2009

ENVIRONMENTAL PROTECTION AGENCIES OF THE REGIONS
AND AUTONOMOUS PROVINCES

Law 133/2008, which converted, following modification, Legislative Decree no. 112 of 25 June 2008, established the ISPRA – Institute for Environmental Protection and Research. The ISPRA carries out the functions that were the responsibility of the Environmental Protection and Technical Services Agency (formerly APAT), of the National Institute for Wild Fauna (formerly INFS) and of the Central Institute for Scientific and Technological Research Applied to the Sea (formerly ICRAM). The present publication refers to activities carried out during a period preceding the merger of the three institutions, meaning that it still contains references and titles the three institutes no longer in existence.

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Environmental Statistics and Yearbook Project Service
Via Vitaliano Brancati, 48 - 00144 ROME
www.apat.gov.it
ISPRA, 2009

ISBN 978-88-448-0363-6

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ISPRA

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Dissolui quo quaeque supremo tempore possint,
materies ut subpeditet rebus reparandis.[1]

Titi Lucreti Cari – De rerum natura
(Liber I, 546-547)

[1] In fact, we see that anything deteriorates more quickly than it renews itself


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Foreword

In the field of the environment, as in other sectors, information represents an indispensable tool when it comes to planning actions and evaluating their outcomes. It also plays a critical role in keeping the general public constantly informed on issues of environment protection.

The term *information* can be used in two different ways: the first implies *knowledge*, meaning the outcome of all those activities designed to identify and assess causes and effects of environmental factors and trends; the second is *communication*, or the dissemination of this knowledge to all potential users and recipients.

This dual task has been widely exercised in all the different guidelines, planning documents and legislative acts drafted over time in various venues and at different levels of government.

Due to these acts, and to the Aarhus Convention in particular, environmental data and information has gradually been made available to all potential users. Until just a few years ago, those who possessed such data could decide - and quite often legitimately – not to distribute them. But today, legislators ensure that such data receive the widest possible visibility and distribution.
One of the most important tasks of ISPRA is to do just that, by collecting, processing and fully disclosing and distributing information on the state of the environment.
The completeness and reliability of the information in ISPRA Yearbook make it single out among other environmental reference sources, allowing both environmental professionals and private citizens to benefit from it.

To all those who have contributed to the publication, I offer my sincerest thanks for a well done job.

Prefect Vincenzo Grimaldi
Commissioner of the ISPRA


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Introduction to the Environmental Data Yearbook

The Environmental Data Yearbook, the most extensive and complete collection of official environmental statistics published in Italy, is the result of the former APAT's years of experience in the field of environmental reporting. With the creation of the ISPRA, the internal potential for improving and further expanding the information base was increased by the contributions of the former ICRAM and INFS institutes. Though the full result of these additions will not be visible until future editions of the Yearbook, starting this year it has already been possible to include new contributions supplied by the INFS on the topic of Biodiversity.

Apart the internal contributions, it should once again be stressed that the activities of collecting and disseminating environmental information carried out by the Institute in synergy with the Environmental Protection Agencies of the Regions and the Autonomous Provinces constitute an essential element in the formulation of the work. Numerous technical-scientific bodies, the so-called Main Reference Institutions, have also provided the Institute with support throughout the process of preparing the document, and especially during the phases involving the validation of the data and the processing of the information.

This edition marks the start of a major revision of the core-set of indicators underlying all the publications tied to the Environmental Data Yearbook. The key elements of this core-set date back to approximately eight years ago. Over time, and on account of subsequent modifications, its make-up has changed. Many indicators have been added, and others have been modified or eliminated. It thus seemed best to subject the current core-set to an attentive control, in order to make the most of its strong points while remedying any weaknesses.

To this end, an attempt was made, first of all, to assess the validity of each of the core-set indicators with regard to the objectives stipulated under national and extra-natural laws and regulations, as well as to national and international reporting obligations and guidelines.

In the case of each indicator, evaluations were also carried out to determine: its capacity to represent to the phenomenon being investigated; the availability of the necessary data on the population involved; the scientific relevance and solidity of the indicator.

In the case of new requirements generated by national and extra-national laws and regulations, new indicators were prepared, and in some instances inserted, when necessary.

New types of indicators were also included (i.e. indicators of efficiency, of sustainability etc.), while a number of others were reassigned to more pertinent thematic areas.

This process, initiated with the current year, is still underway. Hopefully it can be included in time for the next edition of the Yearbook.
The *full version of the Yearbook* provides an extremely detailed treatment of the environmental topics addressed. It contains all the indicator charts populated during 2008, organised by production sectors, environmental conditions and responses.
As a result of the process of revision referred to above, the annual edition presents a variety of new features.
For the first time, a chapter has been included with a number of indicators of the socio-economic context, such as population, territorial surface area, UAA, number of companies and capacity of infrastructures, so that readers may place whatever environmental information interests them in its pertinent context.
Under the section *Production Processes*, the chapters *Agriculture, Energy* and *Transport* have been rationalised, thanks in part to the revision effort involving the core-set of indicators.
The chapters found under the section *Environmental Conditions* have also undergone major modifications. In particular, three indicators previously placed under the heading *Contaminated Sites* were judged to be more appropriate for the chapter *Anthropogenic Risk*.
The section on *Safeguards and Prevention* presents a number of new developments: a chapter on *Planning Instruments* has been included, and the chapter *Environment and Health* has been reformulated and improved.
As for the chapter *Monitoring and Control*, the delicate nature of the subject matter studied made it necessary to organise a working group specifically assigned to draw up adequate indicators for representing the situation in question.
Finally, the chapter *Environmental Assessment and Certification* contains indicators regarding both voluntary instruments (EMAS, Ecolabel) and those called for under current laws and regulations (EIA/SEA).
The full version of the 2008 edition is produced in electronic format (PDF) and available on CD-ROM or at the site www.apat.gov.it e http://annuario.apat.it.
The basic information is provided in three further products, in addition to the full version of the Yearbook:
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 the telematic consultation of the indicator fact-sheets and the production of reports.

In the volume *Key Topics*, the information base of the Yearbook is used to evaluate a number of situations typical of the environmental topics that currently constitute the priority concerns of environmental policy. The areas taken under consideration were chosen in accordance with the topics addressed by the EU's 6th Environmental Action Plan, though, as compared to the Plan, it was decided to place greater emphasis on the aspects of *Soil and Land* and *Coastal Areas*, given the importance of these topics as part of the International Year of the Planet Earth being organised for 2008 by the United Nations.
The same topics are addressed in extremely abbreviated form in the *Vademecum,* so as to provide, through a selection of pieces of information that are few in number but extremely significant, an immediate overview of the situations and development described.
The *Database* of the Yearbook, together with the *Full Version,* make possible in-depth examination of the topics using the database collected.
The database provided by the ISPRA has thus led to the creation of a series of very different information products, with the end goal being to put environmental information at the disposal of a wide range of users: from public decision-makers to researchers, from stakeholders to private citizens. I hold that the success of policies of sustainability depends, first and foremost, on all citizens possessing an awareness of environmental issues. The efforts of the ISPRA to distribute such information, therefore, represent an important contribution to the growth of that awareness. I shall see to it that the Institute is always provided with the resources, both intellectual and material, need to continue carrying out this important function.

Dr. Roberto CARACCIOLO
Director of Department
State of the Environment and Environmental Metrology


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Contributors and Thanks

General considerations

Among the most important of the institutional tasks that ISPRA inherited from the APAT are the management of environmental information and reporting.
To this end, the Institute distributes and promotes the dissemination of data on the state of the environment through thematic and inter-thematic reports, such as the Environmental Data Yearbook, now in its seventh edition.
Compared to the other publications, the Yearbook, given the thoroughness of the treatment of the environmental topics, stands as the best example of the final outcome of the complex synergies involving almost all the Institute's structures in the different disciplines.
As already mentioned, starting from this edition, and in the wake of the merger of the former ICRAM and INFS institutes into the ISPRA, the contributions of the former APAT units to the production of the work have been supplemented, though still in an embryonic state, by those of the new units. To an even greater extent than in years past, the mass of information generated, together with the complexity of the analyses required to prepare this edition of the Yearbook, called for the efforts of a noteworthy number of experts on the different topics, together with reporting analysts.
In citing the main contributions to the publication, special mention must go to 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;* as well as to the Inter-Departmental Services: *Environmental Emergencies, Environmental Information*; *Guidance, Coordination and Control of Inspection Activities* and *Environmental Certification,* carried out in the past by the former APAT, INFS and ICRAM institutes.
Equally important were the contributions of the ARPA/APPA agencies, plus the numerous technical-scientific bodies.

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 Environmental Statistics and Yearbook Project Service, formerly parts of the APAT.

Specific contributions to the present document

I. Purposes and structure of the document

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Annex – Environmental Yearbook Indicators Database

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Editing

The phases of the editing of the Yearbook product were handled by a working group coordinated by Mariaconcetta GIUNTA and consisting of: Giovanni FINOCCHIARO (processing and statistical validation of the data), Cristina FRIZZA (processing and statistical validation of the data), Alessandra GALOSI (processing and statistical validation of the data), Silvia IACCARINO (coordination of the fact-sheet and technical revision), Alessandra MUCCI (revision and editing of texts), Alessia PENNESI (revision and editing of texts), Matteo SALOMONE (processing and statistical validation of data), Luca SEGAZZI (technical revision and processing and statistical validation of data), Paola SESTILI (contact for the processing and statistical validation of data). The Database of the Yearbook Indicators was managed by Raffaele MORELLI.
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 Indica-

tors Database, as well as the integration of the contents of the work, the processing and statistical validation 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 – Reference Units of the former APAT

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 the Institute:

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Environmental Topics	**Topic Coordinator**	**Department Service/Sector**	**Statistical Coordinator**
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Graphics/Photography	Franco IOZZOLI Paolo ORLANDI	DIR-COM DIR	Matteo SALOMONE

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

Departments/Inter-Departmental Services of the former APAT	SYMBOL
Commissioner's Office	DIR
Communications Service	DIR/COM
Inter-Departmental Service for Guidance, Coordination and Control of Inspection Activities	ISP
Inter-Departmental Service for Environmental Emergencies	EME
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
Data Collection and Management Service	ACQ/DAT
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

Departments/Inter-Departmental Services of the former APAT	SYMBOL
Special Environmental Observatory Project	AMB/OAM
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
Radiation Protection Service	RIS/RDP
Nuclear Technologies Service	RIS-NUC
Nuclear Activities Control Service	RIS-CON
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) is included at the start of each chapter of the full version in the electronic format.

Contributions of the Environmental Agency System

Initially, the contribution of the System involved the formulation of methodologies and the collection of data; later, it took the form of invaluable refereeing activities that made it possible to detect and, when necessary, resolve discrepancies inevitably produced by such an elaborately structured, complex process of information management.
The role of liaison between the ISPRA and the individual ARPAs was carried out by: Giovanni AGNESOD (ARPA Aosta Valley), Rossella AZZONI (ARPA Lombardy), Fabio BADALAMENTI (ARPA Sicily), Milena BRANDINELLI (ARPA Marche), Chiara DEFRANCESCO (APPA Trento), Luciana DI CROCE (ARTA Abruzzo), Alessandro Di GIOSA (ARPA Lazio), Giuseppe DI NUZZO (ARPA Basilicata), Ferruccio FORLATI (ARPA Piedmont), Marco GANI (ARPA Friuli Venezia Giulia), Donatella GRIMALDI (ARPA Liguria), Armando LOMBARDI (ARTA Abruzzo), Roberto MALLEGNI (ARPA Emilia Romagna), Luca MENINI (ARPA Veneto), Luigi MINACH (APPA Bolzano), Pina NAPPI (ARPA Piedmont), Paolo Michele RICCI (ARPA Molise), Stefano ROSSI (ARPA Tuscany), Ferdinando SCALA (ARPA Campania), Vincenzo SORRENTI (ARPA Calabria), Stefano SPAGNOLO (ARPA Apulia), Paolo STRANIERI (ARPA Umbria), Carla TESTA (ARPA Sardinia).

Other contributions from the ISPRA Technical Units

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

- on topics regarding the *Atmosphere*, *Waste*, *Noise, Non-Ionising Radiation, Environment and Health*, *Monitoring (Metrology)*, *Environmental Impact Assessment, Dissemination of Environmental Information*, and the production sectors of *Energy*, *Industry*, *Tourism* and *Transport*, from the State of the Environment and Environmental Metrology Department;
- on topics regarding *Water Resources* and *Coastal Defence*, from the Marine and Inland Waters Department;
- on topics regarding the *Soil and Natural Risk*, the Land Resources and Soil Protection Department;
- on topics involving the *Biosphere* and the *Agriculture* 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 regarding 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 Inspections Activities;
- on considerations regarding the *Environmental Quality of Organisations, Businesses and Products*, from the Inter-Departmental Service for Environmental Certification.

Specific *technical contributions* were also provided by the for Institute for Wild Fauna, especially with regard to topics involving the *Biosphere.*

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

- SISTAN interface, through the Statistics Office of the former APAT: Mariaconcetta GIUNTA;
- coordination of the *EIONET* network (formerly handled by the APAT): Claudio MARICCHIOLO, as the *National Focal Point* for Italy;
- chapter on the *Promotion and Dissemination of Environmental Culture*: Inter-Agency Workgroup for Education Geared towards Sustainability (EOS), the network of libraries and contacts for environmental instruction of the Agency System.

Other contributions by Units of the former APAT

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.

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.

Of the 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 and Transportation, the Ministry of Agricultural, Food and Forestry Policies, the Ministry of Labour, Health and Social Policies, 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 ISTAT, the ISS, the basin authorities, the magistrates of bodies of water, the CNR, 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 Yearbook, 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.

It was not always possible to utilise all or a part of these contributions. In certain cases, the key factor was a lack of time. Other contributions that could not immediately be put to use regard proposed additions to the Indicators Database. In such cases, the proposals were not included because the data needed to populate the indicators were lacking.

We shall be sure, however, to return to these proposals in subsequent editions of the Yearbook.

The following individuals were consulted and offered observations and proposals for additions:

Renzo BARBERIS (ARPA Piedmont), Gianfranco BOLOGNA (WWF Italy), Giovanni BRAM-

BILLA (IA CNR) Fabrizio BULGARINI (WWF Italy), Sergio CASTELLARI (National Focal Point for Italy IPCC), Anna Maria DE MARTINO (Ministry of Labour, Health and Social Policies), Cinzia DI FENZA (FORMEZ - Area of Instruments and Policies for Environmental Sustainability; Naples), Alessandro LANZI (ENI), Alessandro Maria MICHETTI (University of Insubria - Como), Romano PAGNOTTA (IRSA CNR), Alessandro POLICHETTI (ISS), Sabina PORFIDO (IAMC CNR), Giuseppe RANDAZZO (University of Messina – Department of Earth Sciences), Ezio RUSCO (JRC; Ispra (EU), Paolo SEQUI (CRA), Paolo VECCHIA (ISS), Giuseppe VIVIANO (ISS), Michele VURRO (IRSA CNR).

Thanks

Heartfelt thanks are once again expressed to those whose contributions have made publication of the 2008 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 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.
There is also no mistaking the fact that, in pursuing these objectives, ongoing efforts must be made to enlarge the network of cooperation with other organisations and institutions, without which it would prove impossible to provide a body of knowledge adequate to current demands.
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.
As was done for the previous editions, we again ask that readers send us any observations or 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.


KEY
TOPICS

CONTENTS


KEY
TOPICS

I. PURPOSES AND STRUCTURE OF THE DOCUMENT

Purposes

This document is meant to provide a sufficiently thorough description of the state of the environment in Italy, especially as regards the topics held by the European Union to be “priority areas for policy initiatives”.

Unlike the complete edition of the Yearbook, which provides detailed descriptions by means of the indicator fact-sheets, this work offers the reader the environmental data structured according to the information base of the Yearbook, which follows the underlying logic of the DPSIR model.

In order to make the publication suitable for the most extensive possible use, the latest reporting techniques have been employed, together with a style of language both clear and precise.
Special care has been taken with the graphic illustration of the information, in order to streamline the communication of the contents. The images included in the text are always accompanied by comments on what is being shown.

Structure of the Document

The document is structured in 11 chapters: each of the first 10 focuses on a different environmental topic, while the eleventh is devoted to instruments of environmental knowledge.
Each environmental topic has been described according to the following logical sequence: first the current environmental conditions are presented, following by an analysis of the underlying causes of these conditions and, finally, a presentation of the solutions currently implemented or that will hopefully be put in place in the future. Special boxes have been included in this edition, where judged to be appropriate, for in-depth examination of certain topics, such as ultraviolet radiation.

There are three different ways of reading chapters one to ten: the text provides the reader with a complete and exhaustive analysis of the topics; the “focuses” in the margins serve for rapid identification of the topics addressed before deciding whether to examine them in depth; by consulting the graphs and the figures, the reader can obtain information tat is sufficiently complete, though limited to the individual aspect illustrated.

The information elements found in the document are the end result of a painstaking selection process carried out on the far more extensive stock of information contained in fact-charts of the Yearbook Indicators Database. An annex provides an in-depth description of this important instrument utilised by the Institute to manage environmental information.

II. SOCIO ECONOMIC FRAMEWORK

Introduction

The characteristics of the country's territorial and socio-economic context and, in particular, the interrelations between demographic dynamics and the modes of behaviour of economic subjects (families and businesses), on the one hand, and the anthropogenic pressures that threaten the national environment (pollution of the air, water, land and nature, waste generation, consumption and deterioration of natural resources), and the other, are illustrated in the paragraphs that follow.
Emphasis is placed on territorial and socio-demographic characteristics, which provide a picture of the country's morphological make-up as well as a structural profile of the national population, with respect to the spending and consumption habits of families, as well as considerations of a more strictly economic nature. The "economic" factors analysed include the main macro-economic indicators and the characteristics of the national production system, with an in-depth look at the production sectors typically considered to be the driving forces behind the heaviest environmental pressures, such as: agriculture, the industrial and energy sector and transport and tourism.

II.1 Socio-demographic considerations

Environmental problems are closely connected with production activities and with the population found within the territory.

The question of the environment is closely tied to production activities and to the individuals found in a given territory. These two factors are the main underlying causes of pressures on the environment in terms of consumption, production of waste, emissions etc.. It follows that any analysis of the environmental situation must also take into account the demographic factor, which has noteworthy repercussions from a socio-economic point of view.
As of 31 December 2007, the resident population in Italy was 59,619,290 [1] inhabitants, making for an increase of 488,003 units over the previous year. As has been the case for a number of years now, this growth is due almost exclusively to immigration from abroad.
The population increase presents regional differences, as a result of contrasting dynamics that channel the majority of the migra-

[1] Source: ISTAT data processed by ISPRA

tory, both internal and from abroad, towards the regions of northern and central Italy. In terms of the territorial make-up, therefore, noteworthy differences can be observed not only between the surface areas of the different regions but as regards their demographic profiles as well.

The most heavily populated region, with more than 9.50 million residents, is Lombardy, followed by Campania (over 5.8 million) and Lazio (over 5.5). The regions with the largest surface area, on the other hand, are Sicily, Piedmont, Sardinia and Lombardy, in that order (Figure II.1). The geographic distribution of the resident as of 31 December 2007 shows 15,779,473 inhabitants on the northwest (26.5%), 11,337,470 in the northeast (19%), 11,675,578 in central Italy (19.6%), 14,131,469 in the south (23%) and 6,695,300 on the major islands (11.2%). In terms of levels of urbanisation, 45% of the Italian population lives in zones with high levels of urbanisation, 39% in zones with medium levels, and the remaining 16% in scarcely urbanised zones. Within Europe

The most heavily populated regions are Lombardy, Campania and Lazio.

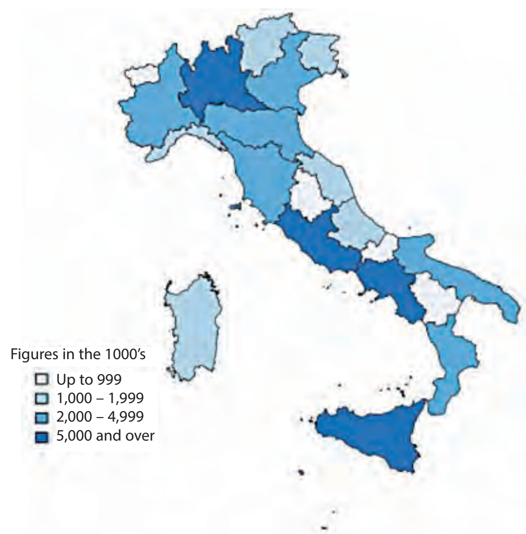

Figure II.1: Resident population as of 31 December 2007[2]

[2] Source: ISTAT data processed by ISPRA

as a whole, Italy is one of the most densely populated countries. The most densely populated regions (2006), with respective figures of 426 and 400 inhabitants per km², are Campania and Lombardy.
Consumption patterns also reflect demographic changes, with variations on the family level having an especially noticeable effect on the allocation of available spending. It should be noted that, since 1990, growth in consumption has been much more vigorous than increases in available income, which, in per capita terms, has remained stable. In recent years per capita spending has also slowed down, after having registered average annual growth of 1.7% in the 90's.
Average monthly spending per family in 2007, at current values, was equal to 2,480 euro (2,461 euro in 2006). Spending on food and beverages stood at 466 euro, while spending on non-food goods was 1,994 euro, with spending on housing and healthcare on the rise. Spending on food and beverages accounts for an average of 18.8% of the total monthly spending of families, while transport absorbs approximately 15% (Figure II.2). The national figures are the result of spending levels that differ among the various parts of the country, though the basic trend remains unchanged: in northern Italy average

Within Europe as a whole, Italy is one of the most densely populated countries. The most densely populated Italian regions, at respective levels of 426 and 400 inhabitants per km², are Campania and Lombardy.

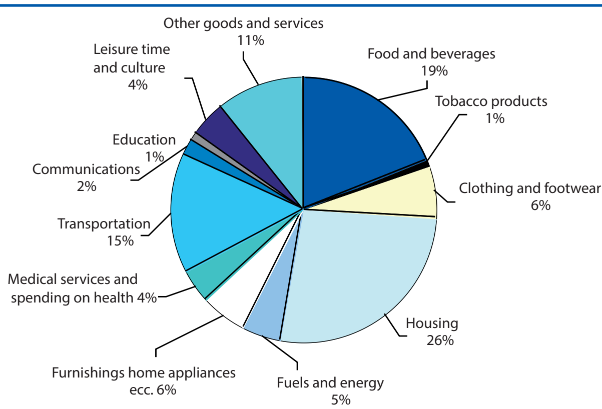

Figure II.2: Average monthly family spending by category (2007) [3]

Spending on food and beverages represents 18.8% of total monthly family spending, while transportation accounts for approximately 15% and housing for roughly 26%.

[3] Source: ISTAT data processed by ISPRA

The region with the highest average spending per family is Veneto, at 3,047 euro, while the region with the lowest level is Sicily, at 1,764 euro.

monthly spending by families 2,796 euro (0.4% higher than the previous year), while the figure for central Italy is 2,539 euro (+1.8%) and that for the southern regions stands at 1,969 euro (+0.9%). Looking at the individual regions, Veneto presents the highest level, at 3,047 euro, while the lowest figures is found in Sicily, with average monthly family spending of 1,764 euro.

II.2 Economic factors

An analysis of the classic macroeconomic indicators, estimated on the basis of national statistics, highlights the distinctive features of Italy's economy.

Between 1970 and 2007 the GDP, consumption and investments doubled. Imports and exports quadrupled.

Between 1970 and 2007, the main categories of the income statement for national resources and investments registered considerable growth, with the GDP doubling, as did consumption and investments, while imports and exports quadrupled (Figure II.3).

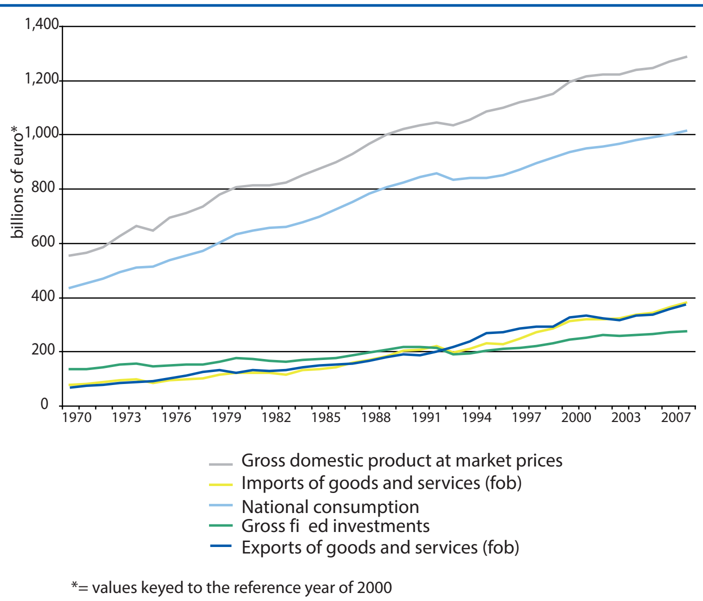

Figure II.3: Main aggregates of the income statement of resources and investments[4]

[4] Source: ISTAT data processed by ISPRA

Looking at the specific figures for 2007 the Italian Gross Domestic Product (GDP), which gives the final result for all the goods and services produced in a country during a given period, stood at approximately 1.285 trillion euro, calculated in values keyed to the reference year of 2000, representing growth of 1.5% over the previous year.

The national GDP for 2007, calculated in values keyed to the reference year of 2000, grew by 1.5% over 2006.

Unlike the trend within the European Union (EU27), where the countries that start at the lower levels of per capita GDP – corrected for ppp[5] – are the ones that grow the fastest, in Italy the southern regions are unable to close the gap with the richer northern zones.

The gap between Italy's northern and southern regions is not being reduced.

As for consumption, which constitutes the main component of aggregate demand[6], all the EU countries, except for Ireland and Luxembourg, present levels of consumption that exceed 70% of their GDP. In 2007 consumption in Italy (74% of which is tied to the family spending) was equal to 1.0125 trillion euro, or 79% of the GDP, while gross fixed investments accounted for 21%. In certain countries[7], especially outside the EU (15), the sum of consumption and investments as percentages of the GDP is greater than 100, meaning that these countries consume and invest more than they produce, and thus need to draw on foreign markets.

In almost all the countries of Europe, consumption amounts to 70% of the national GDPs.

The above situation, which holds for the majority of the countries outside of the EU(15), is also found in southern Italy, whose regions are forced to imports goods and services to sustain levels of consumption and investment which, taken together, exceed the GDP.

In all the European Union member States (EU25), more than 60% of the GDP (70.4% in Italy) is generated by the tertiary sector (which includes banking activities, tourism, transport and insurance). Industry and agricultural, though they still play significant roles, have declined in economic importance in recent years. In Italy, the incidence of the primary sector in terms of value added for 2007 was only 2.5 percentage points, while the industrial sector (meaning industry in the strict sense, plus construction) accounted for 27%.

In all the countries of the EU25, more than 60% of the GDP is generated by the tertiary sector.

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[5] ppp = purchasing power parity
[6] Eurostat, New Cronos Database
[7] Ibidem

Italy's central regions show a greater vocation for service enterprises, while micro-firms are predominant in the South, and medium-size enterprises are the most widespread in the northeast regions. Large-scale industry plays the leading role in the Northwest.

The composition by sectors of Italy's production structure, as shown by "ASIA" [8], the archive of Italian enterprises of ISTAT for 2005, is similar to that illustrated for Germany in the Eurostat[9] statistics for EU enterprises of 2004, though in Germany large-scale enterprises predominate, as is the case in all the economies of continental Europe. Within Italy, on the other hand, the central regions show a greater vocation towards service enterprises, though the two regions with the largest enterprises in the services sector are Lazio and Lombardy. As for the South, the predominant role is played by micro-enterprises, with a particular emphasis on the services sector in Campania, Calabria, Sicily and Sardinia, while industrial firms are the leading force in Apulia, Basilicata and Molise. In the northeast regions medium-size industrial enterprises are the most widespread, whole large-scale industry is dominant in the northwest, and especially in Piedmont.

Industry

Compared to Europe as a whole, Italian companies are more focussed on manufacturing activities, with a marked specialisation in the sub-sectors referred to as "Made in Italy".

In 2006, there were 4.3 million Italian industrial and service enterprises, employing approximately 16.6 million workers (11.1 million salaried employees) and generating roughly 677 million euro of value added. The predominant role in the Italian production structure continues to be played by small-scale enterprises. Within the framework of Europe as a whole, our companies are more focussed on manufacturing activities (despite a late but rapid development of the service industries), with the chief manufacturing sub-sectors being those referred to under the umbrella term "*Made in Italy*". Specialisation in these primarily low-tech sectors was further reinforced in the early 2000's. The limited size of the great majority of Italian enterprises is accompanied by a high incidence of self-employment. This structural profile of the country's production system penalises our economy's prospects for future growth.

In Italy, industry produces roughly 27% of the value added to basic prices, with traditional industries contributing roughly 21%.

In Italy, industry produces roughly 27% of the value added to basic prices, with the contribution of traditional industry equal to approximately 21%.

[8] ISTAT, Statistical Archive on Active Enterprises (ASIA)
[9] Eurostat, *Structural Business Statistics* (SBS)

In 2006 there were 1.12 million Italian industrial firms employing approximately 6.58 million workers (5.11 million salaried employees) and turning out value added of more than 300 million euro. The average industrial firm had 5.9 employees, while each company in the sector of traditional industry operates with an average of 9.1 workers.
An analysis of the total number of people employed compared to the resident population highlights the fact that industrial activity is carried out primarily by the resident populations of Veneto, Lombardy, Emilia Romagna and Marche.

In 2006, there were 4.3 million Italian enterprises in the industrial and service sectors, employing approximately 16.6 million workers.
It was also found that the predominant vocation of the companies in the Italian production structures continues to be manufacturing activities.

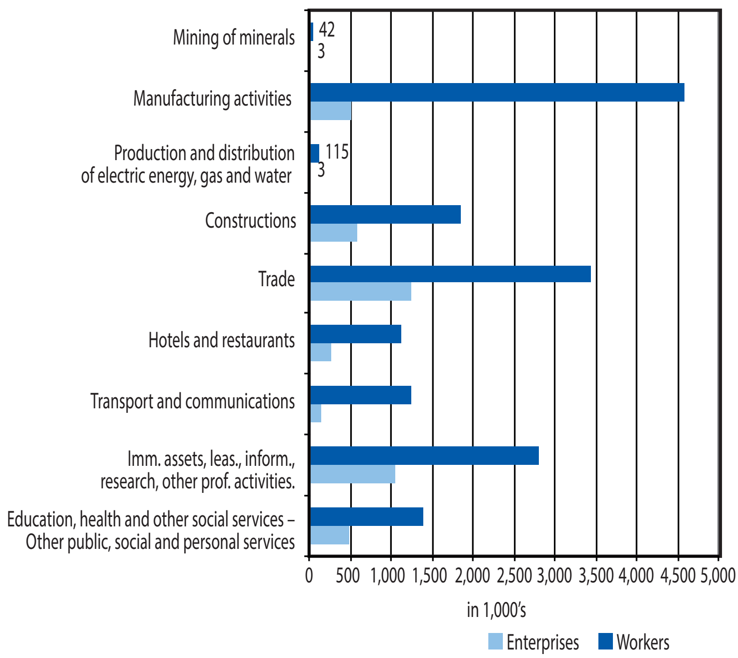

Figure II.4: Number of enterprises in industry and in market services (2006) [10]

[10] Source: ISTAT (2008), *Struttura e competitività del sistema delle imprese industriali e dei servizi*

An analysis of the ratio of total individuals employed to the resident population points to the fact that industrial activities are performed primarily by the resident populations of Veneto, Lombardy, Emilia Romagna and Marche.

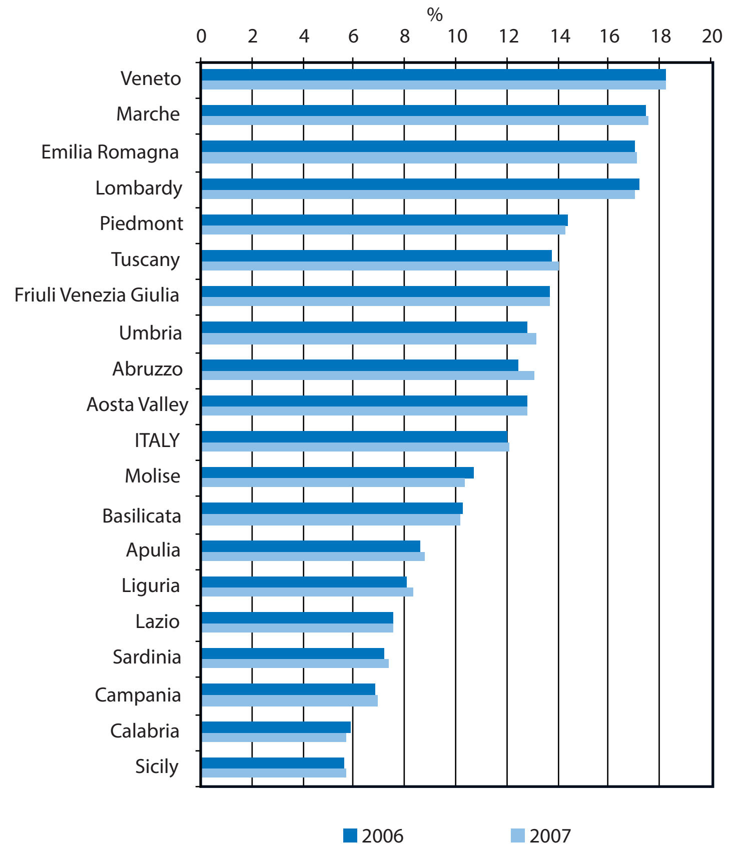

Figure II.5: Ratio between total workers employed in the industrial sector and the resident population [11]

The IPPC Directive (Integrated Pollution Prevention and Control) is the tool created by the European Union to implement of prevention

It should be stressed that the effect of the industrial sector on the environment regards not only the possibility of different forms of environmental pollution, but also the exploitation of natural resources.
In recent years industry has increasingly been called upon to reconcile considerations of growth and competitiveness with those of environmental compatibility and sustainable development, optimising production processes and applying techniques to eliminate

[11] Source: ISTAT (2008), *Principali aggregati dei conti economici regionali*, Rome

or minimise environmental impact while reducing the use of resources, raw materials and energy and observing principles of prevention, including:

- avoiding or reducing the production of pollutants;
- making effective use of energy resources and raw materials;
- reducing scrap and, if possible, recycling it within the production cycle.

that include:

- *avoiding or reducing the production of pollutants;*
- *making effective use of energy resources and raw materials;*
- *reducing scrap, and, if possible, recycling it within the production cycle.*

Directive 96/61/EC, also known as the IPPC Directive (Integrated Pollution Prevention and Control), is the main instrument created by the European Union to implement the principles of prevention illustrated up to this point.

The IPPC Directive introduces the concept of the integrated environmental authorisation, which contains the upper limits for emissions, based on the determination of technological and managerial standards, as well as policy assessment criteria. Directive 96/61/EC was transposed into Italian law in a two-step process: first in part, for existing plants only – Legislative Decree 372/99 – and later in complete form – Legislative Decree 59/05[12].

On the national level, the collection of information on industrial emissions for the establishment of the INES Register is governed by a Ministerial Decree issued on 23 November 2001 and by a decree of the Italian Prime Minister, issued on 24 December 2002.

Since 2003, registration information on plants and information on the quality and the quantity of emissions in the air and water have been collected by means of the INES Declaration.

The information obtained on production establishments and IPPC activities with the INES Declaration for 2007, meaning that it refers to the year 2006, shows that the majority of the declarations regarding industrial establishments was received from northern Italy (67%). As in years past, the regions that accounted for the most declarations were Lombardy (29%), Veneto (11%), Emilia Romagna (10%) and Piedmont (8%), while the categories of IPPC activities most frequently referred to were those of IPPC group 1, regarding energy activities (23%), and IPPC group 6, which involves miscellaneous activities (25%).

Of the INES declarations presented in 2006, for the year 2005, 64% were received from regions of northern Italy.

It is interesting to note that the number of industrial establishments in Italy considered to be at major accident hazards

[12] Governs the integrated prevention of pollution, as well as the issue, renewal and review of the unified environmental authorisation.

As of 30 June 2008 there are 1,119 industrial establishments considered to be at major accident hazard (MAH) in Italy and subject to the obligations contained in arts. 6/7 and 8 of Legislative Decree 238/05.

(MAH)[13], and therefore subject to the obligations stipulated under arts. 6/7 and 8 of Legislative Decree 238/05 (which partially modified the earlier Legislative Decree 334/99) was equal to 1,119 as of 30 June 2008. In terms of the distribution within the national territory of the establishment subject to notification (under arts. 6/7 and art. 8 of Legislative Decree 334/99), fully a fourth are found in Lombardy, with especially noteworthy numbers in the provinces of Milan, Bergamo, Brescia and Varese. The other regions with significant numbers of industrial operations posing risks are: Piedmont, Emilia Romagna and Veneto (accounting for approximately 9%). Such activities are particularly concentrated in areas holding long-time refining and/or petrochemical complexes, such as Trecate (in the vicinity of Novara), Porto Marghera, Ferrara and Ravenna, and in the industrial areas of the provinces of Turin, Alessandria, Bologna, Verona and Vicenza. The central-southern regions with the highest levels of activities requiring notification are: Sicily (roughly 7%), Lazio and Campania (slightly more than 6%), Tuscany (approximately 5%), Apulia and Sardinia (approximately 4%); this is due to the presence of petroleum and petrochemical plants in the areas of Gela (Province of Caltanissetta), Augusta-Priolo-Melilli-Siracusa, Brindisi, Porto Torres (Province of Sassari) and Sarroch (Province of Cagliari), as well as the concentrated presence of industrial activities in the provinces of Livorno, Rome, Frosinone, Naples and Bari, plus the depots for agricultural products in the Province of Ragusa.

[13] A "Major-accident Hazards Establishment" (MAH establishment) is defined as a establishment where potentially hazardous substances (used in the production cycle or simply kept in storage) are found in quantities above certain threshold levels.

A fourth of the establishment requiring notification (arts. 6/7 and art. 8 of Legislative Decree 334/99) are concentrated in Lombardy, and in the provinces of Milan, Bergamo, Brescia and Varese.

Figure II.6: Localisation within the national territory of the establishments subject to Legislative Decree 334/99 (30 June 2008)[14]

[14] Source: Ministry of the Environment, Land and Sea data processed by ISPRA

Energy

As far as the energy sector in Italy is concerned, the most recent data (ISPRA and ENEA[15]) point to a number of different results, including the fact that primary energy intensity[16] is lower than the European average, though a comparison with the situation in the rest of Europe over the years shows that the benefits enjoyed by Italy on account of its initially favourable position in terms of energy intensity are gradually declining, due to the fact that the situation has remained essentially unchanged in Italy over the last decade, while almost all the other European countries have registered improvements. It should also be noted that the ratio between final consumption and total consumption of energy in Italy is higher than the European average, pointing to greater overall efficiency when it comes to converting the energy contained in primary sources[17].
The demand for primary energy totalled 194.5 Mtep in 2007, down by roughly a percentage point compared to 2006. Electricity produced

Italy's ratio of final consumption to total consumption is higher than the European average, pointing to greater overall efficiency in the conversion of the energy found in primary sources.

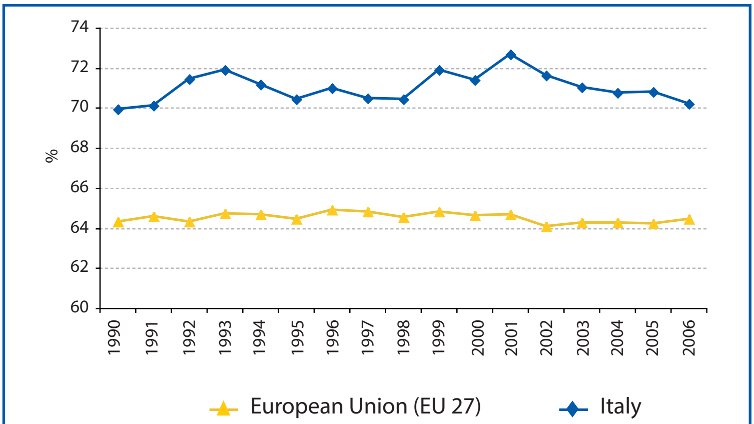

Figure II.7: Ratio between final and total consumption of energy[18]

[15] ENEA (2008). *Rapporto Energia e Ambiente 2007, Analisi e scenari.*
[16] The "primary energy intensity" indicator measures the energy efficiency of economic systems, meaning the quantity of energy needed per unit of GDP produced.
[17] The difference between these two figures corresponds to the energy consumed in processes of conversion (such as the production of electricity and the refining of oil), the energy consumed inside plants that produce electricity and the leakage in distribution and supply activities.
[18] Source: Eurostat data processed by ENEA

from renewable sources as a percentage of total production of electricity in 2007 was 15.7%, due primarily to the significant contribution of hydroelectric energy. But despite the noteworthy increase registered in recent years, the results for the production of electricity from such sources do not appear adequate for achieving the objective set under Directive 2001/77/EC of approximately 75 TWh by the year 2010.
Also observed are a series of ongoing changes in energy supplies, with a sharp reduction in the consumption of oil, while natural-gas consumption grows, compared to that of petroleum products, and renewable sources and cogeneration contribute to the overall energy picture, along with, since 2001, the consumption of solid fuels.
The demand for petroleum products still exceeds that for other sources, covering 42.6% of total primary consumption in 2007, due almost exclusively to the energy needs of the transportation sector.
The upward trend in the total consumption of energy, with an increase of +19.9% between 1990 and 2006, was interrupted in 2007, which showed a decrease of 3.3% over the preceding year. The main sectors in which strong growth in final consumption had been recorded since 1990 presented lower figures in 2007. Looking at the break-down of consumption of final energy (excluding non-energy uses and bunker), the transport absorbed 34.3% of consumption, followed by the civil 32.8% and industrial sectors 30.4%.

The demand for primary energy totalled 194.5 Mtep in 2007, approximately one percent less than in 2006. The primary sectors that showed growth from 1990 onward registered decreases in 2007. Looking at the break-down of final energy consumption, the transport sector absorbed 34.3%, followed by the civil 32.8% and industrial sectors 30.4%.

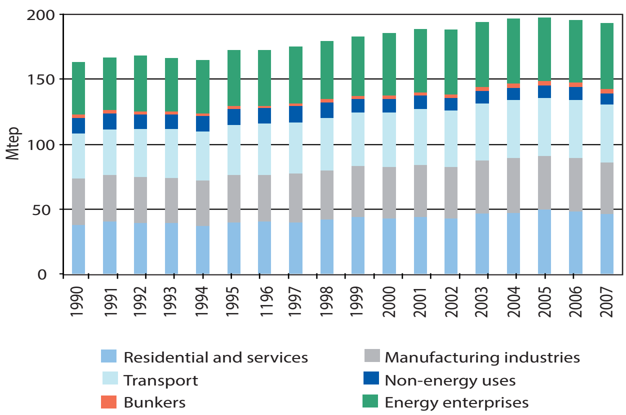

Figure II.8: Final energy consumption by economic sector[18]

[19] Source: Ministry of Economic Development

Agriculture

Agricultural activities generate pressures, but they are also affected by changes in ecosystems.

By their very nature, agricultural activities are closely tied to the environment.
They not only generate pressures, such as pollution of the key elements of the environment, consumption of water resources and loss of biodiversity, but are in turn affected by the changes in ecosystems caused by climate change, plus the competition of other economic activities for the resources utilised.

Agriculture plays a key role in safeguarding the countryside and the territory, making a valuable contribution to the management of the natural resources found in agricultural ecosystems.

In addition, agriculture plays a major role in defending the countryside and the territory, making a valuable contribution to the management of the natural resources found in agricultural ecosystems and to the attenuation of critical trends, such as the greenhouse effect and hydrogeological deterioration.
This extremely positive function is a declared objective of European Community Agricultural policy. Starting from 2005, farmers who receive direct economic subsidies from the EC are subject to obligatory conditions. No fewer than 19 legislative acts place direct constraints on agricultural enterprises with regard to the environment, public health and the health of plants and animals. Under these acts, farmers who wish to benefit from direct subsidies undertake to maintain all the land utilised in good condition from an agricultural and environmental perspective. Penalties are contemplated for failure to do so, such as the partial or full cancellation of the direct subsidy.

In 2007 the Utilised Agricultural Area was equal to 12,744,196 hectares nationwide.

Total farming enterprises number 1,679,439.

Nationally, the Utilised Agricultural Area totalled 12,744,196 hectares in 2007 (Table II.1), representing a slight increase over 2005 (+0.3%) but a level lower than that of 2000 (-2.4%). Compared to 2000, the most noteworthy decreases were observed in the northern (-4.2%) and central regions (-4.5%).
The total number of farming enterprises was 1,679,439, down from 2005 (-2.8%) and compared to 2000 (-22%).
The highest concentration of farming concerns is found in the South (960,736 units), a figure again lower than in 2005 (-3.2%) and even more of a decrease compared to 2000 (-19.8%). Next comes the North, with 449,880 units, and Central Italy, at 268,823 units. This last figure presents the most noticeable decrease compared to 2000 (-28.5%).

Table II.1: Regional break-down of the UAA[20]

Region/ Autonomous province	Utilised Agricultural Area				
	2007	2005	2000	2007/ 2005	2007/ 2000
	number			%	
Piedmont	1,040,185	1,029,189	1,068,079	1.1	-2.6
Aosta Valley	67,878	68,391	71,156	-0.8	-4.6
Lombardy	995,323	978,667	1,039,397	1.7	-4.2
Trentino Alto Adige	399,140	401,078	414,273	-0.5	-3.7
Bolzano-Bozen	*258,010*	*255,668*	*267,394*	*0.9*	*-3.5*
Trento	*141,129*	*145,410*	*146,878*	*-2.9*	*-3.9*
Veneto	820,201	797,571	849,880	2.8	-3.5
Friuli Venezia Giulia	228,063	224,521	237,747	1.6	-4.1
Liguria	49,408	49,082	60,895	0.7	-18.9
Emilia Romagna	1,052,585	1,029,916	1,114,592	2.2	-5.6
Tuscany	806,428	809,487	848,171	-0.4	-4.9
Umbria	339,404	337,915	363,560	0.4	-6.6
Marche	496,417	497,141	505,610	-0.1	-1.8
Lazio	674,011	684,936	706,936	-1.6	-4.7
Abruzzo	434,013	425,179	425,984	2.1	1.9
Molise	200,257	212,608	213,166	-5.8	-6.1
Campania	562,880	563,666	575,872	-0.1	-2.3
Apulia	1,197,380	1,216,924	1,223,401	-1.6	-2.1
Basilicata	542,256	553,589	533,438	-2.0	1.7
Calabria	514,047	514,343	540,055	-0.1	-4.8
Sicily	1,251,851	1,250,703	1,256,534	0.1	-0.4
Sardinia	1,072,469	1,062,940	1,013,512	0.9	5.8
ITALY	**12,744,196**	**12,707,846**	**13,062,256**	**0.3**	**-2.4**
North	4,652,783	4,578,414	4,856,018	1.6	-4.2
Central	2,316,260	2,329,479	2,424,277	-0.6	-4.5
South	5,775,153	5,799,953	5,781,961	-0.4	-0.1

In 2007 Utilised Agricultural Area was equal to 12,744,196 hectares nationwide, a slight increase over 2005 (+0.3%), but lower than the figure for 2000 (-2.4%).

The term Standard Gross Margin (SGM) refers to "*the average level of pre-tax income in a given region or province and for a given production activity*"[21].
Used to determine the economic dimensions of farming enterprises, it is expressed in the European Size Unit (ESU), which is equal to 1,200 ECU of total standard pre-tax income.
The total national SGM for 2007 (Table II.2) was 25,000,347 ESU,

Standard Gross Margin (SGM) is used to determine the economic dimensions of agricultural enterprises.

[20] Source: ISTAT data processed by ISPRA
[21] INEA definition under the RICA methodology.

More than 46% of the SGM for 2007 was produced in the North.

The overall national SGM for 2007 was 25,000,347 ESU, a marked increase over both 2005 (+12.6%) and 2000 (+31.2%).

making or a noteworthy increase over 2005 (+12.6%) and 2000 (+31.2%).
More than 46% of the SGM for 2007 was produced in Northern Italy, another 40% in the South, and the remaining 14% in the central regions. This break-down matches that registered in the years 2005 and 2000.

Table II.2: Regional break-down of Standard Gross Margin[22]

Region/ Autonomous Province	Standard Gross Margin				
	2007	2005	2000	2007/ 2005	2007/ 2000
	ESU[(a)]			%	
Piedmont	1,700,095	1,652,500	1,344,352	2.9	26.5
Aosta Valley	24,582	18,819	28,080	30.6	-12.5
Lombardy	3,074,087	3,084,324	2,355,733	-0.3	30.5
Trentino Alto Adige	894,663	583,284	656,585	53.4	36.3
Bolzano-Bozen	*494,919*	*342,222*	*372,090*	*44.6*	*33.0*
Trento	*399,744*	*241,062*	*284,496*	*65.8*	*40.5*
Veneto	2,254,964	2,199,150	1,805,557	2.5	24.9
Friuli Venezia Giulia	415,106	417,349	413,819	-0.5	0.3
Liguria	248,497	229,765	261,523	8.2	-5.0
Emilia Romagna	2,918,622	2,218,554	2,265,979	31.6	28.8
Tuscany	1,197,857	1,106,719	1,021,881	8.2	17.2
Umbria	376,811	391,268	326,051	-3.7	15.6
Marche	611,262	506,587	498,048	20.7	22.7
Lazio	1,310,166	1,132,687	906,985	15.7	44.5
Abruzzo	619,202	517,262	441,639	19.7	40.2
Molise	226,157	181,728	181,735	24.4	24.4
Campania	1,728,687	1,622,173	1,309,423	6.6	32.0
Apulia	2,322,378	1,880,380	1,858,058	23.5	25.0
Basilicata	452,722	485,133	405,171	-6.7	11.7
Calabria	1,184,102	1,095,877	827,155	8.1	43.2
Sicily	2,243,136	2,022,322	1,500,249	10.9	49.5
Sardinia	1,197,251	850,406	654,091	40.8	83.0
ITALY	**25,000,347**	**22,196,286**	**19,062,114**	**12.6**	**31.2**
North	11,530,616	10,403,744	9,131,629	10.8	26.3
Central	3,496,096	3,137,262	2,752,965	11.4	27.0
South	9,973,636	8,655,281	7,177,521	15.2	39.0

[(a)] The economic dimensions of agricultural enterprises are measured in European Size Units (ESU). An ESU is equal to 1,200 ECU of total standard gross margin.

[22] Source: ISTAT

Plant health products are of use in protecting vegetables or vegetable products from harmful organisms, such as fungi, insects, mites, bacteria, viruses and weeds, and in favouring or regulating the vital processes of vegetables (not including fertilisers). In 2006 (Table II.3) approximately 149 thousand tons of such products were put on the market, a decrease of 4.7% compared to 2005. Fungicides account for 50.9% of the total, followed by insecticides and miticides (18.1%), herbicides (17.8%), miscellaneous products (fumigators, plant regulators, molluscicides, carriers and other) (12.9%) and biological items (0.2%).

Plant care products are of use in protecting vegetables or vegetable products from harmful organisms.

Compared to 1997, distribution has fallen by 10.8%. Decreases were registered in all categories, and especially for insecticides and miticides (-31%), apart from “miscellaneous”, which rose by 31.5%.

Compared to 1997, distribution has fallen by 10.8%.

In 2006 approximately 149 thousand tons of plant care products were placed on the market.
Fungicides represented 50.9% of the total.

Tabella II.3: Distribution of plant care products by category[23]

Category	1997	2005	2006
	Quantity distributed		
	t		
Fungicides	84,450	82,439	75,891
Insecticides and miticides	39,161	29,307	27,036
Herbicides	28,889	25,746	26,542
Miscellaneous	14,589	18,480	19,182
Biological	n.a.	425	344
TOTALS	**167,090**	**156,398**	**148,996**

n.a.: data not available

Emilia Romagna (Figure II.9), at almost 20,000 t (13.2% of the national total) is the region with the highest distribution. Next come Sicily (13.1%), Veneto (11.8%), Apulia (11.5%) and Piedmont (8.4%).

More than half the national total (58%), therefore, is distributed in these five regions.

Emilia Romagna, with almost 20,000 t (13.2% of the national total), is the region with the highest distribution.

[23] Source: ISTAT data processed by ISPRA

More than half the national total (58%) is distributed in only five regions: Emilia Romagna (13.2%), Sicily (13.1%), Veneto (11.8%), Apulia (11.5% and Piedmont (8.4%).

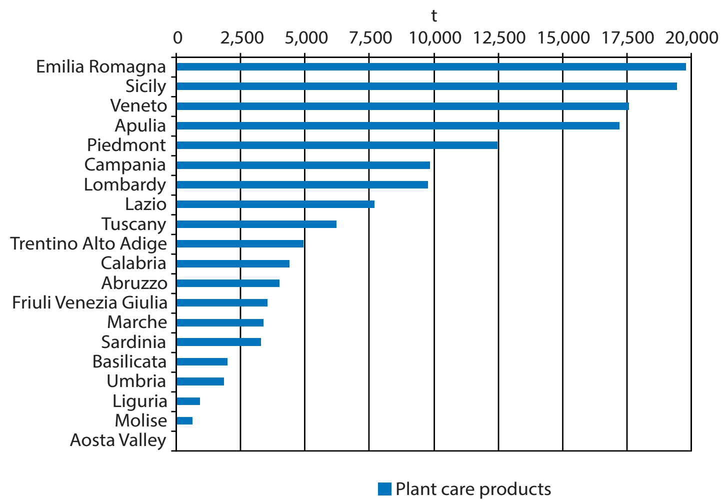

Figure II.9: Regional distribution of plant care products (2006) [24]

The total quantity of fertilisers distributed in Italy was 5,443,730 tons in 2007 (Table II.4). Approximately 60% was used in the North, 24% in the South and 16% in the Central regions.

The quantity of fertilisers distributed in Italy in 2007 totals 5,443,730 tons.

Tabella II.4: Distribution of fertilisers by type[25]

Type	Quantity distributed
	t
Mineral fertilisers	3,385,294
Organic fertilisers	333,443
Organic-mineral fertilisers	396,219
Soil conditioners	1,190,551
Correctives	125,551
Crop substrates	11,573
Products with specific action	1,099
Total fertilisers	**5,443,731**
North	3,254,146
Central	874,822
South	1,314,763

[24] Source: ISTAT data processed by ISPRA
[25] Source: ISTAT

At 901,796 tons (Figure II.10), Veneto is the region with the highest distribution. Next come Lombardy (878,425 t) and Emilia Romagna (646,720 t). These three regions alone account for approximately 45% of the total fertilisers distributed.
Veneto is the leader in the distribution of mineral fertilisers, organic fertilisers and correctives. Lombardy ranks first in terms of soil conditioners, while Emilia Romagna uses the most crop substrates.

Veneto, at 901,796 t, is the region with the highest level of distribution. Next come Lombardy (878,425 t) and Emilia Romagna (646,720 t). These three regions alone account for roughly 45% of the total fertilisers distributed.

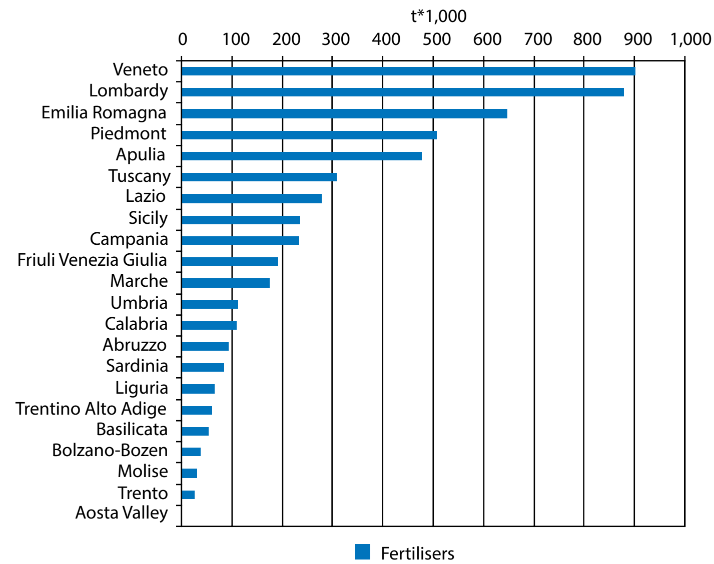

Figure II.10: Distribution of fertilisers by region (2007) [26]

Transport and Mobility

Looking at all modes of transport in Italy, mobility of freight and passengers shows constant growth in recent years. Total domestic freight transport for 2007, estimated at slightly more than 243 billion km-tons, shows an increase of 19% over 2003.

Looking at all modes of transport in Italy, mobility of freight and passengers shows constant growth in recent years.

[26] Source: ISTAT

A break-down of the freight traffic data by mode of transport points to an absolute predominance of roadway traffic, which, in 2007, still absorbed 64.9% of the total km-tons transported. In the same year, the percentages absorbed by the remaining modes of transport were: 19.2% by sea-way; 15.5% by railway and pipeline; 0.45% by air-way, which continues to cover only a minimal portion of domestic freight transport, being devoted primarily to international transport (Figure II.11).

In 2007, roadway transport once again proved to be the predominant mode, accounting for 64.9% of the km-tons transported.

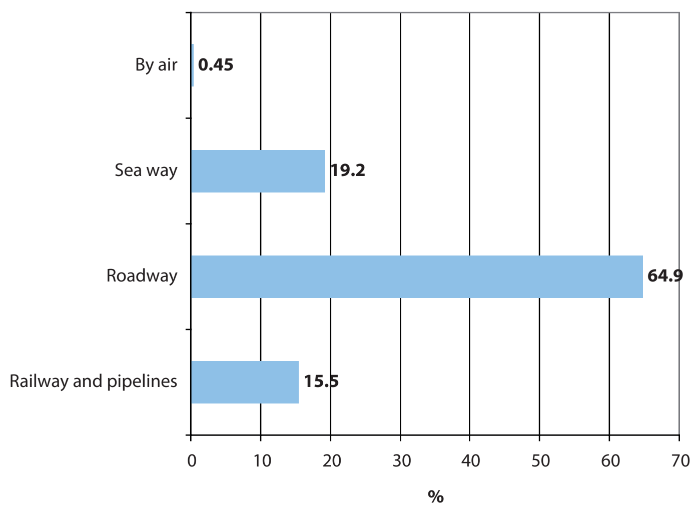

Figure II.11: Percentage of domestic freight traffic by transport mode (2007) [27]

Domestic passenger transport shows a fluctuating trend for the period 2003-2007, with a decrease of 2.3% in 2007.

Domestic passenger transport shows a fluctuating trend during the period 2003-2007, with growth of 6.5% in 2006, compared to 2005, followed by a decrease of -2.3% in 2007, as compared to the previous year. Despite this fragmented trend, there was an overall increase of 2.6% between 2003 and 2007.

[27] Source: CNT data (2006-2007) processed by ISPRA

As in the case of freight transport, the roadway mode is clearly predominant, with 92.2% of the total. The percentages of the other modes remain virtually unchanged, with respective values of 5.8% for transport by railway and other fixed-route systems, 1.6% for air transport and only 0.4% for transport by sea (Figure II.12).

Looking at domestic passenger transport, roadway travel is virtually the only mode used (92.2%).

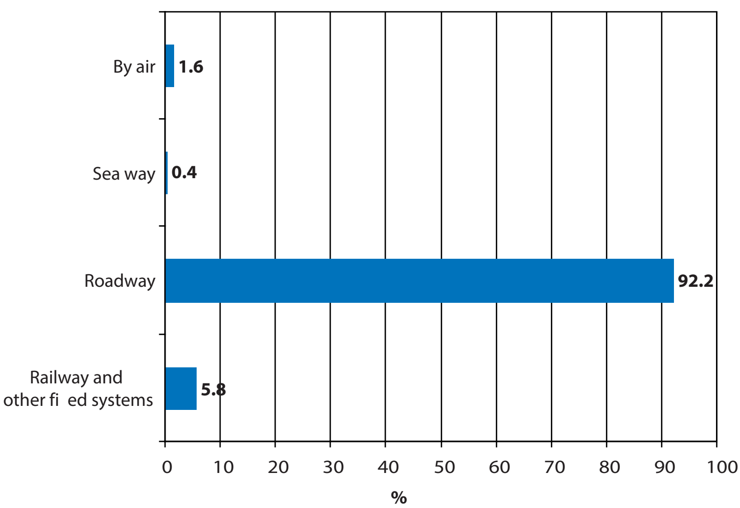

Figure II.12: Percentage of domestic passenger traffic by mode of transport (2007) [28]

A more detailed analysis of traffic, broken down by the different modes of transport, highlights a variety of situations. The data on air traffic, based on the number of movements of commercial aircraft (domestic and international), shows +16.8% growth in 2007, as compared to 2004[29].

Turning to vehicle traffic, an increase of 61% was registered between 1990 and 2007 in the kilometres travelled by light and heavy vehicles on Italian highways[30].

Commercial air transport grows by 16.8% between 2004 and 2007.
Vehicle traffic registers a 61% increase in km travelled on Italian highways between 1990 and 2007.
Between 2004 and 2006, passenger transport on the railway network rose by 2.5%, while freight transport shows a 3.4% increase.

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[28] Source: CNT data (2006-2007) processed by ISPRA
[29] Source: ENAC data processed by ISPRA
[30] Source: AISCAT data processed by ISPRA

As for railway traffic 306 million train-km of passenger transport circulated in 2006 on the State Railway system (+2.5% compared to 2004), and 65 million train-km of freight transport (+3.4% compared to 2004).

To better understand the potential pressures exerted in our country, it is necessary to examine the state of its transport equipment and infrastructures.

As of 31 December 2006, the primary Italian roadway network (not including municipal roads) shows an overall increase of approximately 4.6% compared to 2000.

As of 31 December 2006, the primary Italian roadway network (not including municipal roads) was 175,442 kilometres long, consisting of 6,554 km of motorways, 21,524 km of other roads of national importance and 147,364 km of regional and provincial roads, for an overall increase of 4.6% compared to 2000.

Looking at the statistics on roadway traffic, the figures provided by the AISCAT (Italian Association of Motorway and Tunnel Concessionarie Companies) on the volumes of traffic recorded on the motorway network operated under government concessions (5,654.7 km as of 31 December 2007), shows that the daily average theoretical vehicles in circulation in 2007 numbered more than 42.1 million, consisting of 32 million light vehicles (75.9%) and 10.1 million heavy vehicles (24.1%).

Between 2000 and 2006 the railway network grew by 771 km.

As for the railway network, its total track length as of 2006 was approximately 20,188 km, or 771 km more than in 2000. More significant increases are registered in the lengths of the electrified network and the two-track network, which grew by respective figures of 6.8% and 12.9%.

The available statistics also point to a significant quantity of port infrastructures in Italian territory. As of 1st January 2007, there were 263 ports, with total dock length of slightly more than 401 kilometres, making for an average of approximately 263 metres per berth and 1.5 per port.

Maritime transport registered an increase of 36.1% in 2007, compared to 2001.

Maritime traffic recorded an increase of 36.1% in 2007, as compared to 2001, with a total of 1,523 dockings.

Examining airport infrastructures in Italy, there were 100 airports distributed throughout Italian territory in 2007, one less than in 2006, while the airport grounds covered a surface area of approximately 150.6 km^2 and runway length totalled approximately 202 km.

An overview of the urbanised surface area set aside for infrastructures and the transport network is provided by Figure II.13, which illustrates the percentage of the total surface area found in for each region. The region with the highest infrastructure density is Lombardy, with a percentage of more than 12.3%, followed by a set of regions in the range of 8-10%: Veneto (9.7%), Campania (8.9%), Friuli Venezia Giulia (8.3%) and Lazio (8.2%).

Domestic airports covered a total surface area of 150 km^2 in 2007, and overall runway length was approximately 202 km.

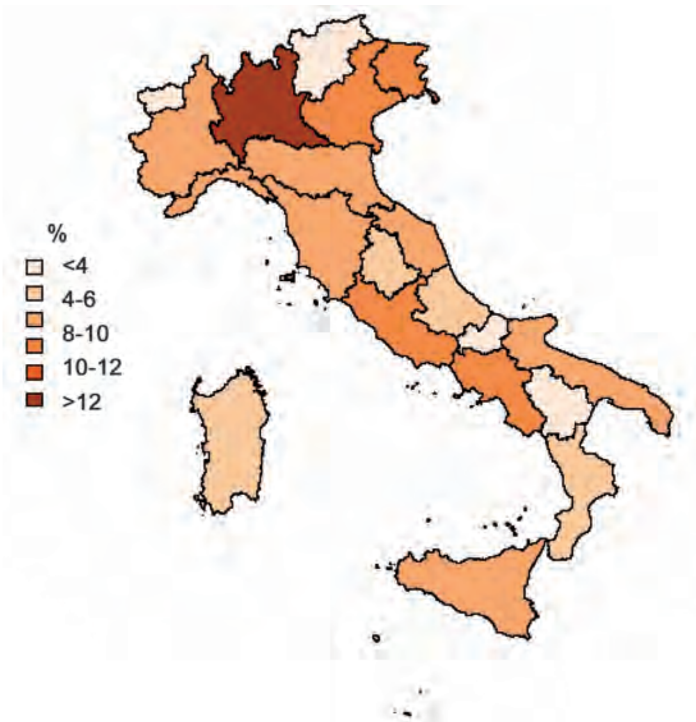


Figure II.13: Percentage of urbanised areas set aside for infrastructures and the transport network out of total regional surface areas (2005) [31]

The region with the highest density of infrastructures is Lombardy, with more than 12.3% of the total, followed by regions falling in a range of 8-10%: Veneto (9.7%), Campania (8.9%), Friuli Venezia Giulia (8.3%) and Lazio (8.2%).

[31] Source: Ministry of Infrastructures and Transportation data, ISTAT data and APAT-CLC 2000 (urbanised) data processed by ISPRA

Tourism

Tourism and the environment are closely connected.

It is impossible to address the subject of tourism without making reference to the environment, given the reciprocal interests and dynamics, based on social, historical and cultural factors, between the two sectors. There is a special tie between tourism and the environment, because tourist activities utilise environmental resources, in the broadest sense of the term, as an indispensable asset for their development, while, at the same time, the environment benefits from the resources brought into play by tourist activities, assuming such operations are compatible with the environment.

Europe receives 54% of international arrivals.

Even though Europe is the most mature tourist destination, it also remains the one most visited (54% of all international arrivals), showing an increase of 5% in arrivals in 2007.

Tourist arrivals and overnight stays in Italy grew by respective figures of 3.3% and 2.7%.

Tourist arrivals and overnight stays in all of Italy's hospitality structures grew (by respective figures of 3.3% and 2.7%) in 2007, with foreign arrivals and overnight stays, which rose by 4%, contributing significantly. The average stay (3.9 days) continued to decline, confirming the trend of recent years towards more frequent trips but for shorter periods.

Arrivals and overnight stays of tourists involve a temporary population increase that can disturb the socio-environmental balances.

Tourist flows represent a temporary increase in the population, with all the problems that arise when the capacity of a system designed to service the resident population is exceeded. An exaggerated increase in the population inevitably leads to a deterioration in the quality of life, negatively affecting living standards, safety, transport, water treatment, waste disposal etc. Similar situations can be found in certain regions, such as Trentino Alto Adige and Aosta Valley, whose ratios of "arrivals/inhabitants" (8.2 and 6.7) and "overnight stays/inhabitants" (41.7 and 24.7) are significantly higher than the national levels (Figure II.14).

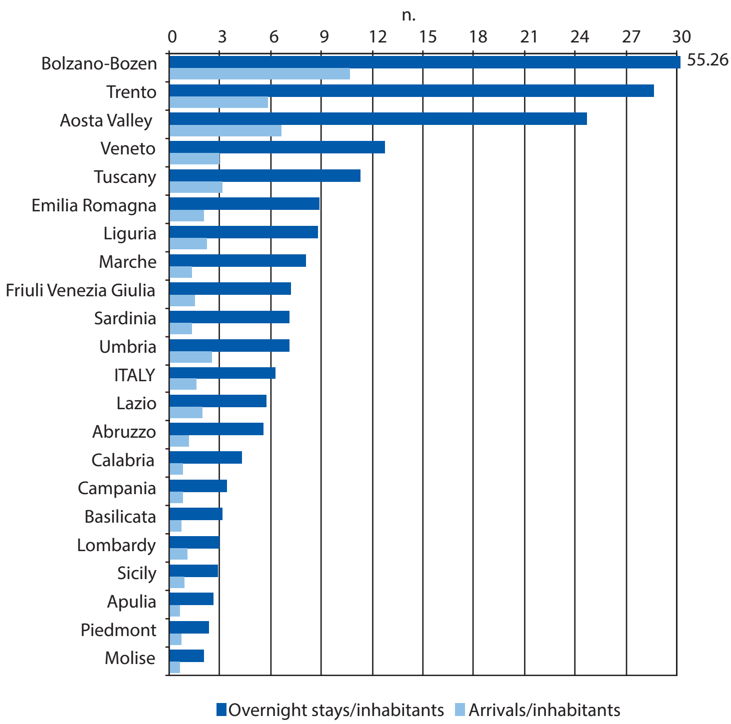


Figure II.14: Tourism intensity (2007) [32]

The autonomous provinces of Bolzano (55.26) and Trento (28.64), together with the Aosta Valley (24.66) present the highest ratios of overnight stays/inhabitants.

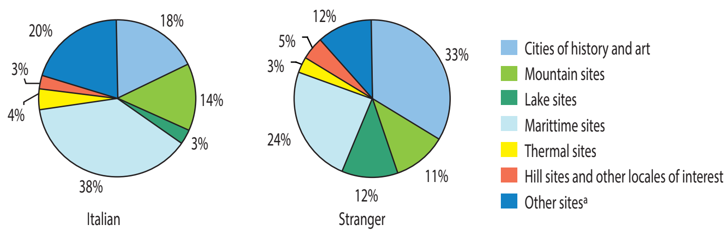
Climate is one of the main driving factors behind the seasonal structure of tourist demand, determining its length and quality and playing a key role in the choice of the destination and decisions on how much to spend. In 2007 the peak season for tourist flows remained the third quarter (with 49% of overnight stays); another development of note was the decrease of 1.2 percentage points for the first quarter between 2006 and 2007. The distribution of the flows by category of tourist site (Figure II.15) shows that Italian tourists tend to favour seaside destinations (38%) and stays in hotels (61%). Foreign tourists, on the other hand, prefer cities and

The climate is one of the key driving factors behind the seasonal structure of tourist activity.
In 2007, 49% of the overnight stays occurred in the third quarter.

[32] Source: ISTAT data processed by ISPRA

towns of historic and artistic interest (33.7%) and also favour staying in hotels (77%).

Italians prefer seaside sites (38%), while foreigners favour cities of art and history (33%).



[a] Municipalities and provincial seats not otherwise classifie

Figure II.15: Overnight stays of Italian and foreign tourists by type of site (all types of accommodations) (2007) [33]

The favourite means of transport of Italians is the car (65.3%).

Of the total number of trips taken by Italians (roughly 112 million), roughly 65.3% are taken in cars. The tendency to travel by air is on the rise (14.5% of the trips), due in part to the increasingly economical and widespread services (low cost/low fare), together with the trend towards "short breaks". As for the means of transport used by foreign tourists who come to Italy, "polluting" options continue to be favoured, such as the car and the airplane, which continued to grow between 2006 and 2007, at respective rates of 5.4% and 8% (Figure II.16).

Tourist places a variety of environmental pressures.

Tourism inevitably brings change with it; the yearning for environmental and cultural values, together with the desire for new experiences, can create disturbances in the balance of socio-environmental factors. Environmental pressures have a wide variety of effects, though a number of constants can be observed: elevated number of tourists, seasonal concentrations, use of the most polluting means of transport etc.. A characteristic typical of big cities is the fact that the problems normally caused by residents have been compounded by the role of the cities as extremely popular tourist destinations.

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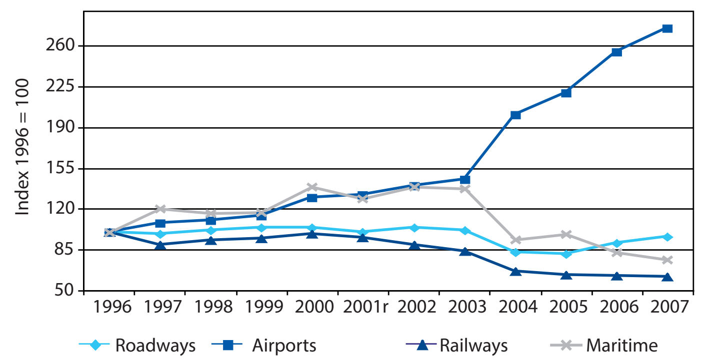
[33] Source: ISTAT data processed by ISPRA

Choice of the most polluting means of transport, cars and airplanes, which rose by respective figures of 5.4% and 8% between 2006 and 2007.



r: The 2001 data relating to border entry points by road and air have been revised, following the introduction of more sophisticated survey methodologies

Figure II.16: Variations in the number of foreign tourists at Italian border entry points[34]

It should be noted that tourist flows significantly alter the residential density of certain Italian provinces. Under normal conditions (taking into account only the resident population), Florence, Venice, Rimini and Rome present respective population densities of 278, 342, 559, 755 inhabitants/km ^{2}, while the arrival of tourists pushes these figures considerably higher. Rimini goes from 559 inhabitants/km ^{2} to 6,087 inhabitants/km ^{2} (population + tourist arrivals), making it the country's most densely populated province. The same type of jump takes place in Florence, whose resident population density is one a part with provinces such as Livorno, Lodi or Pescara, while the addition of the tourists raises the density (1,440 inhabitants/km ^{2}) to a level almost twice that of the resident population density of Rome (Figure II.17).

Tourist flows radically modify population density, as in the cases of Rimini and Florence, whose densities reach noteworthy levels with the addition of the tourists.

[34] Source: Bank of Italy data processed by ISPRA

The map on the left, showing the "Population density", groups the Italian provinces into eight population density classes; the map on the right showing the ,"Total density", groups the same provinces into the same eight density classes, but also takes into account the total density, i.e. Resident (Population + Arrivals) /sur face area in km²

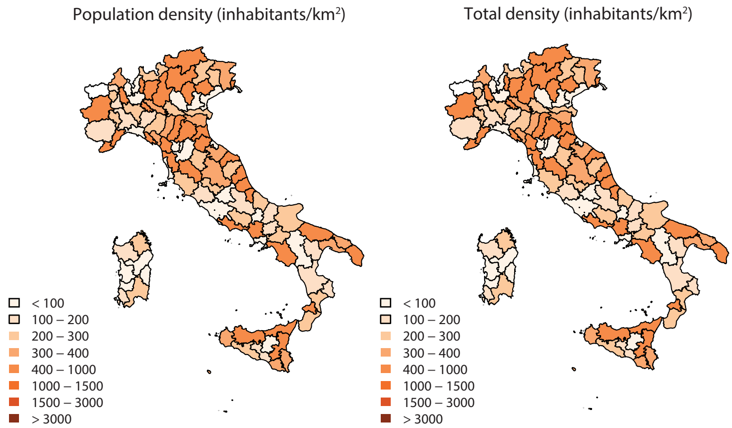


Figure II.17: Variation in the population densities of Italian provinces taking into account tourist flows (2007) [35]

[35] Source: ISTAT data processed by ISPRA

CHAPTER 1

CLIMATE CHANGE

Climate change is no longer a mere scientific issue but a global emergency of increasing priority on the policy agendas of national and international institutions.

Introduction

Climate change is no longer a mere scientific issue, but also a global emergency. For this reason it is given significant relevance on the policy agendas of national and international institutions.
In terms of scientific assessments, the IPCC[1] (Intergovernmental Panel on Climate Change) confirmed that "Warming of the climate system is unequivocal", indicating, "with *a very high confidence*, that the global average net effect of human activities since 1750 has been one of warming."
In terms of public awareness, noteworthy attention was given to this topic on the occasion of the awarding of the Nobel Peace Prize to the IPCC and to former Vice President of the United States Al Gore for his film "*The Inconvenient Truth*". Finally, significant progress has also been made in terms of international policy, in the framework of the negotiations at the 13th session of the Conference of the Parties (COP) of the UNFCCC (United Nations Framework Convention on Climate Change).

Important progress was made at the Bali Conference in terms of the negotiations on climate change.

One of the main results of the Conference was the approval of the *Bali Road Map*, a document which consists of a number of key decisions to guarantee a secure climate future. The *Road Map* includes the *Bali Action Plan*, which lays out the guidelines for a new process designed to lead to the full implementation of the Convention through long-term initiatives. These initiatives are based on five topics for negotiation: a shared vision for long-term cooperative action, mitigation, adaptation, the development and transfer of technology and the provision of financial resources.
A subsidiary body expressly established for the purpose has been assigned the task of leading the process to the full and effective implementation of the Convention through long-term actions running up to and beyond 2012. During the 14th session, held in Poznan (Poland) in December 2008, the Parties reached an agreement on the scheduling of the upcoming negotiating sessions, as well as on a number of important issues related to the enactment of the Kyoto Protocol. On that occasion, the Italian Minister

[1] IPCC (2007). Climate Change 2007 – Fourth Assessment Report-WGI.

of the Environment announced Italy's proposal to take advantage of the meetings of the G8, with the emerging countries included, to promote an agreement by the 15th session of the Conference of the Parties, to be held in 2009 in Copenhagen.

Basic climate trends

Globally

The increase in the average temperature observed in recent decades at the global and European level is unusual both in terms of its magnitude and rate of variation.

The EEA stated that "The global (land and ocean[2]) average temperature increase up to 2006 was 0.76 °C, compared to the pre-industrial level". Based on the fourth assessment report of the IPCC, "The linear warming trend over the last 50 years (0.13 °C per decade) is nearly twice that for the last 100 years". Analyses performed by the East Anglia University, and including data for 2007, show that twelve of the last thirteen years, from 1995 to 2007, rank among the thirteen warmest years since instrumental recording began (in 1850). The results of the observations provided by the European Environment Agency (EEA) make it possible to monitor the EU objective of not exceeding pre-industrial levels by more than 2 °C[3] (Figure 1.1).

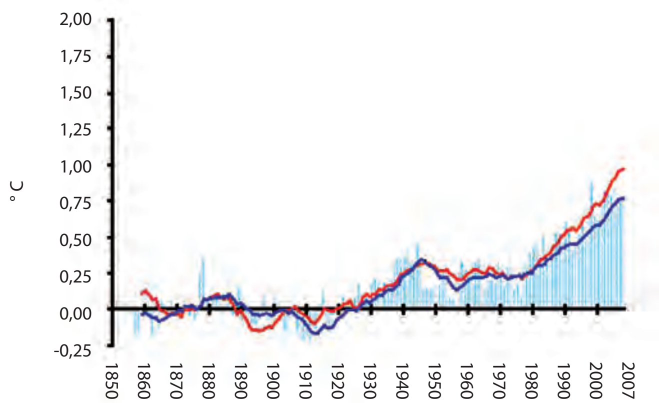
The increase in temperature, at the global and European level, is unusual.

Up to 2006, the overall increase in global average temperature (the land-ocean system) was 0.76 °C compared to the pre-industrial level.

[2] In this document, the term "land and ocean" indicates that the temperature was calculated by taking into account both the temperature of the air on dry land and the sea surface temperature, while the term "land" means that the reading refers only to the temperature of the air on dry land.

[3] EEA, http:// themes.eea.eur opa.eu/IMS/ISpecs/ISpecification20041006175027/IAssessment1202733436537/view_content

Of the 13 warmest years since 1850, twelve have been recorded since 1995.



Legend: The lines represent the moving averages over 10 years, calculated, respectively, for the "land and ocean" system (blue) and for the "land" system (red)

Figure 1.1: Global annual average temperature anomalies[4] (land and ocean system) from 1850 to 2007[5]

Projections based on the six emissions scenarios of the IPCC for the end of the 21st century estimate an increase in global temperature from 1.8 to 4.0 °C by 2090-2099 compared to 1980-1999[6].

As for precipitation trends between 1900 and 2005, a noteworthy increase was registered in the eastern part of North and South America, in Northern Europe and in Northern and Central Asia, whereas water shortages were observed in the Sahel region, in the Mediterranean, in Southern Africa and in certain parts of Southern Asia.

[4] Anomalies calculated for the reference period of 1961-1990 and adjusted to the period 1850-1899 (defined as pre-industrial), in order to obtain an immediate visualisation of the increase in average temperature compared to pre-industrial levels.

[5] Source: European Environment Agency, EEA - Data from the Climatic Research Unit of the East Anglia University

[6] IPCC (2007). Climate Change 2007 – Fourth Assessment Report-WGI.

The frequency of intense precipitation events has increased over most of the dry-land surface, in keeping with the warming trend and the increase in atmospheric water vapour.
Globally, the sea surface temperature rose by 0.038±0.011 °C per decade during the period 1850-2005, according to an estimate based on the HadSST2 dataset of the Hadley Centre.

The frequency of intense precipitation events has increased over most of the dry-land surface, in keeping with the warming trend and the increase in atmospheric water vapour.

Europe

The temperature of the land and ocean system in Europe up to 2006 increased by approximately 0.95 °C compared to pre-industrial levels. This increase was higher compared to the global increase. The change was especially marked in the southwest and northeast regions, and in mountainous zones[7].
Projections point to an average temperature increase of between 1.0 and 5.5 °C by the end of this century. Under the A1B scenario[8], for example, global climate models estimate an average temperature increase, between the periods 1980-1999 and 2080-2099, in a range of 2.3 to 5.3 °C in Northern Europe and of 2.2 to 5.1 °C in Southern Europe and the Mediterranean regions[9]. Naturally, when different emissions scenarios are employed, the estimated intervals for temperature increase vary considerably. The highest warming in Northern Europe is expected for the winter season, while the highest increase in the Mediterranean region is expected in summer (Figure 1.2).

Up to 2006, the increase in the temperature of Europe's land-ocean system was approximately 0.95 °C, compared to pre-industrial values. This increase was higher than the global increase.

[7] EEA, http://themes.eea.europa.eu/IMS/ISpecs/ISpecification20041006175027/IAssessment-1202733436537/view_content
[8] Scenario characterised by very rapid economic growth, population growth that peaks around the middle of the 21st century, and then declines, plus the rapid introduction of new and more efficient technologies, along with a balanced distribution of the various sources of energy (IPCC, *Special Report on Emission Scenarios*, 2000).
[9] IPCC (2007). Climate Change 2007 – Fourth Assessment Report-WGI.

Based on the A1B scenario, global climatic models estimate an average temperature increase, between the periods 1980-1999 and 2080-2099, in a range of 2.3 and 5.3 °C in Northern Europe and in a range of 2.2 and 5.1 °C in Southern Europe and the regions of the Mediterranean.

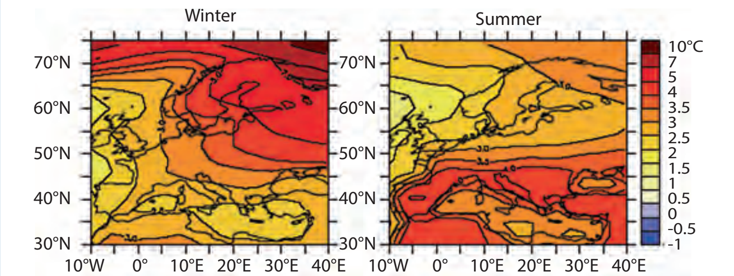


Figure 1.2: Variation in the average temperature in Europe between 1980-1999 and 2080-2099, estimated on the basis of the A1B emissions scenario[10]

Over the last 50 years, changes have been observed in the distribution of extreme temperatures, with an increase in the frequency and intensity of extremely hot events and a decrease in low-temperature episodes. According to the projections this trend will continue in the future as well.

During the 20th century, precipitation increased between 10% and 40% in the regions of Northern Europe, while it decreased by up to 20% in certain parts of Southern Europe.

In terms of precipitation in Europe, an increase between 10% and 40% was observed in the northern regions during the 20th century, together with a decrease of up to 20% in certain parts of Southern Europe[11].

Based on the A1B scenario, global climate models estimate an increase of between 0% and 16% in total annual precipitation between the two periods 1980-1999 and 2080-2099 for Northern Europe, with a decrease of between 4 and 27% in Southern Europe and the Mediterranean regions, showing peak levels in the summer season[12] (Figure 1.3). It should be kept in mind that projections of precipitation, unlike those of temperature, which are distributed fairly uniformly over space, can differ significantly even within relatively small horizontal distances, especially in regions characterised by a complex orography. It has also

[10] Source: IPCC, *Fourth Assessment Report*
[11] EEA, 2008. Impacts of Europe's changing climate – 2008 indicator-based assessment. EEA Report no. 4/2008.
[12] IPCC (2007). Climate Change 2007 – Fourth Assessment Report - WGI.

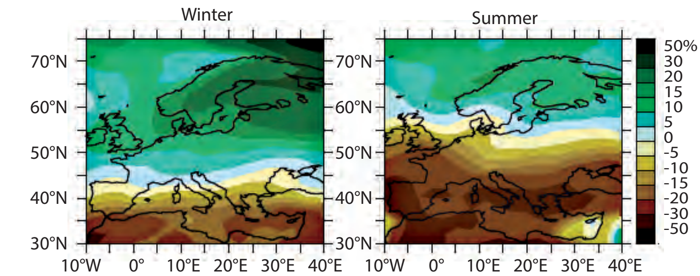


Figure 1.3: Fractional change in total precipitation in Europe between the periods 1980-1999 and 2080-2099, estimated on the basis of the A1B emissions scenario[13]

Based on the A1B scenario, the global climate models estimate an increase in the range of 0% to 16% in total annual precipitation between the periods 1980-1999 and 2080-2099 in Northern Europe, while a decrease of between 4% and 27% is expected for Southern Europe and the Mediterranean regions, especially during the summer season.

been estimated that the frequency and intensity of extreme precipitation events shall increase, especially in the northern regions, while there will be a rise in periods of drought, especially in Southern Europe.
Finally, the surface temperature of Europe's seas is increasing more rapidly than the rates observed in the rest of the globe, with the highest rates recorded in the seas of Northern Europe rather than the Mediterranean. Over the last 25 years (1982-2006), the rate at which the temperature of Europe's seas has risen has been roughly 10 times greater than the figure registered for the period 1871 to 2006[14].

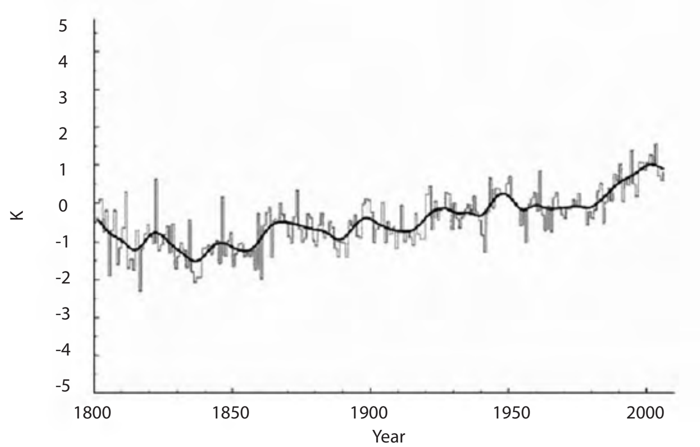
Italy

Estimates of the average temperature trend in Italy over the last 200 years point to levels that were rather low up through 1860, with 1816 representing the coldest year of the entire period. A subsequent trend in the direction of increasingly high values was recorded, with 2003 proving to be the hottest year of the entire series[15] (Figure 1.4).

The average temperature in Italy has increased significantly over the last thirty years, with 2003 representing the hottest year of the entire series.

[13] Source: IPCC *Fourth Assessment Report*
[14] EEA, 2008. Impacts of Europe's changing climate – 2008 indicator-based assessment. EEA *Report* n. 4/2008.
[15] www.dta.cnr.it/dmdocuments/pubblicazioni/volume_clima_07/AT_03/3-20_nanni.pdf

The average temperature in Italy has increased significantly over the last thirty years, with 2003 representing the hottest year of the entire series.



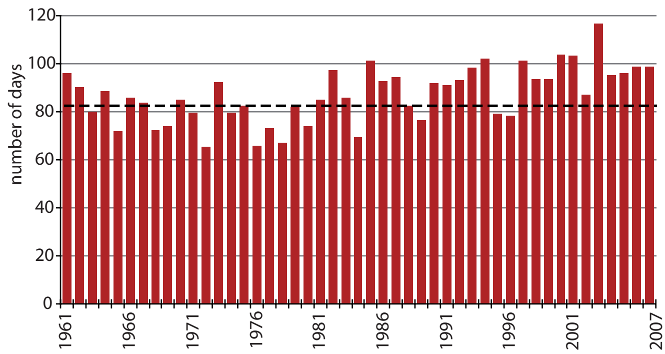
Note: The data are expressed in terms of anomalies compared to the period 1961-1990

Figure 1.4: Average annual temperatures in Italy during the period 1800–2006[16]

The trend of the average temperature in Italy during the period 1961-2007 was estimated by utilising non-linear models. The data processed consisted of a homogenized series of mean annual temperatures of 49 stations of the Italian Air Force network. The estimate shows that the average temperature in Italy decreased between 1961 and 1981, followed by an increase up to 2007, for an overall increase of approximately 0.94 °C.

The upward trend of the temperature in Italy is confirmed by an analysis of extreme temperature values. It is estimated that, during the years 1961-2007, there was an average increase of 14.8 "summer days"[17] (Figure 1.5) and an average increase of 10.4 "tropical nights"[18].

[16] Source: Nanni et al., 2006
[17] Number of days with a maximum air temperature of more than 25 °C.
[18] Number of days with a minimum air temperature of more than 20 °C.



Note: The dotted line represents the average normal value calculated for the period 1961-1990

Figure 1.5: Annual series of average number of summer days in Italy (1961-2007) [19]

There was an estimated average increase of 14.8 "summer days" during the period 1961-2007, meaning days with a maximum air temperature of more than 25 °C.

A seasonal analysis shows that the warming which has characterised the last twenty years has been especially noticeable in Summer and Spring, but less so in the other seasons. For example, in an analysis of the 49 stations of the Italian Air Force during the period 1961-2006, the summer series prior to 1981 (1980 for Central Italy) showed a phase of cooling followed by a period of marked heating, at a rate between 0.056 and 0.072 °C/year[20].
The average Italian series for annual precipitation during the last 200 years shows no noteworthy trends (Figure 1.6). Seasonal and annual precipitation trends are generally negative and limited in size, rarely proving to be statistically significant [21].
For example, an analysis of standardised precipitation anomalies performed on data from 59 stations of the Italian Air Force during the period 1961-2006 shows a downward trend of 0.015/year for Northern Italy during the winter season [22].

An analysis performed on data from 59 stations of the Italian Air Force during the period 1961-2006 shows a downward trend of 0.015/year for Northern Italy during the winter season.

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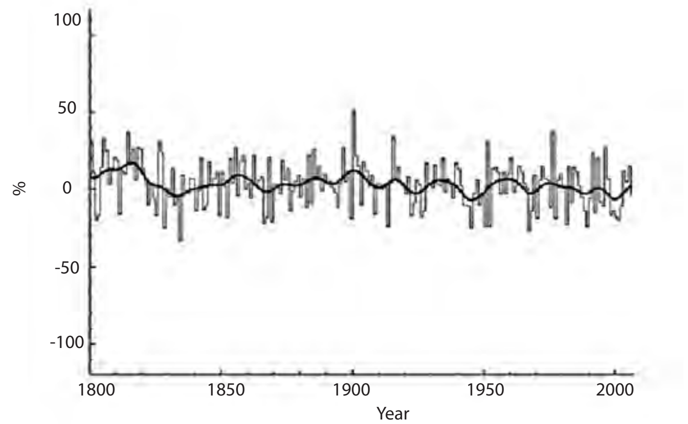
[19] Source: Italian Air Force data processed by ISPRA (former APAT)
[20] A. Toreti, F. Desiato, G. Fioravanti, W. Perconti, 2008, Seasonal temperature and precipitation over Italy from 1961 to 2006. European Conference on Applied Climatology, ECAC, 2008 – Poster Session.
[21] www.dta.cnr.it/dmdocuments/pubblicazioni/volume_clima_07/A T_03/3-20_nanni.pdf
[22] A. Toreti, F. Desiato, G. Fioravanti, W. Perconti, 2008, Seasonal temperature and precipitation over Italy from 1961 to 2006. European Conference on Applied Climatology, ECAC, 2008 – Poster Session.

The average Italian series for precipitation over the last 200 years shows no noteworthy trend.



Note: The figures are expressed as percentage deviations compared to the average values for the period 1961-1990

Figure 1.6: Annual average series of precipitation in Italy during the period 1800–2006[23]

Impacts of climate change

Globally

Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.

As indicated in the Fourth Report of the IPCC[24]: "Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases".

Most of the components of the cryosphere are undergoing a generalised reduction, and at an increasingly rapid pace in recent decades, in keeping with the increased warming observed. In the Arctic and in Antarctica, for example, ice shelves dating back thousands of years have begun to collapse, with a significant impact on mammals and on populations of marine birds. In the tropical Andes and in the Alps, glacier melting has resulted in a run-off increase in recent decades (Figure 1.7).

[23] Fonte: Nanni et al., 2006

[24] IPCC (2007). Climate Change 2007 – Fourth Assessment Report - WGII.

Over the last 65 years, Spring peaks in river flows have moved up to a point one or two weeks earlier in North America and in the northern portion of the Eurasian continent. At lower altitudes, a downward trend in the snow cover has been observed, affecting skiing sites, especially in the Alpine arc.
In certain cases the melting of the glaciers has lowered the temperature of seas, as has been demonstrated in the North Atlantic and in the Ross Sea.
Many coastal regions are suffering the effects of local increases in the sea levels, resulting from a combination of factors related to climate, geology and subsidence traceable to anthropogenic activities and other local characteristics. The sea level has risen at a rate of approximately 1.7-1.8 mm a year during the last century, with an increase of up to 3 mm per year during the last decade.

Globally, a yearly increase of approximately 1.7-1.8 mm was observed in sea level during the last century, while increases of up to 3 mm per year have been registered in the last decade.

The sea level rise, the increased height of waves and the greater intensity of storms are striking certain coastal regions without intense anthropogenic development, such as the polar areas, leading to processes of coastal erosion.
In marine and aquatic ecosystems, many changes in phenology and biogeography, related to the phases of the development of organisms and the distribution of species, are tied to increases in water temperature, as well as to changes in salinity, levels of oxygen and circulation. It is now clear the connection between the coral bleaching and the anomalies in the sea temperature, though it is difficult to distinguish the effect of temperature from non-climatic factors. The most widespread instance of deterioration occurred in 1998, destroying 16% of the world's coral, with an especially devastating effect in the Western Pacific and in the Indian Ocean.
Aquatic ecosystems are showing changes in the abundance of organisms and in productivity, as well as in ranges of expansion and phenological phases, in response to increases in temperature.
Studies of terrestrial biosystems point to impacts of global warming over the last 30-50 years, such as the earlier occurrence of Spring and Summer phenological phases and the extension of the growing season at the medium and high latitudes, as well as

increased vulnerability of certain species, with episodes of extinction at the local level.

In the Northern Hemisphere, the intensity of vegetative activity increased by 12% in Eurasia and by 8% in North America between 1981 and 1999. In contrast, a downward trend in the production of biomass was registered in Southern Europe, tied to the decreased levels of rain, especially following the intense drought of 2003. In recent years, repeated large-scale forest fires have been associated with drought events in the Mediterranean area and in North Africa, as well as in California.

In the countries of the Sahel region, the increase in temperatures, together with lower levels of precipitation, have shortened the vegetation cycle, preventing the area's crop varieties from completing their cycle.

Starting from 1970, an increase in the average intensity of cyclones was registered in the majority of tropical basins.

In terms of extreme meteorological events, starting from 1970 an increase in the average intensity of cyclones has been registered in the majority of tropical basins, together with increases in the number and intensity of storms in the Atlantic. Starting from 1995, the number of intense storms in the Atlantic was more than double the level registered in the period 1970-1994.

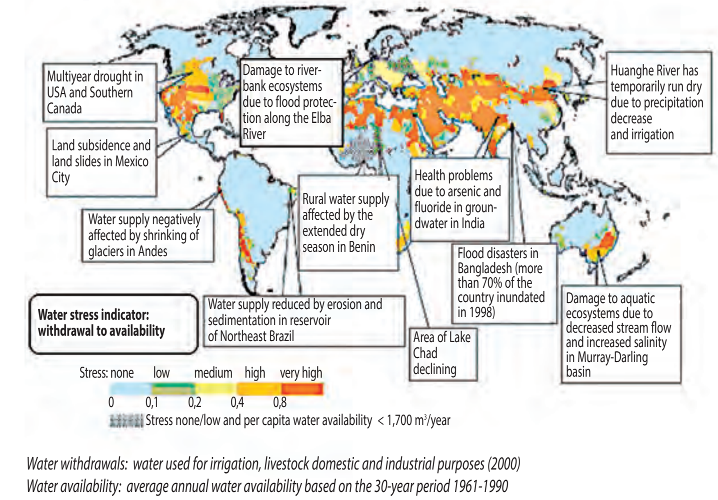
On the Asian continent, extreme meteorological events associated with *El Niño* have been more intense and more frequent during the last 20 years. The damage caused by intense cyclones has increased significantly, especially in India, China, the Philippines, Japan, Vietnam and Cambodia, Iran and Tibet.

In recent decades, production of rice, corn and wheat has fallen in many areas of Asia, on account of increasingly stressful water conditions brought about by higher temperatures, a higher frequency of *El Niño* and fewer days of rain.

Extreme meteorological can also have repercussions on human health, in certain cases even leading to a rise in the mortality rate. In the summer of 2003, the hottest since 1500, the heat wave that hit Western and Central Europe was blamed for 25,000-30,000 deaths, a number far higher than all the heat-related deaths registered during the last century in Europe.

Economic losses traceable to natural disasters increased from 75.5 billion dollars in the 60's to 659.9 billion dollars in the 90's.

In terms of economic losses, the amount traceable to natural disasters rose from $ 75.5 billion US in the 60's to $ 659.9 billion US in the 90's. The private-sector data on insurance costs also



Legend: In the background there is a map of the water stress[25]

Figure 1.7: Examples of current vulnerability of water resources and their management[26]

In recent decades, the production of rice, corn and wheat has decreased in many areas of Asia on account of the growing stress placed on supplies of water by increases in temperature, increases in the frequency of El Niño and fewer days of rain.

point to increased losses during this period.

Europe

Based on the latest report of the EEA on the impact of climate change[27], many natural systems in Europe, as well as a large number of socio-economic sectors, have already undergone the consequences of climate change, in the form of loss of biodiversity, reduced quantities and quality of water resources, risks to human health, damage to farming and forestry activities, to tourism and to the sectors of energy and transportation.

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[25] Alcamo J., P. Doll, T. Henrichs, F. Kaspar, B. Lehner, T. Rosch, S. Siebert, 2003. *Global estimates of water withdrawals and availability under current and future business-as-usual conditions. Hydrological Sciences Journal* 48: 339- 348.
[26] Source: IPCC
[27] EEA, 2008. *Impacts of Europe's changing climate – 2008 indicator-based assessment*. EEA Report n. 4/2008.

Mountainous zones, the Mediterranean area, coastal regions and the Arctic represent the most vulnerable areas in Europe.

Between 1850 and the end of the 1970's, the glaciers in the Alps lost a third of their surface area and half their volume.

The most vulnerable areas of Europe are mountainous zones, the Mediterranean area, coastal regions and the Arctic, and this will increasingly be the case unless, in addition to a noteworthy reduction in global emissions of greenhouse gases, the measures needed to adapt to the impact of the effects of climate change already underway, and to moderate them, are taken.
In almost all the glacial regions of Europe, a generalised loss of glacial mass has been observed. Between 1850 and the end of the 1970's, the glaciers in the Alps lost a third of their surface area and half of their volume. An acceleration in the rate of glacial melting has been observed since 1985, resulting in loss of 25% of the remaining glacier. In the Northern Hemisphere, there has also been a decrease of 1.3% per decade in the snow cover over the last 40 years, especially in Spring and Summer.
The rates of variation in the sea levels in Europe during the 20th century ranged from –0.3 mm/year to 2.8 mm/year (Figure 1.8). It is highly probable that the upward trend in the sea level observed over the last 100 years is traceable primarily to an increase in the volume of ocean waters as a result of rising temperatures, though flows of water from melting glaciers play an increasingly important role.

Rates of variation in sea level in different areas of Europe ranged from -0.3 mm/year to 2.8 mm/year during the 20th century.

Note: Figures expressed in mm/year, corrected for postglacial movement of the earth and variations in the field of gravity

Figure 1.8: Change in the sea level at different tide gauges (1896-2004) [28]

Life cycles have been observed to arrive earlier in marine ecosystems, by as much as 4-6 weeks in the case of some species, while plankton have moved rightly 10° to the north, from the warm water of the Northeast Atlantic over the last 40 years.

[28] Source: EEA

An upward trend in the river flows has been observed in the northern areas of Europe, especially in Winter, while Southern Europe shows a slight decrease.

There have also been changes in the river flows over the last century. An upward trend has been observed in the northern areas of Europe, especially during Winter, while there has been a slight decrease in Southern Europe.
Figure 1.9 illustrates the flooding events that occurred in Europe during the ten-year period 1998 – 2008.

In the decade 1998-2008, the European areas most affected by flooding were Eastern Europe and the Balkans Peninsula, while the area of Italy most affected was its northwest portion.

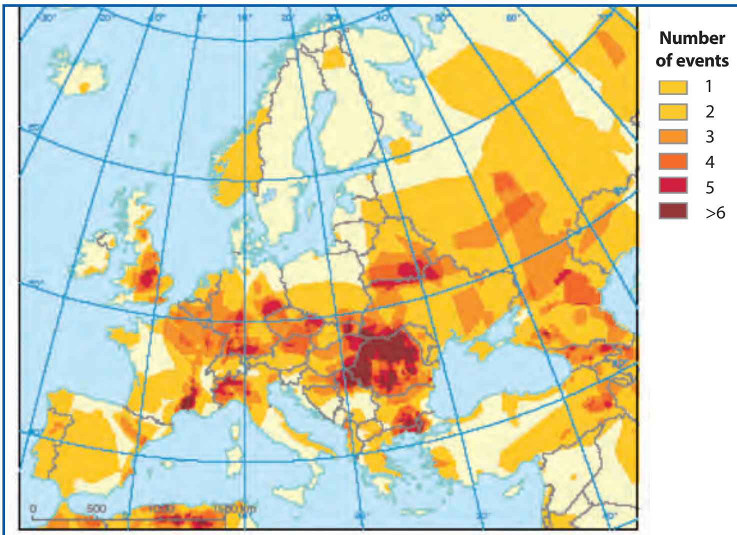

Figure 1.9: Number of flooding events in Europe from 1998 to 2008[29]

In terms of terrestrial ecosystems, it has been observed that many vegetable species are shifting further north, and towards higher altitudes. There have also been variations in the phenological phases: 78% of the figures regarding the development of leaves and blossoms show the dates moving up, while there is a noteworthy delay in only 3% of the cases. The spring and summer phenological events were found to be occurring an average of 2.5 days earlier per decade.
In agriculture, the growing season for crops showed an unmis-

[29] Source: EEA

takable trend towards lengthening between 1975 and 2007, though not to a uniform extent throughout Europe. The most significant changes (roughly 0.5-0.7 days a year) occurred in central and southern Spain, in central Italy, along the Atlantic coasts and in the British Isles, in Denmark and in the central portion of the continent, as a result of a decrease in Spring frosts and a gradual delay in Autumn ones.

Between 1975 and 2006 Europe showed unmistakable trends in the water supply, both upward and downward, with considerable geographic variations: the demand for water rose at an especially high rate (50-70%) in the Mediterranean area, while decreases were registered primarily in the northern and central regions of Europe.

Unmistakable trends in the demand for water were observed between 1975 and 2006: demand rose (50-70%) primarily in the Mediterranean areas, while decreases were registered predominantly in the northern and central zones of Europe.

Numerous epidemiological studies have quantified the impact of temperature on day-to-day mortality. In many European cities, mortality increases beyond a threshold temperature that varies, depending on geographic position [30].

As highlighted by the European Environmental Agency, a report recently published by the United Nations (UNEP FI, 2006) estimates that losses due to meteorological events are doubling every 12 years on a global level. Even though the dominant factors in the increased losses observed are socioeconomic, there can be no denying that ongoing developments in natural disasters constitute an important contributing cause. The average annual number of disastrous events related to the weather and climate in Europe rose by approximately 65% during the period 1998-2007, as compared to the 1980's, while the number of events not related to the climate, such as earthquakes, remained stable. There are no figures, however, of what portion of the increase is traceable to climate change of anthropogenic origin (Figure 1.10).

[30] World Health Organization, 2007 – Environment and health risks from climate change and variability in Italy.

The annual average number of events tied to the weather –climate in Europe rose by approximately 65% during the period 1998-2007, as compared to the 1980's, while events not related to climate, such as earthquakes, remained stable.

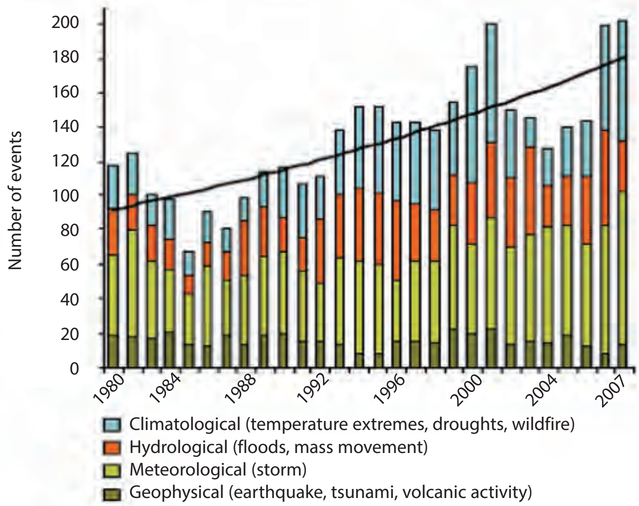

Figure 1.10: Natural disasters in Europe between 1980 and 2007[31]

For the most part, the effect of the foreseen impacts will be negative, resulting in significant economic losses.

Climate change in Europe will be accompanied by numerous economic consequences regarding services associated with the natural environment (including forestry and fishing), coastal areas, agriculture, tourism, energy, human health and the constructed environment. The observed or forecast effects vary by geographic area and sector of activity. The majority of the impacts foreseen will be negative, resulting in economic losses, though some effects may prove positive, as in the case of agricultural production in Northern Europe (Figure 1.11).

[31] Source: EEA

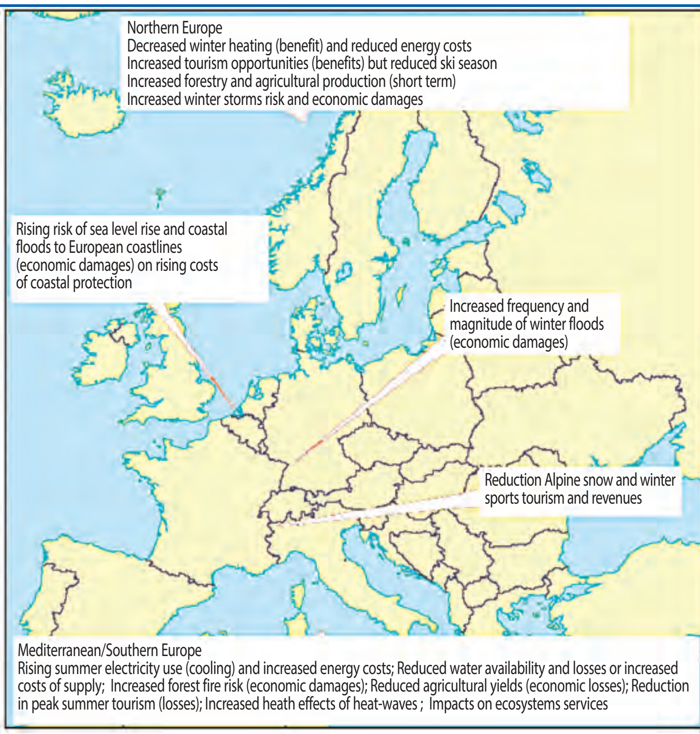

Figure 1.11: Examples of potential economic effects in Europe foreseen for the 21st century[32]

Climate change in Europe will have numerous economic consequences on services associated with the natural environment, on coastal areas, on agriculture, on tourism, on energy, on human health and on the constructed environment.

Italy

Italy is one of the European countries most vulnerable to the impact of climate change, whose effects on our territory and its resources are already visible today.

In recent decades, the gap between the demand for water in various sectors (residential, farming, livestock, industry, recreational activities etc.) and the available supply has grown ever larger. Underlying this problem are a variety of causes, often connected with unsustainable management, due to excessive exploitation and pollution of water tables, the growing demand

Italy is one of the European countries most vulnerable to the impacts of climate change.

[32] Source: EEA

for water tied to the country's socioeconomic development, the inadequacy of the systems for obtaining and distributing water and excessively water-intensive methods of irrigation. Climate changes, which have already led, in some areas, to lower average annual precipitation, increased variability of precipitation in terms of space and time, higher temperatures and a noteworthy reduction in the snow and glacial reserves of the Alpine arc, only worsen the problem, accelerating the decrease in water supplies and the increase in demand[33].

Numerous glaciers distributed along the Alpine arc have been found to have withdrawn, between the early decades of the 20th century and the present, by distances ranging from 400 m to more than 1.5 km.

Along the entire Italian Alpine arc, reductions of glacial reserves equal to the rest of Europe, if not greater, have been registered. As early as 1991, for example, the glaciers on the Piedmont side of the Gran Paradiso mountain had lost 50% of their surface area, compared to what they measured in the 19th century, and they shrunk even further in the years that followed. On the southern slopes of the Alps, the Lys glacier front, on Monte Rosa, withdrew by approximately 1,600 m between 1860 and 2006. Numerous other glaciers found in different points of the Alpine arc have shown significant retreat between the early decades of the 20th century and the present, falling back by distances ranging from 400 m to as much as 1.5 km[34].

Climate warming has unquestionably begin to have an effect on terrestrial biological systems, giving rise to changes such as earlier phenological phase and the migration towards higher latitudes of different animal and vegetable species. The more sensitive species face local extinction, following the disappearance of their ecological niches. In the central Alps, high-altitude vegetable species have been found to move to even higher areas, while observations in the central Apennines point to a tendency on the part of high-altitude ecosystems to adapt to increasingly arid conditions. In such cases, the specific composition has undergone changes of 10-20% in the last ten years, showing worrisome symptoms of a process of degeneration already underway.

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33 www.apat.gov.it/site/_files/CNCC2007Sintesilavori.pdf

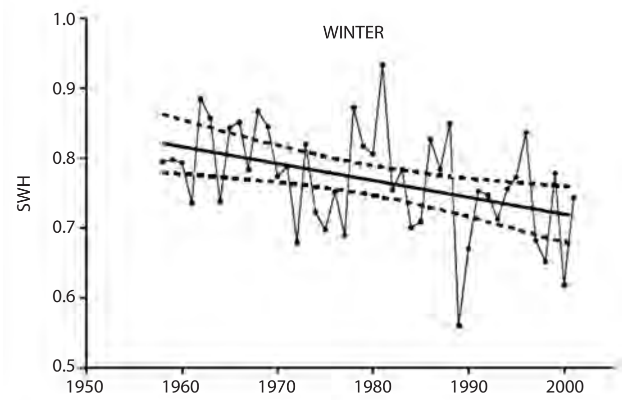
34 www.conferenzacambiamenticlimatici2007.it/site/_Files/145517_Cambiamenti%20climatici.pdf

The Mediterranean sea level is rising at a rate of approximately 1.52 mm/year.

Coastal erosion and flooding caused by variations in the average sea level and by extreme events also have a major impact on the loss of biodiversity, not to mention economic losses tied to tourism. The rate at which the level of the Mediterranean Sea is rising (1.52 mm/year) is roughly half the global rate (2.85 mm/year), and interannual and spatial variations are quite high[35]. Coastal erosion in Italy has reached noteworthy proportions. Of the total 4,860 km of low-lying coastline, 1,500 km are at risk of erosion or flooding, meaning almost 20% of Italy's total coastal areas. The main causes are anthropogenic, but variations in the sea level and extreme tides caused by climate change could aggravate the situation along the coasts. Unfortunately, the information available to date on the Mediterranean Sea is not sufficient to describe the current trends, and meteorological forcing at regional scale results not only in significant internal variability, but also in deviations between Mediterranean and global trends.
An analysis of the average sea level is available for a limited number of locations in Italy. Genoa and Trieste, for example, show respective upward trends of 1.2 mm/year and 1.3 mm/year for the period 1880-2000[36]. During the second half of the 20th century, a decrease in the average intensity of tides during the winter months[37] (Figure 1.12), along with a reduction in extreme events, were observed only in the central portion of the Mediterranean Sea, including Southern Italy[38] (Figure 1.13).

[35] N. Pinardi, A. Navarra, 2007, *Variabilità del livello del mare nel Mediterraneo, il monitoraggio operativo e gli scenari climatici*. Presented at the Workshop "Cambiamenti climatici e rischio costiero", Palermo 27-28, June 2007.
[36] F. Raicich, 2007, *Scenari di sea-level rise nel Mediterraneo*. Presented at the Workshop "Cambiamenti climatici e rischio costiero", Palermo 27-28, June 2007.
[37] P. Lionello, A. Sanna, 2005, *Mediterranean wave climate variability and its links with NAO and Indian Monsoon*. Clim. Dyn., 25, 611-623.
[38] P. Lionello, J. Bhend, A. Buzzi, P. M. Della Marta, S. Krichak, A. Jansà, P. Maheras, A. Sanna, I. F. Trigo, R. Trigo, 2006, *Cyclones in the Mediterranean region: climatology and effects on the environment*. In P. Lionello, P. Malanotte-Rizzoli, R. Boscolo (eds) *Mediterranean Climate Variability*. Amsterdam: Elsevier (Netherlands).

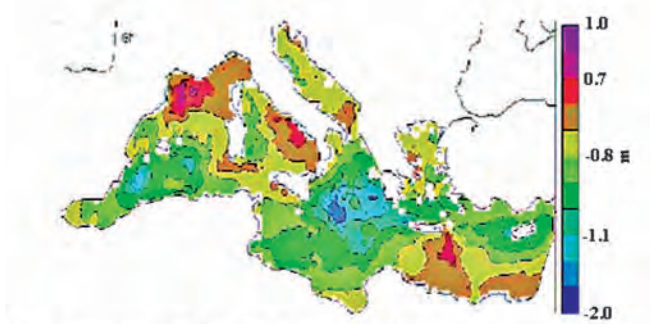
During the second half of the 20th century, a decrease in the average intensity of tides during the winter months was observed.



Legend: SWH= *Significant Wave Height* (expressed in meters)

Figure 1.12: Significant Wave Height[39]

During the second half of the 20th century, a decrease in the number of extreme events was observed only in the central portion of the Mediterranean, which lies off Southern Italy.



Note: Regression analysis of 44 years of maximum events in Winter

Figure 1.13: Extreme values of SWH (Significant Wave Height) [40]

[39] Source: Lionello and Sanna, 2005
[40] Source: Lionello et al., 2006

Agriculture must definitely be counted among the economic sectors most vulnerable to climate change in Italy. Here, in fact, this sector places a particular emphasis on traditional products whose high quality cannot be separated from their territory of origin, making them highly vulnerable to change and the related processes of soil degradation and desertification. The potential impact of climate change on agriculture, tied to increased temperatures and variations in the frequency and intensity of extreme events, such as late frosts and droughts, have significant repercussions on the agro-food sector, which accounted for 15.5% of the GDP in 2006, equal to approximately 229 billion Euro[41].

Agriculture in Italy is highly vulnerable to climate change and the attendant processes of soil deterioration and desertification.

Pressures on the climate system

The vast majority of the scientific community is aware that "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activity"[42], even though the effects of natural phenomena, such as the variability of the intensity of solar radiation, are also taken into consideration. The results of the IPCC's Third Report on climate change were confirmed in the Fourth Report[43].

Much of the warming observed in the last 50 years can be traced to human activities.

As regards CO_2, the main greenhouse gas, the average global atmospheric concentration of carbon dioxide has risen from 280 ppm during the period 1000-1750 to 383 ppm in 2007. This trend is in line with the yearly emissions growth of carbon dioxide from roughly zero to 31.2 billion tons, taking into account only emissions from fossil fuels combustion and cement production[44]. The other greenhouse gases, such as methane, nitrous dioxide and the fluorocarbons, have shown similar patterns of growth, though at lower levels.

[41] www.apat.gov.it/site/_files/CNCC2007Sintesilavori.pdf
[42] IPCC (2001). Climate Change 2001 – Summary Report.
[43] IPCC (2007). Climate Change 2007 – WG-I, WG-II, WG-III, Technical summary.
[44] Global Carbon Project (2008). Carbon budget and trends 2007.

From 1990 to 2006 greenhouse gas emissions in Italy went from 516.9 to 567.9 Mt CO_2 eq, increasing by 9.9%.
Under the Kyoto Protocol, Italy should have reduced its emissions, in the period 2008-2012, by 6.5% of the 1990 level, down to 483.3 Mt CO_2eq.

Italy follows the same trend of greenhouse gas emissions: the most recent figures for the national inventory of greenhouse gas emissions show that emissions of CO_2eq rose from 516.85 million tons to 567.92 million tons during the period 1990-2006, for an increase of 9.9%, whereas, according to the Kyoto Protocol, Italy should have reduced its emissions, during the period 2008-2012, by 6.5%, compared to the 1990 level, down to 483.26 MtCO_2eq. Globally, Italy is responsible for no more than 1.67% of overall emissions generated by fossil fuels, meaning that it ranks ninth out of the ten countries with the highest levels of greenhouse gas emissions [45].

Greenhouse gas emissions in Italy registered overall growth of 51.02 million tons of carbon dioxide equivalent (Mt CO_2eq) between 1990 and 2006. During this period, there were reductions in fugitive emissions due to accidental losses during the production and distribution of hydrocarbons (-3.34 Mt CO_2eq), as well as in emissions by manufacturing enterprises (-6.83 Mt CO_2eq), agriculture (-3.94 Mt CO_2eq) and the use of solvents (-0.25 Mt CO_2eq), while emissions by industrial procedures rose (+0.24 Mt CO_2eq), along with those from waste (+0.73 Mt CO_2eq), the residential sector and services (+10.08 Mt CO_2eq.), energy producers (+22.33 Mt CO_2eq) and the transport sector (+28.66 Mt CO_2eq).

For the first time since 1996, overall emissions were lower in 2006, compared to the previous year, with a reduction of 1.73% in total emissions and 0.91% for combustion emissions.

The emission growth rates indicated above show an inversion of the trend that began in 2005. In fact lower emissions were registered in 2006 for most sectors, as compared to the previous year: industrial processes (-10.55%, equal to – 4,34 Mt CO_2eq), residential sector and services (-6.11%; -5.71 Mt CO_2eq), waste (-3.93%; -0.76 Mt CO_2eq), fugitive emissions (-3.29%; -0.25 Mt CO_2eq) and agriculture (-1.60%; -0.60 Mt CO_2eq). On the other hand, the energy industry remains stationary (-0.14%;-0.24 Mt CO_2eq), and there were increases in transportation (+0.92%; +1.22 Mt CO_2eq), the manufacturing industries (+0.47%; +0.39 Mt CO_2eq) and the use of solvents (+0.41%; 0.01 Mt CO_2eq). Overall, for the first time since 1996,

[45] IEA (2007). *CO_2 emissions from fuel combustion,* 1971-2005.

the figures for 2006 showed a reduction in emissions compared to the previous year: 1.73% (-10.02 Mt CO_2eq) for total emissions and 0.91% (-4.34 Mt CO_2eq) for emissions from combustion.

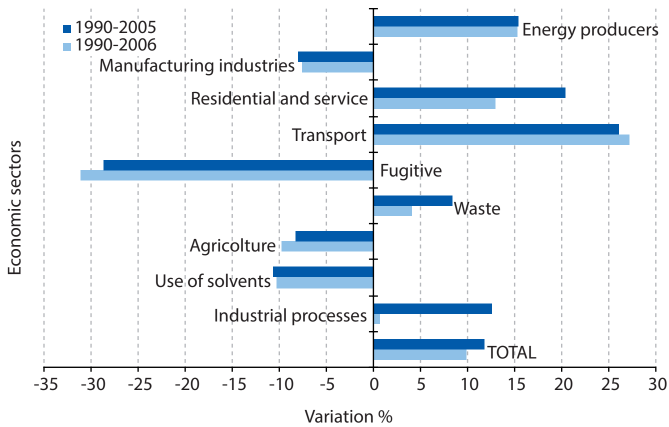


Figure 1.14: Percentage variation in emissions of greenhouse gases by economic sector for the years 2005 and 2006, compared with 1990[46]

Between 1990 and 2006, there were increases in emissions from waste, industrial processes, the residential sector and services and, to a greater extent, from energy industries and transport sector. Only emissions from manufacturing industries were lower than in 1990.

Given the upward trend in emissions from energy industries and the transport sector, Italy is not expected to reach the Kyoto target only with domestic measures. It will have to draw on credits generated by forestry activities and international cooperation initiatives (Clean Development Mechanism, Joint Implementation) as defined under the Kyoto Protocol. In 2006 greenhouse gas emissions were approximately 85 Mt greater than the Kyoto target (+ 17.4%).

[46] Source: ISPRA

Under the Kyoto Protocol, Italy should lower its emissions, during the period 2008-2012 to levels 6.5% below those of 1990, meaning to 483.26 Mt CO_2eq.
In 2006 greenhouse gas emissions were slightly less than 85 Mt above the Kyoto target (+17.4%).

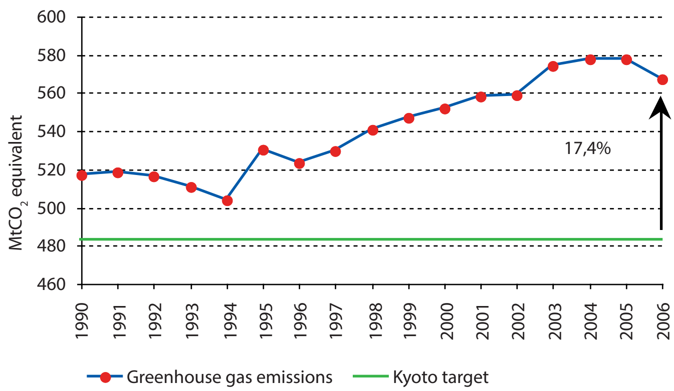


Figure 1.15: Total greenhouse gas emissions compared with the Kyoto target[47]

The majority of the countries of the European Union (EU15) are not in line with their Kyoto targets.

In the European Union (EU15) the majority of the countries are not in line with the objectives set under the Kyoto Protocol. Germany, Belgium and the Netherlands have met the objectives, while, in 2006, the United Kingdom, Sweden and France lowered emissions beyond the targets set for the period 2008-2012.
As a rule, the new Member States (*apart from Slovenia*) have reduced their emissions far beyond their Kyoto targets. Cyprus and Malta, which are not included in the Annex I of the UNFCCC (as developing countries), are not required to reduce emissions.

[47] Source: ISPRA

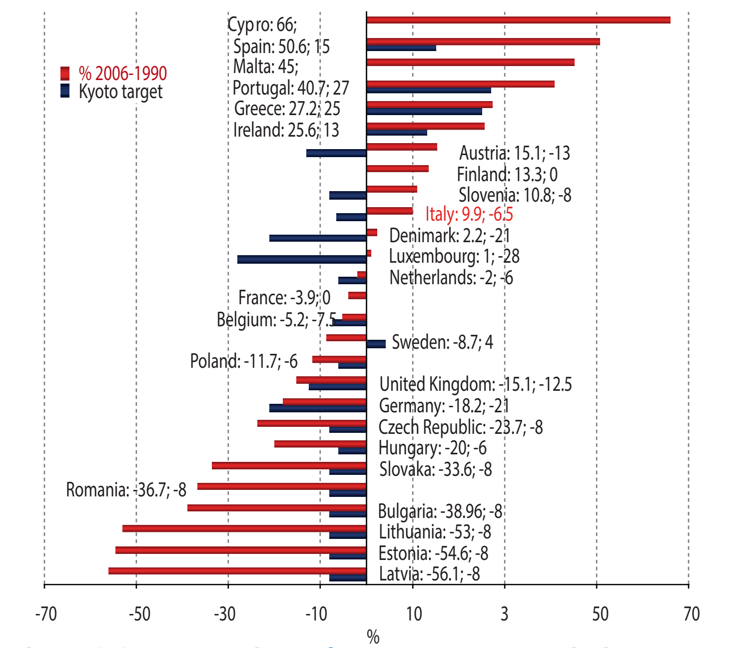


Figure 1.16: Comparison of greenhouse gas emissions levels in 2006 with the 1990 base-year and with the Kyoto target for the period 2008-2012 for EU Member States (EU27) [48]

The majority of the countries in the European Union (EU15), including Italy, is not in line with the Kyoto targets. Germany, Belgium and the Netherlands have met these objectives, while, in 2006, the United Kingdom, Sweden and France reduced emissions beyond the targets set for the period 2008-2012.

Developments in the energy sector were primarily influenced, during 2007 and 2008, by fuel prices in the international markets, and especially the oil market. The price of a barrel of WTI light crude oil traded on the New York Mercantile Exchange (NYMEX) went from $ 60 in January of 2007 to $ 50 in February of 2007, and then to $ 100 in January of 2008 and to $ 150 in July of 2008, only to fall back to $ 70 in the month of October 2008. These fluctuations in energy prices reduced the effects, during the period considered, of new regulatory developments, such as the liberalisation of energy markets and the introduction of new forms of incentives for the production of electricity from renewable sources.

In recent years the price of crude oil has been characterised by significant fluctuations.

[48] Source: UNFCCC data processed by ISPRA

The energy price level is one of the causes of ongoing changes in fuel-supply trends, with natural gas playing an increasingly important role compared to petroleum products, while the contribution of renewable sources and cogeneration grows, as has the consumption of solid fuels since 2001. The contribution of solid fuels to primary energy sources (including primary electric energy) rose from 8.57% in 2001 to 11.13% in 2007.

The energy sector is undergoing changes in terms of supplies, with growth in the consumption of natural gas, reduction of oil products, and a greater contribution from renewable sources and cogeneration, plus higher consumption of solid fuels since 2001.

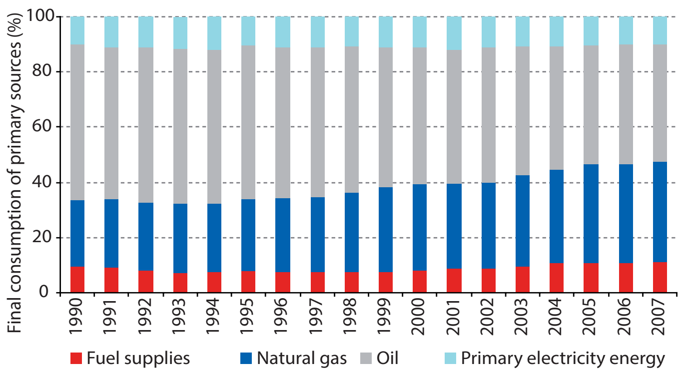


Figure 1.17: Total consumption of energy by primary sources[49]

Despite the modifications in the mix of primary energy sources, our country's energy dependence remains high, having risen from 82.8% in 1990 to 85.8% in 2007, for an increase of 3.6%. With the goal of limiting the vulnerability of our economic system, the current government is planning to revive the production of electricity from nuclear energy.

Starting from 1990, there was a constant upward trend in total energy consumption, with an increase of +19.9% in 2006. On the other hand, in 2007, there was a decrease of 3.3% compared to the previous year. The main sectors which exhibited strong growth since 1990 reduced their final consumption in 2007. The transport sector, the residential/ter tiary sector and the industrial sector showed respective decreases of 0.4%, 4.2% and 2.6% compared to 2006. The agricultural sector also consumed 3.6% less than

The primary sectors that showed strong growth in final consumption since 1990 registered decreases in 2007.

[49] Source: Ministry of Economic Development data processed by ENEA

the preceding year. As for the break-down by sectors of final energy consumption (excluding non-energy uses and bunkers), the transport sector absorbed 34.3%, followed by the residential and industrial sectors, at respective levels of 32.8% and 30.4%.
The decrease in total energy consumption during the last two years, together with the limited growth of the GDP, explains the significant reduction in energy intensity between 2005 and 2006 (-2.6%) and between 2006 and 2007 (-2.3%), following a series of decidedly high values (around 159 tep per millions of Euro) registered between 2003 and 2005. However, Italy remains one of the G20 countries with the lowest total energy intensity, measured with GDP corrected for purchasing power parity, rating below the worldwide average and that of the OECD.

Italy is one of the G20 countries with the lowest total energy intensity, when measured with GDP corrected for purchasing power parity, rating below the world average and the OECD average.

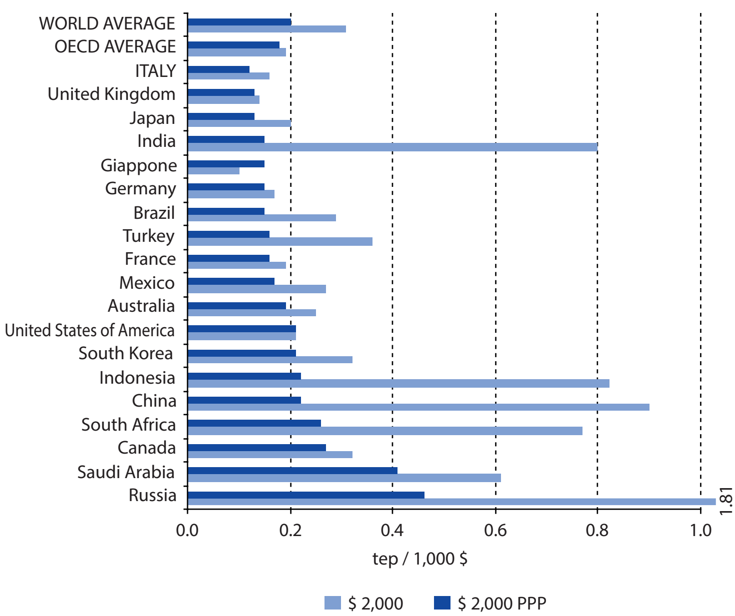


Figure 1.18: Total energy intensity of the G20 countries in 2006, with GDP measured in year-2000 dollars and corrected for purchasing power parity (PPP) [50]

[50] Source: International Energy Agency (IEA)

Between 1994 and 2006, the rate of growth for electricity production was considerably higher than that for total energy consumption. In 2007, electricity production showed a slight decrease, equal to 0.06%, compared to the previous year. This result points to the growing role of electricity as an energy vector in the national energy system.

Between 1994 and 2006 electricity production grew at a rate considerably higher than total energy consumption. In 2007 there was a slight decline, equal to 0.06%, compared to the previous year. This result points to the growing role of electricity as an energy vector in the national energy system.

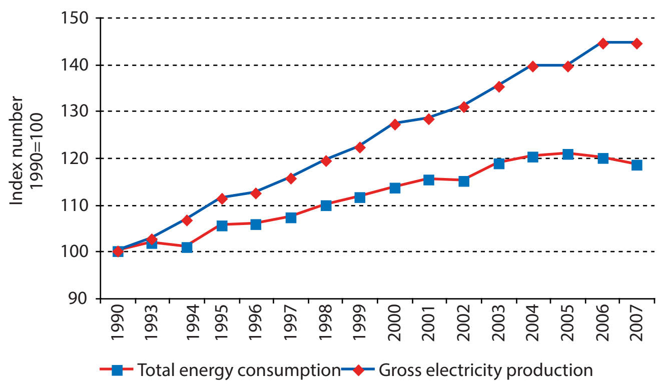


Figure 1.19: Total energy consumption and electricity production (1990 = 100)[51]

Final energy consumption varies considerably within the national territory. The figures for 2005 show that Lombardy accounts for 19.7% of national energy consumption, followed by Emilia Romagna at 10.8%, while Veneto and Piedmont account for respective levels of 9.3% and 9.2%. Other regions, such as Lazio, Apulia and Tuscany, account for an average value of 7.2%. Taken as a whole, these seven regions account for 70.6% of Italian energy consumption. Other regions accounting for significant portions of the total are Sicily (5.3%) and Campania (4.7%).

[51] Source: Ministry of Economic Development and TERNA data processed by ISPRA

Regional energy consumption reveals a highly varied structure with the national territory. Lombardy consumes 19.7% of the national total. Seven regions - Lombardy, Emilia Romagna, Piedmont, Veneto, Lazio, Apulia and Tuscany - when taken together, consume more than 70% of the Italian total.

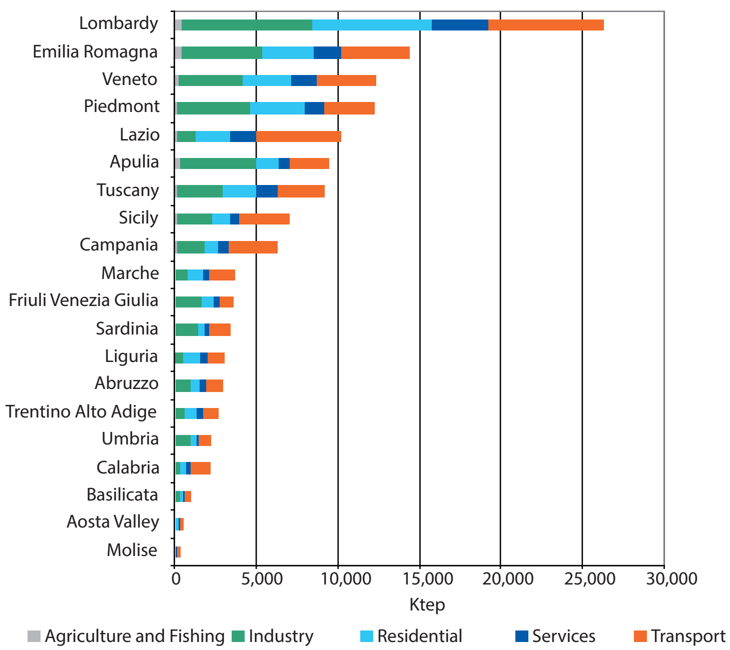


Figure 1.20: Final consumption of energy on the regional level by economic sector (2005) [52]

The transport system must address a sharp rise in the demand for mobility. During the period 1990-2007, the demand for passenger transport increased by 34%, while the demand for domestic freight transport for distances of more than 50 km grew by 27% over the same period.
Growth in passenger demand remained steady during the period 2000-2005, followed by fluctuations in 2006 and 2007.
The demand for passenger transport continued to be met primarily by roadway transportation, the least efficient mode from an economic and environmental perspective. In 2007, automobiles, motorcycles and scooters covered 81.5% of passenger transport demand.

[52] Source: ENEA data processed by ISPRA

Italy ranks second, after Luxembourg, in terms of the ratio of automobiles to resident population, but it is first when motorcycles, scooters and commercial vehicles are taken into consideration. Worldwide, only the USA has a higher rate of motorisation in terms of vehicles per inhabitant.

During the period 1990-2006, the demand for passenger transportation increased by almost 34%. Roadway transportation (automobiles, motorcycles and scooters) covered 81.5% of the demand for passenger transport (automobiles alone 73.8%) in 2007.

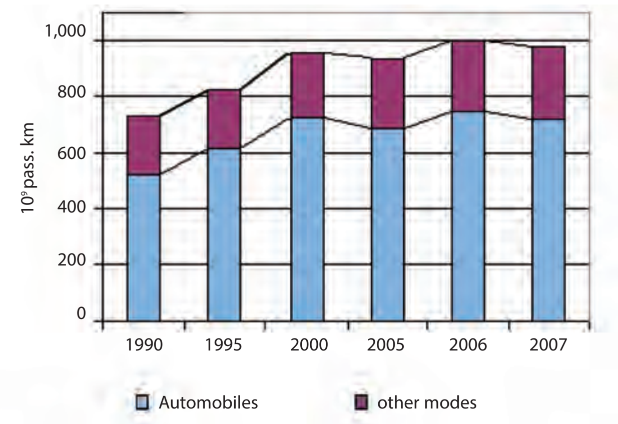


Figure 1.21: Demand for passenger transport[53]

The demand for passenger transport shows an upward trend from 1990 to the present, being closely tied to the dynamics of economic development and the process of European integration. Domestic transportation of freight by Italian carriers takes place primarily by truck (65% in 2007), with the rate having remained fairly constant since 1990.

Worthy of note, however, is a significant rise in roadway transport carried out by foreign carriers, estimated at approximately 20% of the total in 2006 and showing a constant growth trend since 1995, when the share of freight transport covered by foreign carriers was less than 4%. The national statistics do not measure this portion of roadway transportation, which is estimated by Eurostat.

[53] Source: CNT data processed by ISPRA

In 2007, domestic freight transport by sea and by railway accounted for respective percentages of 19.2% and 11%, while air transport represented a marginal 0.45% of total transport. The demand for domestic freight transport met by domestic carriers showed noteworthy growth during the period 2000-2005, following by a period of steady rates in 2006 and 2007. The sizeable rise in "other modes" after 2000 is due exclusively to increased transport of freight by sea, while the levels for railways and pipelines remained fairly stable. A portion of the increase is attributable to a revision in the estimation methodology used by ISTAT.

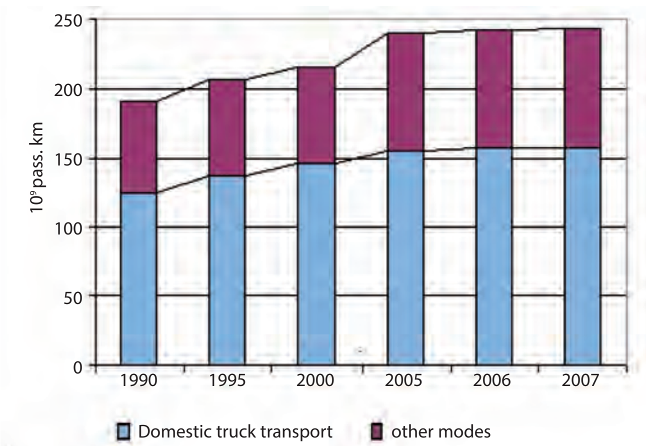


Figure 1.22: Demand for freight transport[54]

The demand for domestic freight transport by national carriers showed growth of 27% between 1990 and 2007.
Furthermore, estimates for 2007 show that freight transport within the national territory occurs primarily by roadway travel (65%) while other modes, such as the transport of freight by sea and by rail, account for respective shares of 19% and 11% of total transport.

Measures of response

The main climate change response measures involve mitigation (meaning a reduction in greenhouse gas emissions) and adaptation. Such measures can be complementary, interchangeable or independent. Recent assessments by the IPCC point to the fact that "With current climate change mitigation policies and related

The main measures of response to the climate change involve mitigation of (meaning a reduction in greenhouse gas emissions) and adaptation.

[54] Source: Past series recalculated by ISPRA under uniform criteria, using data from Ministry of Infrastructures and Transportation (National Accounting of Infrastructures and Transportation); the past series of freight transport is affected by variations in the data-collection methodology employed by ISTAT

sustainable development practices, global GHG emissions will continue to grow over the next few decades" [55]. Therefore, regardless of the mitigation measures implemented, adaptation measures will also be necessary, due to the inertia of the climatic system and the changes already in place. However it should be considered that, given the inertia of the climate system, the benefits of mitigation measures taken today will become effective over the middle term, but the future potential of such measures is higher than any adaptation measures that can be taken today[56].

Mitigation

The policy framework established by the European Council sets the following objectives for the EU by 2020:
- *20% reduction in greenhouse gas emissions compared to 1990;*
- *20% renewable sources accounting for total energy consumption;*
- *20% reduction in energy consumption compared to projections;*
- *bio-fuels accounting for 10% of transportation.*

In Europe, measures for reducing atmospheric emissions already undertaken in the energy sector, or to be undertaken, must fall within the policy framework recently set at the European Council of 8-9 March 2007, which established the following objectives for the European Union by 2020:
a) 20% reduction in greenhouse gas emissions compared to 1990 levels;
b) renewable sources accounting for 20% of total energy consumption;
c) 20% reduction in energy consumption, compared to projected levels;
d) bio-fuels accounting for 10% of energy consumption for transport.
In this way, in addition to countering climate change, three goals should be achieved:
1) the security of energy sources will be increased;
2) the competitiveness of the European economy will be ensured;
3) an economy with a low carbon content will be promoted.
The Conclusions of the Presidency of the European Council also include a commitment to limit the average increase in global temperature to a maximum of 2°C, as compared to pre-industrial levels.
On 18 December 2008, the European Commission reached, after intensive discussion among the Member States, an historic agreement on a package of proposals geared towards achieving the objectives set for 2020. The "Energy – Climate Change" package includes:
a) revision and extension of the European Emissions Trading

[55] IPCC (2007). *Climate Change 2007* – WG-III, Summary for policymakers.
[56] IPCC (2007). *Climate Change 2007* – WG-III, Technical summary.

System: the proposed directive stipulates that, as of 2020, the sectors subject to Directive 2003/87/EC have to reduce their greenhouse emissions by 21% compared to the levels of 2005;

b) establishment of a 10% reduction target, compared to 2005 levels, throughout the EU, for greenhouse gas emissions in sectors not regulated by Directive 2003/87/EC; this burden would be shared among Member States, and Italy's goal would be 13%;
c) introduction of burden-sharing among EU Member States for the renewable sources objective, with Italy being assigned an objective of 17%;
d) establishment of a legal framework for geological storage of carbon dioxide, in order to guarantee permanent containment of this gas and maximum reduction of health risks.

In Italy, cogeneration (Combined Heat and Power, CHP) is playing a growing role, which makes it possible to increase the conversion efficiency of energy from primary sources. Since 1997, the net electricity production through thermal cogeneration has followed a trend parallel to total electricity production from thermal power plants: between 1997 and 2007 the average annual increase was approximately 6,418 GWh/year for electricity produced through thermal cogeneration, while the overall average increase in total production from thermal power plants was 6,413 GWh/year. The figures for the production of electricity alone remained almost constant during the period considered. These figures show that, since 1997, the need for new electricity from thermal power plants has been completely met through cogeneration.

Of note within Italy is the growing role of cogeneration, which makes it possible to increase the efficiency of the conversion of the energy available from primary sources.

As regards the mix of primary sources, it should be noted that the growing role of natural gas used for electricity production in thermal power plants has a positive influence on greenhouse gas emission trends. This is due not only to the low emissions factor of natural gas, compared to other primary sources, but also to the greater efficiency of combined cycles fuelled by natural gas, as opposed to traditional steam cycles.

The growing role of natural gas used to produce electricity in thermal power plants has a positive influence on trends of greenhouse gas emissions.

During the period 1996-2007, the specific average consumption of natural gas for net electricity production decreased by 19.2%. Specific consumption of derived gases also showed a significant drop in 2007, for a decrease of 17.3% compared to 1996.

The average annual increase in the production of electricity between 1997 and 2007 was approximately 6,418 GWh/year for electricity produced through thermal cogeneration and 6,413 GWh/year for total production from thermal power plants, while the production of electricity alone remained almost constant during the period considered. These figures show that, since 1997, the need for new electricity from thermal power plants has been met entirely through cogeneration.

Under Directive 2006/32/EC, the general national objective for energy savings is 9% by 2016.

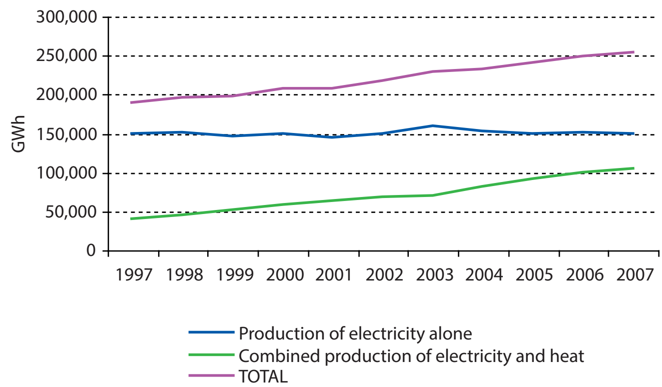


Figure 1.23: Net electricity production from thermal power plants[57]

Taking into consideration all the fuels used for electricity production, specific average consumption fell by 11.6% (-1.0% between 2006 and 2007). Specific average consumption of all fuels for electricity production was influenced by the use of petroleum products and solid fuel, which are less efficient than gaseous fuels. In fact, during the period considered, average specific consumption of petroleum products and solid fuel rose by 12.5% and 8.6% respectively.

Directive 2006/32/EC sets objectives for Member States regarding the efficiency of energy end-uses and energy services. the general national target for energy savings is 9% within the ninth year of the application of the directive (2016). Under the provisions of art. 4, the Member States must enact effective measures to achieve this objective. The Action Plan for Energy Efficiency, presented by Italy in July 2007, in fulfilment of art. 14 of the Directive, identifies a series of measures that will make possible energy savings of 9.6% in 2016, as compared to average energy consumption between 2001 and 2005.

[57] Source: TERNA data processed by ISPRA

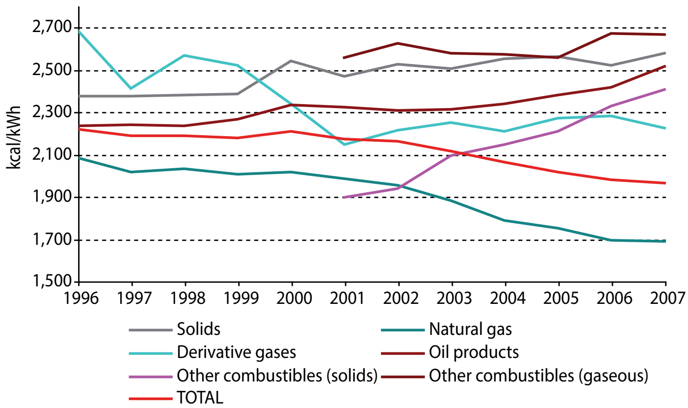


Figure 1.24: Average specific fuel consumption in the net production of electricity from fossil sources[58]

During the period 1996-2007 there was a decrease of 19.2% in the average specific consumption of natural gas and a decrease of 17.3% in consumption of derived gases. In terms of electricity production, average specific consumption fell by 11.6%, while petroleum products and solid fuel rose by 12.5% and 8.6% respectively.

In this framework a key role is played by the system of white certificates, contemplated under art. 6 of Directive 2006/32/EC, which Italy was the second country to implement, right after the United Kingdom, doing so through the Ministerial Decrees of 20 July 2004. The objective of the decrees is to achieve, by the end of the first five years of application (2005-2009), energy savings of 2.9 Mtep a year through the introduction of fixed amounts of energy savings to be achieved by electricity and natural gas distributors.

In 2007, the installed capacity of renewable energy sources increased by approximately 1,000 MW in 2007, for a growth rate of 4.7% on an annual basis. In 2007 the electricity produced from renewable sources was approximately 49.4 TWh, while total electricity production was 313.9 TWh, meaning that electricity from renewable sources accounts for 15.7% of total electricity production. The overall production trend was influenced by fluctuations in the share of hydroelectric energy as a result of meteorological conditions, as well as by the growing contribution of non-traditional sources (wind power, geothermal energy, biomasses and waste). In recent years (1997-2007) there have been noticeable increases in the produc-

The objective of the Ministerial Decrees of 20 July 2004 is to achieve energy savings of 2.9 Mtep a year by the end of the first five years of application (2005-2009).

[58] Source: TERNA data processed by ISPRA

tion of electricity from wind power (from 117.8 to 4,034.4 GWh during the period 1997-2007) and energy from biomasses/waste (from 820.3 to 6,953.6 GWh), as well as, though to a lesser degree, geothermal energy (from 3,905.2 to 5,569.1 GWh). The contribution of photovoltaic energy remains negligible (39.0 GWh in 2007, this figure does not yet include the electricity produced from photovoltaic roofs, which is not considered in the electricity sector statistics, though 18 GWh was produced in this way in 2007). Despite the increased use of renewable sources in recent years, the levels of electricity produced from such sources are not sufficient for reaching the objective of approximately 75 TWh by 2010, as called for under Directive 2001/77/EC.

A regional analysis points to noteworthy differences in the energy sources used. Hydroelectric power, produced primarily in the regions of the Alpine arc, accounts for 66.4% of the electricity produced by renewable sources. The geothermal electricity production, found only in Tuscany, represents 11.3% of the electricity produced from renewable sources. Biomasses account for 14.1%

Regionally, noteworthy differences can be observed in the renewable energy sources utilised. Hydroelectric energy, concentrated in the regions of the Alpine arc, accounts for almost 66.4% of the electricity produced from renewable sources.

Electricity production from renewable sources accounts for 15.7% of total electricity production. Between '97 and 2007 there was a noticeable increase in the production of electricity from wind power (from 117.8 to 4,034.4 GWh) and from biomasses/waste (from 820.3 to 6,953.6 GWh), as well as, though to a lesser extent, from geothermal power (from 3,905.2 to 5,569.1 GWh). Despite the increases recorded in the production of electricity from these sources in recent years, the levels are not sufficient to reach the goal of approximately 75 TWh by 2010 set under Directive 2001/77/EC.

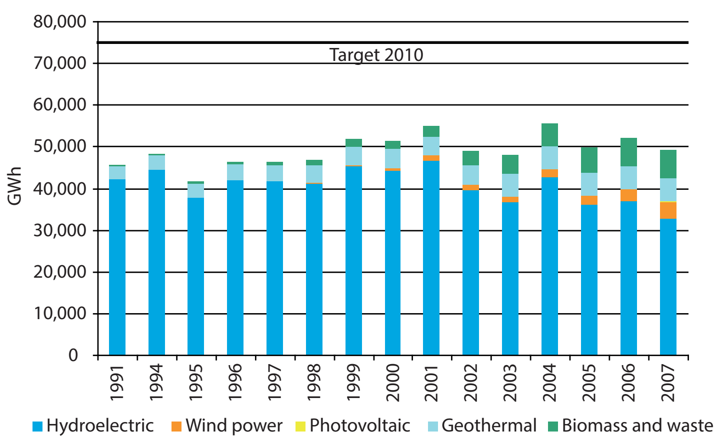


Figure 1.25: Gross electricity production from renewable energy sources[59]

[59] Source: TERNA data processed by ISPRA

of the total, while wind and photovoltaic power registered a share of 8.3% of the electricity produced from renewable sources, though almost all of this last type of production takes place in the southern regions and on the major islands (97.5%). The increase of approximately 1,000 MW in installed power registered between 2006 and 2007 was due primarily to the development of wind power in the South (more than 800 MW of the total increase, followed by biomasses and solar power, with 81 and 79 MW respectively).

As concerns the transport sector, there was a constant increase in fuel consumption between 1990 and 2004 (+27.0% compared to 1990), while levels have essentially remained constant during the last two years. The percentage of fuels with low environmental impact (natural gas, LPG, bio-diesel) out of total fuels shows irreg-

In the transport sector, the effects of technological advances are offset by rising demand, especially for roadway transport.

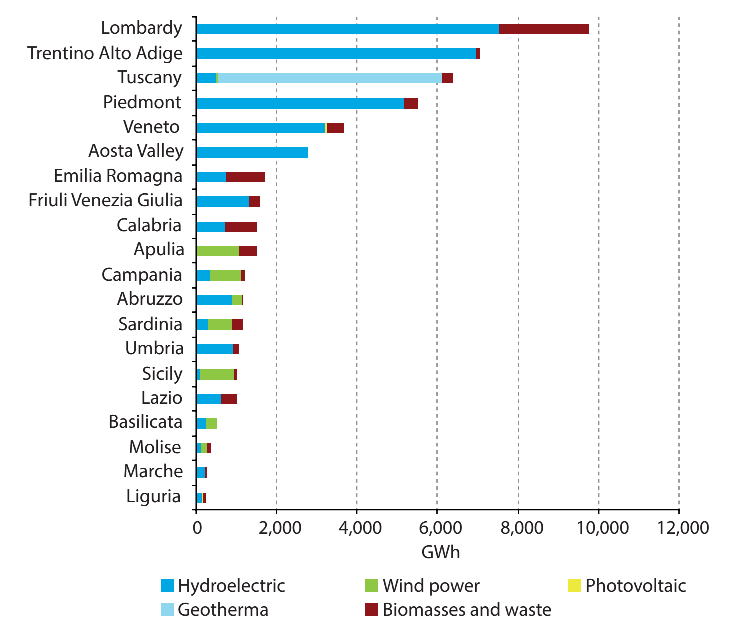


Figure 1.26: Regional analysis of gross electricity production from renewable energy sources (2007) [60]

Regionally, noteworthy differences can be observed in the renewable energy sources used. The primary renewable source used to produce electricity is hydroelectric power, concentrated in the Alpine arc, while production from wind and photovoltaic power takes place in the southern regions and the main islands (97.5%).

[60] Source: TERNA data processed by ISPRA

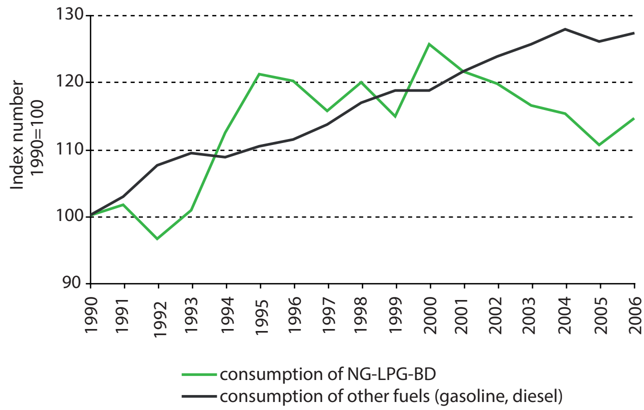
ular results, going from 5.6% in 1990 to 5.0% in 2006, with a peak value of 6.1% in 1995.
Variations in the percentages of the fuels consumed show that, while the classic fuels (gasoline, diesel fuel etc.) have increased constantly, levels of natural gas, LPG and bio-diesel have fluctuated. Compared to 1990, the quantities of lower-impact fuels consumed in 2006 was 14.3% higher.
Based on the available data, it is clear that the limited progress made in the transport sector through the implementation of technological measures involving engine efficiency are offset - to a greater extent in Italy than in the other European countries - by the growth in the demand for transportation, especially with roadway mode, meaning that the environmental impact of the transport sector continues to grow. As for the quality of the fuels used, it can be observed that the quantity of low-impact fuels, in addition to being of marginal importance, is often highly irregular, as demonstrated by the fact that, between 2000 and 2005 there was a constant decrease in the share of total fuels represented by low-impact fuels, followed by a slight increase between 2005 and 2006; these results are due primarily to a drop in sales of LPG, as well as an offsetting increase in the consumption of natural gas, starting from 2005.

Between 1990 and 2006, the stock of carbon in Italy's forests grew by 58%, due primarily to an expansion in forest surface area.

In contrast to the increase in greenhouse gas emissions resulting from various production activities and deforestation, a noteworthy quantity of carbon dioxide has been removed from the atmosphere by the LULUCF (Land Use, Land Use Change and Forestry) sector, worldwide about 0.2 billion tons of carbon during the period 1980-1989 and 0.7 billion tons of carbon has been removed from atmosphere during the period 1989-1998[61]. In Italy, the LULUCF sector, which encompasses the different existing uses of the land, such as forests, cultivated land, grassland, urban settlements and wetlands, accounts for the capture of 21.6 million tons of carbon in 1990 and 30.6 million tons of carbon in 2006.

[61] IPCC (2000). *Land-use, Land-use change and forestry*, IPCC Special Report.

The use of low-impact fuels is subject to noteworthy irregularities: between 2000 and 2005 there was a constant decrease in their share of total fuel consumption.



Legend: NG, natural gas; LPG, liquefied petroleum gas; BD, biodiesel

Figure 1.27: Consumption of fuels for transport (1990=100) [62]

Adaptation Plans in Europe and throughout the world

The United Nations has used the term adaptation with reference to a strategy geared towards minimising the negative consequences of climate change and preventing damage by limiting the vulnerability of the environmental and socioeconomic systems to climate change.

Adaptation is not an alternative to mitigation, which focuses on the causes of climate change in order to reduce emissions of greenhouse gases generated by human activities, but rather a complementary approach: the greater the commitment to mitigation, the smaller the effort in terms of adaptation, and vice versa.

Under the Framework Convention on Climate Change, the National Adaptation Programmes of Action, or NAPA, provide the LDCs (Least Developed Countries) with a procedure for identifying priority activities able to meet their urgent, immediate needs in terms of adaptation to climate change.

Adaptation and mitigation are complementary approaches: the greater the commitment to mitigation, the less the need for adaptation, and vice versa.

[62] Source: Ministry of Economic Development data processed by ISPRA

Many European countries have undertaken initiatives designed to promote adaptation to climate change, drawing up policies, strategies, plans and programs.

The rationale for the NAPAs is the limited ability of the LDCs to adapt to the negative effects of climate change. Their action is not based on long-term national policies, but on strategies implemented at the local level, in order to identify the priority initiatives.
Article 4.9 of the United Nations Convention acknowledges the specific needs and special situations of the LDCs, stipulating that the Parties are required to take into consideration, in the course of their initiatives, the needs and circumstances of the less developed countries in terms of financing and the transfer of technology.
It should be noted that the level of implementation of the NAPAs relies on the aid that they will receive from the developed countries, in the form of financial resources and transfer of technology, taking into account the fact that socioeconomic development and the eradication of poverty are the first and most important priorities of the LDCs[63].
Adaptation is a relatively new topic on the political agenda of the European Union, though many countries have already launched initiatives with the aim to promote adaptation to climate change, drawing up policies, strategies and plans or sectorial programs, in order to ensure future sustainable development for their regions and avoid paying a very high price in terms of environmental damage, loss of human lives and economic costs.
One of the first initiatives of that kind in Europe was undertaken by Finland, which adopted in 2005 a “National Adaptation Strategy”, with the objective of reinforcing and expanding the country’s capacity to adapt to the impacts of climate change.
In the same year, the United Kingdom drew up an “Adaptation Policy Framework”, a consultation procedure to collect information on adaptation activities and to supply a national reference framework that can be used for planning of future actions. The United Kingdom, where a legislative proposal (Climate Change Bill) was presented to Parliament in November of 2007 and converted into law in November of 2008, can be considered one of the first countries in the world to possess a binding, long-term framework for addressing the topics of mitigation and adaptation.

[63] http://unfccc.int/adaptation/items/4159.php

At present, the English Government has drawn up an “Adapting to Climate Change Programme”, in order to arrive at a final draft of the “National Adaptation Programme” no later than 2012.
In 2006, other countries promoted national initiatives as well. France has drawn up a “National Strategy for Adaptation to Climate Change”, which represents an intermediate step between the scientific diagnosis and the implementation of a plan of action containing precise measures to be enacted at different decision-making levels.
Spain is the only European country which has approved a full-fledged “National Adaptation Plan” designed to make adaptation to climate change an integral part of the planning strategy for the socioeconomic sectors and ecological systems.
Other countries, such as Portugal and the Netherlands, have drawn up plans pertaining more closely to specific sectors, focussing attention, respectively, on water resources and spatial planning.
Recently, Denmark also drew up its “National Adaptation Strategy”, in addition to promoting research efforts in this area and establishing a special website providing information on climate change.
Countries such as Germany, Ireland, Norway and Belgium have undertaken a process that will allow them to draw up their strategies between the end of 2008 and 2012[64].

The National Conference on Climate Change organised by Italy in 2007 was a major opportunity for analysis and comparison not only of technical-scientific considerations, but also of social-economic repercussions, marking the start of a process that will allow our country to draw up a national adaptation strategy.

Cooperation between the European Union and the other industrialised countries is necessary, in order to address shared problems by exchanging information and best practices regarding adaptation.

The situations of countries outside the European Union vary greatly and need to be taken into consideration, as stated in the recommendations issued by the European Commission and found in the Green Paper on adaptation, according to which an exchange of know-how and successful practices must be established not only between countries of the European Union, but also with the other industrialised coun-

[64] EEA, 2008. *Impacts of Europe’s changing climate – 2008 indicator-based assessment*. EEA Report no. 4/2008.

tries subject to the impacts of climate change[65].
The first step taken by the Canadian Government to address the topic of adaptation was the creation, in 2001, of the "Climate Change Impacts and Adaptation Programme", designed to promote basic knowledge of impacts and adaptation, in addition to developing skills and know-how in this field. Between 2001 and 2006 the Programme financed 130 research projects on vulnerability, impacts and adaptation in Canada. The "National Climate Change Adaptation Framework" was presented in 2005, providing the groundwork for joint efforts involving different organisational jurisdictions, in order to develop capabilities and tools suitable for drawing up detailed adaptation plans and implementing activities.
The "Climate Change Science Programme" is one of the main components of the climate program of the United States, consisting of an effort to increase scientific understanding of the climate and its potential impacts. As of 2008, it has produced twenty-one summary and assessments reports (some of them not yet complete) focussing on a variety of issues, not only scientific, in order to lay out the guidelines for public debate and policy decisions.
In 2004 the Australian Government initiated its "National Climate Change Adaptation Programme", a four-year program meant to be the starting point for dealing with the inevitable impacts of climate change. The "National Climate Change Adaptation Framework" was drawn up in 2007, illustrating the future agenda for cooperation between different regional Australian governments. A key point is to provide decision-makers with support in integrating climate change into policy decisions and practical initiatives at all levels and in all sectors. The Framework will guide the activities of the different organisational jurisdictions for the next 5-7 years.
In Japan, a committee was established in October of 2007 to study the impacts of climate change and adaptation. For eight months it organised a series of reviews of existing knowledge on the impacts of climate change in Japan. The conclusions of this review phase, published in June of 2008, point out the need to achieve adaptation that proves truly effective and efficient while drawing up a plan of adaptation at the national level.

[65] http://ec.europa.eu/environment/climat/adaptation/index_en.htm

CHAPTER 2

BIODIVERSITY AND NATURAL, AGRICULTURAL AND FOREST AREAS

Biodiversity is the wealth of life on the earth and a source of goods, resources and services indispensable to the survival of man.

Introduction

Biodiversity can be defined as the wealth of life on the earth: the millions of plants, animals and micro-organisms, the genes that they contain and the complex ecosystems of which they are the component parts in the biosphere. The Convention on Biological Diversity (CBD), whose guidelines were set during the world summit held in Rio de Janeiro in 1992, defines biodiversity as the variety and variability of living organisms and of the ecological systems in which they live, stressing that the diversity in question involves genes, individual subjects and ecosystems as a whole. Biodiversity is a source of goods, resources and services (ecosystems services) that are indispensable to the survival of man. The priority objectives of the CBD are the preservation of biodiversity and the sustainable and durable use of its components, in addition to a fair and equitable distribution of the benefits it provides.

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

The state of the natural and semi-natural environments

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 plant species currently found in European territory, together with a third of the animal species.

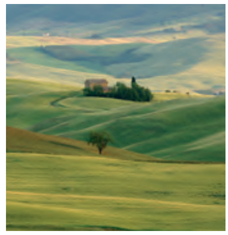
There are more than 57,000 animal species in Italy.
Italy ranks third in Europe in terms of the number of endemic vertebrate species.

According to 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 6,700 species of higher plants in Italy, and 15.6% of the flora consists of

According to the most recent publications[1], Italy's vascular flora includes 6,711 species, divided into 196 families and 1,267

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



genera, and with a contingent of endemic species that account for 15.6% of the total flora. The greatest 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), Veneto (3,111), Friuli Venezia Giulia (3,094), Lazio (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).

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 data 2006 processed by ISPRA) 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 and reforestation 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 2.1).

The national forest area 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 during 2007, with more than 10,600 events affecting over 227,000 hectares, of which approximately 117,000 hectares are part of the forest area in a strict sense (CFS, 2007).

In 2007 a resurgence of forest fires was recorded.

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

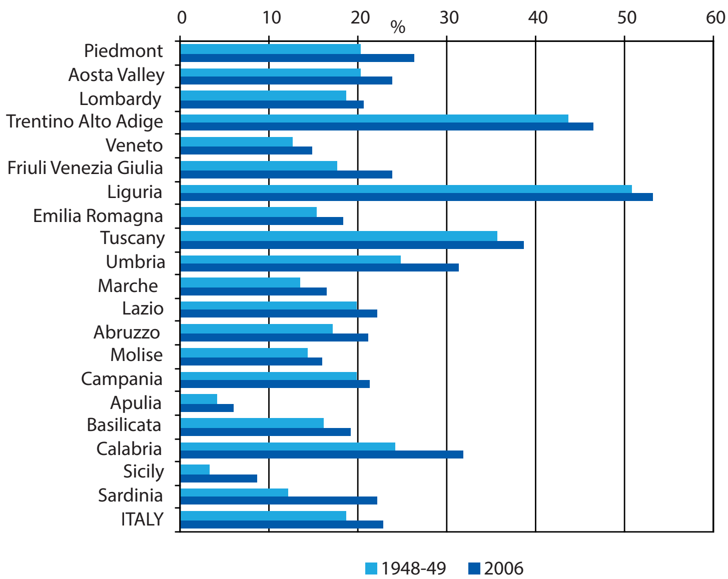


Figure 2.1: Regional forest area index[2]

In cities with more than 150,000 inhabitants, public urban green areas rise by an average of 2.1% between 2000 and 2006.

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, in light of the increasing expansion of urban areas. 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. But despite the importance of urban green areas, there is still a shortage of data, both on account of a lack of shared databanks and due to the failure to arrive at a universally accepted definition of “urban green areas”. In 24 cities that are provincial seats, and that have populations of more than 150,000 inhabitants, the quantity of urban greenery managed (directly or indirectly) by government entities (municipalities,

[2] Source: ISTAT data processed by ISPRA

provinces, regions, the central government) showed a positive trend between 2000 and 2006, 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 percentage points was observed in the quantity of greenery as a ratio of the municipal surface area, with the highest increases in the cities of Naples, Cagliari and Turin. Per capita availability also rose, by an average of 6.9 m^2/inhabitant, especially in the cities of Naples, Foggia and Turin.

The percentage of Vertebrate species at risk fluctuates, depending on the author 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 2.2). 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

[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.

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.

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.

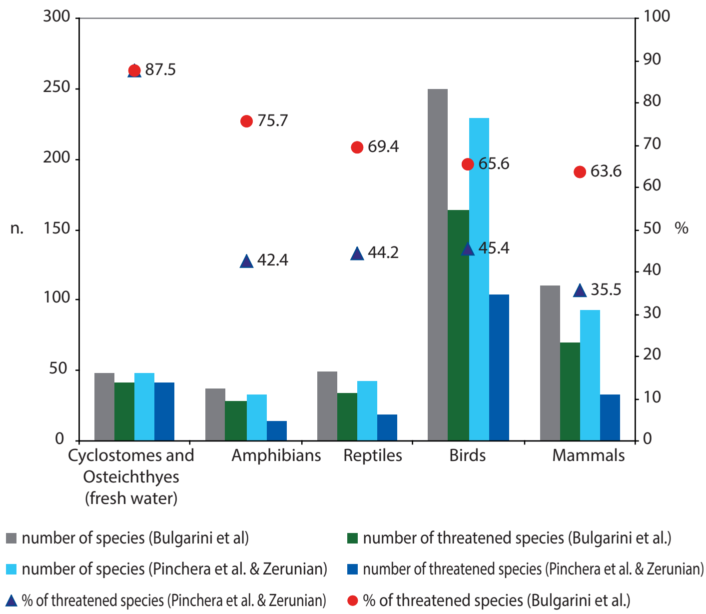


Figure 2.2: Vertebrate species found in Italy and placed on Red Lists[5]

The statistics on the threat faced by plant species in Italy are also taken from Red Lists published by specialists. In 1992 the

[5] Source: ISPRA processing 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

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 revised 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 2.3).

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

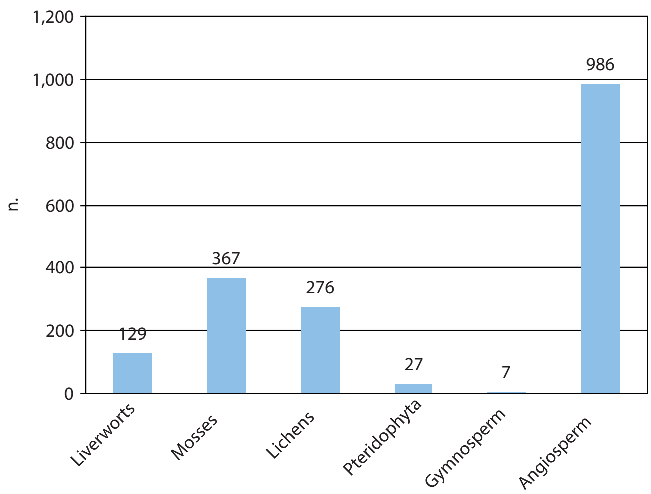


Figure 2.3: Threatened plant species in Italy, distributed by system groups[9]

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 plants at risk include 772 species of Hepaticae, Mosses and Lichens, plus 1,020 vascular plants.

[6] *Libro Rosso delle Piante d'Italia*, Conti *et al.*, 1992.
[7] Conti *et al.*, 1997.
[8] Scoppola and Spampinato, 2005.
[9] Source: 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, Nature Protection Department, Italian Botanical Society, University of the Tuscia, University of Rome, "La Sapienza" Campus

Current knowledge of Italian plants at risk is far from complete, and so the state of preservation of the *taxa* of Italian flora should be evaluated according to the most recent IUCN criteria, in order to draw up a New Red List for Italy. To this end, the Italian Botanical Society undertook the "Italian Initiative for the Implementation of the IUCN Categories and Criteria (2001) for Formulation of new Red Lists" in 2006. The experts involved in this initiative recently published the initial results of application of the IUCN criteria to 40 target species of Italian flora[10].
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 Directive" (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, over 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[11]. 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[12]. 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 not complete, meaning that the regulatory instrument for evaluating and preserving the biodiversity of this environment is rendered insufficient.

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

In addition to natural environments, agricultural areas also play an important role. Not only do they support the production of food and fibres, but they are closely tied to the environment, giving rise to

[10] *Informatore Botanico Italiano, vol 40, suppl. 1, 2008.*
[11] *Reference list of habitat type,* EU Commission and EEA, 2001.
[12] *Libro rosso degli Habitat d'Italia*, WWF, 2005.

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.

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 recent decades, 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 2007, 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 7.6 hectares in 2007, making for an increase of 25.1%.

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 on 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.

Between 1990 and 2007 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, also through processes of soil deterioration.

The main causes of threats to biodiversity

The primary threats to biodiversity are human activities and the growing demand for natural resources and ecosystem services.

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[13]: 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 synanthropic.

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

With respect to Vertebrate animal species, Figure 2.4 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.[14]

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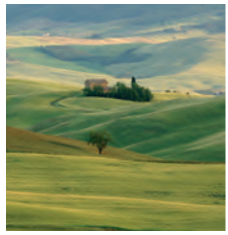
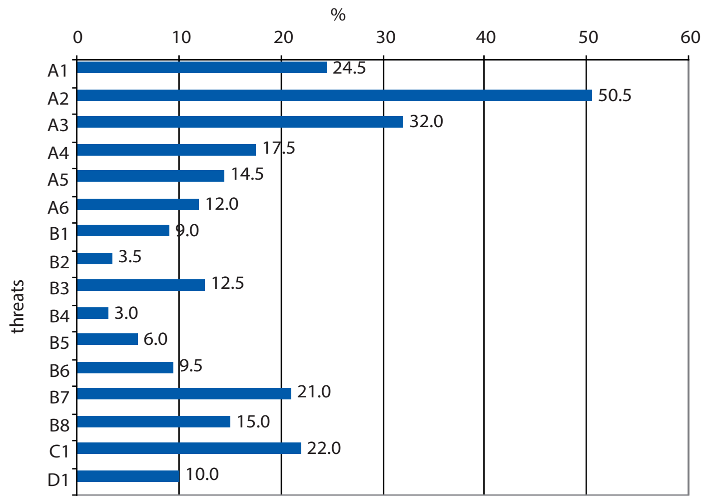
[13] *Conservazione della natura*, Primack and Carotenuto, 2007.
[14] *Libro rosso degli Animali d'Italia*, Bulgarini *et al.*, 1998; *Application to the Terrestrial Vertebrates of Italy of a System Proposed by the IUCN for a New Classification of National Red List Categories*, Pinchera *et al.*, 1997; *Condannati all'estinzione? Biodiversità, biologia, minacce e strategie di conservazione dei Pesci d'acqua dolce indigeni in Italia*, Zerunian, 2002.



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.



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 collection
B4 Vandalism
B5 Genetic pollution
B6 Excessive fishing
B7 Poaching and illegal fishing
B8 Competition or 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 2.4: Incidence of the risk factors for Vertebrates out of the total species threatened[15]

[15] Source: ISPRA processing 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 the IUCN for a New Classification of National Red List Categories*. Biodiversity and Conservation 6, 959-978

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 pressure differs from one region to the next.

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, 2006 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 Umbria and Tuscany, the level is definitely higher than in others. The greatest levels of pressure are to be found both in large-size regions (Tuscany, Lazio, Lombardy, Campania) and in those of limited extension (Umbria, Liguria and Marche). 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 2006, due to a drop of 4.5 percent in the number of hunters on the national level. This outcome was the combined result of a widespread reduction on the regional level (no fewer than fifteen regions out of twenty registered a decrease in the number of hunters), combined with increases in the five remaining regions, and at times by considerable amounts, as in the cases of Calabria (+28.2%) and Trentino Alto Adige (+22.3%).

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.

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. The year 2007 registered a continuation of the trend begun in 2000, with the size of the fishing fleet falling in terms of both ships and overall engine power, while, in contrast, the figure for the total tonnage of the national fleet reversed its downward curve during the last year, growing by 20% over the figure for 2006 (MIPAAF-IREPA, 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, 2007). Naturally, the situation varies throughout the national territory: in 2007 more than 50% of the vessels of the national fishing fleet were registered in Sicily, Apulia, Sardinia and Campania, while the highest figures for average days of fishing were recorded in Lazio, Marche, Campania and Apulia. The most frequently used

fishing systems are bottom and mid-water trawling, together with 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. Even though the vessels are generally small in size, and fishing activities have been successfully limited in recent years, more than 50% of the vessels operate exclusively along the coast (MIPAAF, 2008), subjecting this zone, in which a large part of the resources of the entire marine system are located, to greater pressure.

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 2006, a number of non-wood forest products, with the noteworthy excerption of mushrooms, showed a decrease compared to 2000 (ISTAT, 2007), 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.),

The introduction of potentially invasive alien species constitutes another threat to biodiversity. Italy ranks fourth in Europe for the number of alien species reported.

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 ballast water in ships, fouling etc.). Preliminary results from the DAISIE Project[16] indicate that there are 2,071 alien species in Italy, 302 of which are found in Sardinia alone, while there are 253 in Sicily. Within this group, marine species number 120, fresh water species 97 and terrestrial species 902. Italy ranks fourth among the European countries for the number of the alien species reported.

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 class.

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 class. Of the phytophagous 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[17]. 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 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 allochthonous, with some being cultivated in lagoon environments on account of their excellent commercial value (the Philippine clam, or *Tapes philippinarum*).

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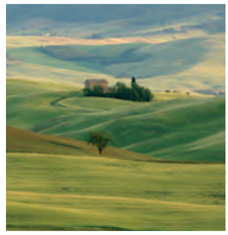
[16] www.europe-aliens.org

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



As far as flora are concerned, the increasingly massive entry of exotic plant species from distant countries, often due to human activities, is causing “floristic pollution”. A recent census in Italy recorded 782 naturalised exotic species[18] that manage to survive and successfully reproduce, to the point where they currently account for 10.4% of our flora (Figure 2.5). 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[19]. At the same time, however, the Mediterranean plant communities have shown themselves to be more resistant to invasions of alien 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 plant 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 alien 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.

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

In Italy the naturalised exotic plant 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.

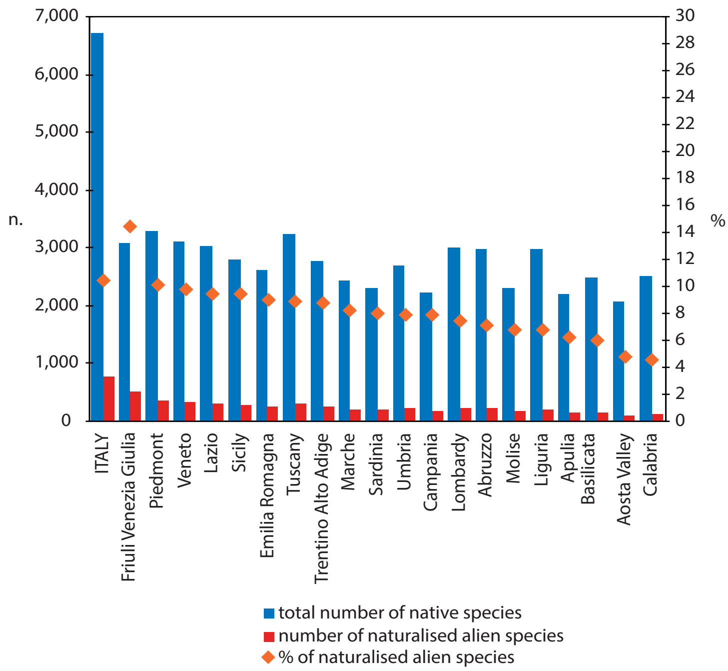


Figure 2.5: Autochthonous and naturalised allochthonous vascular plants (2005) [20]

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

[20] Source: ISPRA processing of data taken from Conti, Abbate, Alessandrini, Blasi, 2005 - *An Annotated Checklist of the Italian Vascular Flora*. Ministry of the Environment, Department of Nature Protection; Department of Vegetable Biology, University of Rome, "La Sapienza" Campus

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.

Construction and 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 and flora.

Construction and infrastructure 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 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 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 1998-2007 (Figure 2.6), registering growth of 22.1% (ISTAT, 2007). The national figure for the year 2007 exceeded 5.4 million tons, 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 1998-2007, there was an increase of 22.1% in the quantity of fertilisers placed on the market.

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 1998-2007, with an increase of 22.1%.

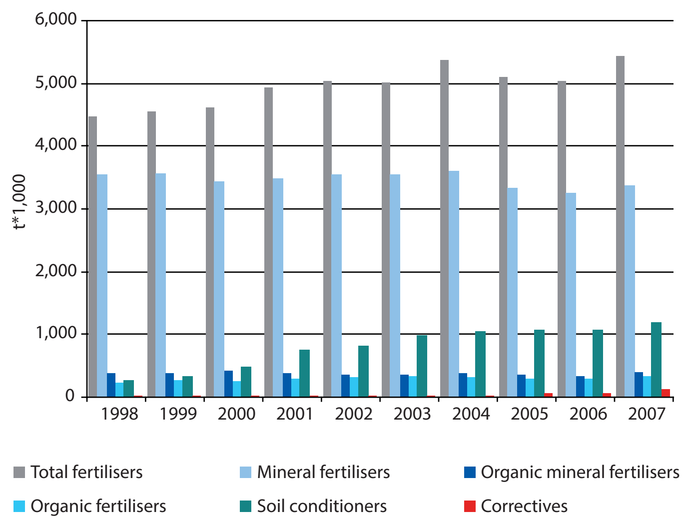
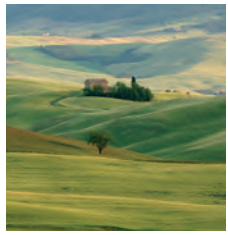


Figure 2.6: Fertilisers distributed by type[21] (1998-2007)[22]

The quantities of plant care products placed on the market during the period 1997-2006 shrank by 10.8%.

As far as plant care products are concerned, the quantities placed on the market in the period 1997-2006 shrank by 10.8% (Figure 2.7). In 2006 more than 149,000 tons were sold (for an increase of approximately 7,000 tons over 2005), with 78.8% of the total consisting of "unclassifiable" products, and the remaining 21.2% 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 2005, there was a worrisome increase in the level of very toxic and toxic products (over 1,100 tons more) and an increase in harmful products (approximately 1,300 tons). For the first time since 1999 the quantity of biological products used as alternatives to products made through chemical synthesis fell from 425 tons in 2005 to 344 tons.

[21] Since 2006 these categories of fertilisers have also been recorded: a) crop substrates; b) products exercising specific action. They are not shown in figure 2.6, however, because of the small quantities involved.
[22] Source: ISTAT



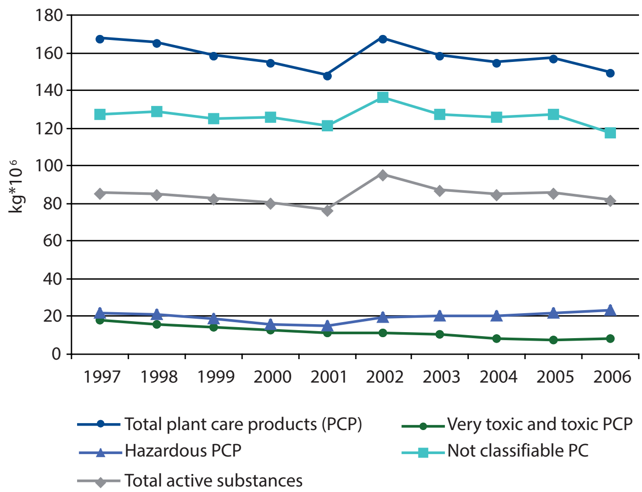


Figure 2.7: Total active substances, total plant care products and products divided by type distributed in the period 1997-2006[23]

The main environmental impacts traceable to agriculture are tied to the use of plant care products. In the period 1997-2006, the distribution of plant care products registered a decrease of 10.8%. In 2006 more than 149,000 tons were sold, for a decrease of approximately 7,500 tons compared to 2005, though quantity of the most hazardous products (very toxic, toxic and harmful) rose by more than 2,400 tons.

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 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[24].

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

[23] Source: ISTAT

[24] *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.*

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

The main initiatives for protection

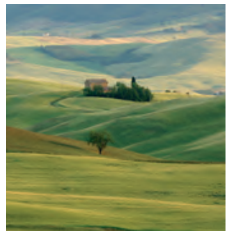
As already noted, the preservation of biodiversity often conflicts with the needs of man. Efforts to reconcile its defence as best as possible with the demands of society frequently result in agreements and legislative instruments, key elements that prove indispensable when it comes to combining the 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 Diversity[25], signed in Rio de Janeiro on 5 June 1992 during the United Nations World Summit on the Environment and Development[26]. 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.

In Italy, the Nature Network 2000 currently consists of 594 SPAs, with a surface area of 4,374,568 hectares, equal to 14.5% of the national territory, plus 2,284 SCIs, with a surface area of 4,511,322 hectares, equal to 15% of the national territory.

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, Italy's Nature Network 2000 consists of 594 SPAs, with a surface area of 4,374,568 hectares, equal to 14.5% of the national territory, and of 2,284 SCIs, with a surface area of

[25] Convention on Biological Diversity - CBD.

[26] United Nations Conference on Environment and Development - UNCED.



4,511,322 hectares, equal to 15% of the national territory (*Database of the Nature Network 2000*, Ministry of the Environment, Land and Sea, 2008). 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, while the overall surface area of these habitats accounts for 71.3% 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 64% of the cases (Ministry of the Environment, Land and Sea data 2008 processed by ISPRA) (Figure 2.8).

At present Italy contains 2,284 Sites of Community Importance (SCIs), with a surface area equal to 15% of the national territory. The state of preservation, 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 64% of the cases.

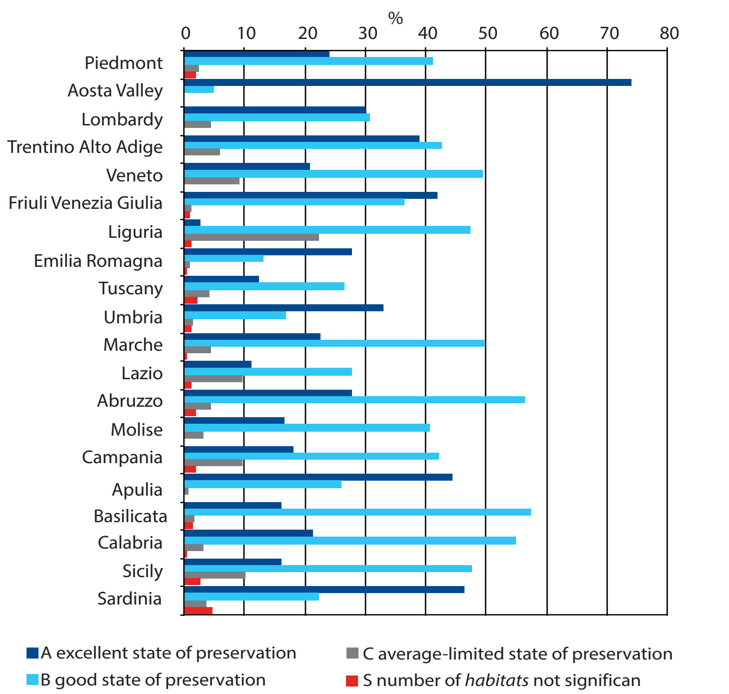


Figure 2.8: Percentage of the surface area of the habitats found in SCIs, with respect to their total surface area, based on the state of preservation (updated to 8 July 2008)[27]

[27] Source: Ministry of the Environment, Land and Sea data processed by ISPRA

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.

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 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[28]. Furthermore, thanks to Italy's endorsement of the Ramsar (Iran) Convention of 1971 on wetlands of international importance, 51 sites of major ecological importance, covering a total surface area of approximately 58,800 hectares, are protected.

Figure 2.9 shows the regional distribution of the protected areas, according to the provisions of the legislative instruments illustrated earlier.

In Italy, a number of "Action Plans" for threatened species of fauna have been drawn up, together with "Guidelines" for limiting species that damage native fauna and natural habitats.

In compliance with the international conventions on the protection of biodiversity, as well as the European Community Directives on birds and habitats, plus national laws on protected areas and the preservation of fauna, a number of different "Action Plans" have been implemented for threatened species of fauna, while "Guidelines" have been drawn up to limit species that damage native fauna and natural habitats. The Action Plans and Guidelines were drafted by the former National Institute for Wild Fauna (currently the ISPRA), on assignment from the Ministry of the Environment, Land and Sea (Nature Protection Department). Leading experts on each species, recommended by the main research institutes, the Italian Zoological Union and non-governmental associations, took part in the project as well.

As regards fishing, it should be noted that the reform of the CFP,

[28] V EUAP, Ministry of the Environment, Land and Sea, 2003.

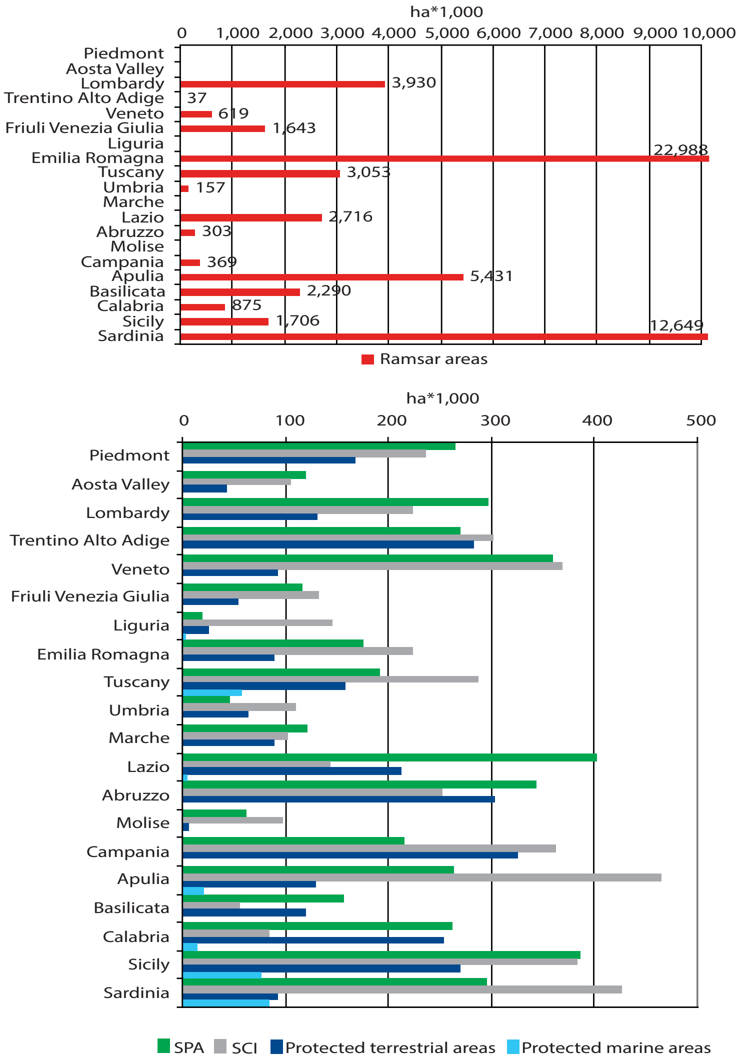


Figure 2.9: Regional distribution of protected areas[29] (Marine Mammals Sanctuary not included)[30]

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, 51 Ramsar sites are protected.

[29] Source: for protected land and sea areas: the Ministry of the Environment, Land and Sea, see the Official List of Protected Nature Areas 2003; for the Ramsar Areas: the Ministry of the Environment, Land and Sea, 2008; for the SCIs and the SPAs: ISPRA processing of data from the Ministry of the Environment, Land and Sea (updated to 8 July 2008)

[30] The surface area of the SCI and SPA found in the Gran Paradiso National Park, a portion of which lies inside the Aosta Valley Region and a portion in Piedmont, was distributed under a criterion that attributed the majority of the areas to Aosta Valley. The SPA surface area of the Gran Sasso-Monti della Laga National Park, which falls within the territories of Abruzzo, Lazio and Marche, was assigned primarily to Abruzzo. The SPA surface area of the Abruzzo National Park, portions of which are found in Abruzzo, Lazio and Molise, was attributed primarily to Abruzzo

Of note among the priority objectives of Community Policy is 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.

referred to earlier, introduced a series of modifications meant to protect fish stocks and preserve the marine environment. Of the priority objectives, mention should be made of 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. 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 year 2008 also saw the introduction of two new European Community regulations meant to address to very important issues: efforts of prevention and dissuasion against illegal, undeclared and unregulated fishing (INN fishing) (Reg. 1005/2008 EC), plus the regulation of fishing by Community boats outside of Community waters and of the entry of the boats of non-EU countries into Community waters (Reg. 1006/2008 EC), all for the purpose of pursuing the objective of sustainable fishing while and extending its territorial scope.

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

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 series of 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 Agencies System and the reporting activities involving environmental data, such as the ISPRA Environmental Data Yearbook, are direct offshoots of, or are closely tied 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), the 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 Educa-

tion, 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.

At present, 745,991 hectares of the national forest area are certified (more than 8% of the total).

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 Fiemme (Province of Trento) in 1997, at present 745,991 hectares of the national forest area has obtained this recognition, meaning more than 8% of the total. 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 Forest 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 Forest Corps (which, as a result of its controls carried out in 2006, undertook more than 1,300 legal measures regarding violations and/or administrative sanctions, an increase over the 1,211 such measures of 2005, but a decrease of 44% compared to 2004) and the Environmental Defence Division of the Carabinieri Corps (which, based on the controls performed in 2006, enacted 727 legal measures regarding violations and/or administrative sanctions, a sharp decrease compared to both 2005 (-28%) and 2004 (-41%)). The various actions

listed up to this point to safeguard nature and biodiversity can be effectively applied only if they are supported with adequate funding. An examination of the available data, supplied by ISTAT[31], shows that spending by different government bodies (grouped by COFOG)[32] on the defence of biodiversity and the countryside totalled 4.088 billion euro in 2006. In 2000, total spending on such efforts was 2.864 billion euro, making for growth of approximately 43% during the period and confirming the attention placed in the sector under public policies.

During the period 2001-2006, the various government bodies spent an average of more than 4.0 billion euro on defending biodiversity and the countryside.

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 90's, 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 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.

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.

In terms of maintaining or increasing the dimensions of the UAA

[31] Spending of government bodies level-II in the years 2000-2006.
[32] Classification Of Function Of Government: a classification determined internationally by the main national accounting institutes.

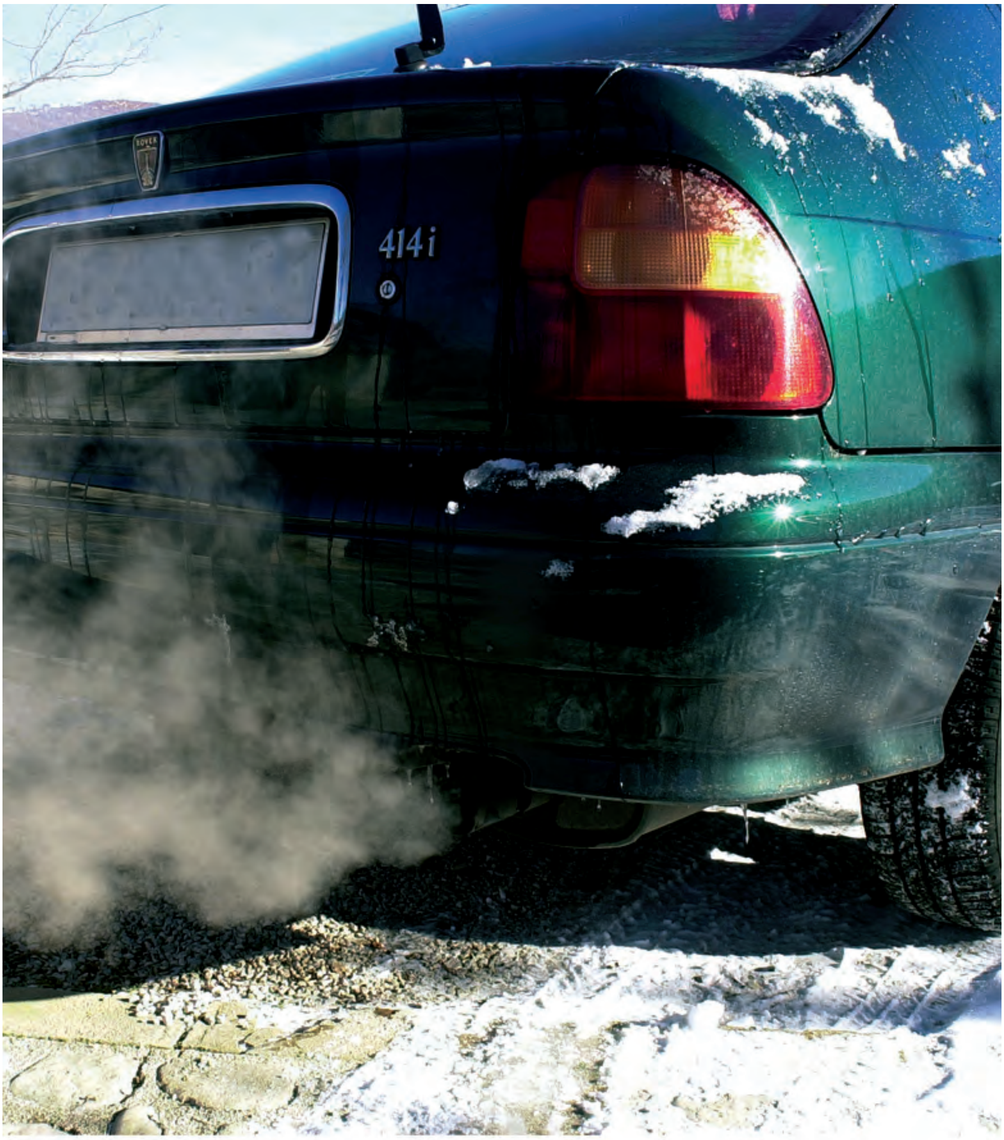
European Community policies on agriculture and the environment call for incentives promoting production activities of low environmental impact. National guidelines promote generational turnover, economic and social development and the reconstitution of farmlands and farming enterprises.

In Italy the surface areas involved in, or being converted to, biological agriculture in 2007 were equal to 1,150,253 hectares (+0.18% compared to 2006), representing 9% of the national 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.

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 2007 were equal to 1,150,253 hectares (+0,18% compared to 2006), representing 9% of the national UAA. The majority of the land used for biological farming produces green animal feed from seed crops and grains. The operators involved (producers, transformers and importers) number 50,276 (-1.55% compared 2006), with the largest concentration in Sicily, while Molise is the region showing the largest increase in operators compared to previous years. Sicily, followed by Calabria, is the region with the most producers, while Calabria, followed by Basilicata, has the highest ratio of producers to UAA. Within the EU-25, Italy retains an uncontested lead in terms of both the number of biological enterprises and the amount of land involved.

CHAPTER 3



AIR QUALITY

Introduction

Air quality represents one of the environmental emergencies that, together with climate change, to which it is closely connected, as well as the management of waste and water, involves all citizens on a daily basis and is of most concern to administrators of local and central governments. This emergency affects not only Italy, but all the countries of Europe, and especially large urban areas, where the percentage of the population exposed to levels that exceed the limit values set under legislative and regulatory measures is highest. The pollutants most responsible for poor air quality continue to be atmospheric particulate PM_{10}, ozone and nitrogen dioxide.

Air pollution is caused by a variety of factors, such as growing urbanisation, policies of mobility and public transportation, decisions regarding energy sources and heating systems, as well as the localisation of industrial plants. The essential stability of levels of air pollution observed in recent years, despite the reductions registered in Italy and the rest of Europe in emissions of primary particulate materials, nitrogen oxides and other substances responsible for poor air quality, demonstrates the great complexity of the factors at work, together with the need for increasingly integrated, long-term reclamation measures. Our country is making a significant effort, both nationally and regionally, to implement measures of reclamation, especially in the mobility sector, one of the main contributors to the emergency in air quality in urban areas.

Air quality

O_3, PM_{10}, NO_2 are the most critical pollutants.

The most critical pollutants, given the high concentrations in the air, 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 nitrogen dioxide (NO_2), despite the downward trend of emissions in recent years. These key problems, shared by most of the European countries, plus the difficulty of bringing pollutant levels below the regulated limits, were taken into account by the new directive on air quality (Directive 2008/50/EC), which, though it maintains the same limit values as the earlier directive, offers the possibility,

in its art. 22, of requesting, based on reliable data and documentation, extensions or postponements with respect to limit values and deadlines (for nitrogen dioxide, PM_{10} and benzene).

The impact on human health is anything but negligible, considering that the highest concentrations of the pollutants referred to are registered 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 limit values[1].

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

The EEA has also estimated that in 32 European countries, including the 25 Member States 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.

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

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 3.1, 3.2, 3.3).

Critical situation in the Po Valley zone.

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

PM_{10}, 2006. Exceedances were registered in all type of stations, with a greater number of registrations in traffic stations than rural ones.

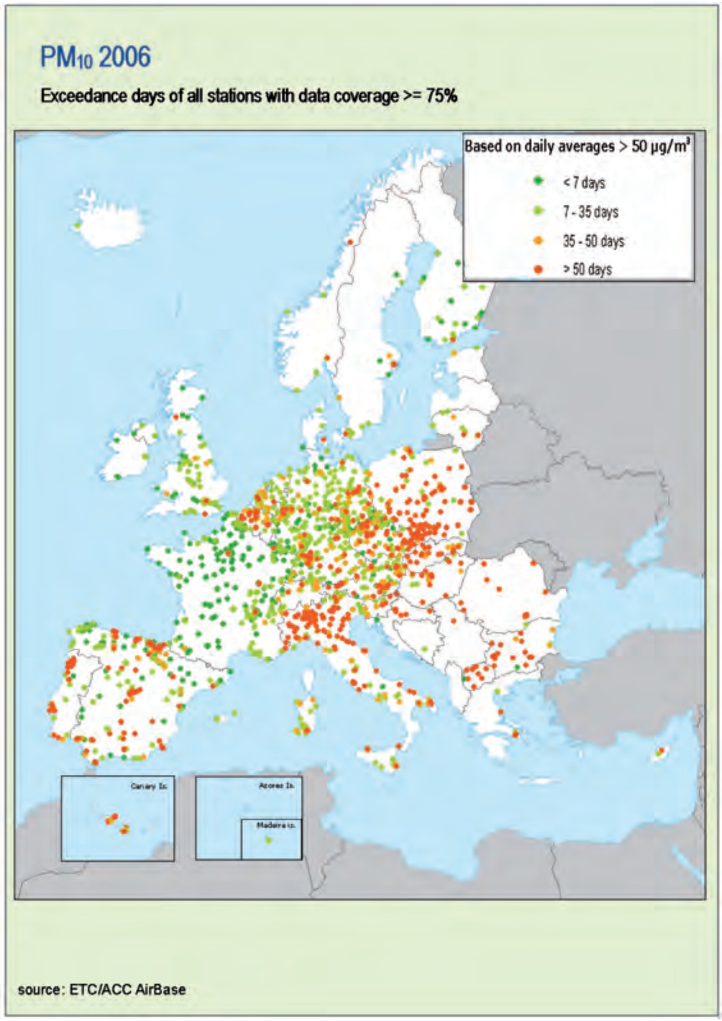


Figure 3.1: PM_{10} – Number of days in exceedance of the daily limit value for the protection of human health (50 µg/m³, not to be exceeded more than 35 times in a calendar year)[2]

[2] Source: http://air-climate.eionet.eur opa.eu/databases/airbase/eoi_maps/index_html

Nitrogen dioxide, 2006. Stations in urban areas registered the highest levels, plus the greatest number of exceedances.

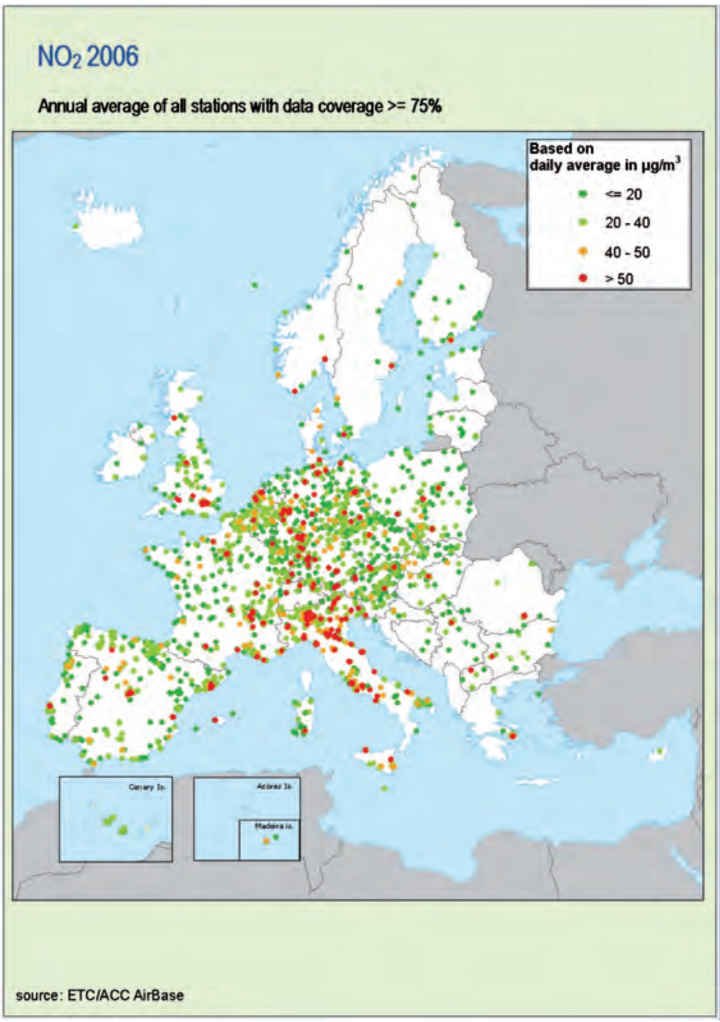


Figure 3.2: NO_2 – Annual average concentration of nitrogen dioxide (limit value 40 µg/m^3)[3]

[3] Source: *ibidem*

Ozone, 2006.
Two thirds of the rural stations, and approximately 50% of those found in urban areas, registered exceedances for protection human health.

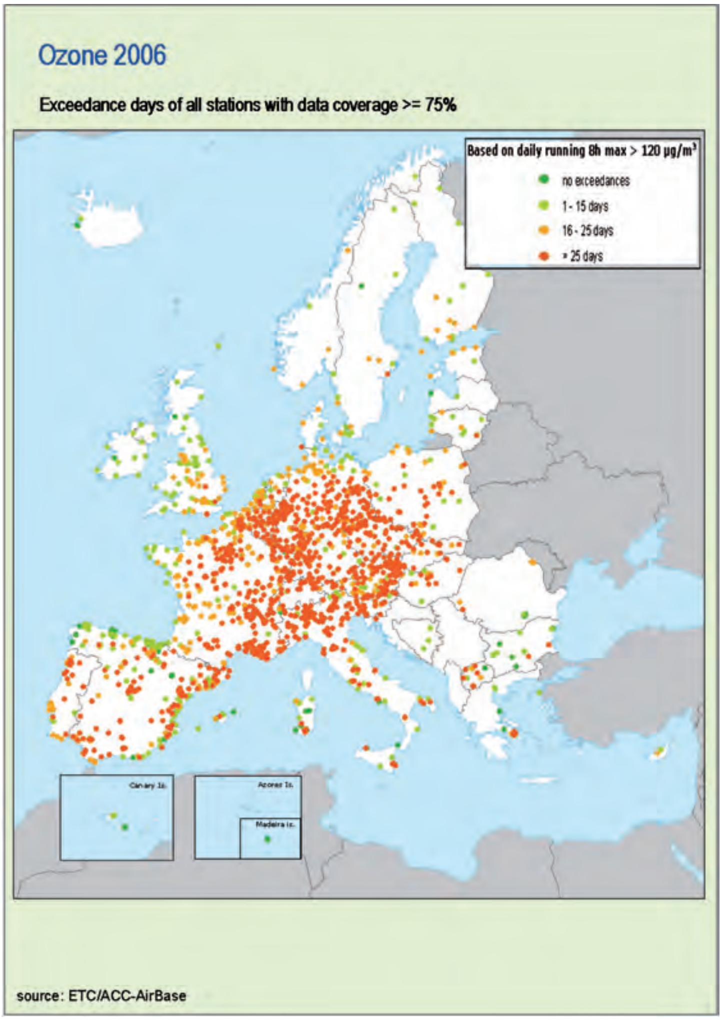


Figure 3.3: O_3 – Number of days in exceedance of the target value for the protection of human health (120 µg/m³ as an average for a maximum of 8 ore daily, not to be exceeded for more than an average of 25 calendar days per year over 3 years)[4]

[4] Source: *ibidem*

In Italy, the main source of information on air quality, and the most reliable, consists of the measurements of the concentrations of the main pollutants taken at the monitoring stations distributed throughout the national territory, operating as part of regional monitoring networks. The data registered at the monitoring stations are used by the individual Italian regions for the evaluation and management of air quality (Legislative Decree 351/99, Ministerial Decree DM 60/2002 and Legislative Decree 183/2004), as well as for exchanges of information between the member countries of the European Community (Decision 97/101/EC on the Exchange of Information, EoI) and for the dissemination of information to the public on the local level and national levels, in this last case by means of the BRACE database (www.brace.sinanet.apat.it) and the ISPRA Yearbook of Environmental Data.

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

The emission reductions of PM_{10} (30%, and especially marked in the energy and industrial sectors), of nitrogen oxides (NO_x 43%) and of non-methane volatile organic compounds (NMVOC 41%) registered between 1990 and 2006 (*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 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).

Unlike the pollutants referred to above, in the case of SO_x, CO, benzene and lead, all pollutants that have no secondary component, reductions in emissions have corresponded to reductions in concentrations in the air, and these substances, on the whole, are no longer a threat to human health, except in certain local settings and specific circumstances [5].

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

[5] EEA, 2007.

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

In the case of PM_{10}, its 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.

The regulation for PM_{10} sets a daily limit value of 50 µg/m³, which is not to be exceeded more than 35 times a year, plus an annual limit value of 40 µg/m³. These limits are frequently exceeded, especially the daily one, which proves to be stricter than the annual limit.

In 2007, 57% of the stations (Figure 3.4) registered exceedances of the daily limit value on more than 35 days; the 35-day limit is often reached as early as the first half of February (Figure 3.5).

In Italy, in 2007, the daily limit value (50 µg/m³, not to be exceeded more than 35 times a year) was broken by 57% of the monitoring stations. The most critical situation is in Northern Italy.

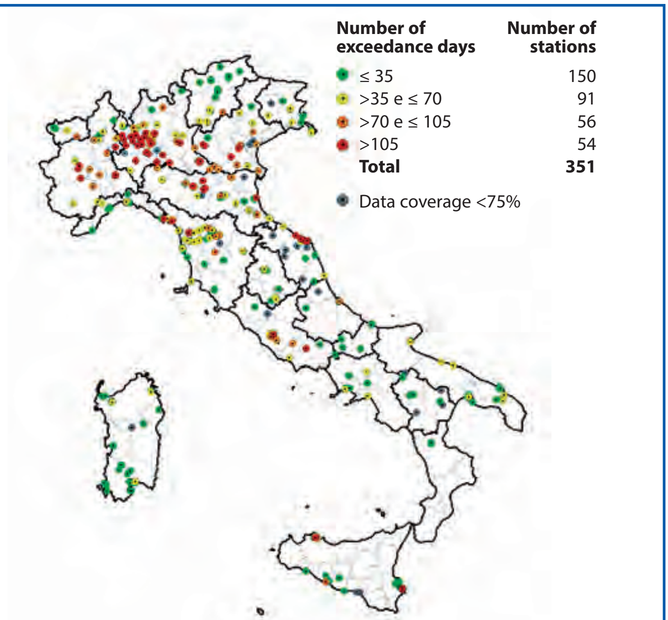


Figure 3.4: PM_{10} – Monitoring stations by categories of days over daily limit value (2007) [6]

[6] Source: EoI data processed by ISPRA (Decision 97/101/EC)

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 Central-Southern Italian Cities shown in Figure 3.5, Rome presents the highest levels).

PM_{10}, daily limit value: 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.

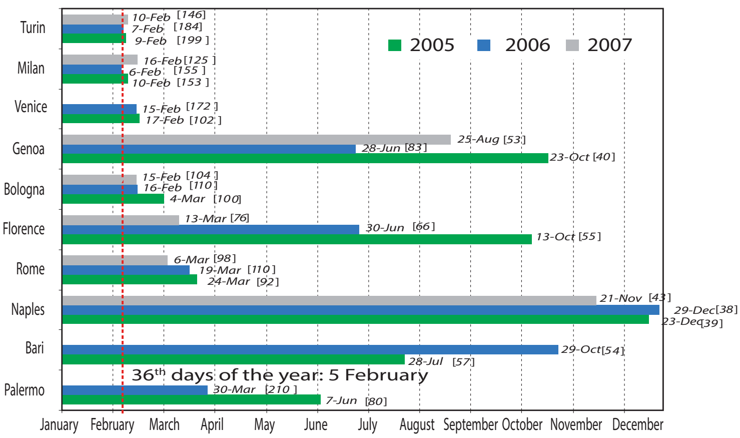


Figure 3.5: PM_{10} – Date on which the daily limit value was exceeded and annual number of exceedances at the monitoring station that first exceeded 35 days (2005-2007) [7]

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 [8], 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.

[7] Source: ISPRA processing of the air-quality assessment questionnaires for 2005, 2006, 2007 (Decision 2004/461/EC). The data refer only to the monitoring stations in municipal territory

[8] M. Martuzzi, F. Mitis, I. Iavarone, M. Serinelli, *Impatto sanitario di PM_{10} e Ozono in 13 città italiane*, WHO, APAT, 2007.

Negative effects on health are tied primarily to $PM_{2.5}$, the fraction of PM_{10} with the finest granulate size.

Current scientific knowledge shows that the negative effects on health are tied primarily to $PM_{2.5}$, the fraction of PM_{10} with the finest granulate size, accounting for roughly 40-80% of the total mass of PM_{10}. Information on emissions and concentrations in the air of $PM_{2.5}$, currently in short supply in both Italy and the rest of Europe, is sure to increase, give the attention focussed on this pollutant by the recently published Directive 2008/50/EC on air quality, which also contains obligations of monitoring and compliance with limit values on all the member countries.

The highest levels of ozone are registered during the summer season and in urban areas where the impact of traffic is not direct.

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 long-term objective for the protection of human health (120 $\mu g/m^3$) - which best describe, of all the parameters defined under the legislation, 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 2008, only 11% of the stations (27 stations out of the 245 that supplied information for at least five summer months out of six) did not register exceedances of the long-term objective (Figure 3.6).

Ozone, summer period 2008: 89% of the stations registered exceedances of the long-term objective. The situation was most critical in Northern Italy.

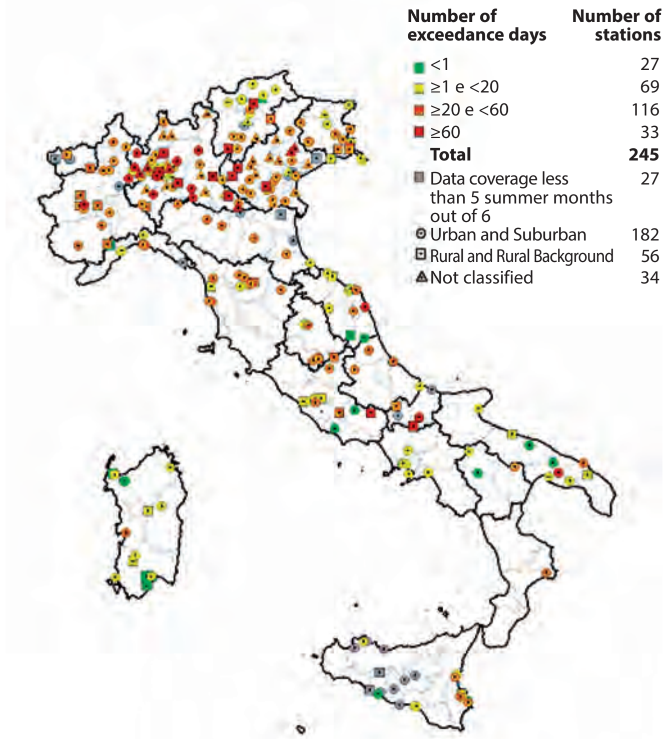


Figure 3.6: Summer O_3 – Monitoring stations by categories of days in exceedance of long-term objectives for the protection of human health (120 μg/m³) (2008) [9]

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.

Ozone also has negative effects on human health, though to a lesser extent than PM_{10}; the WHO estimated [10], in the course of

WHO: 500 deaths a year can be blamed on ozone.

[9] Source: Regions data processed by ISPRA (communicated by the in compliance with Legislative Decree 183/2004)

[10] M. Martuzzi, F. Mitis, I. Iavarone, M. Serinelli, *Impatto sanitario di PM_{10} e Ozono in 13 città italiane*, WHO, APAT, 2007.

the study referred to earlier, carried out in 2002-2004 on 13 Italian cities, that approximately 500 deaths a year can be attributed to this pollutant.
In the case of nitrogen dioxide, the annual limit value for the protection of human health (40 µg/m³), which shall go into force in 2010, was met by 65% of the stations in 2007 (Figure 3.7).

Nitrogen dioxide, 2007: at 65% of the stations, the annual limit for the protection of human health was not exceeded (40 µg/m³).

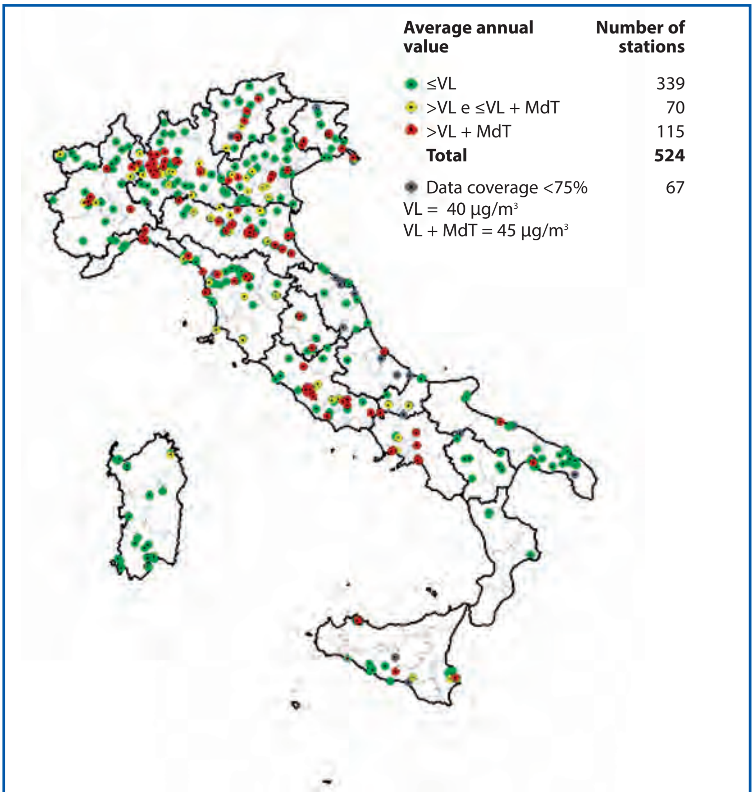


Figure 3.7: NO_2 – Monitoring stations by categories of average annual value (2007) [11]

[11] Source: EoI data processed by ISPRA (Decision 97/101/EC)

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 APAT in the National Emissions Inventory for 2006, in the case of PM_{10}, with regard only to its primary component, shows that transport is the main source of pollution, accounting for 41% of the total, of which approximately 27% is attributable to roadway transport; next come industry (25%), the residential sector (13%) and agriculture (10%).

In 2006, 41% of PM_{10}, 65% of NO_x and 39% of NMVOC were caused by the transport sector.

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 15%, the production of energy for 11% and the residential sector for 9%.

As for volatile organic compounds, but solely with regard to the non-methane ones (NMVOC), transport is responsible for 39%, while 42% come from the use of solvents, and the rest from the industrial sector, the residential sector and other minor sectors.

The national trends in emission reductions have also been observed on the European level. As noted in EEA report n. 7/2008, emissions of NO_x in the countries of the EU27 fell, between 1990 and 2006, by 35%, emissions of NMVOC by 44% and those of SO_x by approximately 70%. Emissions of PM_{10}, on the other hand, showed a 10% decrease between 2000 and 2006. Roadway transport was the main source of emissions in 2006, responsible for 40% of emissions of NO_x and 18% of NMVOC. The other main sources of NO_x emissions are electricity production (19%), industrial combustion (14%) and the residential sector (14%). The main sources of NMVOC, apart from roadway transport, are domestic and industrial uses of solvents (16%), the use of solvents in paints (16%) and domestic heating (10%).

Between 1990 and 2006, in the countries of the EU27, emissions of NOx dropped by 35%, of NMVOC by 44% and of SOx by 70%. Between 2000 and 2006, emissions of PM_{10} dropped by 10%.

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, emis-

Emissions of PM_{10}, SO_x and NOx fell in all the regions, and especially those where large-scale combustion plants are found.

sions 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, 2000 and 2005 (Figures 3.8, 3.9, 3.10).

Reductions in SO_x were registered by all the regions between 1990 and 2005, in a range of 60% to 90%.

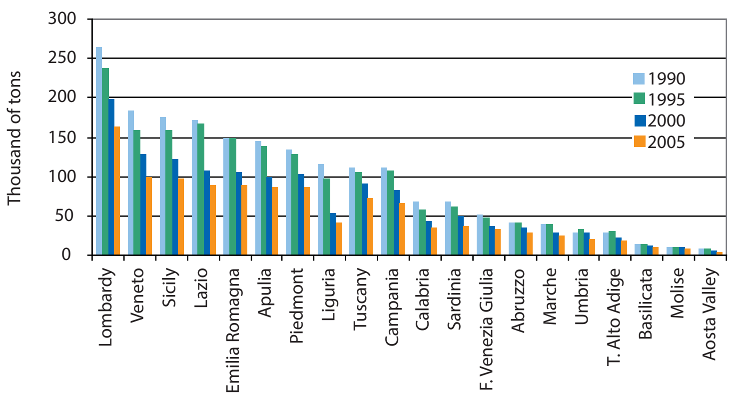


Figure 3.8: Regional emissions of SO_x[12]

Reductions in NO_x were registered by all the regions between 1990 and 2005, in a range of 30% to 60%, with the exception of Molise, where emissions remained stable.

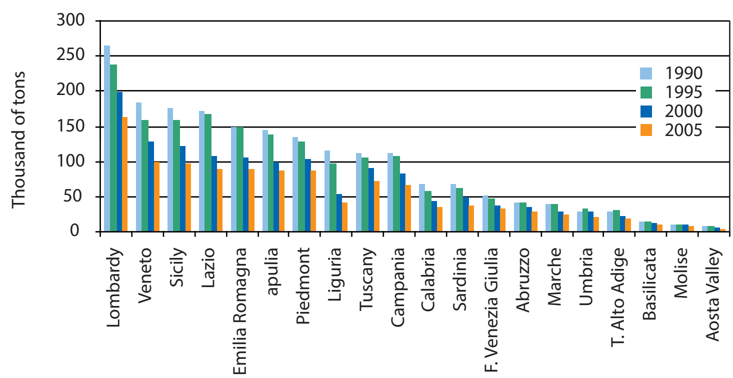


Figure 3.9: Regional emissions of NO_x[13]

[12] Source: APAT
[13] Source: APAT

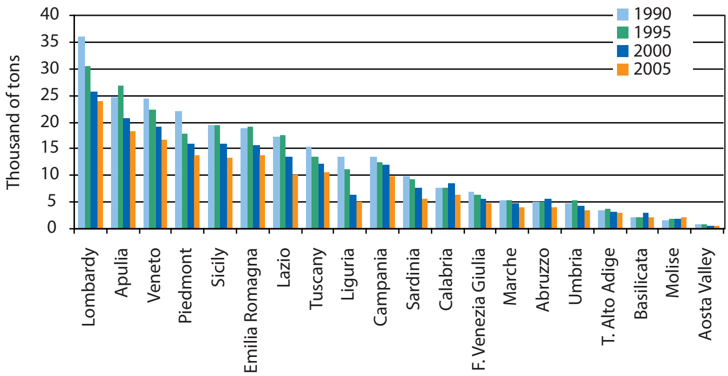


Figure 3.10: Regional emissions of PM_{10} [14]

Reductions in PM_{10} were registered by all the regions between 1990 and 2005, in a range of 15% to 45%, with the exception of Molise, where emissions rose slightly, and Basilicata, where they remained stable.

The emissions of industrial plants, as well as those of other production sectors, including agriculture, and those due to heating in the residential sector, affect 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 Po basin regions, for example, levels of air quality are highly influenced by total emissions, and by the specific conditions of weather and climate in force, especially during the winter period.

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.

Within this scenario, emissions of PM_{10} caused by the combustion of wood in fireplaces and stoves for house heating, an emissions source concentrated in the winter months, become equally as relevant as emissions due to roadway transport in terms of exceedances of the limit value established by the legislation. In the case of large urban 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 exceedances of the legal limits.

The points briefly illustrated indicate that transport, and especially by roadway, is one of the main causes of the high concentrations of PM_{10} and ozone in the air. This critical problem is especially

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

[14] Source: APAT

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.

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 indicators entitled TERM (*Transport and Environment Reporting Mechanism*), covering the main elements of the transport – environment system.

Harmful gas emissions during the period 1990-2006 were the result of two contrasting trends: emissions tend to increase, because of the continuous growth in the vehicle fleet and the paths covered, though, in reality, they decrease, thanks to the renewal of the vehicle fleet.

Since 1995, there have been significant reductions in NO_x, COV, Pb and C_6H_6, as well as PM_{10}, though to a lesser extent, on account of the renewal of the vehicle pool and the quality of the fuels.

In the years since 1995, NO_x, VOC and benzene have fallen at significant rates, thanks primarily to the renewal of the vehicle fleet.
As for the other harmful compounds, concentrations of PM_{10}, whose main source, at present, are freight vehicles, both light and heavy duty, 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, with the use of catalytic converters also contributing to the drop in benzene.

The demand for passenger transport increased by 34.1% between 1990 and 2007.

Demand for mobility, and especially the portion consisting of roadway transport, has grown constantly during the period under examination.
During the years 1990-2007, the demand for passenger transport increased by 34.1%, at a rate often higher than the increase in the GDP.

Private transport covers 81.5%.

Tranport demand has been satisfied to an increasing extent by private transport, which now accounts for approximately 81.5%.

During the same period, passenger transport by rail increased by 8.1% and bus transport by 24.1%, while air transport was the mode that grew most rapidly: the number of landings and take-offs rose by 217%.

Air transport shows extremely rapid growth.

Freight transport growth for the period 1990-2007 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 freight traffic: +27.2% (total freight traffic for distances of more than 50 km) between 1990 and 2007, with an increasing percentage travelling on the road. This trend is forecast to continue over the next few years. In 2007 roadway transport absorbed 64.9% of the demand, railway 10.9% and short-haul shipping 19.2%.

Between 1990 and 2007 there was a noteworthy increase in freight traffic (27.2%), especially that travelling on roadways.

Initiatives designed to improve air quality

Directive 96/62/EC [15], transposed into Italian law under Legislative Decree 351/1999 [16], sets the criteria for the assessment and management of the ambient 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 one or more air pollutants regulated under Ministerial Decree 60/2002 [17] are greater than the limit values (LV), plus the margin of tolerance (LV+MOT), the regions

[15] Directive 1996/62/EC, issued by the Council on 27 September 1996, with regard to the assessment and management of environmental air quality – Official Gazette, issue L 296 of 21 November 1996.
[16] Implementation of Directive 96/62/EC on the assessment and management of environmental air quality – Official Gazette, issue no. 241 of 13 October 1999.
[17] Transposition into Italian law of Directive 1999/30/EC, issued by the Council on 22 April 1999, regarding the environmental air-quality limit values for sulphur dioxide, nitrogen dioxide, particulate and lead, plus Directive 2000/69/EC on the environmental air-quality limit values for benzene and carbon monoxide – Official Gazette, issue no. 87 of 13 April 2002 – Ordinary Supplement no. 77.

and the autonomous provinces are required to implement a plan or program (art. 8 of Legislative Decree 351/1999), in order to bring the levels under the limits within the deadlines set in the above decree.
In the same way, when concentrations of ozone in the air exceed the long-term objective (LTO) and/or the target value (TV) set under Legislative Decree 183/2004 [18] for the protection of health, the regions and the autonomous provinces are required to implement a plan or program.

Plans for upgrading: investigative phase (local inventories), assessment phase (data on air quality), proposal phase (reclamation measures, 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*).
There follows an *assessment* phase, involving an *air quality assessment* whose purpose is to describe the state of the atmospheric environment, identifying 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 maintenance or 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 conditions and in the presence of certain emissions input.

[18] Implementation of Directive 2002/3/EC on ozone in the air – Official Gazette, issue no. 171 of 23 July 2004 – Ordinary Supplement.

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 obtain 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 industry and commercial, and domestic activities);
- indicating the *"additional" measures* through which the region/autonomous province intends to achieve these objectives. The measures can involve economic/tax initiatives (tax reductions, incentives), technical considerations (use of lower-impact technologies) or even information (awareness campaigns);
- 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 ISPRA (formerly the APAT), information on their plans and/or programs (by means of questionnaires), 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 information on the plans or programs to the European Commission within two years after the end of the year during which the exceedances were observed (in 2008 the plans for 2006 are transmitted).
The current situation of the transmission of the plans is indicated on Table 3.1.

Roughly a third of the regions/autonomous provinces have not sent in the information for 2006. They are almost all located in the South.

Table 3.1: Information on plans and programs set by the regions/autonomous provinces, as per the legislation currently in force[19]

Year to which the plan refers	**2001**	**2002**	**2003**	**2004**	**2005**	**2006[a]**
Year information sent in	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***
Piedmont	YES	YES	YES	YES	YES	YES
Aosta Valley	*	*	*	*	YES	YES
Lombardy	YES	YES	YES	YES	YES	YES
Bolzano	*	*	*	YES	YES	YES
Trento	*	*	*	YES	YES	YES
Veneto	YES	YES	YES	YES	YES	**NO**
Friuli Venezia Giulia	*	YES	YES	YES	YES	YES
Liguria	YES	YES	YES	YES	YES	YES
Emilia Romagna	YES	YES	YES	YES	YES	YES
Tuscany	YES	YES	YES	YES	YES	YES
Umbria	YES	YES	YES	YES	YES	YES
Marche	YES	YES	YES	YES	YES	YES
Lazio	YES	YES	YES	YES	YES	YES
Abruzzo	YES	YES	YES	YES	YES	YES
Molise	*	*	**NO**	**	**	**
Campania	YES	YES	YES	YES	YES	**NO**
Apulia	YES	YES	YES	YES	YES	YES
Basilicata	*	*	*	*	**NO**	**
Calabria[b]	*	*	*	**NO**	**NO**	*
Sicily	YES	YES	**NO**	**NO**	**NO**	**
Sardinia	YES	YES	YES	YES	YES	**NO**

Legend:
[a] Temporary figures: the regions are still sending in the questionnaires
[b] In the years 2005 and 2006, only exceedances of the ozone TV were recorded
* Absence of exceedances, no plan required
** No air quality questionnaires sent in

There were noteworthy delays in the sending of information for 2006: even though the deadline set was 30 June 2008, the majority of the questionnaires were sent in the months of October, November and December.

[19] Source: Regions/autonomous provinces data processed by ISPRA

As for the contents of the documents, those analysed show critical problems with regard to the “proposal” section; as a rule, the information is incomplete, especially in the portions regarding:

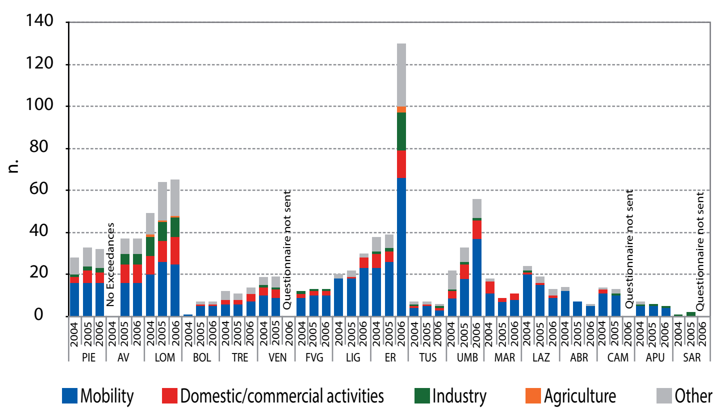
- assessment of the actual effectiveness of the additional measures identified;
- quantification of the time required for these measures to be effective.

The main sectors of intervention in which the additional measures identified by the regions fall are: mobility, domestic/commercial activities, industry, agriculture, other[20].

Figure 3.11 shows the number of measures implemented by the regions in the three-year period 2004 – 2006, classified.

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

Sectors of intervention.



The regions that did not send in the questionnaire, or that did not register exceedances, are not shown (see table 3.1)

Legend:

* Provisional data

Figure 3.11: Measures taken to restore air quality, detailed by region (2004-2006) [21]

Between 2004 and 2006 there was a significant increase in the measures taken to restore the air quality in the Emilia Romagna and Umbria Regions, while the number of measures in the Lazio and Abruzzo Regions decreased. The sector most frequently involved was mobility.

[20] The category “Other” includes: accessory measures in urban centres; studies and projects; initiatives for restructuring or expansion of air quality monitoring networks.

[21] Source: Regions and the autonomous provinces data processed by ISPRA

More than 400 measures are forecast for 2006, as compared to 284 in 2004.

As shown by Figure 3.11, the number of measures undertaken by the regions to restore air quality increased during the three-year period 2004-2006. In 2004, there were 284 measures throughout the national territory, with the number rising to 341 in 2005 and, based on the information currently available, to 398 (provisional data) in 2006. It can further be observed that mobility is the sector most frequently involved.

In 2006, the regions that undertook the most measures were: Emilia Romagna and Lombardy.

Measures for sustainable mobility.

For 2006, to date, the regions that have undertaken the most measures are Emilia Romagna, at 130, and Lombardy, at 65 measures.
The specific mobility initiatives include the following types of measures:

1. Promotion and dissemination of clean vehicles in public transport[22]
2. Reinforcement of local public transport (LPT)
3. Promotion and dissemination of clean vehicles in private transport
4. Testing of exhaust emissions from motor vehicles
5. Traffic restriction measures
6. Regulation of urban freight distribution
7. Drafting of urban plans (Traffic, mobility, transport)
8. Structural initiatives regarding mobility
9. Initiatives for alternative mobility[23]
10. Promotion and dissemination of clean vehicles in freight transport
11. Technological support for sustainable mobility

In order to provide a complete overview of the information received on the measures implemented in the mobility sector, the figures for 2005 have been examined. The number of measures enacted by each region are shown below, broken down by type.

The measures most often adopted regard alternative mobility (17%).

Figure 3.12 shows that the measures most frequently taken were:

• initiatives in favour of alternative mobility (17%);
• measures regarding the public vehicle pool (16%);
• measures regarding the private vehicle pool (15%);
• structural measures involving mobility (15%).

[22] Low Environmental Impact.
[23] 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.

Roughly 50% of all the measures on mobility were concentrated in 5 regions: Piedmont, Lombardy, Liguria, Emilia Romagna and Lazio.

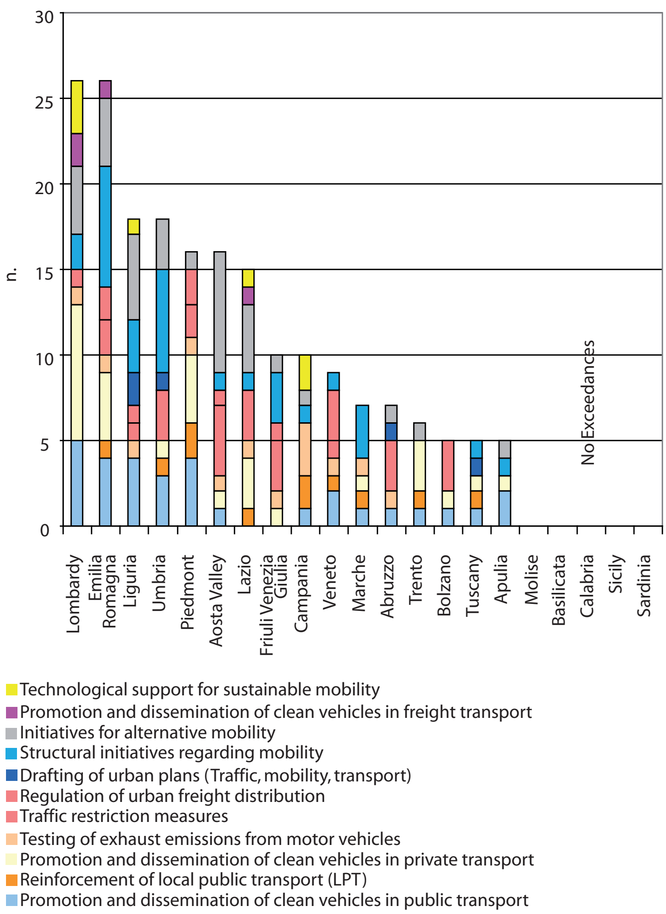


Figure 3.12: Regional restoration measures in the mobility sector (2005) [24]

In terms of actions for the restoration of air quality, investigative initiatives, an area in which the ISPRA plays a major role, should not be neglected. At present, the prevalent and most reliable

[24] Source: Regions and the autonomous provinces data processed by ISPRA

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

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 to verify compliance with air quality limits (Legislative Decree 351/99, Ministerial Decree 60/2002 and Decision 2004/461/EC, plus Legislative Decree 183/2004).
The inconsistencies registered between the two flows, essentially stemming from the fact that the air quality data produced by a given monitoring station are not always present in both flows, were almost completely resolved in 2007 - 2008, and the problem will be solved completely by the implementation of a new directive on air quality, calling for a single flow of information carried exclusively by telematic means.

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.

In terms of monitoring network quality and compliance with regulatory criteria, a process of updating and revision is currently underway, based on standards that call for, among other innovations, subdivision of the territory into zones, in order to assess and manage air quality, in addition to integrating the monitoring data with other techniques (spatial surveying, modelling, satellite procedures and others). This process of revising the monitoring networks, which involves the regions and the Agency System on the local level, together with the ISPRA and the Ministry of the Environment, Land and Sea on the central level, though it currently makes for complications when comparing data in terms of time and space, shall ultimately lead to more uniform, easier to compare information for the entire national and European territories.

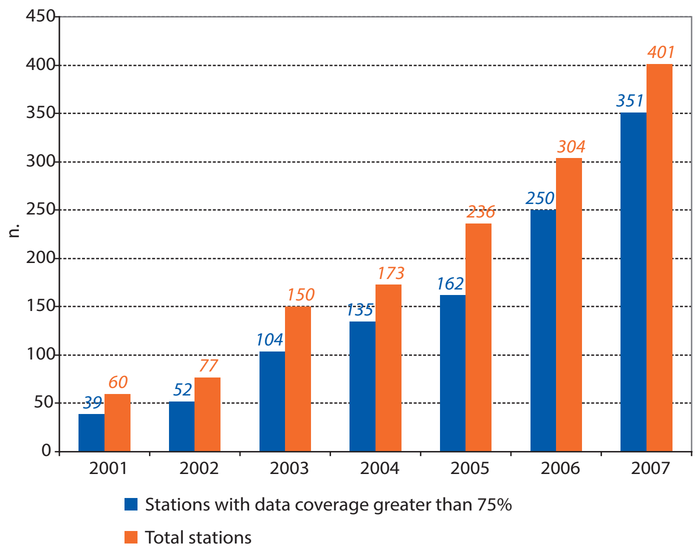


Figure 3.13: PM_{10} – Number of monitoring stations with time coverage of more than 75% and total number of stations[25]

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

In terms of monitoring network rationalisation, what stands out is that the number of stations utilised under the EoI continues to grow. Together with the number of stations, the number of data sets whose time coverage is in compliance has also increased, as shown in Figure 3.13 for PM_{10}: all these developments point to an improvement in monitoring activities and communication of information on the local and national levels.

[25] Source: EoI data processed by ISPRA (Decision 97/101/EC)

CHAPTER 4

WATER QUALITY

Introduction

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

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

Ecological status must be based on 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. In addition, for the first time, a directive calls for measures to be issued to maintain sustainable hydrological levels and systems and to defend and restore coastal habitats.

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

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 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 (production of drinking water, water suitable for swimming) or for the lives of fishes and molluscs.

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

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 has already been reached, maintenance of a "high" environmental quality rating.

Introduction of the principle of "non deterioration".

The Directive, which introduces the principle of the "non deterioration" of water bodies, in addition to adopting the further principles of precaution, prevention and "if you pollute, you pay", obliges the Member Countries to protect their transitional and

internal surface waters, as well as coastal and underground waters. The objective of "good" ecological and chemical status by 2015 must be reached by managing water on the scale, and within the framework, of the watershed, and not within the confines of administrative borders, pursuing the optimisation of uses and promoting the integration of existing measures regarding water and the sectors that depend on it.

The state of water quality

In 2007, water was monitored by the institutions assigned to the task under Legislative Decree n. 152/99, plus subsequent modifications and additions, while the monitoring of water bodies, pursuant to the European Directive and Legislative Decree 152/06, is currently getting underway. The departments and agencies responsible for the work are currently engaged in identifying, categorising and characterising the water bodies, while the identification of the sites and the reference communities for the different bio-indicators, activities preliminary to the start-up of the monitoring itself, has begun.

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

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, in 2007, 48% of the sites monitored fell under classes 1 and 2, meaning an ecological status of "high" (5%) or "good" (43%) (Figure 4.1).

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.

A total of 1,014 stations were monitored, distributed throughout the national territory.

The percentage of the stations ranking in quality class 1 remained the same as last year (5%), while there was an increase in the stations in class 2 (from 38% to 43%). This rise resulted in an overall decrease in the stations ranked in classes 3 (from 35% to 32%), 4 (from 16% to 15%) and 5 (from 6% to 5%).

This year data were not received in complete form, or in time for processing, from the following regions: Calabria, Sardinia, Molise (only partial results) and Campania (where biological monitoring was not performed).

Of the 1,014 points monitored, 48% fall within the quality classes of "good" and "high".

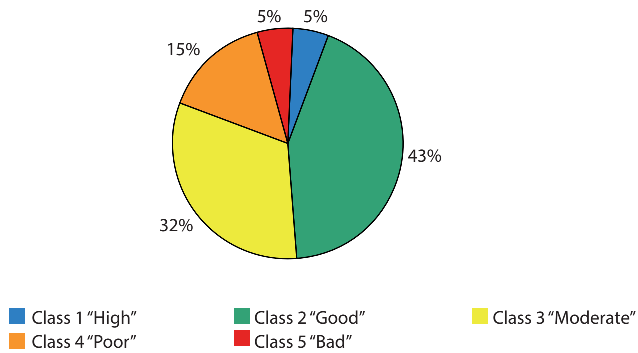


Figure 4.1: Percentage distribution of the classes of the SECA quality index (2007) [1]

In Northern Italy, 55% of the points monitored fall in classes 1 and 2.

The data analysis (Figure 4.2) shows that the best situation is found in Northern Italy, where the percentage of stations falling under classes 1 and 2 is 55%, while the result is 41% for the Central Italy and 48% for the South and the Islands. However, these results should be evaluated in light of the different numbers of stations monitored in the various macro-areas, as well as the fact, with regard to Southern Italy and the Islands, that no data are available for Basilicata, Campania, Calabria or Sardinia.
In 2007, there were 1,014 monitoring points distributed throughout the national territory, as compared to 1,257 registered in 2006. Further differences in 2007, compared to the previous year, were the 102 fewer stations monitored in Northern Italy, the 121 additional stations in the central regions and the 262 fewer stations in Southern Italy and the major islands. The differences in the number of monitoring points makes it difficult to compare the 2007 data with those for 2006.

[1] Source: ARPA/APPA data processed by ISPRA

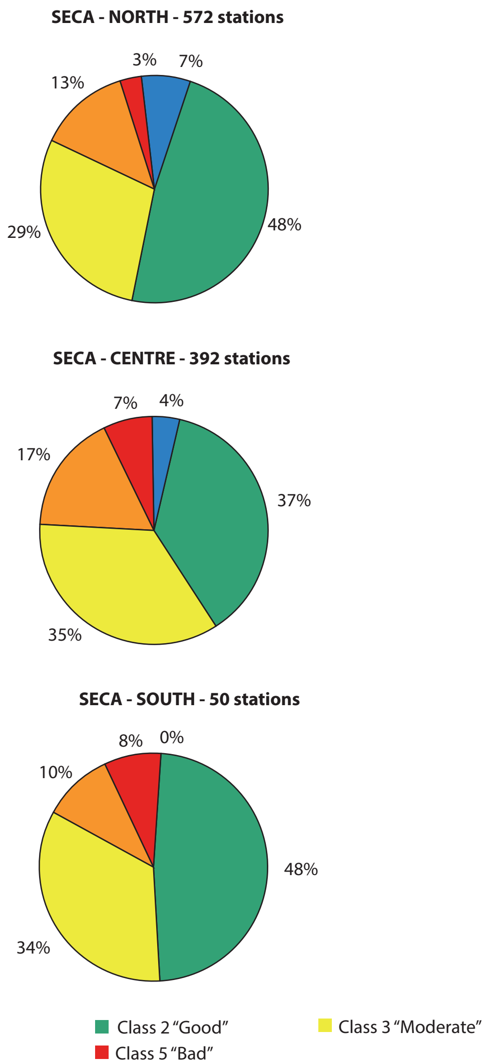


Figure 4.2: Percentage distribution of the SECA index quality classes by macro-region (2007) [2]

In 2007, the ecological status of waterways in Italy was not especially critical. Of the 572 stations in Northern Italy, 55% fell within classes 1 and 2. Of the 392 stations in Central Italy, 41% were rated in the "high" or "good" classes, while 48% of the 50 stations in Southern Italy and the Islands were rated in these classes.

[2] Source: ARPA/APPA data processed by ISPRA

As noted earlier, seeing that the SECA is established with the integrated results of the chemical and biological analyses, when the incidence of LIM and IBE in determining the SECA is examined (Figure 4.3), it is found that, in the case of 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.

In 2007, as in previous years, the macrobenthic community played a greater role in determining the SECA than did the chemical-physical macro-descriptors.

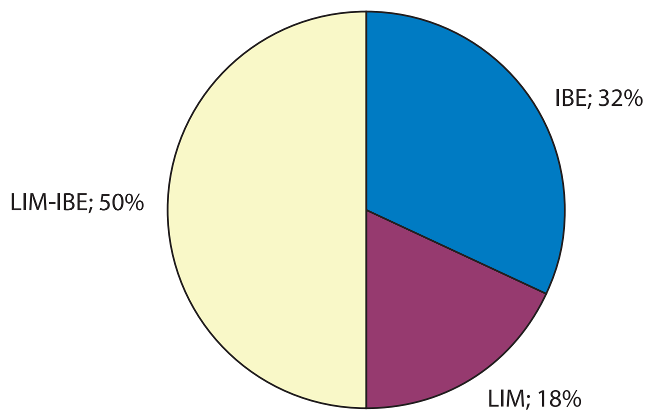


Figure 4.3: The percentage incidence of the LIM and IBE indexes on the SECA index (2007) [3]

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

In 73% of the cases, lake quality readings (Ecological Status of Lakes - SEL), taken from a total of 148 stations in 14 regions, fall within the classes ranging from "moderate" to "high" (Figure 4.4), an incidence that has decreased by 1% compared to 2006.

[3] Source: ARPA/APPA data processed by ISPRA

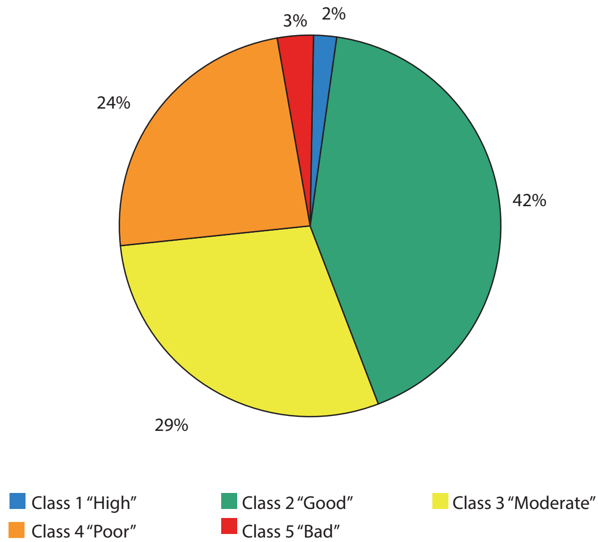


Figure 4.4: Percentage distribution of the SEL quality classes (2007) [4]

In 2007, 73% of the stations (148, representing 134 lakes) were ranked in the classes from "moderate" to "high".

An analysis of Northern Italy shows that 52% of the 107 stations are classified "high" and "good". The percentages of lake quality by macro-geographic area bear relatively little significance, given the limited number of monitoring stations for the regions of Central Italy (38 stations) and the South (3 stations). This situation reflects not only the fact that a number of regions have failed to send in the data, but also the uneven distribution of lakes within Italian territory: 85% of the lake bodies (natural and artificial) are found in Northern Italy[5].

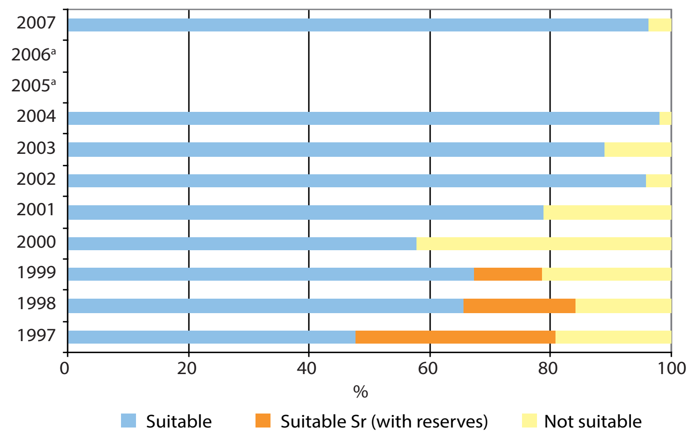
[4] Source: Autonomous provinces and ARPA/APPA data processed by ISPRA/ARPA Lombardy

[5] LIMNO Project: complete, updated databank of the main morpho-metric, chemical, biological and anthropogenic characteristics of Italian lake environments.

In 2007, based on the monitoring of segments of rivers and lake areas designated as being suitable for fish to live in, 96.2% of the segments examined and 100% of the lakes were found to be suitable.

Looking ahead, and in light of the new monitoring programs carried out under Legislative Decree 152/06, which transposed the contents of Directive 2000/60/EC into Italian legislation, it can be assumed, in the case of surface water bodies (rivers and lakes), that the stations ranked in ecological quality classes 1 and 2 (SECA and SEL) belong to water bodies that should not present particular problems in achieving the quality objective set under the new legislation.

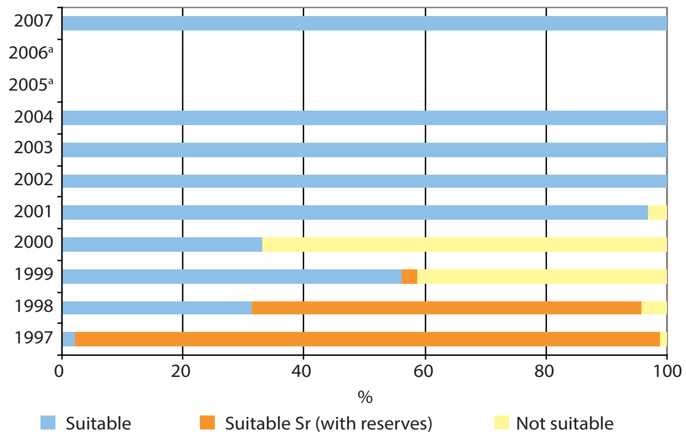
Another assessment of the water bodies quality regards the satisfactory state of segments of waterways and of lake areas requiring protection or upgrading to be suitable for fish life.
The monitoring data for 2007 (on 14 regions) show that the state of the designated waterways complies with the irremovable values found on Table 1/B – Annex 2 – Part III of Legislative Decree 152/06 for chemical and physical parameters, and that only 3.8% of the segments classified are not suitable (Figure 4.5). Lake bodies, on the other hand, proved 100% suitable (Figure 4.6).



NOTE: Since 2000, the category Suitable with Reserves has been eliminated
Sr – Suitable with reserves
[a] - Insufficien data

Figure 4.5: Waters suitable for fish to live in – Rivers[6]

[6] Source: Regions and the Autonomous provinces data processed by ISPRA



NOTE: Since 2000, the category Suitable with Reserves has been eliminated
Sr – Suitable with reserves
[a] - Insufficien data

Figure 4.6: Waters suitable for fish to live in – Lakes[7]

The monitoring for 2007 (data on 7 out of 15 coastal regions) of marine and brackish areas suitable for mollusc life, designated by regions, sites and natural populations of bivalve and gastropod mollusc-beds, requiring protection and/or upgrading, in order to improve the quality of the molluscs as food, regards a total of 66 designated areas, of which 45 are marine zones and 21 brackish areas. A ranking of suitable was given to 47 areas, of which 36 are marine and 11 brackish (Table 4.1).

Looking at marine areas and brackish waters suitable for molluscs to live in, 47 were found to be so, consisting of 36 marine areas and 11 brackish zones.

[7] Source: Regions and the Autonomous provinces data processed by ISPRA

Suitability of marine and brackish areas designated for molluscs to live in.

Table 4.1: Waters designated as suitable for molluscs to live in (2007 monitoring)[8]

Region	Designated Areas									
	TOTAL		Marine		Suit able	Un-suit.	Brackish		Suit able	Un-suit.
	n.	km²	n.	km²	n.		n.	km²	n.	
Veneto	8	684	1	46.5	1	0	7	637	5	2
Friuli Venezia Giulia	12	312	10	204	6	4	2	108	0	2
Liguria	2	3,92	2	3.92	2	0	0	0	0	0
Emilia Romagna	13	1,784	11	1,748	11	0	2	36.5	1	1
Tuscany	-	-	-	-	-	-	-	-	-	-
Marche	-	-	-	-	-	-	-	-	-	-
Lazio	3	-	3	-	3	0	0	0	0	0
Abruzzo	-	-	-	-	-	-	-	-	-	-
Molise	11	65.5	11	65.5	11	0	0	0	0	0
Campania	-	-	-	-	-	-	-	-	-	-
Basilicata	-	-	-	-	-	-	-	-	-	-
Apulia	-	-	-	-	-	-	-	-	-	-
Calabria	-	-	-	-	-	-	-	-	-	-
Sicily	-	-	-	-	-	-	-	-	-	-
Sardinia	17	-	7	-	2	5	10	-	5	5
TOTAL	**66**	**2,849**	**45**	**2,068**	**36**	**9**	**21**	**781.5**	**11**	**10**

The designated waters are considered suitable when the parameter values contemplated under the legislation fall within the guideline values or satisfy the irremovable limits listed on Table 1/C - Appendix 2 - Part III of Legislative Decree 152/06. The waters were found to be suitable for 100% of the samples in terms of organic-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, faecal coliforms and algae bio-toxins.

[8] Source: Regions and the Autonomous provinces data processed by ISPRA

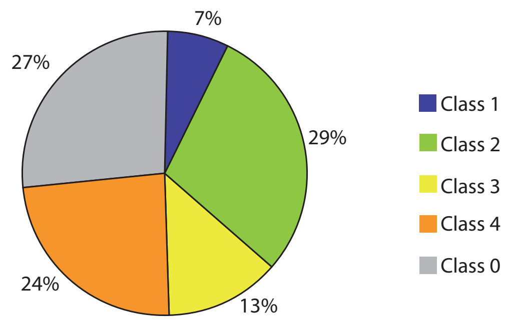
Legislative Decree 152/99 has defined the "environmental status" of underground waters, which consists of the "quantitative" and "chemical" status. To date there are no data available on quantity, but only on "chemical" status, meaning the figures used to establish the SCAS (Chemical Status of Underground Waters) index. Expressed in 5 classes (1-2-3-4-0), this index indicates the quality of the zones subject to the most critical environmental conditions: the first three classes stand for levels of quality from good to moderate, while the remaining two point to poor quality: on account of anthropogenic contamination, in the case of class 4, and of natural origin with class 0. The contaminants of anthropogenic origin include nitrates, which, beyond the limit of 50 mg/l (drinking water limit), are responsible for the demotion to class 4 of many regions. Their presence is correlated to widespread pollution, 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 plants for the treatment and discharge of urban and industrial liquid waste that has not been denitrified. Apart from nitrate pollution, a number of dangerous substances of unmistakable anthropogenic origin were found to be present at certain sampling points, such as plant care products, aliphatic halogenate compounds and aromatic polycyclic hydrocarbons, plus certain heavy metals (primarily chrome, lead, nickel and zinc).

The presence of arsenic, iron, manganese, the ammonia ion, sulphates, chlorides and conductivity beyond the legal limit has been attributed by various regions to natural causes, in certain hydrogeological settings, producing a class 0 result.

The results for 2007 (Figure 4.7) show that 49% of the sampling points present a chemical status falling within classes 1 to 3, meaning a level of quality between good and moderate, while poor quality due to anthropogenic causes was observed at 24% of the points, with the remaining 27% were rated poor due to natural causes (the specific hydrogeochemical conditions of the water tables).

The Chemical Status of Underground Waters defines the quality of water tables and is obtained by analysing their content of both pollutants originating from anthropogenic activities and chemical substances which, though natural in origin, can nevertheless compromise the use of the water.

In 2007, on a national level, out of 2,890 sampling points distributed in 11 regions and 2 autonomous provinces, 49% present a chemical status ranked between classes 1 and 3, while 24% are characterised by water of poor chemical quality due to causes of anthropogenic origin, and the remaining 27% are rated poor 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 4.7: Sampling points for SCAS quality classes (2,890 points – 11 regions and 2 autonomous provinces) (2007) [9]

Considering the different numbers of monitored points in the regions and autonomous provinces (from a minimum of 29 to a maximum of 605), Figure 4.8 shows that, in the autonomous provinces of Trento and Bolzano, and in the regions of Marche, Aosta Valley, Campania, Lazio, Veneto, Piedmont and Abruzzo, 97% to 53% of sampling points ranked within classes 1 to 3. The highest percentages for class 4 were the respective figures of 54% and 46% registered in Lombardy and Abruzzo. Finally, 58% of the monitoring points in Emilia Romagna and 52% of those in Tuscany fell under class 0, for bad quality on account of natural causes.

[9] Source: Regions, Autonomous provinces and ARPA/APPA data processed by ISPRA/ARPA Emilia Romagna

The numbers of sampling points in the regions vary widely (from 29 to 605). In the autonomous provinces of Trento and Bolzano, and in the regions of the Marche, Aosta Valley, Campania, Lazio, Veneto, Piedmont and Abruzzo, the percentages of sampling points ranked in classes 1 to 3 range from 53% to 97%, while 54% of the points in Lombardy are ranked class 4, and 58% of those in Emilia Romagna fall in class 0.

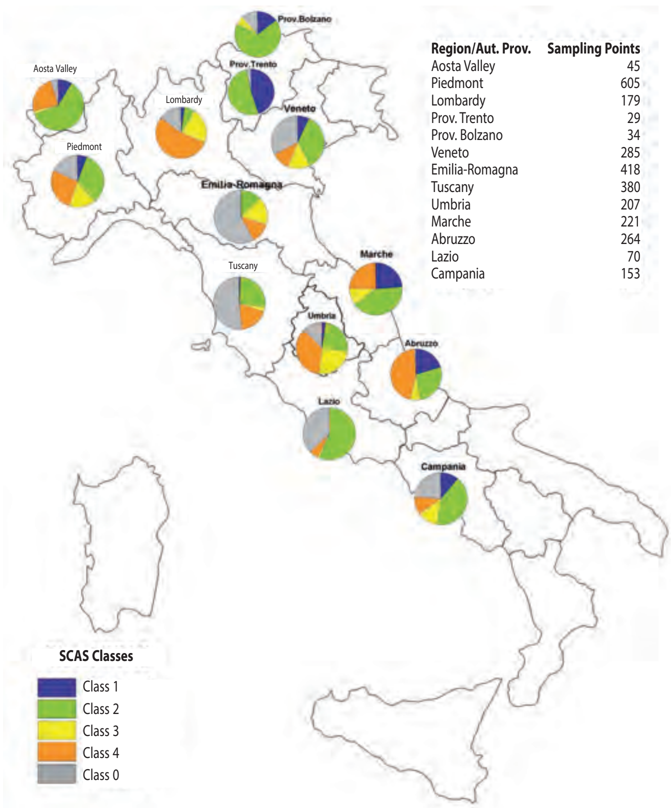


Figure 4.8: The quality status of underground water bodies on the regional level (2,890 points monitored – 11 regions and 2 autonomous provinces) (2007) [10]

The waters of the Venice Lagoon constitute a case apart. For these waters, which belong to an especially valuable ecosystem, and one subject to marked anthropogenic pressures, objectives of coastal water quality were set in the Inter-Ministerial Decree of 23 April 1998 ("Ronchi-Costa"). These objectives do not repre-

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

[10] Source: Regions, Autonomous provinces and ARPA/APPA data processed by ISPRA/ARPA Emilia Romagna

sent 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 restoration of the Lagoon.
In setting these criteria, a variety of different factors must be taken into account, including the different types of contaminants involved. The first priority is to guarantee that pollutants do not accumulate 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[11]) of synthetic origin, which tend to last for lengthy periods in water-based environments.
An obvious reference for the formulation of objectives of quality is the environmental condition of comparable areas where anthropogenic influxes are negligible. As for the substances present naturally in the environment (macro-constituents, metals etc.), reference can be made to the background values, meaning, in this case, the waters of the Adriatic Sea, which replenish the Lagoon. In this way, the range within which a quality objective may be set for the lagoon environment has a lower limit consisting of the figures taken from the reference environments or the background values 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 introduced two values as objectives for the Venetian Lagoon: the “guide” value, which can be compared with the background situation, and the “imperative” 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. Furthermore, the “Ronchi-Costa” Decree has set a single value as the objective for the entire Lagoon, without any distinction between imperative and guide values, thus ignoring considerations on the different lagoon settings and their specific designated uses.

[11] Persistent Organic Pollutant

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.

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 polychlorobiphenyls.

For this reason, the Decree of 23 April 1998 set imperative 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.

Refinement of monitoring techniques.

The main causes of alteration

Water is a resource 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 sectors of energy, agricultural and livestock.
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 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 devel-

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

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

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

opment. A further difficulty is monitoring industrial discharges precisely, as well as the lack of awareness of such problems on the part of some operators in the various production sectors.
Of particular note, from this prospective, is the absence of a full national information framework on 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 runoff from sealed soil in urban areas and in zones falling within the range of small-scale industrial and service activities.
The intensive use of fertilisers in agriculture (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 potentially have an impact on water life, in addition to modifying the quality of both surface and underground drinking water.

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.

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 result in increasingly elaborate and complex policies, seeing that the objectives to be reached call for integrated initiatives on different levels.

On the national level, the key planning instrument for formulating strategies of action regarding water is the Water Defence Plan (PTA) drawn up by the regions, in accordance with art. 121 of Legislative Decree 152/06. This specific sector plan has to contain not only initiatives designed to guarantee the achievement or maintenance of quality objectives, but also the measures needed to defend the levels of quality and quantity of the water system.

The Water Defence 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.

Approval of this plan by the regional governments (art. 44 of Legislative Decree 152/99), together with the first characterisation of significant watersheds and the classification of the environmental status of surface and underground waster bodies, based on the monitoring carried out under Legislative Decree 152/99, have made it possible, to date, to obtain excellent knowledge of the status of water resources.

The current national situation, in terms of Defence Plans, consists of six plans that have been implemented (Veneto, Liguria, Marche, Campania, Apulia and Sicily) and eight plans that have been approved (Aosta Valley, Piedmont, Lombardy, the Autonomous Province of Trento, Emilia Romagna, Tuscany, Lazio and Sardinia).

To date, 6 PTAS have been implemented and 8 have been approved.

With its Decree no. 3243 of 2004, the government of the Autonomous Province of Bolzano approved a “separate plan for limiting drainage basins in sensitive areas”.

Finally, the Umbria Regional Government approved preliminary passage of a Protection Plan with its Resolution no. 1175 of 16 September 2008.

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

In terms of planning and management tools for the defence of aquatic resources, the legislation required that the regional governments present programs of measures for water bodies used for drinking, in order to ensure a constantly increase water quality.

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

The measures undertaken by the regions consist primarily of works meant to maintain and upgrade the systems for collecting and purifying waste water; poor management of such facilities represents one of the main causes of the pollution of drinking water. In order to be used or allocated for the production of drinking

Decrease in the number of water bodies subject to improvement.
Increase in the programs of measures.
Sardinia the region with the highest level of critical problems.

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); subclass 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, assuming there is no threat to human health).
Monitoring for 2005/2007 showed a decrease from 78 to 60 in the number of water bodies used for drinking supplies and subject to improvement. Still, the number of programs of measures presented rose from 110 to 130. The region that presented the greatest number of programs was Sardinia (47), followed by Lombardy (26), Tuscany (22) and Veneto (14).
The elevated number of programs presented by Sardinia was due both to the presence of the greatest number of water bodies classified sub A3 (making it the region with the highest level of critical problems involving quality) and to the virtuous approach of the Regional Government, which procured the funds for the activities in question. The other regions with water bodies sub A3 are Liguria and Emilia Romagna.
Given that the official classification of water bodies used for drinking supplies has still not been published by the Ministry of Health, only those water bodies for which the regional governments drew up programs of measures in the three-year period 2005-2007 have been considered for this edition, meaning that not all of the classified water bodies nor all of the water bodies subject to improvement are included.

The monitoring for 2005-2007 shows a large number of water bodies classified as sub A3 in Sardinia, the region with the most critical problems, followed by Liguria and Emilia Romagna.

Table 4.2: Number of water bodies for drinking supplies subdivided by categories, and for which programs of measures have been implemented (2005-2007) [12]

Region/Autonomous Province	A1	A2	A3	Sub A3	Number of water bodies subject to improvement	Programs of measures (three-year period 2005-2007)
Piedmont	0	0	4	0	4	4
Aosta Valley	0	0	0	0	0	0
Lombardy	2	6	1	0	9	26
Bolzano Bozen	*0*	*0*	*0*	*0*	*0*	*0*
Trento	*0*	*0*	*0*	*0*	*0*	*0*
Veneto	0	0	3	0	3	14
Friuli Venezia Giulia	0	4	0	0	4	4
Liguria	0	0	3	2	5	6
Emilia Romagna	0	0	1	2	3	5
Tuscany	0	0	18	0	18	22
Umbria	0	0	0	0	0	0
Marche	0	0	0	0	0	0
Lazio	0	0	1	0	1	2
Abruzzo	0	0	0	0	0	0
Molise	0	0	0	0	0	0
Campania	0	0	0	0	0	0
Apulia	0	0	0	0	0	0
Basilicata	0	0	0	0	0	0
Calabria	0	0	0	0	0	0
Sicily	0	0	0	0	0	0
Sardinia	0	0	0	13	13	47
TOTAL	**2**	**10**	**31**	**17**	**60**	**130**

Programs of measures have been presented by 9 regions: Piedmont, Lombardy, Veneto, Friuli Venezia Giulia, Emilia Romagna, Tuscany, Liguria, Lazio and Sardinia (130 programs regarding 60 water bodies) (Figure 4.9).
The programs of measures implemented in the three-year period 2002-2004 did not achieve the objective of improving the water bodies involved. In fact, for the three-year period 2005-2007, the classifications of these water bodies remained unchanged. Only following completion of the works underway will it be possible to note an improvement.

[12] Source: Regions and the Autonomous provinces data processed by ISPRA

130 improvement projects were presented by 9 regions regarding 60 water bodies. Based on the monitoring for 2005-2007, application of these programs (2002-2004) has not reached the objective of improving quality.

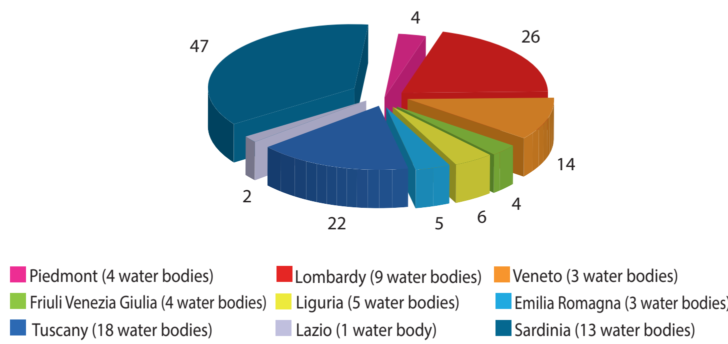


Figure 4.9: Programs of measures presented and number of water bodies subject to improvement[13]

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

Another response instrument for protecting water quality is represented by the improvement programs of the regions for the recovery of sites not suitable for swimming.
The 2006 monitoring, performed on waters earmarked for swimming, regarded 5,265 sites, breaking down into 4,724 points for marine waters, 534 for lakes and 7 for rivers. In 2005, the number of sites classified as unsuitable for swimming was 147, while the number stood at 256 for 2006.
This worsening of the situation for all the categories of unsuitability identified under Presidential Decree 470/82, with the sites classified as unsuitable on the basis of arts. 6, 7.1/A and 7.1/B rising from 126 to 191, while those classified as unsuitable on account of insufficient monitoring (art. 7.2) went from 21 to 65 (Figure 4.10).
The decision on suitability for swimming is reached prior to the start of the swimming season, based on the monitoring carried out during the previous year.

[13] Source: Regions and the Autonomous provinces data processed by ISPRA

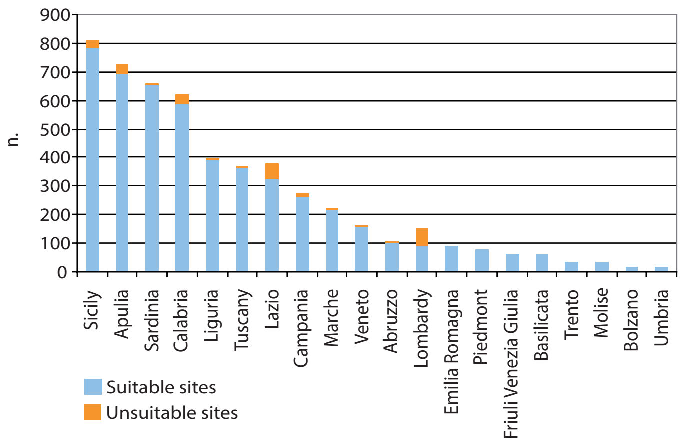


Figure 4.10: Sites unsuitable for swimming out of the total sites monitored (2006) [14]

The improvement programs for the restoration of sites unsuitable for swimming are another instrument of response.
The 2006 monitoring, carried out on waters earmarked for swimming, regarded 5,265 sites, breaking down into 4,724 points for marine waters, 534 for lakes and 7 for rivers. The unsuitable classification was given to 256 sites.

With regard to the measures of improvement implemented for the restoration of zones unsuitable for swimming, the regional governments have sent in programs for 112 sites.
In 2006, the programs and the information presented by the regional governments decreased compared to the previous year (from 159 to 112), as did the number of sites recovered, which went from 219 in 2005 to 66 in 2006. Overall, the total number of sites to be recovered, including those of earlier years, is 719. The reason for the small number of sites recovered each year and the large number still to be recovered is the lengthy periods of time needed to implement the measures.

In 2006 the number of programs presented by the regional governments decreased.
Only 66 sites were recovered for swimming.

Data are also available on the portion of Italian coastal waters controlled suitability for swimming (Figure 4.11). These controls show the variations in the length of coastal waters suitable for swimming as a result of temporary bans due to pollution in areas where reclamation measures are to be carried out in order to restore suitability for swimming.

Control of the coast.

[14] Source: Ministry of Labour, Health and Social Policies data processed by ISPRA

Based on the monitoring performed in 2007, between 2006 and 2007 there was an increase of approximately 28.8 km in the length of coastline suitable for swimming (from 4,941.4 in 2006 to 4,970.2 in 2007).

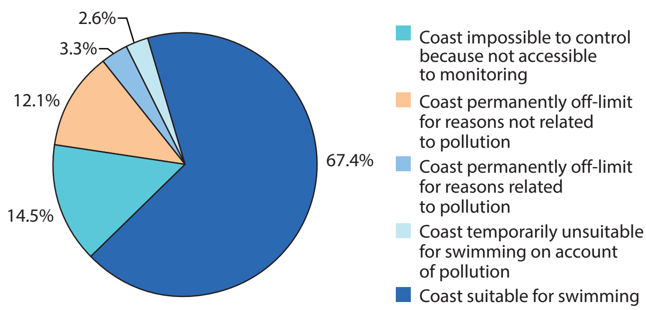


Figure 4.11: Control of swimming with regard to the full length of the coast (2007) [15]

Compared to 2006, the percentage of the total coastline suitable for swimming showed a small increase of 0.34%, corresponding to approximately 29 km. This was due, at least in some cases, to the implementation of programs of improvement resulting in the recovery of portions of coastline previously off-limits for swimming. An analysis of the controls for 2007 also points to a slight decrease in the portions of the coastline temporarily off-limits to swimming. The overall picture confirms the successful implementation of a legislative tool of proven effectiveness, following a noteworthy period of application.

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

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.

[15] Source: Ibidem

Compared to 2005, it has been possible to extend the assessment of compliance to treatment and sewage systems serving smaller agglomerations as well. Nevertheless, the national reference framework for 2006 is not complete, seeing that the ISPRA (formerly the APAT) has received information on only 14 regions, plus the autonomous provinces of Trento and Bolzano.

In 2006, assessment of compliance was extended to the purification and sewage systems of smaller size agglomerations.

In 2006, though all the information necessary for a complete overview has not been transmitted, the nationals level of compliance of purification systems was 76% for agglomerations with waste-water discharges located in normal areas and 70% for those discharging waste water in sensitive areas or drainage basins; with regard to sewage systems, the respective figures for compliance were 82% and 96%.

Though the overview of national compliance is not complete, the figures for purification systems were 76% in normal areas and 70% in sensitive 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).

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.

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.

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.

With reference to 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 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.

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

Of the measures undertaken to protect the Venice Lagoon, the systematic continuation of the monitoring of lagoon waters by the Waters Magistrate is definitely worthwhile. This 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.

A integrated and sustainable operating strategy.

The European strategy for the sustainable use of water resources has led to noteworthy changes in Community and Italian legislation. In order to complete the progress made by transforming the EU directives into Legislative Decree 152/06, further measures are planned. The recently issued Ministerial Decree 131/2008 regards the technical criteria for categorising and identifying water bodies and for analysing pressures and impacts. Once the European Community measures have been fully transposed into Italian law, it shall be possible to obtain data and information that can be used to describe water quality, potentially by means of new biological indicators.

CHAPTER 5

EXPOSURE TO PHYSICAL AGENTS

Noise
Electromagnetic Fields
Ionising Radiation

Introduction

A physical agent is by definition the element that, governed by the laws of physics, brings about a change in the environmental conditions of the context in which it is exhibited. Its presence in living and working environments determines the energy that is emitted and which is potentially detrimental to human health. Physical agents that effect the environment are electromagnetic fields, environmental noise and noise inside working places, ionising radiation, vibrations, light pollution and UV (ultraviolet) radiation.

Noise pollution is characterized by widespread and an elevate impact on the environment, on eco-systems and on the population. The bothersome or disturbing effects it causes have been well-documented and are such that the European Community has been persuaded that reducing the number of people living its member states exposed to noise must be a primary objective achievable by specifying the methods and instruments to be adopted to quantify and manage noise levels. The detailed legislation on this subject and the existence of measures devoted to preventing or reducing noise levels, have not however resolved an environmental issue that remains a priority.

There is still greater social concern about electromagnetic pollution however, and the effect it is feared it has on human health despite the fact that at national level, the risk connected with prolonged exposure is considered to be low, in part because cause and effect between exposure to electric, magnetic and electromagnetic fields and any subsequent consequences to health has not been established. Legislation regarding this sector has also resulted in specific regulations aimed quite clearly at safeguarding the individual.

Ionising radiation consists of particles and/or energy of natural or artificial origin able to modify the structure of the matter with which it interacts.

Interaction with biological tissue can result in possible cell damage, in the form of morphological or functional alterations to the organs concerned, as well as medical consequences that can be clinically observed in individuals that have suffered exposure. Although there are no nuclear plants in operation in Italy, the pressure on the environment caused by ionising radiation continue to

A physical agent is that element, that governed by the laws of physics, brings about a change in the environmental conditions in which it exists.

Noise pollution is characterized by widespread and an elevate impact it has on the environment, on eco-systems and on the population and is significant enough to induce the EU to pursue as an objective, the reduction of the number of people exposed to noise.

There is still greater social concern about electromagnetic pollution and its effects on human health.

Ionising radiation consists of particles and/or energy of natural or artificial origin able to modify the structure of the matter with which it interacts. Interaction with biological tissue can result in possible cell damage, in the form of morphological or functional alterations to the organs concerned, of those who have been subjected to exposure.

be both relevant and numerous: the production and necessary treatment of radioactive waste brought about by diagnostic and/or radiotherapy procedures carried out in hospitals, the growing production and worldwide circulation of radioactive materials and radiation of natural origin (radon and NORM) which continue to constitute the main source of exposure, call for radiation-protection capacity to remain a key element of the environmental safeguards and the protection of the population and workers. The risks, deriving from a decrease in the attention and the capacity to control the levels of radioactivity in the environment and in foodstuffs, could inevitably lead to uncontrollable social and economic situations.

Less attention is paid, by both the public at large and legislators, to other agents, and this would seem to be because the impact they have on man and the environment is perceived differently or as being less significant. Vibrations, for example, disturb an extremely limited percentage of individuals and only in very specific situations (the proximity of certain types of transport infrastructures) and light pollution does not create any easily apparent discomfort to the individual. UV radiation warrants separate consideration as the health implications are particularly noticeable in terms of the damage excessive exposure this type of radiation causes to the skin and to the eyes. With the exception of occupational exposure to UV rays emitted by artificial sources, exposure to the Sun, the most significant natural source of such rays, has not yet been formally regulated. Both national and international institutes confine themselves to merely recommending, in opportune notices published in the press, what protective measures should be taken and to providing bulletins about UV levels. These use a number scale to indicate the risk factor incurred by direct exposure of the skin to the sun's rays relative to the subsequent short term effects such as irritation (common sun-burn). The information included suggests the use of protection (sunglasses, protective clothing, creams etc.) and maximum exposure time according to skin type (phototype) and the health risks incurred by an individual are not stressed at all. When it comes to long-term effects (skin cancers and malignant melanomas), these cannot be avoided altogether, but they can be limited by

The medical consequences of being exposed to UV radiation are particularly evident when it comes to the damage this causes to skin and eyes. To date, no actual laws have been passed to regulate exposure to the sun which is the main natural source of this type of radiation.

minimising exposure as much as possible (and, for melanomas, the number of times an individual suffers sunburn).
In any event, it must be borne in mind that corrective measures on this point would be difficult to impose in that these would impinge on an individual's habits and limit personal behaviour that is, conversely, a source of satisfaction (for example tanning in the summer or artificial tanning).

NOISE

The problem

Noise pollution is one of the most significant environmental problems of all and is such that the European Community has identified reducing the number of people exposed as a priority objective.

Having identified noise pollution as one of the most significant environmental problems, reducing the number of people exposed to noise levels believed to have a detrimental effect on the quality of life and health of its citizens is now the European Community's main objective.
The data relating to the percentage of the population exposed to noise levels high enough to create annoyance or disturb reveals that the number of people exposed is indeed significant.
European Directive 2002/49/EU relating to the assessment and management of environmental noise, transposed into Italian legislation with Legislative Decree no. 194/2005, defines the methods and indicators by which noise pollution can be measured and managed in order that that the data from all member states is produced and provided in a comparable and uniform manner.
Creating harmonization between the national legislative tools and the methods adopted by the Community is the main task to achieving the unequivocal identification of the methods and tools to be used in the planning and management of environmental noise pollution.

It is obvious that the general public is extremely concerned about personal and environmental safeguards: 79 out of 100 complaints are made by the public and of these, 49% of the noise sources reported prove to exceed permitted limits.

The control activities carried out by the Environmental Agencies System, performed primarily in response to complaints presented by citizens, demonstrate an increased concern with this environmental issue, and at the same time confirm that the legal limits are not only succeeded but in many of the situations reported, even reach critical levels. Out of 100 controls performed, 79 result from complaints made by citizens, in percentages that vary among the different sectors: 86.3% of

these cases involve service or commercial operations and 27.8% transport infrastructures. 47% of the noise sources reported by citizens prove to exceed the permitted limits showing that the situation is indeed critical .
The data shows the type of noise sources that citizens find particularly disturbing. Of the 3,614 sources checked, the greatest number, namely 48.2%, deal with those produced by commercial and service activities, followed by productive activities that account for 35.4% and roadway infrastructures at 9.7% (Figure 5.1).

The noise sources checked and that the general public find extremely disturbing relate to commercial and service activities (48.2%) productive activities (35.4%) and roadway infrastructures. (9.7%).

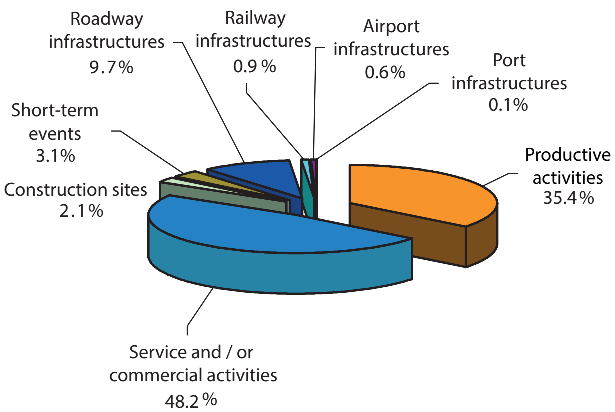


Figure 5.1: Distribution of the sources controlled (3,614) amongst the different types of activities/infrastructures (2007) [1]

The main sources of noise

The main sources of noise, identified as road, rail and air traffic, have all registered a general increase in volume, with distinctive characteristics of the rise that are linked to individual sources. Data pertaining to airport traffic in particular showed a percentage variation of +16.8% in 2007 compared to 2004, whilst motorway traffic registered a percentage increase of approximately

The main sources of noise that have registered an increase in volume have been identified as road, rail and air traffic.

[1] Source: ARPA/APPA data processed by ISPRA
Note: No data is available on the autonomous province of Bolzano or the regions of the Veneto, Lazio, Molise and Campania.

61% between 1990 and 2007. As far as passenger rail traffic is concerned, 306 million trains-km travelled on the State Railway system in 2006 (up 2.5% on 2004), whilst rail freight accounted for 65 million trains-km (up 3.4% on 2004).
The requirement for those bodies responsible for running transport infrastructures to draft Noise Reduction and Abatement Plans, as set out in the Ministerial Decree of 29 November 2000, does not yet appear to have been carried out by all those concerned, although during the course of the previous year many of them have presented the studies that they have undertaken.
The increase in the above-mentioned pressure factors, combined with the shortcomings in the legislation plus the lack of synergy and forms of dialogue between the principal players, is an obstacle to the determination of an organic and shared definition of the action to take.

Shortcomings in the legislation and the lack of dialogue between the principal players create an obstacle to an organic definition of the action to take.

Vehicle traffic represents the main source of urban noise pollution, though other sources should not be forgotten, such as: industrial and small-scale production activities, commercial activities with all their related plants and systems (air conditioning, refrigerators etc.) and discotheques, that have a notable impact on their immediate surroundings.

Actions to limit noise pollution

The existing situation is characterised by the fragmented efforts made to prevent and mitigate the effects of noise pollution, the lack of a coherent approach to legislation and the lack of coordination between those involved. The inconsistencies are evident when comparing different sectors characterised by an articulated number of actions such as transport infrastructures and other sectors that are paid insufficient attention such as construction, territorial and acoustical planning, communications and education on environmental issues.

There continues to be a situation that is characterized by the fragmented efforts being made, the lack of a coherent approach to legislation and the lack of coordination between those involved.

Other factors to consider in the present situation are the undertakings set out in Community regulations regarding new tools specifically designed to manage noise pollution, the introduction of new noise indicators, the attention now being paid to the issue of providing information and the participation of the public at large.

Many initiatives have been formulated in response to the critical state of affairs described. The national lawmaking corpus is close to completion, with the passing of Framework Law no. 447 of 1995 which embodies the obligations stipulated in European Directive 2002/49/EC. The system currently in force, completed by regional laws of transposition, sets out elaborate regulatory measures for specific sources and noise-producing activities. It reveals however that there are considerable inconsistencies in terms of its actual implementation status by the various sectors and in the different territorial contexts.
The institutional activities carried out by the Agency System have been intensified in response to the increased demands of the general public. Initiatives are underway to raise the awareness of local government bodies aimed at achieving an accurate and conscious management of preventative measures such as the acoustical classification of municipal territories, and of mitigation, such as the abatement plan, capable of ensuring that all development is acoustically compatible with the territory. Regrettably however, it must be noted that there has been a contradictory response by local administrations, as although some territorial situations are functioning, others are totally inadequate.
Analysis of the data regarding the fulfilment of the required procedures prescribed by the laws governing the different sectors, shows that in comparison to previous years, the situation in 2007 was stagnant, with little having been done to tackle the current state of affairs. In particular, the fact that many individual regions have failed to pass laws containing measures to deal with noise pollution, as established by the Framework Law, underlines the inadequacy of the response and a fragmentation that characterises the state of affairs at national level. Based on the available data, there are five regions that have not yet passed such regional laws: Molise, Campania, Calabria, Sicily and Sardinia. It should be noted that often, deliberations by Regional Administrations have resulted in measures that deal with individual procedural matters, such as guidelines regarding the drawing up of an acoustic classification or the procedures for certifying an acoustic technician, and these circumvent the lack of a systematic approach at regional level. Regarding acoustical classification, the main tool for establishing how the territory should be used and, therefore the priority initiative in terms of abatement measures, the percentage of

Initiatives are underway to raise the awareness of local governments aimed at encouraging preventative measures.

Unfortunately, it must be noted that there has been a contradictory response by local administrations, as although some territorial situations are functioning, others are totally inadequate.

Acoustical classification of a municipal area, the main tool in the preventative process, is not evenly used across the entire country and the frequent failure to explain its usefulness means that the population concerned does not receive accurate information.

By 2007, the equivalent of only 35% of all Italy's municipalities had approved acoustical classifications: Marche (94%), Tuscany (88%), Liguria (85%), Piedmont (69%).

Italian municipalities to have approved this classification was equal to 35% in 2007 showing a slight increase over the 31.5% in 2006, while the percentage of the resident population in municipalities that have approved such zoning was 46.4%, compared to 40.8% in 2006. There are notable distinctions in the different regional situations: in the Marche, 94% of municipalities have approved acoustical zoning plans, 88% in Tuscany, 85% in Liguria and 69% in Piedmont whilst the 1% in Sicily, 2% in Abruzzo and 3% in Sardinia are extremely low percentages indeed. Available data shows that in Friuli Venezia Giulia, five municipalities have approved a zoning plan, but following an appeal made by a private company, the TAR (Regional Administration Court) overturned the zoning resolution passed by one of these on the basis that it was passed prior to the issuing of regional criteria and this rendered the implementation of the zoning plans passed by

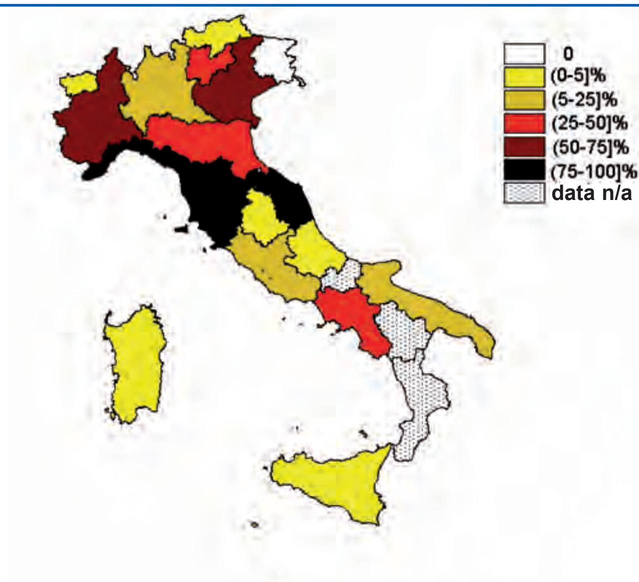


Figure 5.2: Percentage of municipalities that have approved acoustical classifications out of the total number of municipalities for each region/autonomous province (2007) [2]

[2] Source: ARPA/APPA data processed by ISPRA

the other four municipalities impossible. At national level, the territorial surface now encompassed by zoning plans approved by local councils has reached 32% compared with 27% in 2006 (Figures 5.2, 5.3, 5.4). With the exception of Marche, (the only positive note) where 94% of municipalities now have zoning plans compared with a mere 30% in 2006, all the other regions with active preventative policies in place for some time show only a slight percentage increase in both the number of municipalities that have approved acoustic classification and the percentage of population resident, as well as the percentage of the municipal territory included in a zoning plan. A negative note arises from the verifiable territorial differences and contrasts and the realization that some thirteen years since the passing of the Framework Law on noise pollution, the principal means of acoustic prevention and planning is not yet a tool that has been evenly adopted throughout the entire national territory. Its effectiveness is often not publicized and as a result, the population concerned does not receive accurate information.

With the exception of Marche, where 94% of municipalities have zoning plans, there has been only a slight increase in the number of such plans in all other regions.

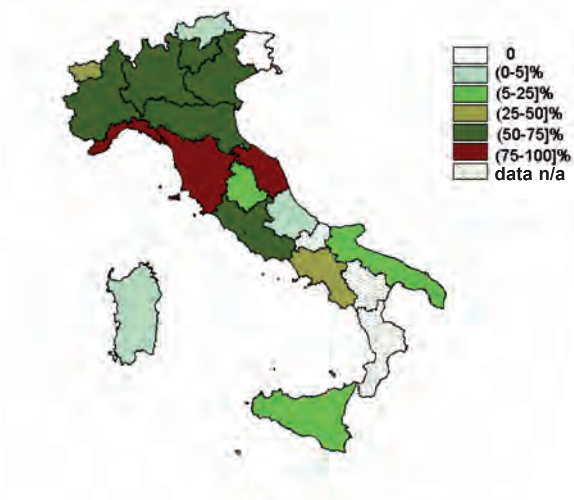


Figure 5.3: Percentage of the population residing in municipalities with an approved acoustical classification out of the total population of each region/autonomous province (2007) [3]

The percentage of the population resident in municipalities that have approved zoning plans reached 46.4% in 2007, showing an increase in respect of the previous year.

[3] Source: ARPA/APPA data processed by ISPRA

The percentage of the territorial surface area of municipalities that have approved classifications is 32%, compared with the 26.3% in 2006.

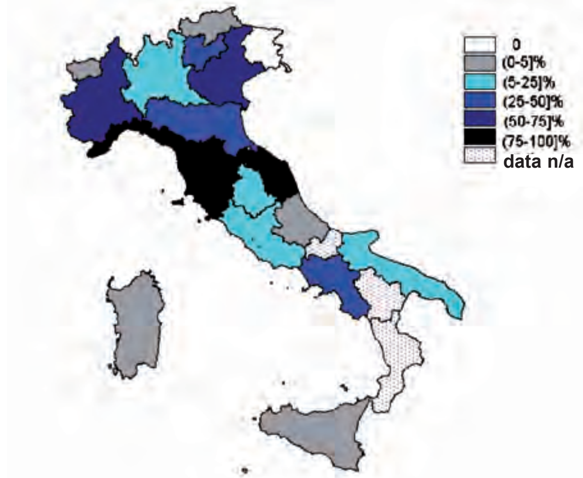


Figure 5.4: Percentage of the territorial surface area of the municipalities that have approved acoustical classifications out of the total surface area of the municipalities in each region/autonomous province (2007) [4]

The obligation to draw up a report on the acoustical status of municipalities at two-year intervals, as established by Law 447/95, an important act for the analysis and management of the problem of noise pollution at municipal level, 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, that are therefore required to draw up a report, as of 2007 only 21 had approved a report on their acoustical status. Tuscany, with 11 out of 12 compliant municipalities, has produced the most reports, followed by Lombardy, with 4 out of 14. Implementation of the municipal noise abatement plan, as called for under Law 447/95, is not widespread and undoubtedly suffers from insufficient use of other instruments of acoustical planning, such as the municipal acoustical classification, and the failure to pass regional laws on the subject. The available data show that 47 noise abatement plans were adopted, with the highest concentrations in two regions: Tuscany, with 38, and Emilia Romagna with 4.

[4] Source: ARPA/APPA data processed by ISPRA

In 2007, the acoustical classification of the areas surrounding airports, called for under Law 447/95 on the subject of airport noise, was carried out by only 10 of the 39 main national airports although these are being elaborated/evaluated in a further 13 airports at this time.
There are distinctions in the abatement measures that managers/owners of transportation infrastructures are required to take under the Framework Law: in the case of railways and the vast majority of motorways, studies were completed on the critical problems presented within their respective infrastructure networks, and an initial series of mitigating actions has been drawn up and programmed, whilst similar efforts for roadways and airports are decidedly behind schedule.
In this current phase, concentrating efforts on the harmonisation and co-existence of methods and instruments introduced by both Community and national legislation to prevent and mitigate noise pollution is what is required, highlighting the conflicts and critical aspects of the situation and defining the solutions to be adopted, so that existing legislation is rendered effective. In light of the information provided above however, the general expectation is that this is unlikely to happen.
The instruments used in the prevention, planning and abatement processes contained within national laws must be made more effective and incisive. This can be achieved by fully enacting the undertakings set out in European Directive 2002/49/EC, in synergy with other initiatives introduced through community regulations.

At present, only 10 out of 39 airports have an approved acoustical classification, the main tool used in planning for airport noise.

Noise abatement and reduction measures regarding railways and motorways is underway, whilst airports and roadways are behind in the drawing up of plans to contain and abate noise.

ELECTROMAGNETIC FIELDS

The problem

A significant environmental issue that has become a more pressing part of our reality in recent years is undoubtedly the presence of electromagnetic fields (EMF) and their relationship with both the territory and the population.
The continual development of new telecommunications systems and the intensification of the electricity transmission network that result from the increased demand for electric energy, certainly bring about an improvement to the quality of life but they also often cause environmental problems, and with the risk of conflicts between the general public and the institutions, with can lead to social problems.

The prolonged exposure to electromagnetic fields is believed to be potential dangerous.

This predicament, made worse by the public perception that it could be a health risk, must be tackled in a coherent, clear and transparent manner if pointless panic, a response that current medical knowledge would deem unjustifiable, is to be avoided.
As of today, despite the huge strides made to safeguard public health, both in terms of the legislation passed and in technical-scientific expertise, there continue to be heated social clashes between the public and consumer associations on the one hand, and those running the plants on the other, with local government administrators caught in the middle, often along with the control agencies that act as mediators and provide the public with support, without however, losing sight of the rights of plant owners.

The main EMF sources

The sources of electromagnetic fields can be divided into two main categories: low frequency fields (0-300 Hz) or ELF (Extremely Low Frequency) fields, essentially caused by 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 and high-frequency fields (100 kHz - 300 GHz), or RF (Radio Frequency) fields, caused by radio and telecommunications plants (radio, TV, mobile, radar).
In terms of radio and television plants (RTV) and radio base stations (RBS), the environmental impact, meaning electromag-

netic emissions evaluated according to violations of the limits permitted by the prevailing legislation, show respective increases of approximately 6% and 17% between 2006 and 2007. These percentages were calculated, for those regions that supplied complete data, by analysing data from the EMF (Electromagnetic Fields) Observatory.

Analysis of the data regarding the density of RTV and RBS plants (Figure 5.5) shows that the density of the RBS plants is roughly double that of RTV plants (respectively 0.29 and 0.13 plants per km^2), whilst the density of RBS sites (0.16 sites per km^2) is around five times higher than RTV sites (0.03 sites per km^2).

Between 2006 and 2007, there was a recorded rise in violations of limits by both RTV and RBS plants of +6% and 17% respectively.

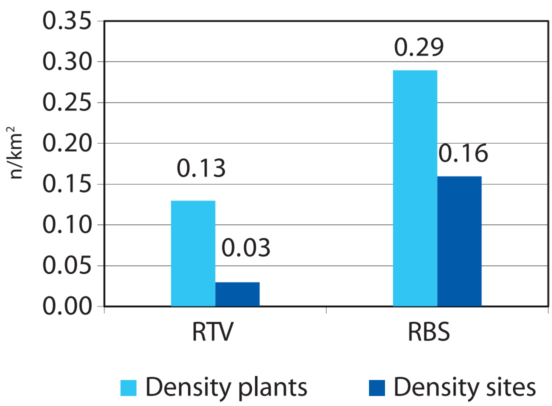


Figure 5.5: Density of plants and sites, a comparison of RTV and RBS for the regions for which full results are available (2007) [5]

It can be seen that the density of the RBS plants is roughly twice that of the RTV plants. There is a similar situation regarding the density of sites as the density of RBS sites is five times higher than the RTV sites.

In terms of the overall power of RTV and RBS plants (Figure 5.6), it is clear that the most significant environmental pressure produced by electromagnetic fields is generated by radio and television plants; in fact, the total RBS power (1,971 kW) is only around 25% of that generated by RTV plants (7,957 kW). The overall lower power levels associated with RBS plants in compar-

[5] Source: ISPRA/ ARPA/APPA (EMF Observatory) data processed by ISPRA

ison to RTV plants means that RBS sites create, as previously highlighted, greater territorial pressure than RTV sites and this is so that the territorial coverage needed to provide a mobile phone service can be guaranteed.

The most consistent form of environmental pressure is caused by RTV plants that are overall four times more potent than their RBS counterparts.

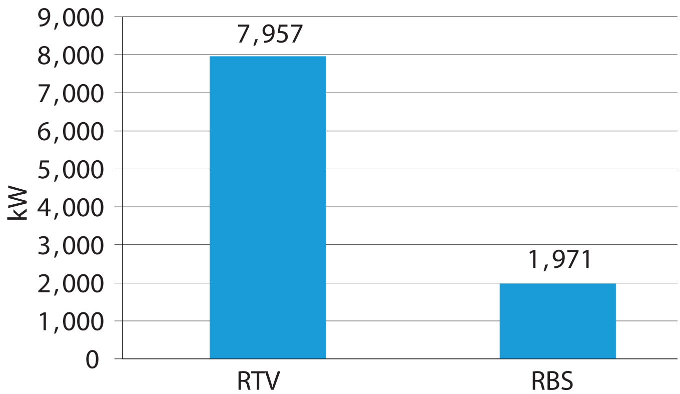


Figure 5.6: Total power, comparison between RTV and RBS for regions for which complete results are available (2007) [6]

In this context, another significant source of pressure is that created by high and extra-high voltage power lines (Figure 5.7).
Based on the regions that have provided complete data for the years 2006 and 2007, it can be seen that there has been a 27% increase in the number of 200kV and a 2% increase in the number of 380kV power lines. In contrast, there has been a slight decrease, equivalent to 4%, in the number of low voltage power lines carrying less than 40kV and a slight increase, equivalent to 7%, of those carrying between 40kV and 150kV.
In 2007, medium and low voltage power lines (<40kV) accounted for most of Italy's power grid. The latter represent the final stages of the production, transmission and distribution of electric energy and are therefore present in far greater numbers than power lines carrying higher voltage electricity (the kilometres of power lines carrying >40kW represent only 5% of the total).

[6] Source: ISPRA/ARPA/APPA (EMF Observatory) data processed by ISPRA

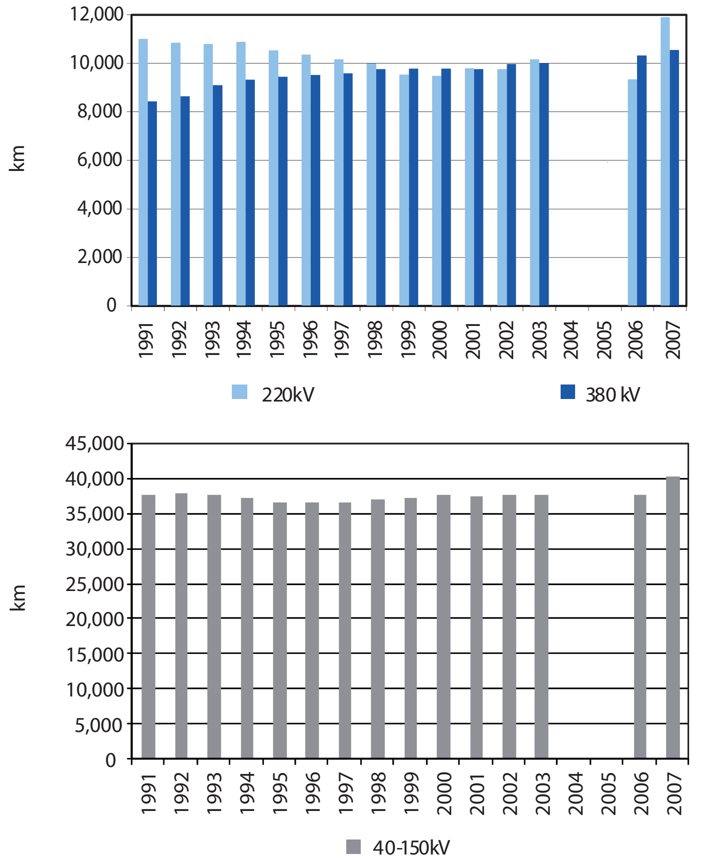


Figure 5.7: Trends in the length of high and extra-high electric power lines in Italy[7]

Between 2006 and 2007, there was the equivalent of a 27% increase in the number of 220 kV power lines and a 2% increase in those of 380 kV. There was also a slight reduction, equivalent to 4%, in the number of power lines under 40kV and a slight increase, equivalent to 7%, of those between 40kV and 150 kV.

It is important to remember that the intensity of electro and magnetic fields is, respectively, proportional to the operating voltage (which is fixed) and the electric current circulating in the conductors (which varies according to customer demand). Gener-

[7] Source: ENEL Terna, ENEL Distribution, DEVAL S.p.A. and the EMF Observatory data processed by ISPRA
Note: The data relates only to those regions that have provided full and complete information.

ally speaking, higher voltage power lines carry a greater amount of electricity and as a result, the electric and magnetic fields generated by medium-low voltage lines are, on the whole, smaller than those created by higher voltage power lines.

Actions to limit electromagnetic pollution

Carrying out controls is fundamental when they reveal that exposure limits have been exceeded.

In terms of both RTV and RBS radio frequencies and extremely low ELF frequencies, control activities are a fundamental part of the operations carried out by the responsible authorities (ARPA/APPA), and in cases where such initiatives reveal violations of exposure limits, safety levels and quality targets, those who manage or own the plants take whatever clean-up action is necessary.
Analysis of the data from the EMF Observatory shows that, between 2006 and 2007, there was a decrease in the number of preliminary assessments regarding the authorization of both RBS and RTV plants of 23% and 14% respectively. As to the number of controls, both experimental and those using models, there was 19% decrease of those relating to RBS and a slight increase, of 42%, for RTV (Figure 5.8).

Between 2006 and 2007, a reduction in the number of preliminary assessments is evident for both RBS (-23%) and RTV plants (-14%), along with a reduction (-19%) in the number of checks carried out on RBS plants and a notable increase (+42%) of those regarding RTV plants.

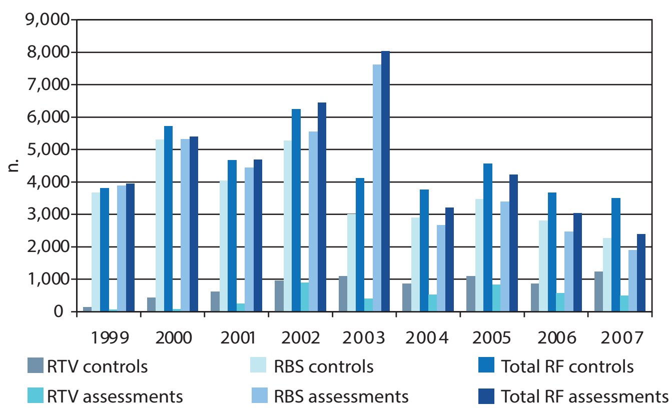


Figure 5.8: Assessments and controls carried out on RF plants in Italy, broken down by source type[8]

[8] Source: ISPRA, ARPA/APPA (EMF Observatory) data processed by ISPRA
Note: The data relates only to those regions/autonomous provinces that have provided full and complete information.

As to the number of assessments and controls regarding ELF (extremely low frequency) power lines, Figure 5.9 shows that there was a significant increase, between 2006 and 2007, in the number of assessments and the number of controls effected (both in terms of measures taken and models based on calculations), equivalent to 10.6% and 21.2% respectively.

The number of assessments carried out between 2006 and 2007 increased by 10.6% whilst the number of checks carried out increased by 21.2%.

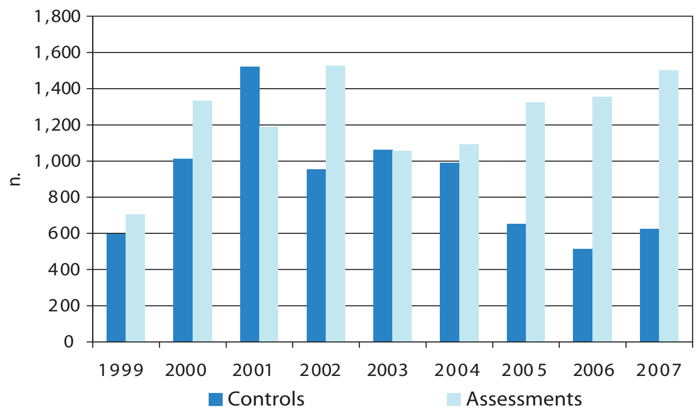


Figure 5.9: Trends in the number of assessments and controls of sources of ELF fields in Italy[9]

In terms of the clean-up initiatives undertaken to date regarding violations identified through control activities, what stands out is that from 2006 to 2007, in those regions that have all the data pertaining to those two years, there was a 7% increase in the number of RTV plants and a 25% increase in RBS plants. It is interesting to note (Figure 5.10) the differences between the two types of sources, RTV and RBS, with regard to the clean-up activities that have been completed and those still underway: for RBS plants, the difference between the percentage of completed clean-up activities and those underway is greater than that relating to RTV plants. This is due to the fact that, in the case of the RTV plants, clean-up activities are technically more complex, generally involve more plants and it frequently proves impossible to

Fewer interventions were completed on RTV plants than on their RBS counterparts because the clean-up process is that much more complex.

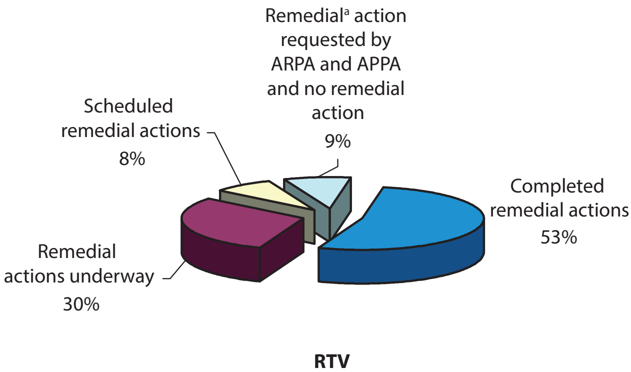
[9] Source: ISPRA, ARPA/APPA (EMF Observatory) data processed by ISPRA
Note: The data relates only to those regions/autonomous provinces that have provided full and complete information.

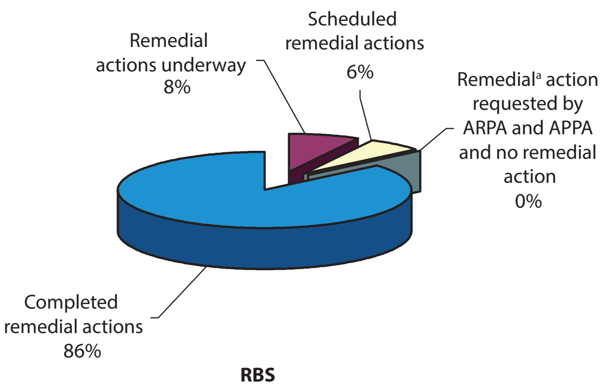
maintain the quality of service set down in the acts of concession. Conversely, in the case of RBS plants, clean-up activities generally take place immediately, are technically less demanding and costs are generally more contained.
Regions for which data relating to 2006 and 2007 is complete, also show that the number of cases of "clean-up efforts requested by regional and provincial agencies to safeguard the environment and no clean-up activities" have been reset at zero as far as RBS plants are concerned and reveal an approximate 8% reduction for RTV plants. This means that there is a marked tendency to deal with situations in which legal limits are exceeded and not to leave them unresolved.
There is, however, no information available regarding clean-up efforts relating to power lines and this is probably due to the lack of a decree of implementation of Law 36/2001 (article 4, paragraph 4) which does, in fact, set out the criteria to be used in formulating such clean-up efforts.

Italian legislation is based on the principle of precaution and in fact takes the possibility of risks related to prolonged exposure into consideration, even when this is at low-levels.

The current Italian legislative scenario pivots around the concept of "prudent avoidance", which underlines the importance of avoiding or reducing exposure to an external agent to the minimum possible should there be any doubts regarding 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 any health consequences, the practice at national level is to consider the potential risk connected to prolonged low-level exposure over time.
At present, 19 regions have regulatory measures in place in compliance with current national legislation. This, combined with a legislative framework that places a special focus on safeguarding the individual and respecting the environment (the correct urban/environmental development of plants and systems, techniques for mitigating the visual impact of the same etc.), means that public awareness remains noticeably high and shows no signs of waning, meaning that social attention to the issue continues to be elevated.

In 2007, the clean-up operations carried out on RBS plants were considerably more than those carried out on RTV plants (53%).





Note: [a] By clean-up action requested, it is those actions requested by ARPA/APPA that is intended, not those programmed by those who own the plants.

Figure 5.10: Status of clean-up activities at sites where a violation of a limit was recorded on account of RTV or RBS plants (2007) [10]

[10] Source: ISPRA, ARPA/APPA (EMF Observatory) data processed by ISPRA
Note: The data relates only to those regions/autonomous provinces that have provided full and complete information.

HIGHLIGHT BOX

Ultraviolet radiation

Ultraviolet radiation takes up the 100 to 400 nanometres (nm) range of the electromagnetic wavelength spectrum. With regard to other wavelengths, UV radiation occurs just beyond (ultra) light that is visible at a shorter wavelength perceived by the human eye to be violet in colour, hence the name "ultraviolet".
UV rays are generally divided into three spectral ranges:

- UV-C 100-280 nm: this form of radiation is completely absorbed by the ozone and oxygen present in the upper layers of the atmosphere. UV-Cs account for 0.5% of the solar energy that affects the outermost layers of the atmosphere.
- UV-B 280-315 nm: this component represents 1.5% of the solar energy that affects the outermost layers of the atmosphere. Stratospheric ozone absorbs more UV-B radiation than anything else. Thanks to the shielding effect of the ozone layer, only 10% of the UV-Bs produced by the sun reach the earth's surface.
- UV-A 315-400 nm: is the range of UV rays least absorbed by the atmosphere. It carries 6.3% of the solar energy that reaches the outer layers of the atmosphere and more than 95% of all the UV rays that reach the earth's surface.

The changes in the middle layers of stratospheric ozone and the ozone "hole" above Antarctica make studying ultraviolet solar radiation and its effects on the environment and human health ever more topical.
The study of UV radiation is carried out within two vastly different parameters:

- the UV-index, which describes the intensity of UV radiation found in shorter wavelengths that have a higher photon energy level (around 280-320 nm) and its capacity to cause skin irritation.
- UV radiation within the UV-A range which produces rays less likely to cause skin irritation but that are overall more active.

The measurements of solar UV radiation taken by the ARPA Aosta Valley are generally expressed as units of the UV index. This number, usually somewhere between 1 and 10, has been chosen as the way in which to raise public awareness of the dangers asso-

ciated with excessive exposure to the sun, according to individual skin type, and the importance of taking adequate protective measures.

Use of the UV index is recommended by important world-wide organizations such as the World Health Organization (WHO), the United Nations Environment Programme (UNEP) the World Meteorological Organization (WMO) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Exposure to the ultraviolet component of solar radiation has physiological benefits to human health – UV-B radiation is in fact fundamentally important in the endogenous production of Vitamin D3 – and also has a tanning effect that is much sought after for aesthetic reasons. That said, it should also be remembered that a tan is a defensive response by the body when faced with progressive exposure to the sun's rays, which is triggered by knowledge of the harm this causes that is inherent in the DNA contained in skin cells.

Solar radiation as a whole (ultraviolet, visible, infra-red) has been assigned group one classification by the IRAC (International Agency for Research on Cancer), or in other words, not only is it certainly cancerous to man, it is believed that it is its UV component that makes it so.

Monitoring ultraviolet radiation is particularly important in the Aosta Valley given the average altitude of the area (UV radiation increases with height), the noteworthy segment of the population that carries out activities at altitude and because of the presence of snow on the ground for much of the year which, due to its reflective potential (its albedo), effectively increases exposure to ultraviolet radiation. The ARPA Aosta Valley has undertaken a monitoring programme aimed at:

- starting to acquire a series of historic data that can be used to evaluate the medium and long term tendencies of UV solar radiation on the earth's surface as related to variations to stratospheric ozone levels.
- obtaining data that can be used to acquire a better knowledge and understanding of the interaction between the UV component of solar radiation and the atmosphere that will also lead to greater knowledge of the dynamics of photochemical smog.

• evaluating the effect of exposure to solar UV radiation on a large number of people who are for either professional or leisure purposes, involved in activities carried out at altitude.

UV radiation is measured at three locations in the Aosta Valley:
– Saint-Christophe (570 m.a.s.l.- meters above sea level)
– La Thuile - Les Granges (1,640 m.a.s.l.)
– Plateau Rosa (Valtournenche, 3,500 m.a.s.l)

These three locations represent three different environmental situations. Saint-Christophe is located on the valley floor, characterized by its lower height and less frequent occurrences of snow that settles. La Thuile - Les Granges is a typical mountain location and its higher altitude is susceptible to climatic conditions and solar radiation, which is also determined by the more extensive presence of snow throughout the year. It is also not far from the ski-area that is very busy during the winter season. Plateau Rosa, finally, is a typical Alpine glacier area that is subject to extreme climatic conditions and the presence of snow throughout the year.

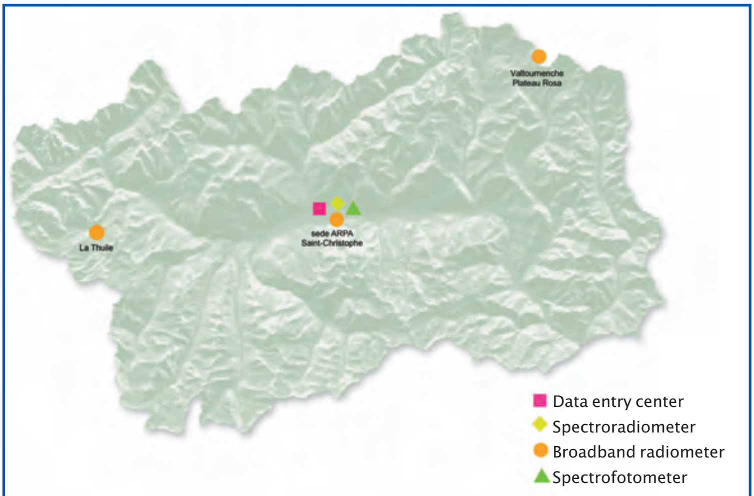


Figure 5.11: The UV radiation monitoring network of ARPA Aosta Valley[11]

[11] Source: ARPA Aosta Valley

The choice of sites in which monitoring is carried out is deliberate, made so that the so-called “altitude effect” - how UV radiation increases along with the height - can be studied as fully as possible. The reason for this effect is that sun rays passing through a thinner atmospheric layer are not absorbed to the same extent, and snow on the ground, which is highly reflective, is able to increase the levels of radiation received.

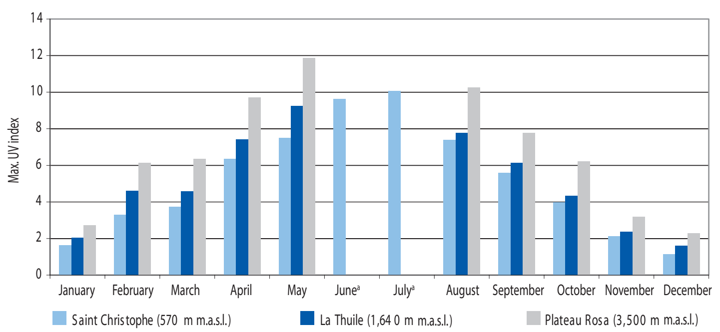


Figure 5.12: UV index, the maximum hourly value by month (2007) [12]

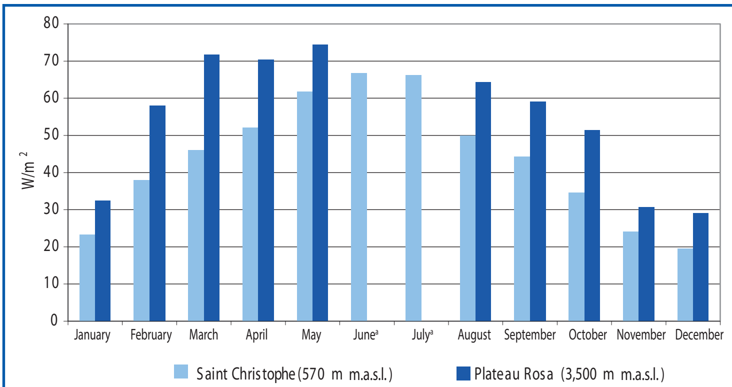


Figure 5.13: UV radiation in the UV-A range, maximum hourly value by month (2007) [13]

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[12] Source: ARPA Aosta Valley
[13] Source: ARPA Aosta Valley
[a] Note: Some radiometric values in June and July are being calibrated.

As can be seen, the annual UV index typically registers its lowest levels in Winter and the highest in Summer, in the same way as solar irradiation. Use of mathematical models makes it possible to project the measurements taken locally at the three locations throughout the entire Aosta Valley area. Below is a typical map showing the UV index forecast across the entire Aosta Valley area on a day when the skies are clear.

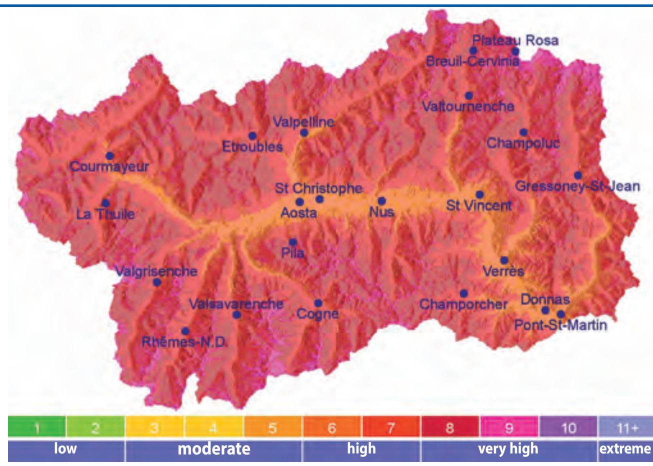

Figure 5.14: Maximum UV index forecast for a clear day in the Aosta Valley - 22/04/2008 (at 12:20 Italian summer time)[14]

The colour scale used for maps of the UV index is that established as standard by the WMO. When clear skies are forecast, the factors listed below are borne in mind as they determine the intensity of UV radiation emitted by the sun that reaches ground level:

- the inclination of the sun in respect of the vertical axis (zenith angle), that varies according to season
- the altimetrical height
- orientation of the slopes
- the amount of sky visible above the outline of the mountains, from all points of view

[14] Source: ARPA Aosta Valley

• the total amount of ozone present in the atmosphere
• the presence of aerosols in the atmosphere
• the ground's reflection coefficient (albedo) based on the presence or absence of snow.

Forecast maps are also produced on the basis of cloud cover, based initially on images received from weather satellites. As one might imagine, cloud cover is an important influence when it comes to determining the effective levels of UV radiation in each location and on a minute by minute basis. The map (Figure 5.15) is an example of one that illustrates actual levels of UV radiation, effectively updating the situation forecast for the identical time frame (same day, same time) shown in Figure 5.14 but which is based on the cloud cover present. Forecast maps are updated daily and disseminated over the ARPA's website Aosta Valley and on a portal dedicated to this topic (www.uv-index.vda.it).

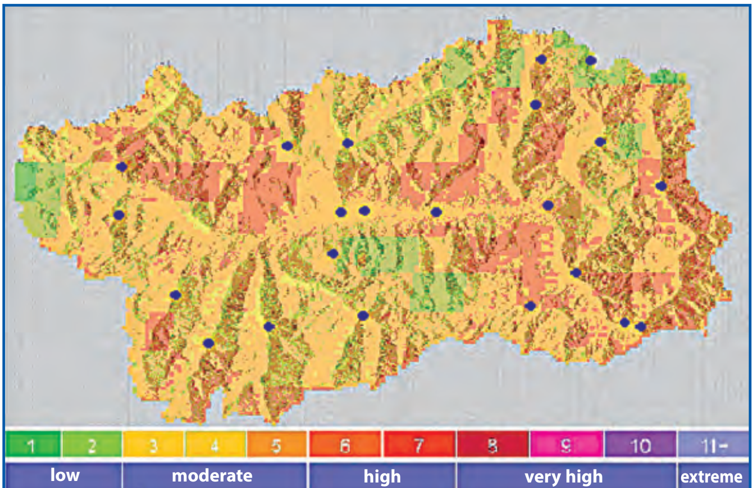

Figure 5.15: Actual UV index in the Aosta Valley, on a cloudy day - 22/04/2008 (at 12:26 Italian summer time)[15]

In addition to the monitoring and forecasting the situation regarding solar UV radiation in the environment, the ARPA Aosta Valley has also, in collaboration with the Physics Department of

[15] Source: ARPA Aosta Valley

the University of Rome “Sapienza”, carried out research into the UV exposure of individuals in a snowy location. This research project, aimed at better determining levels of exposure to solar UV radiation by skiers, was carried out in the La Thuile ski area in April 2006 and February 2007 and involved two groups of volunteers, skiers and ski instructors from the local school.
The research entailed measuring the amount of UV radiation registered by fixed instruments in specific locations (recording environmental levels) and at the same time, the amount to which skiers were exposed (recording individual levels). The instruments (radiometers), in fact, measure the radiation attracted by a fixed, horizontal surface, and by skiers who are constantly on the move and whose bodies are in a vertical position. The levels to which skiers were exposed were evaluated by means of chemical dosimeters fixed to the front part of the skiers hats in a vertical position. The dosimeters themselves were made of a tiny piece (approx. 1 cm^2) of polysolphone film, a material that has the capacity to alter its properties (photodegrade itself) and the greater the exposure, the greater the change. It is characterized by the fact that its sensitivity to change is similar to that of human skin. Skiers used a specially designed chart to record the length of time the different dosimeters were exposed and the basic details of the weather conditions at the time they were skiing: sunny, overcast or variable sunny/overcast conditions and researchers replaced the dosimeters every 2 hours. The purpose of the research was to determine the relationship between individual and environmental exposure (known as the Exposure Ratio or ER).
The results of this study highlighted the fact that skiers are frequently exposed to greater levels of exposure than their surrounding environment.
Although the average Exposure Ratio recorded was 60% in February and 102% in April, maximum levels as high as 172% were also recorded. When skiing in fact, one is exposed to UV radiation emitted directly by the sun as well as that reflected off the snow. The conclusions drawn by the research will make it possible to update some of the tables used by the World Health Organization that currently show test measurements of Exposure Ratios that are decidedly

lower (under 30%), and to introduce appropriate preventative programmes that promote safe exposure to the sun. Analysis has also determined the limitations of the current definition of the UV index as a guide to personal levels of UV exposure.
Another important variable of UV radiation is column ozone, that is to say the ozone contained within a vertical band of the atmosphere that extends from the earth's surface to the apex of the atmosphere itself. Ozone, together with oxygen, is one of the most significant absorbents of ultraviolet rays: every decrease in the amount of ozone in the atmosphere causes an increase in the amount of UV radiation that reaches ground level and consequently also increases the risk to human health.
Between heights of 15 and 50 km in the stratosphere, the ozone produced by UV rays acts as a shield against the actual UV rays themselves and is therefore of benefit to and a safeguard for the eco-system.
Stratospheric ozone accounts for 90% of column ozone, whilst the remaining 10% concerns tropospheric ozone, which is generated in the lower layers of the atmosphere by the reaction of solar rays to pollutants. The amount of column ozone varies according to the season but that variability is not symmetrical in both hemispheres, as the highest levels of ozone are to be found at higher latitudes and in winter and spring. Furthermore, the greatest amount of ozone is produced in the tropical stratosphere but is considerably less around higher latitudes and in the lower stratosphere. Meteorological phenomena also effect the variability of column ozone – a few days of low or high pressure conditions can make a noticeable difference in the measurements of ozone levels taken. The primary concern when measuring column ozone levels is the rate at which the atmosphere absorbs ultraviolet radiation emitted by the sun. The path this takes as it intersects the atmosphere passes through different heights, latitudes and longitudes before it touches the ground.
The ARPA Aosta Valley is part of a worldwide network that monitors ozone levels (www.woudc.org), and creates mathematical models so that a global map of the situation can be drawn up. There are currently two test sites in Italy that supply the worldwide network with figures, one is that used by the ARPA Aosta Valley whilst the University of Rome "Sapienza" mans the other.

The diagram that follows shows average daily column ozone levels measured in Dobson Units[16] by the Saint-Christophe test station. The two blue arrows show the minimum and maximum levels (at the bottom and top of the chart respectively) recorded there.

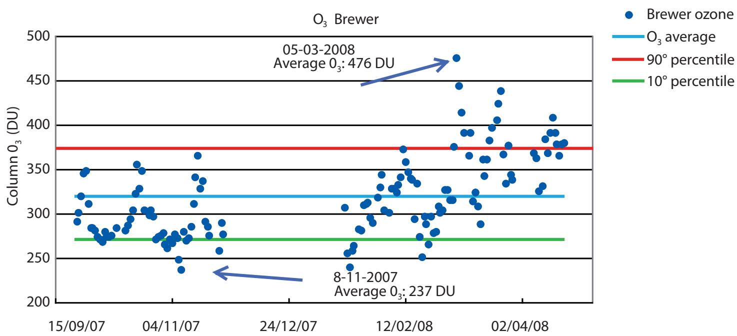

Figure 5.16: Average daily levels of column ozone recorded at the Saint-Christophe test station[17]

With a view to involving all regions in the positive outcome already experienced by the Aosta Valley and establishing, in the short term, a national network that monitors UV radiation, all regional agencies have accepted the proposal put forward by the Institute for Environmental Protection and Research (ISPRA) to set up a working group which is in fact, being co-ordinated from the Aosta Valley.
Details of the activities being carried out by these working groups can be found on a website created for that purpose and are available at www.uv-index.it

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[16] A Dobson Unit or DU, named after G.M.B. Dobson (1889-1976), who pioneerd research into stratospheric ozone, expresses the concentration of ozone in a column as the thickness of the layer that all the ozone present in a column would have if it were laid out on the ground to form a layer of pure O_3 at a temperature of 0 °C and at 1 atmosphere of pressure. The thickness of this layer in hundredths of a millimeter (10-5 m) represents the concentration in terms of DU, so if it were 1mm thick it could be described as having 100 DU of O_3.Calculations confiirm that one DU is equal to 2.69×10^{16} ozone molecules in a column that measures 1 cm^2 at its base or a volume of 5 x 109 m^3 of O_3 (0 °C; 1 atm)
[17] Source: ARPA Aosta Valley

IONISING RADIATION

The problem

To the general public, the term “ionizing radiation” often provokes the fear associated with effects on health, such as burns resulting from extreme exposure similar to those incurred following the explosion of the nuclear bombs over Hiroshima and Nagasaki. These effects are technically defined as “deterministic” and are the result of extreme exposure. Other fears concern the effects of less severe exposure that are not immediately noticeable but that manifest themselves over time or in future generations and they are often associated with the risk of cancer . A clear example of this are the consequences on the exposed population following the accident at the Soviet nuclear reactor in Chernobyl. These effects are technically known as “stochastic”, meaning that the probability of them to occur depends on the intensity and duration of the exposure.

To the general public however, ionizing radiation is nearly always only associated with the production of nuclear energy, including the treatment and disposal of the radioactive waste it generates. The fear this incurs is often caused by a preconceived idea that totally fails to take into account the costs and benefits associated with this form of energy when compared to other technological means of energy production.

Even so, there are cases when exposure to ionizing radiation is generally accepted, such as for medical, diagnostic or therapeutic purposes. In such cases, any resulting risks are perceived to be more than outweighed by the benefits that those undergoing such treatments experience.

“Justification” is one of the fundamental principles adopted in safeguarding the general public and the workforce from radiation. Any activity that subjects either the general public or the workforce to exposure, must in fact be justifiable once costs and benefits have been weighed up and other alternatives have been considered. Moreover, the level of exposure must be “optimized”, so that it is as low as possible.

A second consideration regards the entity of any exposure to sources generated by anything other than those described above.

Ionising radiation is almost always only associated with the production of nuclear energy although in fact, exposure to ionizing radiation is also a medical, diagnostic or therapeutic procedure. In such instances, the risks involved are considered to be more than outweighed by the benefits incurred by those that undergo such treatments.

These considerations make the need to find out more and increase awareness of exposure to ionizing radiation, so that the assessment of the risks and benefits associated with all sources of radiation becomes easier and is better understood.

In fact, if atomic bombs and nuclear incidents are excluded, then any exposure that results from activities associated with energy production is by far inferior to any that results from natural sources. Both in the cosmos and in the earth is crust, and even in our own body, there are sources of ionizing radiation responsible for an exposure thousands of times greater than the nuclear industry.
The main source of exposure to ionizing radiation occurs in a domestic setting and in other indoor situations, which is where people spend most of their time. In fact there is a natural gas present in the air in all these locations, called radon, which is one of the main risk factors that everyone has to face. Moreover, in some cases, it reaches such high levels of concentration that on the cost – benefit scale mentioned above, the associated risks are considered unacceptable and taking action to restore healthy conditions to the living environment is highly recommended or even obligatory.
These considerations make the need to find out more and increase awareness of exposure to sources of ionizing radiation clear. In this way, the assessment of the risks and benefits associated with all sources of radiation will become less difficult and better understood.

Radon exposure

The situation with regard to radon exposure was made clear in the results of a nationwide investigation carried out in the 80s and 90s, which is still valid for the characteristics of the phenomenon (Figure 5.17).

High concentrations of radon (Rn-222) have been noted in Lazio and Lombardy. The two regions differ from the others mainly because of their uranium content and the different permeability of their rock and soil beds.

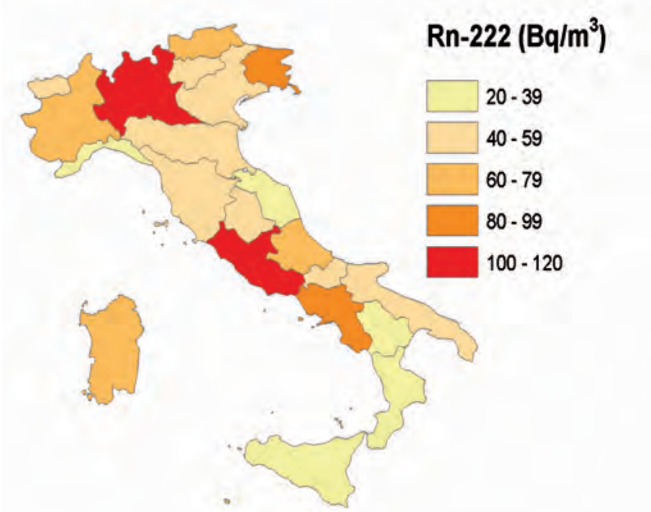


Figure 5.17: Map showing the concentration of Rn-222 present in homes by region and autonomous province (the choice of scale used is of purely exemplary value) (1989-1997) [18]

As a consequence of this investigation, the problem of protecting the workplace from radon exposure was legally addressed with Legislative Decree n. 241/2000, which implements the Council Directive 96/29/Euratom and modifies and integrates the earlier Decree n. 230/1995. The decree sets out the obligations of both employers and the regions. In particular, the latter are charged with identifying the "prone areas" meaning areas with higher probability of high indoor radon concentrations. Pending the determination of the criteria to be used to identify these areas and the methods to be adopted in that process, some regions and some ARPA/APPA have started studies and investigations that will permit classification areas according to the likelihood of high concentrations of indoor radon. The regions, in which such studies have been started are shown in Figure 5.18.

[18] Source: F. Bochicchio, et al., *Results of the national survey on radon indoors in the all the 21 Italian region, Proceedings of Radon in the Living Environmental* Workshop, Athens, April 1999

Pending the determination of the criteria to be used to identify the areas with high concentrations of radon and the methods to be adopted in that process, some regions and some ARPA/APPA have started studies and investigations that will make it possible to classify areas according to the likelihood of high concentrations of radon being present.

Figure 5.18: The regions (in green) where studies/initiatives aimed to identify radon prone areas have been underway since 2002 [19]

In conclusion, information on the remedial action carried out in Italy in places where there is a high concentration of radon is still scarce for both domestic situations and workplaces.

Surveillance of environmental radioactivity in Italy

In Italy, controlling levels of radioactivity is organized at three levels: local, regional and national.

The surveillance of environmental radioactivity in Italy is organized according to Italian law, under Legislative Decree 230/95 and its subsequent modifications, as well as European legislation, through a combination of networks that operate at three distinct levels: local, regional and national.
Local networks are in charge of surveillance on nuclear plants, regional networks are in charge of monitoring the level of radioac-

[19] Source: ISPRA, ARPA/APPA

tivity in the environment in their respective territories, whilst national networks provide an overall picture of the situation in Italy and are responsible for raising the alarm in the event of widespread contamination.
The diagrams below show the trend of Cesium-137 concentration in airborne particulate over a period of years, as well as in wet and dry deposition and in cow's milk (Figures 5.19, 5.20 and 5.21).

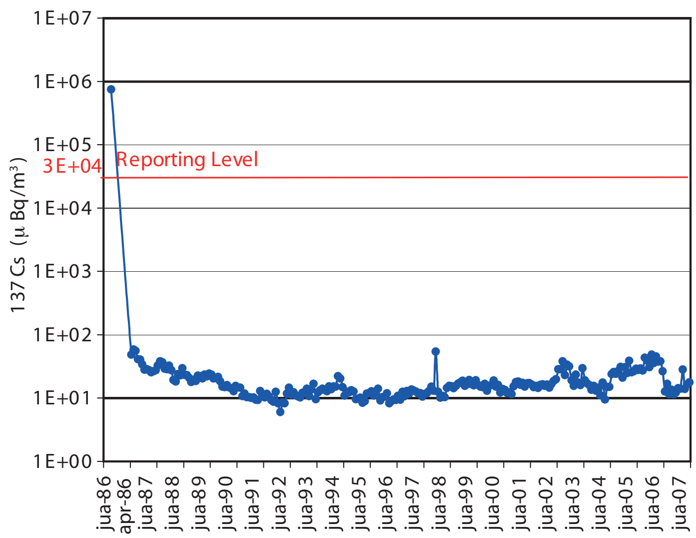


Figure 5.19: Trend of Cs-137 concentrate in airborne particulate in Italy[20]

The diagram shows the contamination peaks associated with the arrival in Italy of the "Chernobyl cloud" (April 1986) and of the fall-out that resulted from an incident in a Spanish foundry in Algeciras (June 1998) which was much more noticeable in northern Italy. Levels recorded in recent years have remained stationary and well below the reporting level established by the EU (30 μBq/m³).

[20] Source: ISPRA/ARPA/APPA data processed by ISPRA's environmental radiation laboratory service, OECD-ENEA, 1987, *The Radiological impact the Chernobyl accident in OECD countries*, Paris - ISPRA

This diagram highlights the level of Cs-137 in the fallout associated with tests carried out in the atmosphere in the 50s and 60s as well as the peak that resulted from the Chernobyl accident in 1986. Since then, there has been a steady reduction in contamination levels of dry and wet deposition.

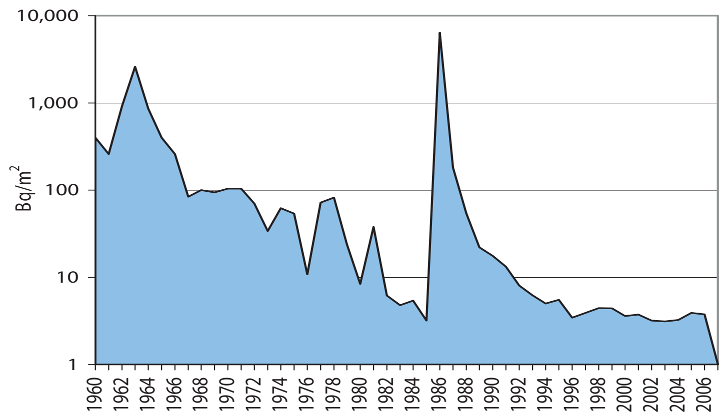


Figure 5.20: Trend of wet and dry deposition of Cs-137 in Italy[21]

This diagram reveals ever-decreasing levels of contamination in cow's milk that is today, approximately two orders of magnitude less than it was in 1987, the year after the fallout from Chernobyl. Since 1990 Cs-137 contamination levels have been below the reporting level established by the EU (0,5 Bq/l).

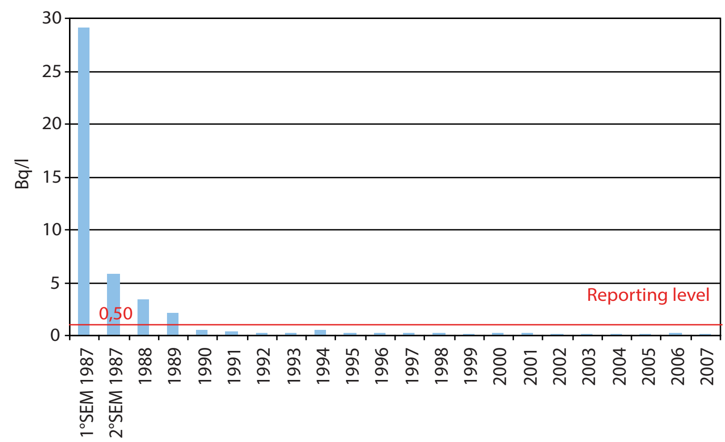


Figure 5.21: *Trend* showing the concentration of Cs-137 in cow's milk in Italy [22]

[21] Source: ISPRA/ARPA/APPA data processed by ISPRA's environmental radiation laboratory service, OECD-ENEA, 1987, *The Radiological impact the Chernobyl accident in OECD countries*, Paris - ISPRA

[22] *Source:* ISPRA/ARPA/APPA data processed by ISPRA's environmental radiation laboratory service, OECD-ENEA, 1987, *The Radiological impact the Chernobyl accident in OECD countries,* Paris - ISPRA

In terms of response, the situation in Italy can be represented by the level of implementation of the network monitoring programme.
Table 5.1 shows the scores given during the evaluation of nationwide monitoring carried out from 1997 onwards that is based on methodology elaborated for the ECOEHIS (Development of Environment and Health Indicators for EU countries) project.
Annual scores are attributed on the basis of the following matrices: airborne particulate, ambient gamma dose rate, cow's milk, surface water and drinking water. Each of these matrices was evaluated according to the frequency of the measurements, the sensitivity of the measurements, territorial coverage of controls, regularity of monitoring, the organization of and participation in interconfrontation initiatives on a nationwide basis.

Analysis of the monitoring programme highlighted that coverage of the entire national territory was incomplete and that corrective measures must therefore be taken.

Table 5.1: Evaluation of the state of monitoring carried out over national networks[23]

Year	Ranking	Evaluation
1997	15	satisfactory
1998	17	satisfactory
1999	13	unsatisfactory
2000	17	satisfactory
2001	17	satisfactory
2002	17	satisfactory
2003	17	satisfactory
2004	17	satisfactory
2005	17	satisfactory
2006	17	satisfactory
2007	17	satisfactory

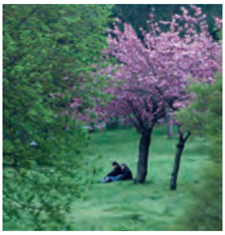
Legend: classes of quality : unsatisfactory 0 ≤15 satisfactory 15 ≤21 good 21-25

Analysis of the monitoring programme highlighted that coverage of the entire national territory was incomplete and that corrective measures must therefore be taken.

[23] Source: ISPRA/ARPA Emilia Romagna data processed by ISPRA

CHAPTER 6

ENVIRONMENT AND HEALTH



New socio-economic scenarios, technological development and lifestyles have changed global exposure to environmental risk factors.

These factors are driven by environmental change. Climate change increases environmental and territorial vulnerability.

Governance of these problems is a very complicated process and there are still many doubts.

European and WHO approaches indicate that environmental prevention tools against risk factors need to be improved.

Introduction

In the last few decades, rapid changes in lifestyles and new socio-political and technological scenarios have both changed the pressures on the environment and, improved conditions of life and prevention systems (especially in the developed countries).

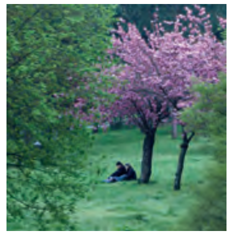
This made it possible to reduce traditional health risk factors, especially those related to hygienic and sanitary conditions. But it has also created an unprecedented global exposure to environmental risk factors of chemical, physical and biological nature with a potential impact on both individual and collective health and well-being.

The drivers of these risk factors are correlated to global environmental change such as: urbanization, fragmentation of territories and ecosystems, globalization and increased social mobility, lifestyles, new technologies, demand for energy and water resources, increased use of chemical substances that persist in the environment and, last but not least, climate change that expands environmental and territorial vulnerability.

Inevitably, transforming scientific knowledge (scientific evidence of health risks caused by environmental factors) into institutional action (regulations and global initiatives in the sector) is a complicated process. There are still many doubts on the evaluation of risks, their communication, the realization of an integrated approach and the definition of priorities and areas of action to focus on.

Below is a brief description on the evolution of environment and health problems focusing on the three main areas that govern the entire process: scientific difficulties, institutional awareness and the population's risk perception management.

European and WHO approaches indicate the need to improve environmental tools that prevent environmental risk factors using methods that better represent the exposure and improving information and environmental communication.



Environment and health problems and environmental policies

Scientific complexity

Theoretically, every day each one of us comes into contact with countless risk factors in the form of harmful substances or chemical compounds, bacteria, viruses, allergens, electromagnetic waves and noise sources. However, not everybody develops diseases that research underlines as being associated to single factors.

Every day, each of us comes into contact with countless risk factors. However, not everybody develops diseases that research associates with single factors.

The uncertainty of each individual outcome is due to numerous exposure variables (the amount of time or concentration of the exposure to a specific substance) and the person's vulnerability. Each population has a wide range of different susceptibilities and some people are more vulnerable than others when exposed to some pollutants. During the various phases of the vital cycle, all living organisms experience different "windows" of vulnerability and susceptibility that can depend on: age and development (children/adolescents and elderly persons), physiological state (pregnancy), clinical state (chronic diseases), lifestyles and socio-economic factors. Susceptibility implies a higher mortality and morbosity risk. Children are more susceptible than adults to the effects of some pollutants (e.g. neurotoxic ones) and have lower threshold levels than those producing effects on adults.

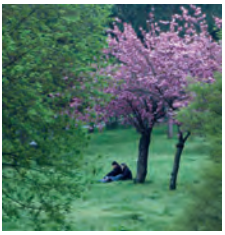
Many risk factors are, in turn, influenced by different determinants such as environmental (urbanization and territorial integrity) and socio-economic contexts (capacity and efficiency of environmental prevention systems and health services, lifestyles, professional exposure, etc.). Furthermore, some risks are caused by conditions that are considered healthy (internal heating) or which belong to lifestyles (using mobile telephones).

Some risk factors are caused by conditions perceived as an indication of wellbeing.

Environmental policies can act directly on some risk factor determinants, for example by protecting resources (water, air, soil, biodiversity) and the integrity of the territory, studying the exposure and spreading information and environmental communication.

Managing healthcare risks posed by environmental determinants is a complex task, calling not only for scientific evidence, arrived at by cross-analysing exposure to risk factors with disease, but also for tools with which to identify priorities, emerging risks, vulnerable populations and feasible actions (Figure 6.1).

Environmental policies can act directly on some determinants and must take into account emerging risks, local priorities and action feasibility.



Environmental prevention actions are the result of a complicated cognitive process that includes considering risk hypotheses developed by research, their association to clinical effects, studying exposure and identifying preventive action areas and tools. It also includes information and communication.

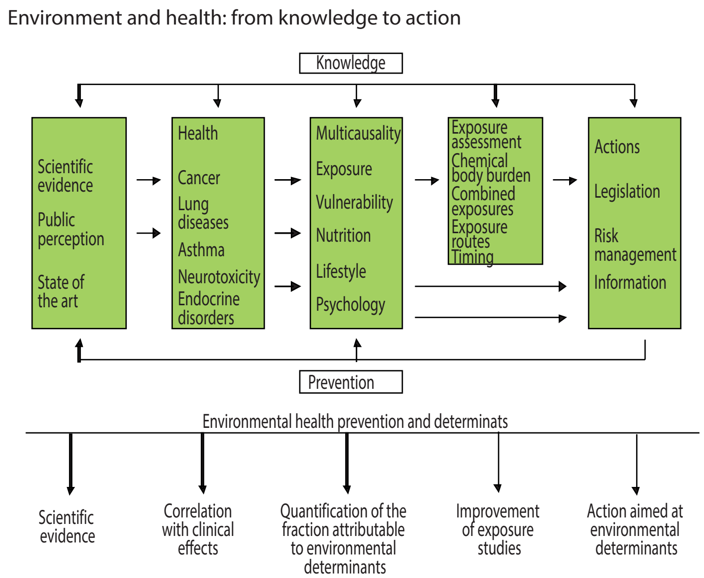


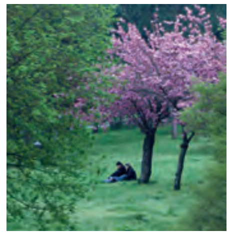
Figure 6.1: Environment and health: from knowledge to action [1]

Theoretically speaking, to assess an individual's exposure to a harmful substance, the point of contact (food, air, water, etc.) should be known, together with the number of times and the amount of the substance to which the individual is exposed. The biological response to this exposure, which includes other individual variables, (age, metabolic capacity, etc.), should also be determined. Actually, though toxicology research and epidemiological studies have made possible the identification of dangers and risks, we are exposed to a combination of several substances therefore the process is even more complex. In general, the mitigation of exposure to the identified factors is the most effective preventive approach.

In practice, studying exposure to risk factors is possible by means of proxy indicators but these need to be updated according to new risks and new environmental determinants identified by research.

In practice, since individual exposure is impossible to asses, *proxy* indicators are used. These take into account some characteristics of the environmental factor to which people are exposed

[1] Source: Prepared by ISPRA based on EEA model, 2005



(concentration or intensity in a specific area of reference, exposed population, etc.).

The study of exposure is a significant preventive tool but environmental information must be updated according to research results that indicate new risks and their environmental determinants.

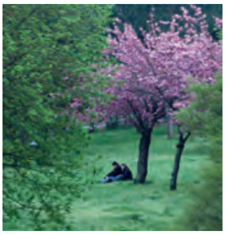
Biomonitoring techniques are another tool to assess exposure.

The absorption of a certain substance through exposure can be quantified by biomonitoring techniques, in other words through a chemical and physical analysis of substances from biological samples (blood, hair, urine, etc.). These methods of estimation and measurement do not, however, indicate the possible development of diseases because other factors contribute to this process. This is because there is no linear correlation between exposure (especially chronic) and clinical effects and there are no diseases caused only by environmental factors. In any case, action that prevents exposure to risk factors causing diseases needs to be taken. To date, exposure has been studied only by analysing exceedances of threshold values.

Preventive efficiency cannot be governed only by referring to sectors and limit values but new tools and different approaches are needed, as considered in the EU Environment and Health Strategy 2003.

However, scientific knowledge has highlighted that preventive efficiency cannot be governed only by referring to sectors and limit values established by the law. New tools and different approaches are needed, as declared with the European Environment and Health Strategy 2003: *"Until now environmental assessments and policy actions have focused on single pollutants in single environmental compartments (air, water, soil ...) and many related environmental health problems have indeed been solved.*

However, by doing so some health impacts are underestimated, because in reality the situation is much more complicated: pollutants are transferred between different environmental compartments (air to soil, to water, ...); people are exposed to a combination of pollutants that interact in the environment and in the human body. These facts are not sufficiently taken into account in the actual policy responses. Furthermore, the present policy responses are not sufficiently integrated (e.g. air monitoring data are not linked to water monitoring data, to soil monitoring data... and to health monitoring data) and therefore do not always effectively address the specific "environment and health" interface. Such integration is essential to further develop environmental legislation and measures to protect human health..."



Emerging risks may not be considered by traditional monitoring and environmental information systems.

Finally, we must take into account that traditional monitoring systems can oversee emerging risks that are not controlled by specific regulations. These are due, for example, to changes in environmental scenarios (toxic algae and warming of waters, new allergens, etc.) and combined physical (noise) and chemical (air pollution) exposure which are typical to the built environment.

The process of institutional awareness

The initial difficulties met in the governance of the "environment and health" issue, which constitutes a discipline unto itself, are probably due to the extended definition introduced by the European Region of the WHO in 1989[2] (Figure 6.2) which included many complex subsystems governed by different actors and relevant sectors.

The figure shows the different systems included in the extended definition of "environment" which influence health and the quality of life.

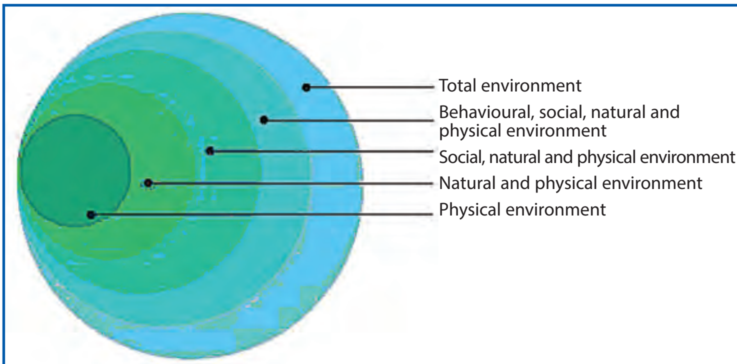
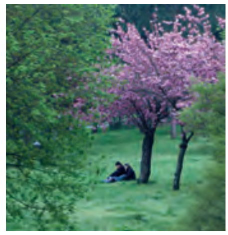


Figure 6.2: The definition of environment[3]

[2] "Environmental health comprises those aspects of human health and disease that are determined by factors in the environment. It also refers to the theory and practice of assessing and controlling factors in the environment that can potentially affect health. As used by WHO/Europe, environmental health includes both the direct pathological effects of chemicals, radiation and some biological agents, and the effects (often indirect) on health and wellbeing of the broad physical, psychological, social and aesthetic environment. (Environment and Health, the European Charter and Commentary, Frankfurt, 1989).
[3] Source: Smith, Corvalàn e Kjellstrom, 1999



Prevention policies have already reaped results but determinants need to be considered as a whole.

Today, roles and responsibilities have become clearer but the modern concept of "health" still needs to be integrated with policies of other sectors.

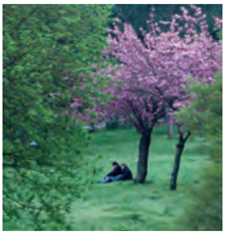
Initially, many Community policies were driven by environmental factors that represented a health risk. Research results and the commitment of institutions have made it possible to use low-impact technologies and adopt preventive measures not only for control and monitoring systems but also for emission sources. An example of this action can be seen in Figure 6.3, which refers to the city of Milan and shows the trend of an atmospheric pollutant that influences the quality of air. Between 1977 and 1993 there was a sensitive reduction of about 100 μg/m³ in the annual mean concentration of Total Suspended Particles (TSP). This progress is due to the preventive measures and action that was taken. Between 1993 and 2003 there were no significant change and the concentration practically remained stable, yet always above the limits provided by the law.

Figure 6.3: TSP annual mean concentration in Milan[4]

Between 1977 and 1993 there was a considerable reduction of about 100 μg/m³ in the annual mean concentration of TSP. This was also due to preventive measures and action taken. Between 1993 and 2003 the situation remained stable and the concentration was almost the same, yet still above the limits provided by the law.

Risk prevention therefore also needs to be aimed at other determinants, such as mobility management, while we wait for low-impact vehicle technologies to be improved.

[4] Source: ARPA Lombardy



There is a growing awareness that such a complicated system cannot be managed only by identifying threshold values but it needs a specific, integrated, multisector approach.

Europe is creating new preventive tools. The WHO has launched the Environment and Health Action Plans.

Environmental information needs to be in line with new strategic objectives.

Population perception of environmental risk as a factor that influences the quality of life and health is also growing.

Different institutions have gradually become aware that a system as complex as air pollution or chemical pollution cannot be managed only by identifying threshold values but requires an integrated approach. This has led the European Union to adopt new tools such as the European Environment and Health Strategy, the Environment and Health Action Plan (2004), the Urban Environment Strategy, the establishment of Food Security Agencies (EFSA) and REACH regulations.

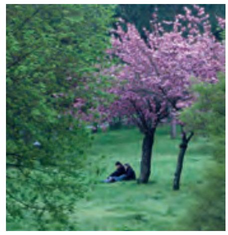
The WHO has reminded the 53 countries of WHO/Europe to adopt National Environment and Health Action Plans (NEHAP). Since 2003, the attention is also more focused on the more vulnerable groups, children, with institutional initiatives such as the Children Environmental Health Action Plans (CEHAP) and the adoption of priority objectives for the European Region or the SCALE initiative of the Commission within the framework of the European Environment and Health Strategy.

Each of these tools needs to be supported by adequate environmental information, in line with the specific strategic objectives.

The population's risk perception

Even the population is growing always more aware of how important the environment in which we live is for our well-being and health. In the recent Eurobarometer[5] of 2008, over 80% of European citizens associated the quality of life to environmental factors (Italy is above average. In particular, 86% of Italian citizens perceive the quality of life as something that depends on environmental factors, 89% on economic ones).

[5] The Eurobarometer is a tool created by the European Commission to carry out surveys aimed at knowing and understanding the behaviours of European citizens.



In Europe (25) more than 80% of the population perceives the environment as an important factor that influences the quality of life.

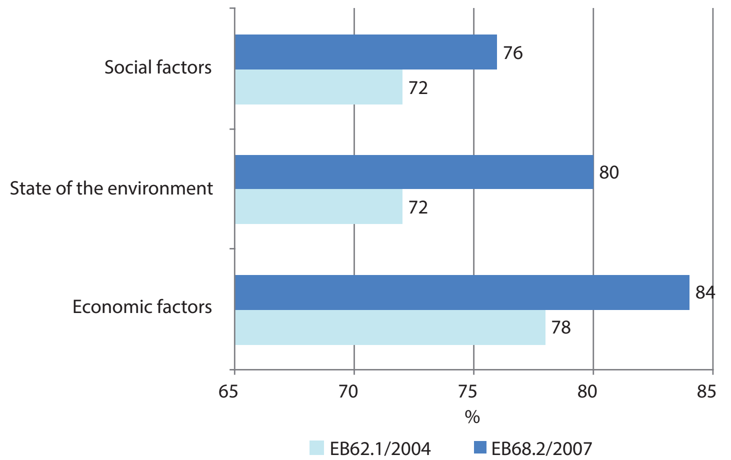
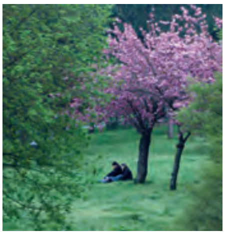


Figure 6.4: Perception of the main factors that influence the quality of life[6]

Another survey on the perception of risks that endanger our health (Eurobarometer 2006) highlighted how citizens identify environmental factors as the most serious risk, even compared to crime or serious diseases (Figure 6.5). The perception of Italian citizens is not very different from the European average.
It is therefore necessary to develop a community system integrating information on the state of the environment and including all major health aspects.

Such a significant risk perception calls the attention on the need to develop a community system integrating information on the state of the environment and including major health aspects.

[6] Source: Eurobarometer



Exposure to environmental risk factors (pollution, food security, etc.) is perceived by European citizens as one of the most probable causes of health risks.

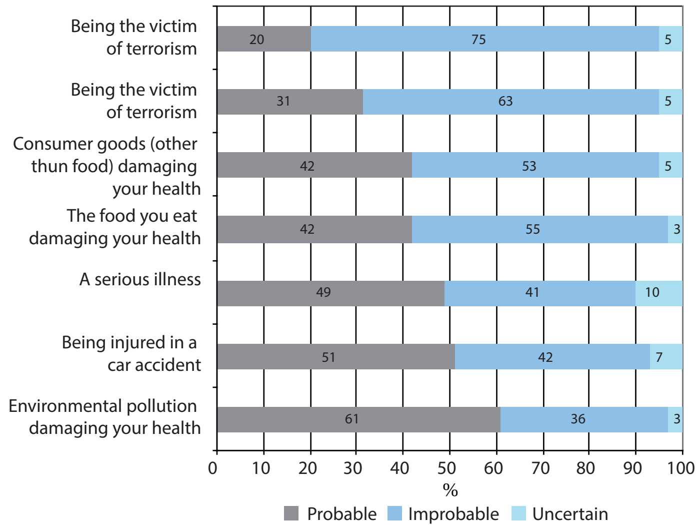


Figure 6.5: Perception of the European population towards potential health risks[7]

Defining areas of environmental prevention

What are the action areas of environmental prevention in such a complicated system?

Many sources in scientific literature have long highlighted the association between exposure to environmental risk factors and the potential development of some diseases.

As already stressed, exposure to dangerous substances does not necessarily imply the development of a disease or that the exposure could be related only to environmental factors. The methods we have today do not allow us to make an exact estimate of the health effects of long-term environmental exposure to reduced concentrations or exposure to various pollutants, especially when considering long-term diseases (cancer). In addition, there are still many doubts on the complicated methodology and our knowledge on risks associated to many substances and many determinants is still poor.

In any case, research continues to evolve trying to provide more focused information for decision-makers.

Abundant scientific literature has highlighted the association between exposure to environmental risk factors and potential disease development. But we have no knowledge of the long-term effects or exclusive, direct cause/effect relationship.

[7] Source: Eurobarometer no. 238 of 2006

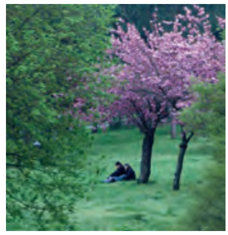


Table 6.1: Major health impacts and some associations with environmental exposures to chemicals and other environmental stressors and lifestyle factors[8]

Health Impact	Associations with some environmental exposures
Infectious diseases	• water, air and food contamination • climate-change-related changes in pathogen life cycle
Cancer	• air pollution (PM), mainly $PM_{2.5}$ or less • smoking and environmental tobacco smoke (ETS) • some pesticides • asbestos • natural toxins (aflatoxin) • polycyclic aromatic hydrocarbons, e.g. in diesel fumes • some metals, e.g. arsenic, cadmium, chromium • radiation (including sunlight) • radon • dioxin
Cardiovascular diseases	• air pollution (carbon monoxide, ozone, PM) • smoking and ETS • carbon monoxide • lead • noise • inhalable particles • food, e.g. high cholesterol • stress
Respiratory diseases, including asthma	• smoking and ETS • sulphur dioxide • nitrogen dioxide • inhalable particles ($PM_{2.5}$ and PM_{10}) • ground-level ozone • fungal spores • dust mites • pollen • pet hair, skin and excreta • damp
Skin diseases	• UV radiation • Some metals, e.g. nickel • pentachlorophenol • dioxins

Exposure to substances such as pesticides or PMs does not imply the development of a tumour or that the tumour can be directly related only to environmental factors. Objectively speaking, the methods available today do not enable us to make exact assessments on the effects of long-term exposure or exposure to reduced concentrations or more pollutants. It is, anyway, possible to associate some diseases with environmental factors, within the limits of each individual's diversity.

[8] Source: EEA information (*Environment and Health* EEA Report no. 10/2005) processed by ISPRA

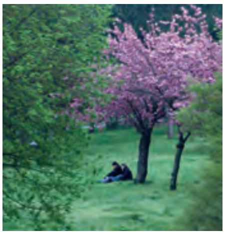
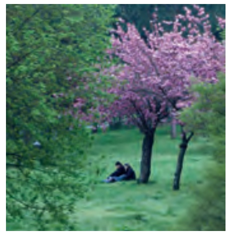


Table 6.1: Major health impacts and some associations with environmental exposures to chemicals and other environmental stressors and lifestyle factors

Health Impact	Associations with some environmental exposures
Diabetes, obesity	• food, e.g. high fat • poor exercise
Reproductive dysfunctions	• polychlorinated biphenyls (PCBs) • DDT • cadmium • phthalates • endocrine disruptors • pharmaceuticals
Developmental (foetal and childhood) disorders	• lead • mercury • smoking and ETS • cadmium • some pesticides • endocrine disruptors
Nervous system disorders lead	• PCBs • methyl mercury • manganese • some solvents • organophosphates
Immune response	• UVB radiation • some pesticides
Increased chemical sensitivity	• multiple chemical exposures at low doses

With the need to identify preventive priority action, more attention is being paid to both the power of association between environmental stressors and clinical effects and the feasibility of preventive actions.
In its "Environment and Health" Report (2005), EEA provides results of a study (Table 6.2) aimed at establishing: the degree of correlation between some diseases and specific pollutants; the potential impact in quantitative terms and the possibility of taking preventive action against risk factors. For example, the correlation between radon and lung cancer is considered "very likely".



Despite this, the impact is assessed as "moderate" because exposure to radon does not involve the whole population (radon is only found in some areas). On the contrary, the possibility of taking preventive action is identified as "high".

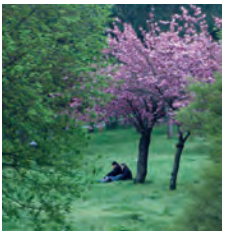
Table 6.2: Strengths of associations between environmental factors and a selection of diseases, corresponding population impact and prevention possibilities[9]

Disease/pollutant	Strenght of Association	Qualitative descriptor	Population Impact	Prevention possibilities
Cancer/ radon Neurodevelopment/ lead	Very likely (90-99%)	Statistical significance: beyond all reasonable doubt	moderate	high
Neurodevelopment / mercury	Very likely (90-99%)	Statistical significance: beyond all reasonable doubt	low	high
Respiratory diseases / air pollution	Very likely (90-99%)	Statistical significance: beyond all reasonable doubt	high	moderate
Neurodevelopment / POPs (Persistent Organic Pollutants)	Likely (66-90%)	Reasonable certainty: sufficient scientific evidence	moderate	moderate
Asthma causation / air pollution	medium likelihood (33-66%)	Balanced of evidence: strong possibility	high	moderate
Cancer / EMF (Electromagnetic Fields)	low likeli-hood (10-33%)	Scientific suspicion of risk	high	low
Cancer / low level radioactivity	very unlikely (1-10%)	Low risk	moderate	high

Results of the study contained in the EEA "Environment and Health" Report show the degree of association between some diseases and specific pollutants and the potential impact on the population, in quantitative terms. The study also highlights the possibility of influencing the considered factors through preventive action.

In its recent report "Preventing disease through healthy environments" *(2007*), the WHO introduced a similar operative approach for the management of the environment and health issue.
The international study defines operational areas for environment and health policies introducing new determinants, such as *built environment*, climate change and agricultural practices, in addi-

[9] Source: EEA information (*Environment and Health* EEA Report no. 10/2005) processed by ISPRA



Apart from protecting the quality of natural resources, the WHO identifies other areas of preventive action: built environment, climate change and agricultural practices.

The WHO has defined action areas for environment and health policies and has highlighted areas of intervention. The contribution of environmental factors to the causing of diseases has also been assessed.

tion to the traditional biological, chemical and physical risk factors (water pollution, indoor and outdoor air pollution, noise, ionizing radiations, etc.). In the specific case of the *built environment* this new determinant is defined as a set of factors which includes urban planning[10], mobility areas and land use, all of which influence causes of death either directly (road accidents) or indirectly (through a reduced quality of life or physical inactivity which are known as being health risks common to many diseases representing the main causes of death and disability in the world (diabetes, cardiovascular diseases, obesity). The report also highlights feasible areas of intervention. Taking the diseases as an end point, the report considers and assesses environmental risk factors that can realistically change using available technologies, policies and preventive environmental and health action.
The study also assesses the contribution of environmental factors in causing diseases that acknowledge them as a joint cause. In particular, the report highlights that:

- Environmental factors contribute to 85 of the 102 main diseases considered in the *World Health Report* of the same international organisation.
- Globally, about 25% of diseases and 23% of early death cases can be attributed to environmental factors of chemical, physical and biological nature or to factors that encourage unhealthy behaviours which have a well-known exposure chain (lack of physical activity).

The study also highlights that the weight of environmental factors also depends on other determinants, such as socio-economic, managerial and organizational contexts that vary according to the different continental regions and the pathology that is considered. In developing countries, for instance, the main effect of environmental factors is their contribution to n the incidence of infectious diseases and mortality, in developed, it is their contribution to neoplastic diseases. However, the WHO reminds that these

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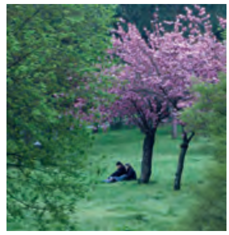
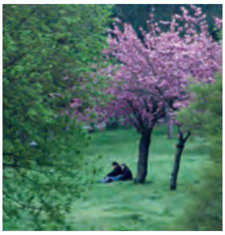
[10] In particular, some aspects in the modern organization of cities such as circulation, generally influence the quality of life through air pollution, reduced physical activity, noise, accidents and social isolation which often are due to the lack of urban space available for vehicle circulation.



assessments are underestimated with respect to actual facts, since they do not include categories of exposure to many environmental risks (prolonged exposure to chemical pollution, endocrine disruptors, new technologies) and it is still not clear whether they are associated to clinical effects. According to this new WHO approach, most health determinants cannot be directly controlled by public health authorities and attributed to the efficiency of health services, since they are strictly correlated to policies and strategies of other sectors (protection of natural resources and the territory, urban planning, mobility and transport, energy, productive activities and socio-economic variables). Environmental information relevant to health could be extended even to new areas of action. Among these are built environment, climate change and agricultural practices.

The new WHO assessment approach confirms that most health determinants cannot be directly controlled by public health, being the efficiency of health services strictly correlated to policies and strategies of other sectors.



Starting from the disease, as end point of the process, the table analyses environmental factors realistically susceptible of change and assesses them by means of available technologies, policies and preventive action on environment and health. For example, the percentage that can be attributed to the environment (for indoor air pollution) varies between 5% and 25% of cases of chronic bronchopathy. This high value is due to the common practice of using biomass for lighting, cooking and heating in developing countries. The risk can be mitigated by adopting basic energy practices.

Disease or risk / Risk factors	Water, sanitation and hygener	Inddoor air pollution	Outdoor air pollution	Noise	Other housing risks	Chemical	Recreational environment	Water resources management	Land use and built environment	Other Community risks	Radiations	Occupation	Climate change
Lower respiratory		>25%	<5%		<5%								
Upper respiratory		5-25%	<5%		<5%								
Diarrhoeal diseases	>25%						<5%						<5%
Malaria								>25%		5-25%		<5%	<5%
Intestinal Nematode Infection	>25%												
Trachoma	>25%												
Schistosomiasis	>25%											5-25%	
Chagas disease					>25%								
Lymphatic Filariasis	>25%							5-25%					
Onchocerciasis								5-25%					
Leishmaniasis					5-25%								
Dengue					>25%								<5%
Japanese encephalitis								>25%					
Venereal diseases STDs												5-25%	
HIV												5-25%	
Hepatitis B and C												<5%	
Tuberculosis		<5%			5-25%							5-25%	
Perinatal conditions	<5%	<5%	<5%			<5%						<5%	
Congenital anomalies			<5%			<5%					<5%	<5%	
Malnutrition	>25%									<5%			<5%
Cancer	<5%	<5%	<5%			<5%				<5%	<5%	5-25%	
Neuropsychiatric Disorders				<5%	<5%	<5%						5-25%	<5%
Cataracts		<5%									5-25%	<5%	
Deafness												5-25%	
Cardiovascular diseases	<5%	<5%	<5%	<5%		<5%	<5%		<5%			5-25%	<5%
COPD		5-25%	<5%									5-25%	
Asthma		5-25%	<5%		<5%							5-25%	
Musculoskeletal diseases												5-25%	
Physical inactivity									5-25%				
Road traffic accidents									>25%			5-25%	
Falls					5-25%		<5%		<5%	5-25%		5-25%	
Drowning							>25%			5-25%		<5%	<5%
Fires					5-25%							<5%	
Poisoning					<5%	>25%						<5%	
Other unintentional injuries					<5%		<5%		5-25%	<5%	<5%	<5%	<5%
Violence					5-25%	<5%			5-25%				
Suicide					<5%	5-25%			<5%			<5%	

Fraction attributable to the environment: <5% · 5-25% · >25 %

Figure 6.6: Indicative values for environmental attributable fractions, by specific environmental risk factor and disease risk[11]

[11] Source: A. Prüss-Ustün and C. Corvalán (Eds) PREVENTING DISEASE THROUGH HEALTHY ENVIRONMENTS *Towards an estimate of the environmental burden of disease*, WHO 2007

Emerging issues

Children's environmental health

In scientific and institutional contexts there is a growing awareness towards the effects that environmental factors have on children's health (allergies, respiratory diseases, paediatric cancer, alterations of neurological development, lack of physical activity and obesity). According to many scientific studies, children are more vulnerable and more exposed to a variety of environmental agents existing in outdoor and indoor air (houses and schools), water and food. This is due to their biological nature and behaviour, even if their exposure is different according to their age and socio-economic conditions. Scientific knowledge indicates that exposure to chemical substances, which are hazardous to their development, starts at prenatal stage.

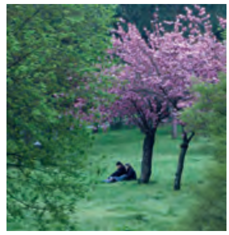
In 2004, a WHO study conducted in Europe estimated the burden of disease on children with respect to 5 environmental risk factors: outdoor and indoor air pollution, quality of water, sanitation systems, exposure to concentrations of lead, accidents. In general, 1/3 of the global burden of disease on children aged between 0 and 19 can be attributed to these factors, with some differences according to age subgroups and risk factors.

In the same period, in Budapest, the Inter-Ministerial Conference on Environment and Health was dedicated to children's health. Government delegations signed their commitment towards:

1) The adoption of the CEHAP: *Children Environmental Health Action Plan.*

2) The adoption of measures for achieving the *Regional Priority Goals* (RPGs).

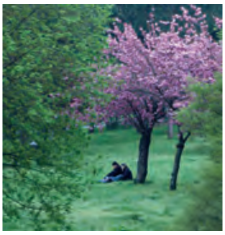
In scientific and institutional contexts there is a growing attention towards the effects that environmental factors have on children's health (allergies, respiratory diseases, tumours in infancy, alterations of neurological development, lack of physical activity and obesity).



Regional Priority Goal I: prevent and significantly reduce the morbidity and mortality arising from gastrointestinal disorders and other health effects, by ensuring that adequate measures are taken to improve access to safe and affordable water and adequate sanitation for all children.

Regional Priority Goal II: prevent and substantially reduce health consequences from accidents and injuries and pursue a decrease in morbidity from lack of adequate physical activity, by

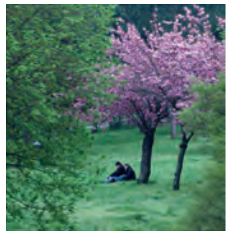
The WHO establishes the four main goals for protecting children's environmental health.



promoting safe, secure and supportive human settlements for all children.
Regional Priority Goal III: prevent and reduce respiratory disease due to outdoor and indoor air pollution thereby contributing to a reduction in the frequency of asthmatic attacks in order to ensure that children can live in an environment with clean air.
Regional Priority Goal IV: reducing the risk of disease and disability arising from exposure to hazardous chemicals (such as heavy metals), physical agents (e.g. excessive noise) and biological agents and to hazardous working environments during pregnancy, childhood and adolescence.

The EU Environment and Health Strategy COM (2003) identifies children's environmental health as a priority on the basis of some fundamental scientific evidence.

The EU Health and Environment Strategy COM (2003) 338, with the SCALE initiative (*Science, Children, Awareness, Legal instrument, Evaluation*) launched during the 4th Inter-Ministerial Conference, identifies children's environmental health as a priority on the basis of some fundamental scientific evidence:
"Over the last few decades, asthma and allergies have increased throughout Europe. On average, 10% of children suffer from asthmatic symptoms........ In Western Europe, the symptom rate is up to ten times that in eastern countries. This suggests that a western lifestyle is associated with allergic diseases in childhood. In European countries, 1 out of 5,000 children is estimated to be diagnosed with cancer before the age of 15. Although the role of environmental exposure in childhood cancer is limited, children are more prone to biological events potentially related to the development of cancer because exposure to carcinogens during childhood can be reflected in cancer occurrence later in life....
The developing nervous system is particularly vulnerable very early in life to damaging effects of exposure to specific contaminants such as lead, methylmercury and polychlorinated biphenyls (PCBs). A child can absorb as much as 50% of the lead present in food, while an adult takes up only 10%. Exposure to such substances has been associated with developmental disabilities in the form of physical, cognitive, sensory and speech impairments, including in particular learning disabilities and intellectual retardation. Prevalence rates are up to about 10% in certain populations. When



incurred early in life such developmental effects are likely to be permanent".

Environmental knowledge should therefore also be focused on studying the exposure of the more vulnerable age groups.

Climate change and health

Climate variability and change contribute to creating new environmental scenarios. These continually evolve and have an impact on social and economic systems, which depend on the availability of resources and meteo-climatic and structural stability of territorial contexts. It is known that the evolution of climate change is substantially controlled by global mitigation policies, while action required for reducing the environmental impacts and the social, health and economic effects associated to climate change are, instead, managed by national and regional strategies.

Climate variability and change have created new environmental scenarios that have an impact on social and economic systems.

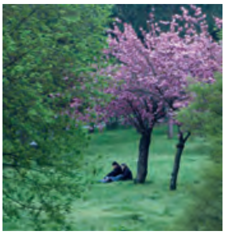
Their efficiency does not only depend on the investment possibilities of the country, but also on the technical and managerial capacity of preventive systems to respond to emergencies and the way local production systems adapt to these new environmental scenarios. There are therefore many actors involved, with complex responsibilities and integration of actions taken by single relevant sectors.

The efficiency of national and regional strategies to adapt to new scenarios also depends on the technical and managerial capacity of prevention systems.

There are many needs to know more about the phenomena that are taking place and the future local scenarios that will be responsible for emerging or re-emerging risks.

Meteo-climatic changes observed and future scenarios shared by the international scientific community therefore also require an adjustment of environmental prevention and territorial protection systems.

Major changes such as global and sea warming, the sea level rise and the increase in the frequency of storms, floods and droughts cause environmental conditions (more pollution of waters during floods) that increase risks for human beings as they come into contact with environmental factors that contribute to causing many diseases. The correlation between climate and environmental change and effects on people's health and on certain health determinants (overcrowding) is summarized in Figure 6.7.



Environmental determinants induced by climate change and variability, relevant to our health, have been identified.

Environmental determinants induced by climate change and variability, relevant to our health, have been identified. Among them are:

- Increase in disastrous events (heat and cold waves, floods, droughts, hurricanes and storms, etc.) associated to climate change and variability;
- Alteration of pollution levels and of the type of atmospheric allergens;
- Changes in the distribution and quantity of insects carrying infectious diseases;
- Production and quality of food due to climate influence on distribution and vegetable diseases;
- Quality of water used for bathing, drinking and irrigation;
- Urban planning and construction.

Major changes such as overheating, sea level rise and the increase in the frequency of storms, floods and droughts cause environmental conditions (more pollution of waters during floods) that increase risks for human beings as they come into contact with hazardous environmental factors.

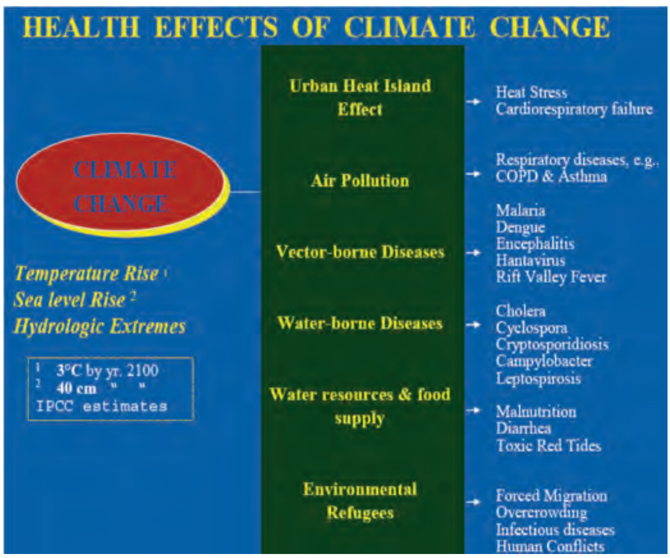
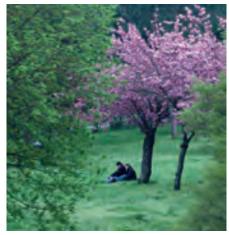


Figure 6.7: Effects on health associated to climate change[12]

[12] Source: Jonathan Patz. *Meeting Report Workshop Environmental change and infectious disease*, Stockholm, 29–30 March 2007 - European CDC Ed, 2007



The report entitled "*Cambiamenti climatici ed eventi estremi: rischi per la salute in Italia*" (APAT, 2007), drawn up by APAT-WHO, provided a first screening of available information to assess the environmental and territorial vulnerability of our country, highlighting emerging health risks. It was then followed by other more detailed studies carried out for the National Conference on Climate Change of 2007. Globally, the analysis stressed that our country already has conditions of vulnerability both for direct (hydrogeological risk) and indirect damages (increase in infectious disease risk). These are related to the alteration of environmental quality and meteo-climatic conditions.

The report drawn up by APAT/WHO entitled: "Cambiamenti climatici ed eventi estremi: rischi per la salute in Italia" (APAT, 2007) provides a first screening of our country, highlighting emerging health risks.

In terms of territorial vulnerability, other national studies (Basin Authority, MATTM, APAT) have identified about 13,000 areas where there is a high and very high risk of floods, landslides and avalanches. These cover a surface area of about 30,000 km^2 and involve 6,352 municipalities including urban centres, infrastructures and productive settlements. In the period between 1999 and 2007, about 1,982 million euros were allocated for 2,671 interventions only for hydrogeological instability recovery works (Legislative Decree 180/98 and Law 179/02).

Our country already has conditions of vulnerability for both direct and indirect damages.

Similar considerations are valid for marine and coastal areas, which need preventive and cognitive action. As regards risks, it has been estimated that of the 4,863 km of Italian low coasts (over a total of approximately 8,353 km of coast) about 1,170 km are already eroding and risk overflowing.

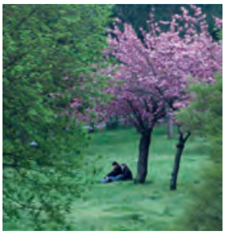
Floods also contribute to water and biota contamination. The density of pathogenic agents is amplified by the flow of flood waters contaminated by material coming from flooded fertilized soils, sludge and sewage treatment plants as well as animal carcasses. Microbial agents can contaminate human beings by direct contact with water, consumption of fish or fresh fruit and vegetables, through irrigation waters or contamination caused by floods.

Floods are also an important source of water and biota contamination.

Furthermore, the increase in the earth and sea's temperature also produces an increased toxicity of lake and marine bathing waters (toxic algae) and changes in the distribution of marine pathogens.

Indeed, climate change can influence water toxicity both directly and indirectly. Environmental factors such as temperature, solar radiations, pH and salinity can influence the biological cycle of

Climate change can influence water toxicity.



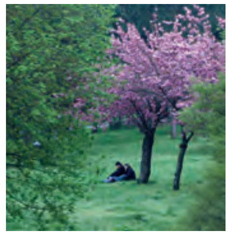
autochthonous microorganisms and influence the survival of pathogenic organisms introduced in the natural environment by human activities (sewage discharges, agriculture and animal breeding). Climate, population and ecological changes have produced a lager distribution of bacteria, viruses and parasites which, for this reason, are considered "emerging". Viruses, especially RNA and segmented RNA, are subject to frequent mutations and genetic reassortments. They therefore have more probability of emerging as new pathogens.
An example is the rapid diffusion, all over Europe, of a new variant of Norovirus GII-4, which is probably more virulent and stable in the natural environment than the already existing strains (Lopman, 2004). Of similar nature is the presence of Hepatitis E (HEV) in non-endemic areas, while molecular analyses say the virus genetically diverges from strains of endemic areas (Casares et al., 2003).

Many environmental factors induced by climate change contribute to increasing the risk of diseases caused by vector bites (tics and mosquitoes) carrying viral, bacterial and parasite diseases.

Many environmental factors induced by climate change contribute to increasing the risk of diseases caused by vector bites (tics and mosquitoes) carrying viral, bacterial and parasite diseases.
Below are some meteo-climatic and environmental factors that increase the distribution of vectors, environmental receptivity and the reproduction period of hematophagous arthropods (mosquitoes, Phlebotomus and tics):

- increase in global temperature, milder winters, reduction of nightly thermic excursions;
- floods, alternation of meteorological events, drought and other cofactors related to global and individual changes.

The increase in the quantity and distribution of vectors is therefore a phenomenon that, in itself, is specifically associated to climate change. Italy is not exempted from this risk and in 2007 the country "hosted" the first epidemic caused by a virus transmitted by the tiger mosquito to the European continent. This showed how mosquitoes can act as vectors introducing new viruses, environmental conditions permitting.



In 2007 Italy, where the tiger mosquito has become ubiquitous in very few years, "hosted" the first epidemic caused by a virus transmitted by the tiger mosquito to the European continent. This showed how mosquitoes can act as vectors introducing new viruses, environmental conditions permitting.

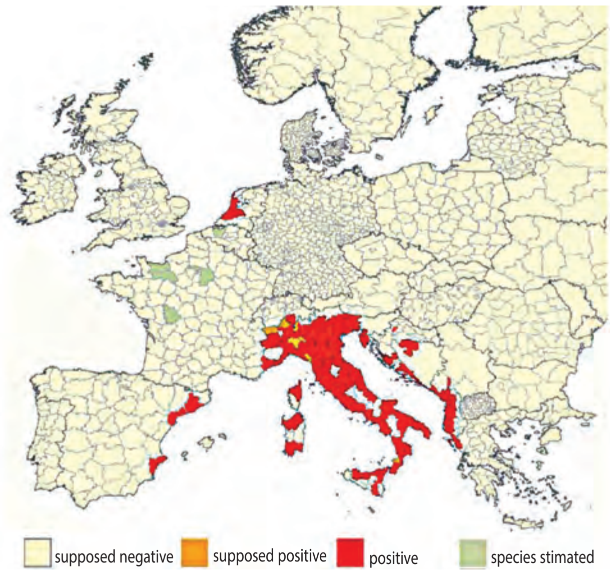
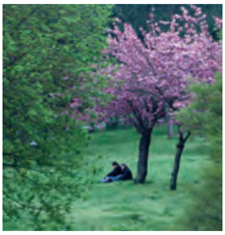


Figure 6.8: Distribution of the tiger mosquito in Europe 2007[13]

In august 2007 in the region of Emilia Romagna, particularly in the province of Ravenna, over 200 cases of "*Chikungunya* arboviral disease" occurred. This virus belongs to the Togaviridae family and is transmitted by the tiger mosquito. Before then, the disease's endemic basin was typical of different tropical areas of Asia and Africa.
The only tool we have available is the vector's environmental control.
The tiger mosquito, which is ubiquitous in our territory (see Figure 6.8), is also responsible of other effects/inconveniences deriving from its direct bites and due to its well-known aggressiveness and urban settlement capacity. The insect has required expensive local control interventions which were estimated to have cost between 10 and 15 million Euros only in 2005. This amount does not include the costs directly incurred by families in terms of personal protec-

[13] Source: *European* CDC *Report*, 2007. National data supplied by ISS



Environment and health governance mainly started in the 1990s and it rapidly evolved in the following years.

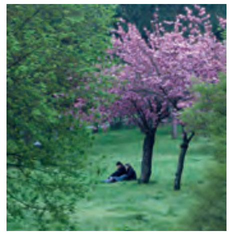
The fundamental Community documents of reference are the 6th Environment Action Programme, the European Environment and Health Strategy and the Environment and Health Action Plan.

tion systems (repellents, domestic insecticides, traps, mosquito nets, etc.) as well as medical and pharmaceutical treatments that can be estimated between 20 and 30 million euros. A favourable habitat for the development of these vectors is also found in artificial open water basins, which are generally used for managing water resources especially in dry territories. In some African countries the adoption of these practices has increased the incidence of malaria, because of lack of water due to climate change.
The synergy between environment and health systems should be improved in order to anticipate risks and manage them in a sustainable way. Even in this case, environmental information should include environmental risk factors.

Institutional action responses and environment and health information

As highlighted above, environment and health governance mainly started in the 1990s and it rapidly evolved in the following years. The main national, European and international documents on this issue are summarized in the reference list below.
The approach of integrated governance recommended under the European Environment and Health Strategy (COM (2003) 338) is a recent development, having already been proposed with the 6th Environment Action Programme, which highlighted the importance of environment and health information[14].
The 6th Environment Action Programme defines strategic action (adequate application of laws, policy integration, individual behaviours, role of the market, urban planning) and priority areas (climate change, biodiversity, health, resource and waste management). The European Community action is aimed at contributing to reach a high level in the quality of life and social well-being of its citizens creating an environment where the pollution level does not have harmful effects on human health and the environment. This aim can be reached also by increasing research in the fields of health and environment and including these priorities in other policies.

[14] Specifically requested also with the Aarhus Directive, implemented in our country in 2005.



The European strategy identifies strategic action principles aimed at favouring the integrated development of different sectors by means of a new approach. This involves:

- Integration of information;
- Integration of research activities;
- Integration of environment and health applications in the various policies which can have direct or indirect effects on health and the environment (transport, agriculture, etc.);
- Integrated action that is also able to assess the feasibility of interventions (from a technical, economical and practical point of view), analyse the cost-benefit ratio and make considerations of ethical nature, among others, which also encourage individual behaviour changes;
- Integration of the subjects involved.

The long-term objectives are:

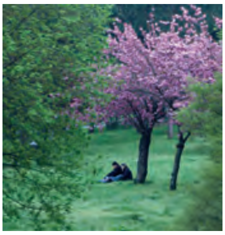
- Reducing the impact of the burden of diseases caused by environmental factors in the EU;
- Identifying and preventing new health hazards related to environmental factors;
- Strengthening EU capacity to promote policies in this sector.

The subsequent Action Plan implementing the 2004-2010 Strategy (*Action Plan for Environment and Health*[15]) considers three fundamental themes identified by the European Strategy. These are:

- Implementing an integrated Community System of control and action in the field of environment and health in order to asses the global impact that the environment has on human health and develop integrated information systems and indicators on environment and health;
- Promoting research for the purpose of increasing our understanding of basic themes related to environment and health;
- Reducing exposure[16].

Both documents mention the commitment to renew environmental information: "...The added value of the proposed European Environment and Health Strategy [...] is therefore the development of a Community System integrating information on the state of the environment, the ecosystem and human health".

[15] COM (2004) 416.
[16] European Environment and Health Strategy, June 2003 – COM (2003) 338.



Environment and health governance needs to make use of adequate environmental information that can support a global process. This will be aimed at improving and implementing: environment and health approaches; assessment of exposure; research priorities and communication of risk (both at national and local level).

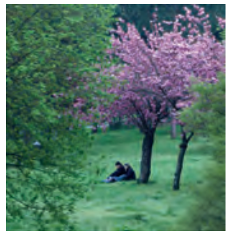
We are assisting a global process that will initially need to pursue three main goals (both at local, national and Community level). These are:

1. Improving and implementing approaches in the field of environment and health.
   Tools such as Environment and Health Action Plans (NEHAP; CEHAP) are a valid reference for multisectorial discussions and programs. In our country, both Action Plans will be presented at the next Inter-ministerial Conference on “Environment and Health” that will be hosted in Italy in 2009;
2. Improving the assessment of environmental exposure as a scientific reference in order to formulate proactive risk management strategies which have operative effects on environmental information and knowledge systems;
3. Defining assessment strategies and research priorities to inform and communicate emerging risks.
   Knowing the extent and type of health risks and impacts is, indeed, essential for developing information aimed at identifying priorities and action areas for certain environment and health determinants. It is also fundamental for developing preventive action aimed at creating specialised environmental information systems on new issues, such as the built environment, climate change and health, and children’s environmental health. These will, most probably, be the main points on the agenda of the next Inter-ministerial Conference on “Environment and Health” that will be held in 2009.

In conclusion, European and international approaches highlight the need to establish a strategic and focused governance of “environment and health” issues. Information on the environment cannot be limited to concentration or emission indicators. There is a common feeling that environment information systems need to be adapted to feature the population’s exposure and not only to provide data reporting.

Providing adequate information on the environment is a valid support for managing health prevention systems, communicating risks, knowing the emerging risks and developing response tools. In other words there is the need to establish integrated risk governance.

The aim is also to provide always more updated information to improve health prevention systems, develop risk communication, have a more in-depth knowledge of emerging risks and endow prevention systems with adequate response tools. In short, there is the need to establish integrated risk governance.



REFERENCE

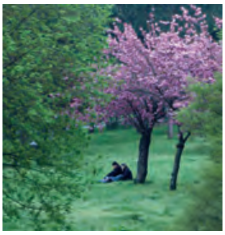
The main national, European and international documents on environment and health

International

1972 - UN Conference on Human Environment (Stockholm)
1983 - UNEP World Commission on Environment and Development "Brundtland Commission"
1987 - Brundtland Report: birth of sustainable development "environment-health-economic development"
1992 – Rio de Janeiro: UN Conference on Environment and Development: WHO publication "Our Planet; our health"
1997 – G8 Declaration on Environmental health
2000 - Millennium Development Goals
2002 - Johannesburg World Summit: strategies of sustainable development
2006 - IV IPCC Assessment: climate and health
2006 - Dubai International Agreement on Chemicals Management

World Health Organization/Europe

1989 – Establishment of Inter-ministerial Conference on Health and Environment (Environment and Health delegations from 53 countries)
1989 – 1st Frankfurt Conference on the adoption of the: European Charter on Environment and Health
1994 – 2nd Helsinki Conference: first European assessment report on environment and health
1999 – 3rd London Conference: NEHAP, PEP, Protocol on Water and Health
2004 – 4th Budapest Conference on: children's environmental health, four regional priority goals (RPGs) CEHAP
2009 – 5th Italy Conference 2009
1990 - Establishment of WHO European Centres for Environment and Health
1999 - Establishment of the European Environment and Health Committee



European Union

Articles 152 and 174 of the Amsterdam Treaty
1999 – Community action program on diseases related to pollution (Decision 1296/1999/EC of the European Parliament and Council)
2001- Sustainable Development Strategy
2002- Community action program on public health (2003-2008), Decision 1786/2002/EC
2002- 6th Community action program on the Environment (Decision 1600/2002/EC)
2002 - Commission Communication on impact assessment (COM(2002)276)
2002 – Establishment of the EFSA (*European Food Safety Agency*)
2003 - European Strategy on Environment and Health 2003
2004 – Action Plan implementing the Strategy 2004-2010 (*Action Plan for Environment and Health* - COM (2004) 416
2004 - Establishment of the SCENIHR (*Scientific Committee on Emerging and Newly Identified Health Risks*)
2004 – Community Directive REACH *(Registration, Evaluation, Authorisation and Restrictions of Chemicals*)

National

1986 - Establishment of the Ministry of the Environment
1994- Establishment of the Environmental Agency System
1999 – Art. 7 quinquies D.Lgs. 229/99
2000 – Introduction of environment and health in the National Health Plan 1998-2000
2005 - Establishment of the Disease Control Centre (CCM) – Ministry of Health
2006 – Art. 5 Doctor’s Deontology Code
2008 - NEHAP and CEHAP *in progress*

CHAPTER 7

ENVIRONMENTAL RISK

Risk of Natural Origin

Anthropogenic Risk

Introduction

Evaluating environmental risk means estimating the detrimental effects produced by natural events or human activities on the environment as well as on man and human activities.

Evaluating environmental risk means estimating the detrimental effects produced by natural events or human activities (especially industrial ones) on the environment itself, as well as on humans and their activities.
As a rule, risk is defined 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. When environmental risk is involved, the level of hazard is the probability that a given natural event or an industrial accident will occur at a certain intensity in a given area and within a certain interval of time. Vulnerability expresses the capacity 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.

Problems tied to environmental risk are analysed according to their connection with risk of natural origin or anthropogenic risk.

In the present analysis of the problems tied to risk, it has been decided to subdivide the topic into two parts: risk of natural origin 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.

Risk of natural origin

Natural events may be of exogenous or endogenous origin.

Natural events that are likely to give rise to conditions of risk can be subdivided into two main categories of underlying causes: events of endogenous origin (including for instance volcanic eruptions, earthquakes, etc.), set off by forces within the earth, and those of exogenous origin (including floods, landslides, avalanches, etc.), occurring on the terrestrial surface. The intensity and frequency of such events may range within a wide scale. Certain phenomena tend to occur in a sudden and extreme way, while others operate more slowly and continuously (subsidence is a typical example).

Both types of events are likely to cause serious damages on man and human activities.
The concept of natural risk should, therefore, be understood as an interaction between the processes of instability that “naturally” occur in the territory, remodelling its shape, and human assets, whether physical or economic, social or environmental. The interaction between the natural events referred to above and anthropogenic activities is reciprocal, with the consequence that inappropriate modes of use and management of the territory frequently result in an amplification of disturbances underway or in the triggering of new ones.

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

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) makes Italy one of the countries facing the greatest seismic and volcanic danger in the area. A similar level of hazard, combined with the widespread presence of exposed elements (population centres, infrastructures, elements of 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 Apennine range and especially in the sectors of the inter-Apennine basin, along the Calabrian edge of the Tyrrhenian and in Southeast Sicily (Figure 7.1).

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

The areas facing the greatest seismic risk are found in the Friuli area, along the central-southern spine of the Apennine range, along the Calabrian edge of the Tyrrhenian and in Southeast Sicily.

Figure 7.1: Distribution throughout the national territory of the major seismic events of the past (magnitude ≥ 6.5) [1]

The conditions of greatest volcanic risk are naturally related to the proximity of Italy's active volcanoes.

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 part, the Alban Hills (Figure 7.2). A decidedly lower level of risk, though not one entirely to be ignored, is connected

[1] Source: Parametric Catalogue of Italian Earthquakes (INGV) data processed by ISPRA

with the underwater volcanoes found in both the Tyrrhenian Sea and the Straits of Sicily. In the Tyrrhenian basin the Marsili would appear to be confirmed as 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. The danger of such volcanoes is tied not only to their endogenous activity, but also to the probable activation of gravity slides along the slopes, resulting in tidal waves.

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

[2] Source: Parametric Catalogue of Italian Earthquakes (INGV) data processed by ISPRA

Seismic and volcanic events can often manifest themselves in tandem, as frequently occurs in the Etna area.

Seismic and volcanic events can often manifest themselves in tandem, as frequently occurs in the Etna area. Furthermore, in addition to the damage tied to the seismic quake alone, further harm is done by natural events brought about by or related to the earthquake, such as landslides and falling rocks, liquefaction, consolidation, tsunami and surface faulting. Quite frequently volcanic events also present related phenomena, such as: activation of mud and/or debris flows (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

Though there were no massive manifestations during 2007, seismic and volcanic activities remained sources of elevated risk in Italy.
In 2007, only one seismic event exceeded the threshold magnitude of 4.5. This event occurred in the Aeolian Islands on 4 July, at a magnitude of 4.9.

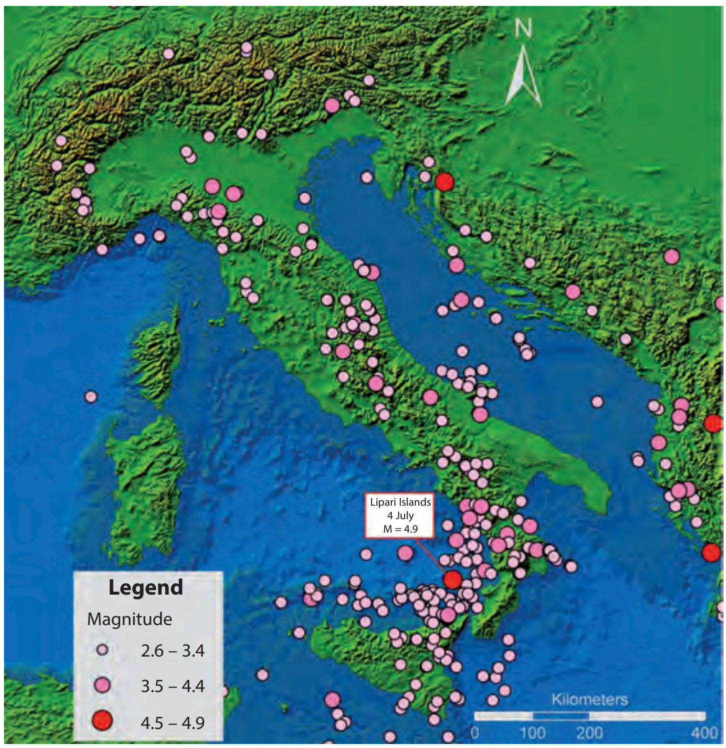


Figure 7.3: Main seismic events registered during 2007[3]

[3] Source: INGV data processed by ISPRA

directly on the sea bottom, as occurred at Stromboli in 2002); secondary quakes (typical of the Phlegraean fields).

There were no extreme examples of seismic or volcanic activity during the year 2007. Only one seismic event exceeded the threshold magnitude of 4.5 (Figure 7.3). Such event occurred in the Aeolian Islands on 4 July, with a magnitude of 4.9 and depth of the epicentre of 280 km. On account of the noteworthy depth of the epicentre, no significant damage occurred.

In 2007, only one event, which occurred in the Aeolian Islands on 4 July, exceeded the threshold magnitude of 4.5.

Landslides and flooding are among the most frequent natural disasters in Italian territory and one of the primary causes of risk for the country's socio-economic structure. In terms of the level of hazard of the events, whether they involve flooding or sliding, Italian territory presents a great variety of geological, climatic, morphological and tectonic situations. Large alluvial plains facilitate the occurrence of extensive flooding, while the dynamics of hydraulic disturbances in mountain areas are characterised by high flow speed due to the steep gradients of river and stream beds. Landslide events present an even more complex scenario, due to multiple combinations of geological, morphological and climatic factors that give rise to phenomena which vary greatly in terms of type, kinematic properties, ongoing development and extension of the areas involved.

Landslides and flooding are among the most frequent natural disasters in the Italian territory, and one of the primary causes of risk for the country's socio-economic structure.

Since 2002, APAT (now ISPRA, the Institute for Environmental Protection and Research) has carried out a systematic study on the main meteorological events that have occurred in Italy from the post-war period (1951) to the present, publishing pluviometric data, plus information on the types of flooding, the numbers of individuals involved and the urgent measures adopted to face the disturbances. Information on the principal floods that occurred in Italy in 2007, indicating the dates and locations of the events, the number of human deaths and the total estimated damage, is shown in Table 7.1. The information listed (indicating the period and location of flooding events) is taken from the reports published on the web by the main Italian media, while the figures on the number of victims and the total estimated damage have been taken from official sources (ISTAT, CNR, Civil Defence Department, ARPA and local government bodies).

Since 2002, APAT (now ISPRA) has carried out a systematic study of the main meteorological events that have occurred in Italy from the post-war period (1951) to the present.

Table 7.1: List of the main floods in Italy (2007) [4]

Period of the event	Region	Deaths	Total estimated damage	Total estimated damage/GDP
		n.	milioni di €	‰
1- 4 May 2007	Piedmont	0	7	0.00521
4 May 2007	Liguria	0	5.75*	0.00428
26-28 May 2007	Veneto, Friuli Venezia Giulia, Lombardy, Piedmont	1	2	0.00149
1 June 2007	Liguria	0		0
From 13 to 15 June 2007	Veneto	0		0
20 June 2007	Piedmont	0	1*	0.00074
8-9 August 2007	Aosta Valley, Piedmont, Lombardy, Liguria, Tuscany	0		0
19-20 August 2007	Liguria	0		0
30-31 August 2007	Piedmont, Lombardy	0	2.2*	0.00163
26-27 September 2007	Veneto	0	100	0.07451
6-7 October 2007	Abruzzo, Molise, Campania, Lazio, Marche	1	50	0.03725
18-21 October 2007	Sicily, Calabria	0	150*	0,11177
25 October 2007	Sicily, Calabria	0	150*	0,11177
2-3 November 2007	Sicily	0	150*	0,11177
22-24 November 2007	Friuli Venezia Giulia, Liguria, Tuscany	0		

(*) Data based on funds appropriated

[4] Source: ISPRA processing of ISTAT data; Coldiretti data; CIA data; www.corriere.it; www.repubblica.it; www.rainews24.it; www.gazzettadelsud.it; www.sambenedettoggi.it; www.ilgrecale.it; www.ilmeridiano.info; http://laprovinciapavese.repubblica.it; http://www.commissarioallagamenti.veneto.it; www.meteoweb.it; www.meteoitalia.it; www.meteo4.com; www.meteolive.it; www.meteoveneto.com; www.meteotriveneto.it; http://www.protezionecivile.it; CNR-GNDCI Progetto AVI; ARPA Piedmont; Benedini & Gisotti Il dissesto idrogeologico

Data presented during the National Conference on Climate Change (organised in 2007 by the Ministry of the Environment, Land and Sea and the APAT) show a general downward trend of scarce seasonal and annual precipitation. This drop is particularly evident on the national level (-5% per century), with a sharper decrease for the regions of Central Italy, showing a negative trend of –10% per century. Furthermore, it has been noted that, during the last 120 years, in addition to a slight decrease in global precipitation, there has been a sharp reduction in the number of rainy days, combined with a significant increase in intensity. There has been an especially noticeable increase in the contribution of heavy precipitation events to total precipitation, combined with a significant decrease in the number of weak rainfall days.
Figures 7.4 and 7.5 show, respectively, data on victims and on total damage compared to GDP produced by flooding between 1951 and 2007.
Nevertheless, despite some sporadic events that occurred around the 90's [Valtellina, in Lombardy (1987), Piedmont (1994), Sarno, in Campania (1998), Soverato, in Calabria and Piedmont/Aosta Valley (2000)], there has been a downward trend in damage and victims, as compared to GDP. This can mostly be attributed to improvements in structural and non-structural systems for safeguarding the territory and mitigating risk.
The estimated economic damage amounts to no less than 5 billion euros for the last seven years. This parameter is also influenced by the course of socio-economic and demographic development whose demands have resulted in a use of the territory that does not always respect its natural role.

Hydro-geological disruptions: in recent years there has been a downward trend in victims and damage produced by extreme events, probably due to improvements in the systems for safeguarding the territory.

In recent years there has been a downward trend in victims and damage produced by extreme events.
Only 4 events exceeded the threshold of a hundred victims. These occurred in 1998, 1966, 1954, 1951.

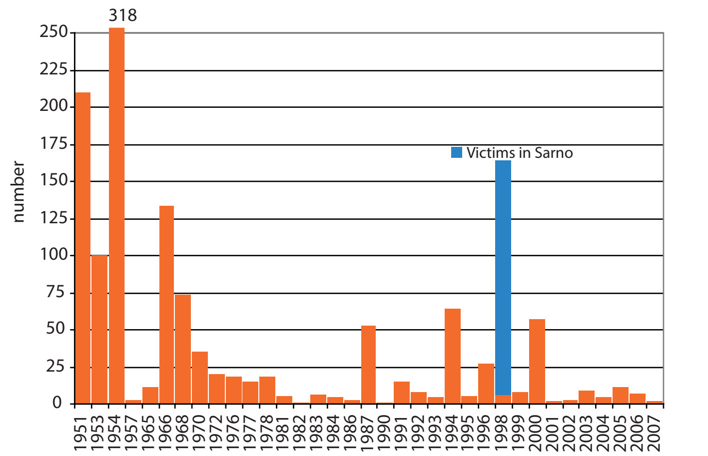


Figure 7.4: Victims of the main floods in Italy from 1951 to 2007[5]

The estimated economic damage amounts to no less than 5 billion euros for the last seven years.

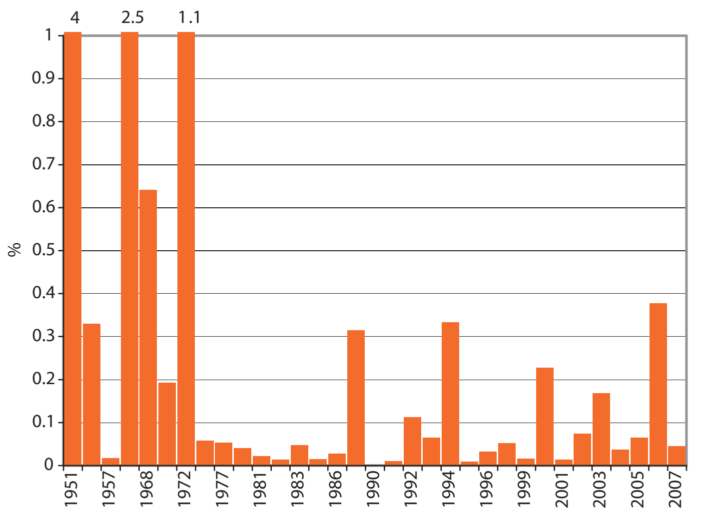


Figure 7.5: Estimated economic damage compared to GDP, for flood events occurred from 1951 to 2007[6]

[5] Source: ISPRA
[6] Source: ISPRA

In terms of landslide disturbances, Italy presents an especially high risk 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 Venezia Giulia (2003). A census carried out under the IFFI Project (Inventory of Landslide Events in Italy) has identified 483,272 landslides involving an area of 20,573 km^2, equal to 6.8% of the national territory. This census has been carried out since 1999 by the Italian Geological Service (since 2002 part of the APAT, now the ISPRA), in cooperation with 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 7.6). The data on Basilicata, Calabria and Sicily tend to underestimate the actual situation of disruption, because surveys of landslide events carried out to date have focused on areas where urban centres or major transport infrastructures are located. The data gathered by the 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 32.5%, slow earth flow, at 15.3%, rapid debris flow, at 14.6%, and complex landslides, at 11.3%. A large portion of landslide events present renewed activity over time; quite often, dormant periods of 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

Landslides are the natural disasters that occur with the greatest frequency and, after earthquakes, cause the greatest number of victims.
In Italy, more than 480,000 landslides have been identified, involving an area of over 20,500 km^2.

The data gathered by the IFFI show that the most frequent types of movement (classified on the basis of the prevalent component of the movement) are rotational/translational slides.

mud/debris flows. Not all landslides present the same level of hazard, with those involving high-speed movement and noteworthy volumes of rock or soil causing the greatest damage and number of victims.
In order to obtain a preliminary landslide risk assessment of Italian territory, landslides (recorded in the IFFI database) have been

Italy presents an especially high risk of landslide, on account of its geological and morphological characteristics (75% of the territory is mountainous-hilly). As of December 2007, the landslides recorded covered 6.8% of the national territory.

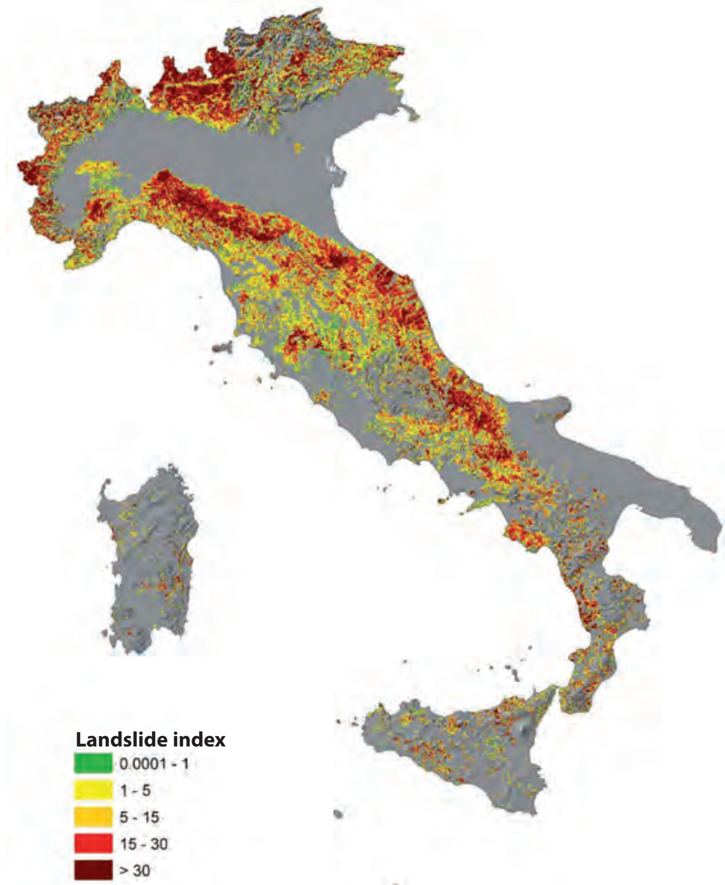


Figura 7.6: Landslide index (%) [7]

[7] Source: ISPRA

cross-analysed with the exposed elements (infrastructures, urban centres, etc.), taken from the Corine Land Cover 2000 (Figure 7.7).

In Italy, a total of 2,940 municipalities were classified at very high levels of attention, 1,732 municipalities require high levels of attention, 1,036 municipalities warrant a moderate level, and 2,393 call for negligible levels of attention.

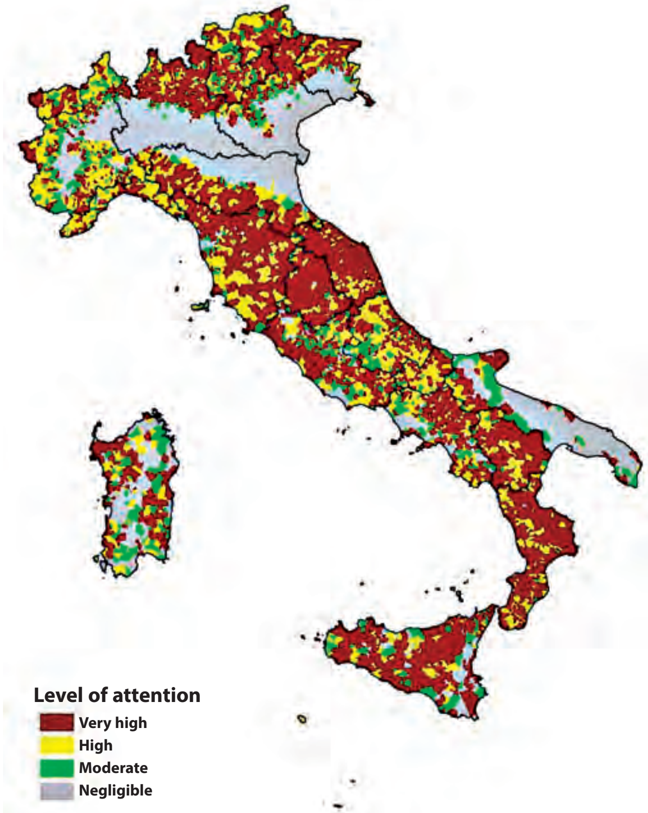


Figure 7.7: Level of attention for landslide risk, on municipality basis [8]

The Italian municipalities affected by landslides currently number 5,708, or 70.5% of the total, while 2,393 present negligible levels of attention (municipalities in which no landslides have been registered). A total of 2,940 municipalities have been classified at very high levels of attention (intersections between landslides and the continuous and discontinuous urban texture, as well as industrial or commercial areas),

Italian municipalities affected by landslides currently number 5,708, equal to 70.5% of the total.

[8] Source: ISPRA

1,732 municipalities call for high levels of attention (intersections between landslides and the highway, railway and road networks, areas used for mining, dumping and worksites), and 1,036 rate a moderate level of attention (intersection between landslides and arable lands, wooded territories, and semi-natural environments, green urban areas and spor ts and recreation areas), and 2,393 call for negligible levels of attention (municipalities in which no landslides have been register ed). The estimated population exposed to landslide risk, on the basis of landslides recorded in the IFFI inventor y and the data gathered during the ISTAT 2001 census, totals 992,403 inhabitants, equal to 1.74% of Italy's resident population. The data, grouped by municipality, show that the greatest number of individuals at risk are found in the regions of Calabria, Marche and Sicily (Figure 7.8).

The population exposed to landslide risk totals 992,403 inhabitants, equal to 1.74% of Italy's resident populationy.

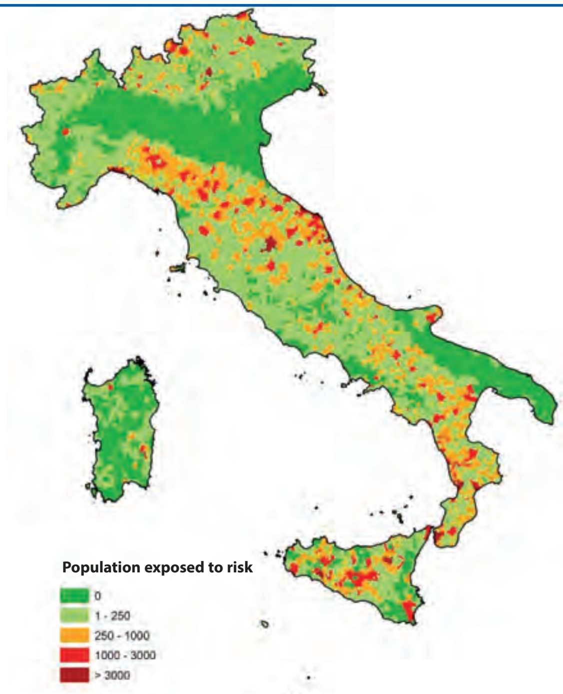


Figure 7.8: Population exposed to landslide risk[9]

[9] Source: ISPRA

All of Europe's coastal states are in some way affected by coastal erosion. About 20,000 km of coastline (equal to 20% of the European total) have been severely impacted. Most of the areas involved (15,000 km) are currently affected by coastal erosion, partly due to the realisation of defence works (2,900 km). Moreover, 4,700 km of coastline has been artificially stabilised.
The total surface area lost or severely affected by erosion is estimated at 15 km^2/year. In the period between 1999 and 2002, more than 250 buildings were abandoned owing to imminent threats posed by coastal erosion, while 3,000 buildings lost at least 10% of their market value. Such losses are negligible, however, when compared to the risk of coastal flooding due to the destruction of dunes or the collapse of protective works due to the action of the waves.
Thousands of square kilometres and millions of people are exposed to this kind of risk. In the last 50 years, the population of Europe's coastal communities has more than doubled, reaching 70 million inhabitants in 2001, and the overall value of economic activities located within 500 metres of the seashore has continued to grow, reaching 500 billion-1 trillion euros. In light of estimates of climate change, the risk of erosion and flooding for urban centres, tourist resorts and industrial areas, as well as for agricultural territories, recreation centres and natural habitats, grows year after year.
Data on the erosion and flooding of coastal areas in Italy, 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 1,170 km of Italy's roughly 4,863 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 Italy's total of approximately 8,350 km of coastline.

About 20,000 km of coastline (20% of the European total) have been severely impacted.

The estimated total surface area that has been lost or severely affected by erosion is 15 km^2/year.

A general retreat of Italy's sandy coastlines was registered from the '70s to the present.

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

The effect on our territory of the erosion and flooding of coastal areas is significant.

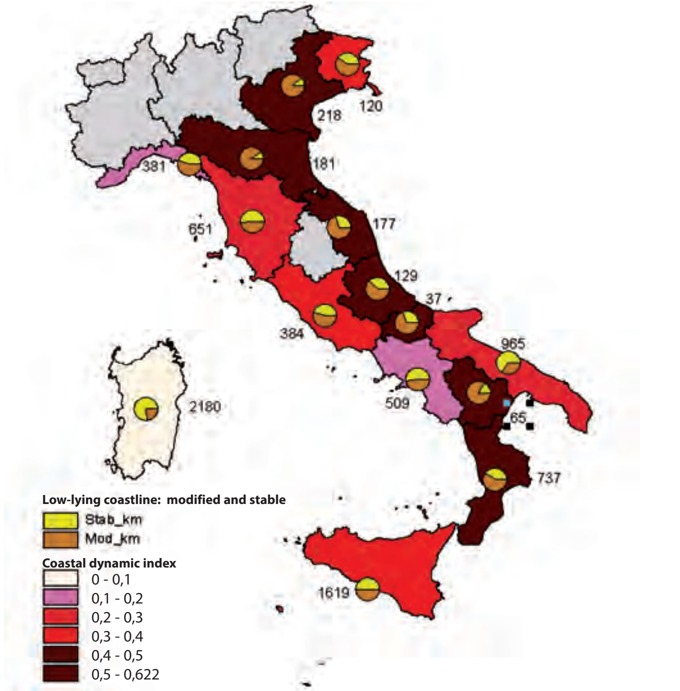


Figure 7.9: Variation > 25m of the low-lying coastline and the index of coastal dynamic[10]

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

The need for wide-scale, integrated management of coastal areas, with appropriate steps taken 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 falling in the RICE[11] category, meaning a zone potentially subject to erosion and flooding within the next 100

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[10] Source: ISPRA
[11] 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, a value of 10 m was used for the limit curve.

years (Figure 7.10a) was identified. Of note is the fact that the area potentially at risk occupies approximately 1 million hectares, equal to 3.17% of the entire national surface area, and houses more than 5 million inhabitants, or 9.12% of the entire population. Within this zone, it is estimated that a surface area of about 340,000 ha (1.12 of the national surface area) and a population exceeding 2 million inhabitants (3.69% of the total population) are exposed to a moderate-high or high risk (Figure 7.10b).

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 houses roughly 5.3 million 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.

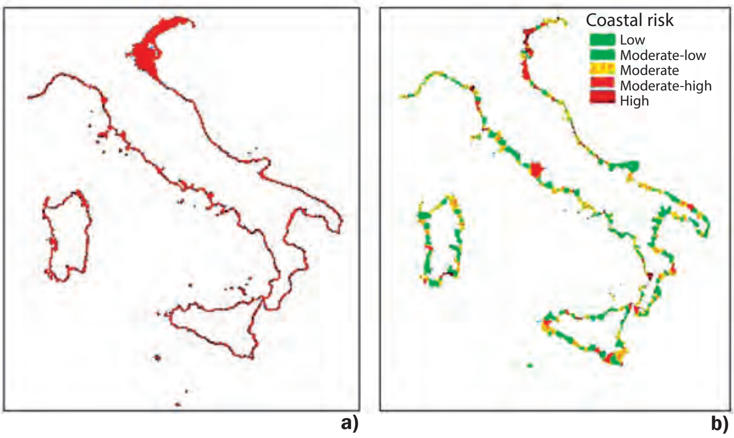

Figure 7.10: a) RICE Area in Italy and b) Map of the coastal risk by municipality[12]

The causes

Events such as earthquakes, volcanic eruptions, landslides and flooding occur with great frequency in Italy, owing to the geodynamic context of our country and to the morphological characteristics of its territory. These events often give rise to conditions of elevated risk, given the presence of human activities even in areas at high risk. Such activities can even contribute to the danger, modifying areas whose natural balances are already precarious (through either direct actions, such as roadway construction, excavation or overloads, or indirect actions, including negligent maintenance of defence works).

The evolution of the main disruptive events occurring on the Italian peninsula is influenced by both natural and anthropogenic factors.

[12] Source: ISPRA

Physical mechanisms governing the onset and the evolution of natural hazard events are very complex and not linear.

Anthropogenic causes include, among others, a use of the territory that does not pay sufficient attention to the characteristics and the delicate natural balances of Italian terrain.

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

Disruptive events are influenced by a multiplicity of "natural" factors that are mainly tied to the special geo-morphological conformation of the Italian territory, as well as to the type and extension of the vegetative coverage and conditions of weather and climate. Physical mechanisms ruling the onset and the evolution of natural hazard events are very complex and not linear, and can set off different effects from one place to the next, even in situations that would appear to be similar.

Anthropogenic causes include, among others, a use of the territory that does not pay sufficient attention to the characteristics and the delicate natural balances of Italian terrain. The management of the environment does not always respects the "environmental" traits of the territory, allowing planning and implementation of increasingly invasive works (such as embankments, dikes, canals, reclamation works and retaining walls) that prevent 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.

Coastal environments and the watersheds underneath them (subdivided into physiographic units) also present a conformation that is the end result of a complex interaction among numerous factors, the majority of which are anthropogenic. 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 slopes.

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

- reduced flow of solid river materials to beaches, due to works for the stabilisation of slopes, the control of rivers and the building of dams (primarily anthropogenic, as opposed to natural);
- the combined effects of tides and flood events, which cause heightened erosion at river mouths, where large volumes of river water reach the sea;
- a rise in the sea level due to a lowering of the terrain caused by the combined effect of natural and anthropogenic subsidence, plus eustatic movements.

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

Solutions

Seismic and volcanic activities, flooding, landslides and coastal erosion are outcomes of the planet's natural dynamics, meaning that there is little that man can do to control them. Nevertheless, conditions of risk 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 set 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.

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

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, while prevention mostly consists of making appropriate planning choices, as well as selecting and applying technical procedures designed on the basis of the knowledge obtained. An urban planning approach that takes into consideration natural hazards (including the effects of seismic phenomena and those produced by intense meteorological events) needs to become an essential component in the decision-making process, on both the political and administrative levels.

Forecasting can be carried out through specific studies of the zones subject to risk. Prevention consists of selecting and applying technical procedures designed on the basis of the knowledge obtained. Unfortunately, the choices made in this field have not always been the right ones.

In terms of seismic risk, for example, although it is not possible to reduce the hazard component, less vulnerable buildings should be constructed in areas exposed to this risk. The seismic classification of the national territory can be a precious tool. Having been significantly reinforced following the 1980 earthquake in Irpinia and, more recently, after the earthquake of 2002 in the Molise, by the issue of Ordinance no. 3274 of 20 March 2003 and no. 3519 of 28 April 2006 by the Prime Minister, the classification reflects the state of the art as far as knowledge of seismic risk in Italy is concerned (Figure 7.11). The Map of seismic classification provides an updated overview of the various areas of Italian territory characterised by different levels of seismic

This map presents seismic hazard in terms of maximum ground acceleration, with a 10% probability of exceedance over 50 years on rigid terrain.

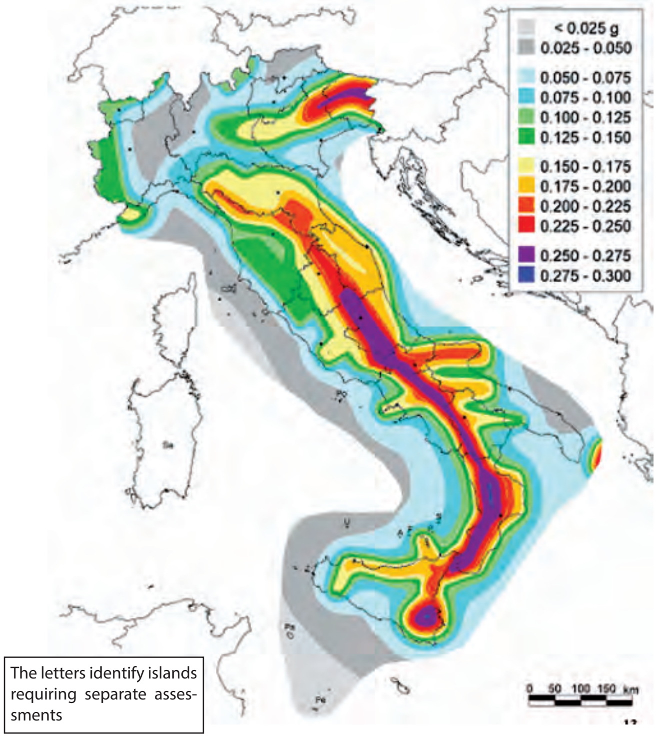

Figure 7.11: Seismic hazard map of the national territory[13]

The seismic classification map provides an updated overview of the various areas of Italian territory characterised by different levels of seismic hazard, together with appropriate anti-seismic regulations for the construction of buildings and other public works.

hazard (Figure 7.12), together with appropriate anti-seismic regulations for the construction of buildings and other public works. Unfortunately, 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 regulations 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 construction codes.

[13] Sources: INGV

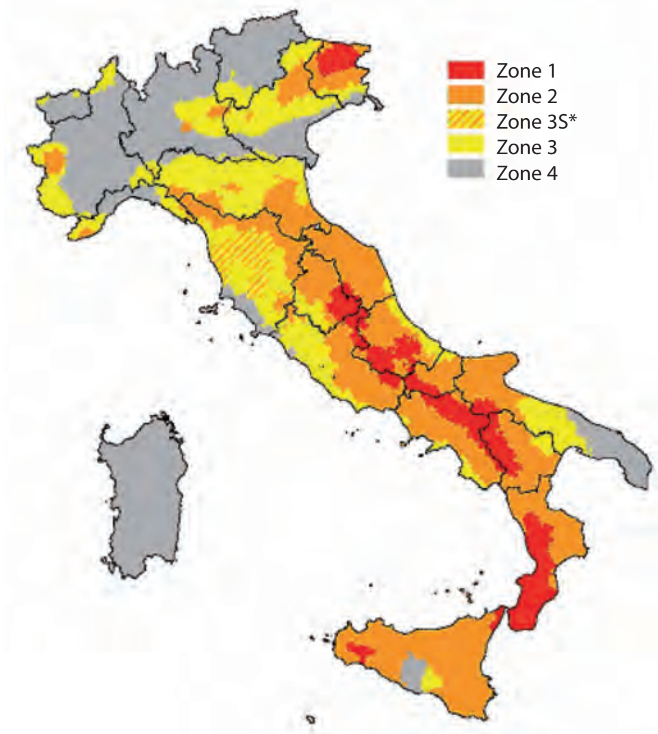

Figure 7.12: Seismic classification map[14]

The seismic classification map shows Italian municipalities subdivided into four seismic areas of decreasing seismic hazard, from area 1 to area 4; these areas correspond to four classes of maximum ground acceleration presenting a 10% probability of occurrence over 50 years.

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 review, for the purpose of managing the emergency phases of any eruptions, eventually through the evacuation of the areas held to be at risk, based

In the case of Vesuvius and the Phlegraean Fields, the Italian Civil Defence Department has drawn up specific emergency plans for handling the critical phases of any eruptions.

[14] Source: ISPRA
Note: The 3S* area (created for the Tuscany Region by Regional Decree no. 431/06) is based on a precautionary principle, under which the municipalities in the area, classified as facing "low seismic hazard", nevertheless follow the anti-seismic planning criteria indicated for medium seismic hazard areas (S2)

In many sectors of Italian territory, there has been urban development on active tectonic structures capable of producing significant dislocations/deformations of the topographic surface (capable faults). In such cases, assessment of seismic risk is underestimated.

Policies protecting the land are governed in Italy by Legislative Decree no. 152/06, whose provisions are mant to ensure protection and reclamation of ground and subsoil, the hydrogeological reclamation of the territory and precautionary measures against hazardous situations.

on the reference eruption scenarios. What is necessary, and should be aimed at, is a combination of planning and initiatives geared towards the decongestion of an urban situation that is simply unfeasible in an area containing active volcanic structures, together with 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 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 governed in Italy by Legislative Decree no. 152/06 on “Environment Regulation”, plus subsequent modifications and updating containing provisions aiming at ensuring protection and reclamation of the ground and subsoil, the hydrogeological reclamation of the territory and precautionary measures against hazard situations. Some contents of this measure were already found in Law 183/89, which “Regulated the organisational and functional framework for land protection”. This is the first law that, following a 30-year debate on assessments of land protection, has promoted an exhaustive national policy on the question. In particular, this law introduced the concept 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. A subsequent contribution to application of the regulation on the preservation of the territory from “hydrogeological disarray” 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), 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 decree has promoted research on risk conditions throughout the national territory, for the purpose of mitigating them through a policy combining forecasting and prevention. 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", implemented through later regulations. Data updated to March 2008, taken from the National Repertory of Measures and Works for Mitigation of Hydrogeological Risk (ReNDiS) drawn up by the ISPRA, show that, from 1998 to the present, the Ministry of the Environment, Land and Sea has financed, in accordance with Legislative Decree 180/98, plus subsequent modifications and updates, 2,671 urgent initiatives for the reduction of hydro-geological risk, at a total cost of roughly 2 billion euros (Figure 7.13).

Starting from 1998, the Ministry of the Environment, Land and Sea has financed 2,671 urgent initiatives for the reduction of hydro-geological risk, at a cost of about 2 billion euros.

Figure 7.13: Distribution throughout the national territory of the initiatives financed in accordance with Legislative Decree 180/98 plus subsequent modifications and updating[15]

Starting from 1998, and in accordance with Legislative Decree 180/98, the Ministry of the Environment, Land and Sea has financed 2,671 urgent initiatives for the reduction of hydro-geological risk, at a total cost of roughly 2 billion euros.

[15] Source: ISPRA

The majority of urgent interventions financed in accordance with Legislative Decree 180/98 concern landslides (40%) and flood events (18%).

The majority of the urgent initiatives concern gravity slides (40%) and flood events (18%), followed by mixed (2%) and avalanche events (1%), as well as disturbances affecting fire-damaged areas (1%). In the case of about 40% of the initiatives, the main type of disturbance is not indicated in the financing decree.

A further regulatory tool for the assessment and management of flood risk is the Directive 2007/60/EC of 23 October 2007. The "Floods Directive" aims to minimise the adverse consequences of floods – which occur with increasing frequency, due to climate change – by adopting joint cross-border policies for protection against flood risk. The Directive provides an articulated strategy consisting of a preliminary phase of flood risk assessment, followed by the establishment of flood risk maps and the development of risk management plans for areas at risk. Management plans should focus on prevention and protection.

The dissemination of information on hydro-geological instability (landslides, floods, avalanches) among the central and local bodies of the Public Administration, as well as the general population, plays a very important role in risk prevention.
Projects carried out by the ISPRA, such as ReNDiS and IFFI, are important tools for gathering the basic knowledge required to develop proper territorial planning.

The dissemination of information on hydro-geological instability (landslides, floods, avalanches) among the central and local bodies of the Public Administration, as well as the general population, also plays a very important role in risk prevention. Projects carried out by the ISPRA, such as the National Repertory of Measures and Works for Mitigation of Hydrogeological Risk (ReNDiS), and the Inventory of Landslide Events in Italy (IFFI), are important tools for gathering the basic knowledge required to develop proper 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. To this end, in 2005, the APAT (now the ISPRA) 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. Since 2008, thanks to a newly-created function, WebGIS, landslides can be visualised with *Google Earth*.The dissemination of data is also a factor of noteworthy importance when it comes to analysing coastal erosion. A step held to be extremely important is making the best possible use of existing national databases (which are extremely accurate and, in theory, provide more cartographic information than do the databases of other countries), in order to offset the major shortcoming represented by

the lack of uniform, readily available knowledge. 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 fundamentals and "strategic" thematic write-ups between the various bodies and branches of the central, regional and local governments.

Possible approaches for protecting human life and property can be classified in three main categories:

- Retreat: no action is taken to protect land from the sea. Motives for choosing this option are the huge economic and environmental impact of protective measures;
- Protection: involving operations such as as the construction of permanent protection structures, dune reconstruction, the introduction of vegetation and replenishment of beaches;
- Accommodation: meaning people going on living in the territory at risk, without attempting to prevent erosion or flood events.

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 for all of the more than 4,863 km of Italy's low sandy coasts. Even limiting efforts to the approximately 1,170 km where erosion, as of today, has already occurred would call for enormous initial investments (on the order of 2 billion euros) needing to be repeated over time, plus the use of quantities of sediment for replenishing on the order of 150-200 million cubic metres, and this only at the start, to say nothing of 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 further need to comply with current regulations in the sector.

Possible solutions for enacting strategies of adaptation include:

- abandoning areas to their natural course of evolution;
- preserving and/or reconstructing nature zones that serve as "soft" interfaces between the land and the sea;
- preserving and/or reconstructing coastal dunes;
- implementing strategies of territorial planning, in order to avoid further deterioration, in terms of vulnerability, with one option being planning constraints;

The dissemination of data is also a factor of noteworthy importance when it comes to analysing coastal erosion. Existing national databases can offset the major shortcoming represented by the lack of uniform, readily available knowledge.

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

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

- 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 overlay the Municipal Regulatory Plans (MRP) with the recommendations of the Coastal Management Plans while making the Strategic Environmental Assessment (SEA) part of the process for assessing coastal plains. It should also be ensured that the system of assessment is independent of the subject that formulates the plan.

The risk of erosion makes necessary a balance between residential/productive 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 first and second strategies are based on the principle of abandoning the struggle for territorial advantage 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 a project 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”.

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

At present 9 out of 15 coastal regions possess tools that cover their entire regional territory, in the form of coastal protection plans or integrated management plans for coastal zones.

In terms of coastal planning, 9 out of 15 coastal regions currently possess tools that cover their entire regional territory, in the form of coastal protection plans or integrated management plans for coastal zones (see chapter 9).

The remaining regions generally adopt programmes of intervention and Regional Operating Plans (ROP) whose aim is limited to the identification of a series of protective works to be realised along short coastal segments.

The lack of general guidelines and approaches on a national level has led to the development of different regulatory plans (individual plans, as provided for by Law 183/89 and Legislative Decree 180/98, landscape plans, as provided for by Law 431/89 and Legislative Decree 94/04), and consequently various approaches in terms of planning, compulsory compliance and protection of the areas involved.

In light of the above, an increasingly urgent priority is the implementation of the EC recommendations on ICZM (Recommendations of the European Parliament and Council concerning the implementation of Integrated Coastal Zone Management in Europe-05/03/2002), through formulation of national guidelines endorsed by the government bodies and the authorities which currently hold responsibility for planning. Equally urgent is the need for a regulatory definition of the concept of "Coastal Plan", 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.

The implementation of the EC recommendations on ICZM.

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 interventions that will prove necessary for coastal planning call for synergy between public and private investment, as well as a coordination of local and national initiatives.

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. A concrete action could be the result of an approach that groups initiatives on a central level, with the participation of representatives of institutions, regional governments and the academic world, for projects and programmes to be undertaken in coastal zones.

Anthropogenic risk

Anthropogenic risk is defined as the risk (direct or indirect) caused by human activities that are potentially dangerous for both the environment and human life. This broad definition encompasses so-called "industrial risk" arising from activities carried out in industrial establishments.

Anthropogenic risk is directly or indirectly tied to human activities that are potentially dangerous for human life and the environment.

A "Major-Accident Hazards Establishment" (MAH establishment)

is defined as an establishment containing dangerous substances (used in the production cycle or simply stored) in quantities that exceed the thresholds established under the Seveso regulations (Directive 82/501/ EEC, plus subsequent modifications).
As a matter of fact, the handling and/or use of huge quantities of substances classified as toxic, flammable, explosive or oxidizing, and therefore dangerous for the environment can eventually lead to the occurrence and uncontrolled development of an accident posing a serious threat to human health and/or the environment, either immediate or delayed, potentially inside or outside the establishment, with fires, explosions or toxic release.
In the Eighties, the European Community took into consideration this type of establishments for the first time, in order to prevent major accidents in industrial plants and limit their consequences for man and the environment as a whole, issuing a special directive (the abovementioned 82/501/EEC, also known as the "Seveso Directive").
Operative application of the directive by the member states of the European Community has made clear the urgent need for updates and modifications, to the point where the Seveso Directive has been updated twice in the last years, under Directives 96/82/EC and 2003/105/EC, transposed into national law with Legislative Decrees 334/99 and 238/05.

The Seveso Directive, plus subsequent modifications, aims at reducing major-accident hazards, as well as their impact on man and the environment.

These regulations aim at reducing the probability of accidents, as well as their consequences on man and the environment.
To this end, operators of potential major-accident hazards establishments are obliged to fulfil special commitments, such as the production of specific technical and informative documentation, and the implementation of safety management systems. They must also submit to inspections and controls by the competent authorities.

The situation

The ISPRA, together with Ministry of Environment, Land and Sea, collects the information on major-accident hazards establishments supplied by operators to the competent authorities.

The information on major-accident hazards establishments supplied by operators to the competent authorities (including the Ministry of the Environment, Land and Sea, under the specific obligations indicated in Legislative Decree 334/99, with administrative and penal sanctions handed down in the event of failure to present the declaration, or of incorrect or incomplete declarations)

are collected by the ISPRA, together with the Ministry of the Environment, Land and Sea, through the production and updating of the National Inventory of Major- Accident Hazards Establishments (MAH industries), as stipulated under Legislative Decree 334/99 (Art. 15, fourth paragraph), and validated through a cross-analysis with the data already in the possession of the regional governments and the regional agencies with territorial jurisdiction.

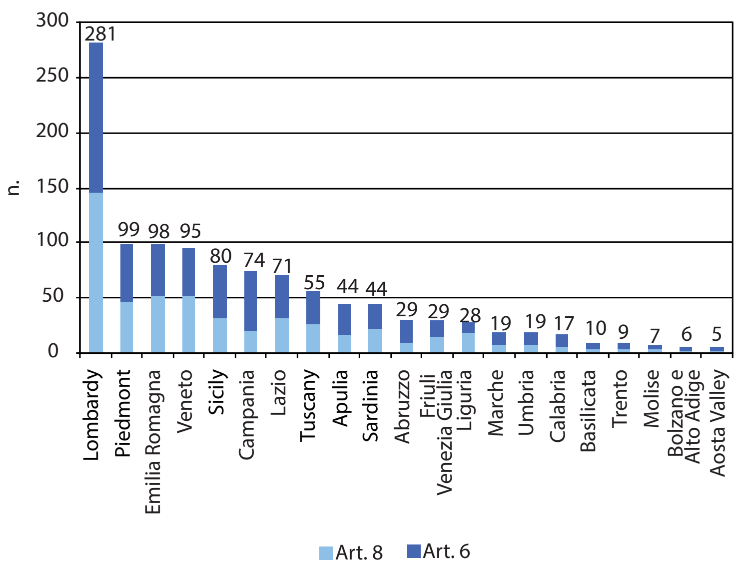

Figure 7.14: Distribution by region of establishments subject to Legislative Decree 334/99 plus subsequent modifications and updating (30/6/2008) [16]

The regions with the greatest concentration of major-accident hazards establishments are: Lombardy, Piedmont, Emilia Romagna and Veneto, followed by Sicily, Campania and Lazio.

When, for example, the following information is known:

- the number of major-accident hazards establishments, on a regional basis (Figure 7.14);
- the number of major-accident hazards establishments, on a provincial basis (Figure 7.15);

When the number and distribution within the territory of major-accident hazards establishments is known, risk maps can be drawn.

[16] Source: Ministry of the Environment, Land and Sea data processed by ISPRA

The highest concentrations of major accident hazard establishments are found in the provinces of Central and Northern Italy, notably Milan, Bergamo, Brescia and Ravenna in the North, and Naples in Centre-South.

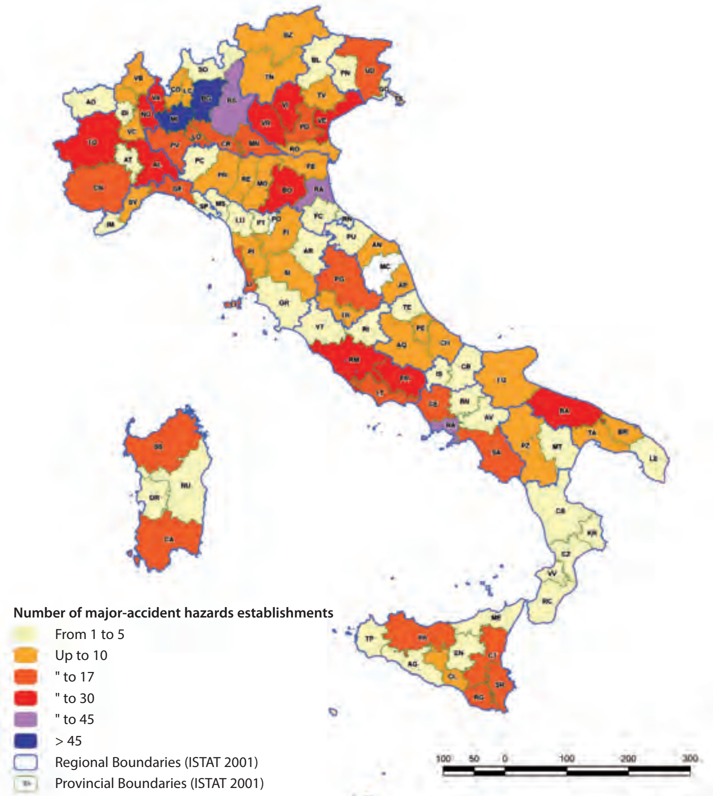

Figure 7.15: Number of major-accident hazards establishments – Distribution by province (30/6/2008) [17]

- the number of municipalities with 4 or more major- accident hazards establishments (Figure 7.16), then the areas with the highest concentrations of MAH establishments can be identified, in order to implement controls and precautionary measures adequate to keeping a possible accident in any one of the establishments from involving other plants and causing serious consequences both for man and the environment.

[17] Source: Ministry of the Environment, Land and Sea data processed by ISPRA

Municipalities with 4 or more major- accident hazards establishments include Venice and Ravenna.

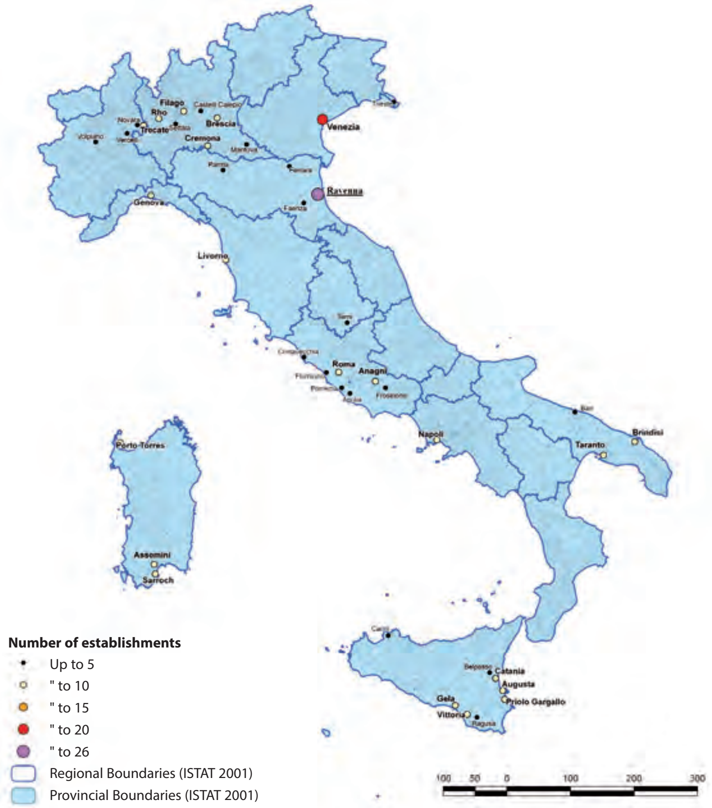

Figure 7.16: Municipalities with 4 or more major-accident hazards establishments (30/6/2008) [18]

An analysis of the types of establishments (Figure 7.17) also points to further considerations regarding our country's map of industrial risks. Similar information makes it possible to identify the industrial activities most widespread among the major-accident hazards establishments, as well as their distribution within the national territory.

When the activities of an establishment are known, then its potential

When the activities of an establishment are known, its potential risk can be identified.

[18] Source: Ministry of the Environment, Land and Sea data processed by ISPRA

Chemical and/or petrochemical establishments, as well as liquefied gas storage facilties (mostly LPG), are the most widespread, corresponding to roughly 50% of the total number of establishments.

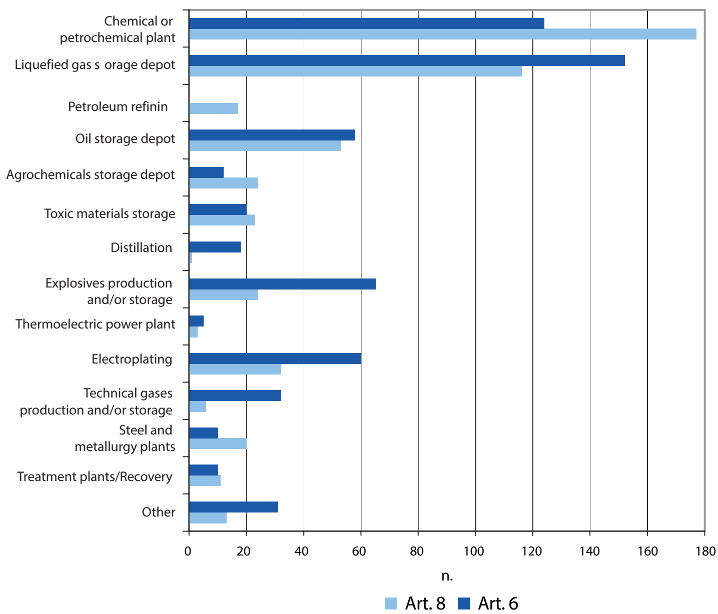

Figure 7.17: Distribution on a national basis of establishments subject to Legislative Decree 334/99 plus subsequent modifications and updating, by type of activity (30/6/2008) [19]

risk can be foreseen, at least in general terms. For example, storage sites for LPG or explosives, as well as distilleries and plants for production and/or storage of technical gases, present a shared risk of fire and/or explosion, with effects traceable, in the event of an accident, to radiation or overpressure of varying intensity, with possible structural damage to plants and buildings, as well as damage to human health. Chemical establishments, refineries, toxic gases and agrochemicals storage depots are exposed not only to the risk of fire and/or explosion, as in the case of the facilities referred to earlier, but also to the risk of diffusion of toxic and eco-toxic substances, even at a distance, giving rise to immediate and/or delayed danger for both man and the environment. An analysis of the types of activities that are carried out on the national territory shows a prevalence of chemical

[19] Source: Ministry of the Environment, Land and Sea data processed by ISPRA

and/or petrochemical establishments, as well as liquefied gas facilities (notably LPG), corresponding, when taken as a whole, to 50% of the total number of establishments. Chemical and petrochemical establishments are mainly concentrated in Lombardy, Piedmont, Emilia Romagna and Veneto. Refineries (17 plants in Italy) are distributed more or less throughout the national territory, with especially heavy concentrations in the regions of Sicily and Lombardy, which respectively contain 5 and 3 plants. A similar situation is observable with regard to oil storage depots, which are concentrated near the country's major urban areas. LPG tank storage sites are currently widespread in Campania and Sicily, as well as in Lombardy, Tuscany, Veneto and Emilia Romagna. The sites of these plants are often located near urban areas, and are particularly concentrated in the provinces of Naples, Salerno, Brescia, Venice and Catania.

In Italy, there is a prevalence of chemical and/or petrochemical plants, as well as LPG facilities (roughly 50%). The former are essentially concentrated in the Northern regions, while the latter are widespread in the South.

The causes

The potential danger tied to the presence of major-accident hazards establishments in Italy is comparable to that of the other major European industrial countries, though Italy presents certain peculiarities tied to the development and history of its industry, as well as to choices made in the past, notably in terms of energy supply. A example worth note is the concentration of refineries to be found in Sicily and Lombardy, due to the development of major petrochemical complexes in the post-war period, as well as in the Po Valley (Ravenna, Ferrara), in the Venetian Lagoon (Marghera), and, starting from the '60 and '70 period, in South Italy (Brindisi, Priolo, Gela, Porto Torres, etc.). Within the overall European framework of establishments at risk of accident, one of the Italian peculiarities is the impressive development of the network of LPG tank storage sites, supplying gas to the areas of the country that are not reached by the methane distribution network. Another characteristic of the Italian situation is the presence of industrial districts characterised by a concentration of small and medium-size industries with production activities that are similar or belong to the same production chain, such as the chemical or pharmaceutical sectors in certain areas of the Lombardy Region (where 25% of major accident hazard establishments are located) and in the Pontine area, or the electroplating industry in Veneto, Piedmont and Lombardy. These establishments often operate in congested territories located near urban areas, or in any case densely

One of the peculiarities of Italy is the impressive development of the network of LPG tank storage sites, supplying gas to the areas of the country that are not reached by the methane distribution network. Another national characteristic is the presence of industrial districts, characterised by a concentration of small and medium-size industries whose operations are similar or belong to the same production chain.

populated zones, characterised by the presence of population centres that would be highly vulnerable in the event of accidents.

Solutions

The regulatory framework on the control of major-accident hazards on the European and national levels is now thorough and complete, following the passage of three subsequent directives subsequently transposed into national legislation. Procedures adopted in Italy are in line with those applied in the other EU countries, confirming a substantial alignment with the European standards, though there is room for improvement in terms of:

- streamlining and accelerating procedures for the assessment of safety reports and the intensification of inspections and controls;
- increasing awareness of municipal administrations as regards problems tied to industrial risk, with reinforcement of the activities involved in the control of the territory and the supply of information to the public;
- qualitative improvement of activities related to external emergency planning in the event of accidents.

Procedures adopted in Italy are in line with those applied in the other EU countries.

The abovementioned improvements can be introduced, provided that the following requirements are satisfied:

- the certainty of resources being available to the municipal governments and the technical agencies involved, including the introduction, as provided for under the Seveso regulation, of a system of fees to be paid by operators of major-accident hazards establishments, based on the controls carried out by the Public Administration;
- progressive decentralisation of regional controls, in accordance with provisions of the “Bassanini Law”, once the presence of the competent local authorities and/or guarantees of their reinforcement have been verified, notably in the Southern regions; organisation and follow-up of monitoring procedures by the Ministry of the Environment, Land and Sea;
- accurate and timely definition, on a national level, of detailed technical references and criteria, to be supplied to local authorities and technical organs responsible for activities of control.

Within this framework, a point of vital importance is the enhancement of the Environmental Agencies System, which – given its role, competence and the experience acquired – can offer a valid contribution to the solution of many of the problems at issue.

The Environmental Agencies System can offer a valid contribution to the solution of problems tied to anthropogenic risk.

CHAPTER 8

SOIL AND LAND

Introduction

Soil provides the elements required to sustain societies, but it is too often treated as a container for human waste or as a means of exploitation. There is a limited awareness of the effects deriving from the loss of its functions.

Soil is an essential environmental compartment for the existence of living species on our planet. Despite this, it is too often perceived only in terms of support to agricultural production and as a physical base on which to develop human activities.
In actual fact, soil is an extraordinarily differentiated biological laboratory that carries out a series of functions making it essential for maintaining the environmental balance.
Soil plays a primary role in: maintaining biodiversity (over 95% of terrestrial biodiversity lies in soil for a relevant part of its natural history), regulating nutritional element cycles; controlling the quantity of atmospheric CO_2, protecting underground waters from pollution, regulating surface water flows producing direct effects on floods and landslides, etc. Plant biomass depends on the soil's conditions with evident consequences on the whole food chain.
Soil is a complex living body that continually evolves and, under certain aspects, is far from being well known. It supplies worldwide life and human beings with the necessary elements for their sustenance, nevertheless it is also a non-renewable and extremely fragile resource.
Soil can be affected by serious degradation processes caused by: concrete and asphalt sealing, particularly on densely populated areas and where economic activities are concentrated; incorrect agricultural practices; contamination; climate change and land cover changes. These processes limit or totally inhibit its functions and often can be highlighted only when they are irreversible or at such an advanced stage that recovery is extremely difficult and economically inconvenient. This resource must therefore be used in an adequate way, according to its intrinsic properties so that it can continue to carry out its irreplaceable sustainable and effective function on our planet.

The situation in Italy

Currently, there is a good knowledge on land use in Italy but soil data are still rather heterogeneous.

An important asset to understand soil-related factors, processes and services is to implement sustainable development and land planning policies. This strategy might be performed by combining socio-economic needs and requirements, also in terms of safety, with a cautious and respectful

management of the natural heritage and its associated resources. Still, in Italy available information should necessarily be improved to give a thorough and harmonised outline of soil use and information.
In Italy, thorough information on soil has a relatively recent history. Starting from the 1990s, many Italian regions started to systematically collect data on soil and produce maps and databases. Despite the large amount of data on soil collected, even if not equally distributed, the absence of central coordination contributed to creating heterogeneous information. In many cases, this limited the possibility of making organic syntheses throughout the country. To try and resolve this situation, projects for harmonising soil regional information have been established. Most of the data provided below should therefore be considered approximate. They will represent the national situation, but no sooner they have been completed.
Organic carbon (OC), which accounts for approximately 60% of soil organic matter, carries out an essential positive function on many soil properties. It facilitates the aggregation and stability of soil particles reducing erosion, compression, cracking and the formation of surface crusts. Organic carbon binds effectively with various substances, improving soil fertility and its control capacity and increasing microbial activity. It also makes nutritional elements, such as nitrogen and phosphorus, available to plants. As far as farmland is concerned, depending on the nature of soils and climate areas in Italy, a average 2% level of OC can be considered sufficient to guarantee a soil high performance in supplying plants with nutritional elements and performing many other important functions. Knowing the amount of OC stored in Italian soils is therefore the starting point to establish the role these soils can play in reducing greenhouse gas emissions. Even if the amount of carbon contained in soil and vegetation is lower than that of oceans and fossils, the role of soils is still considered more important, even because they are directly influenced by human action.
Figure 8.1 shows the national distribution of organic carbon in percentage into the first 30 cm of soil. The map was accomplished using data from the Italian Ecopedological Map inte-

grated, where necessary, with those of the European Soil Database. The situation given in this map raises some concern: about 80% of Italian soils have a presence of OC lower than 2%, while the "high" OC content class practically does not exist on the Italian territory, at least according to this reference scale. The spatial distribution traces the climatic one, with an increase in the "medium" content class in the North of Italy and along the main mountain ridges. At an higher resolution, however, the first regional maps realised within SIAS project (*Sviluppo di Indicatori Ambientali sul Suolo* - Development of Soil Environmental Indicators) framework, show an improved situation, at least in some areas of the country.

The map was accomplished on the basis of available national data and shows how most Italian soils have low levels of organic carbon especially in farmland. However, preliminary data from the SIAS project show an improved situation in some areas.

Figure 8.1: Percentage of OC in the topsoil layers of Italian soils (1988-2003) [1]

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[1] Source: Ministry of the Environment, Land and Sea and JRC processed by APAT

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.

Impacts caused by soil contamination also involve surface and underground waters, the atmosphere and the food web creating serious risks even human health. The economic consequences are mainly related to the need to allocate substantial financial resources for the soil's environmental reclamation and recovery. But they are also related to the loss of value of contaminated areas and the need to intervene on environmental matrices that are indirectly affected by the impacts of soil contamination (particularly underground waters). Consumers may also refuse to buy products obtained from polluted soils. The overall economic importance of soil functions have been estimated accounting every year over 10 trillion euro, while an impact evaluation (SEC (2006)1165) related to the Thematic Strategy for Soil Protection (COM (2006) 231), performed by European Commission, estimated that the annual cost of soil contamination ranges between 2.4-17.3 billion euro.

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).

Soil contamination may impact on limited areas (contaminated sites) or it can affect extensive areas (diffuse contamination).

At present, in Italian national territory, 57 contaminated Sites of National Interest have been located (SIN, Figure 8.2). 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 Protection, which draws on the services of the ISPRA for the assessment of site characterization and remediation projects, as well as Regional and Provincial Environmental Agencies and the National Institute of Health (ISS).

In Italy there are 57 contaminated Sites of National Interest. The Ministry of Environment, Land and Sea Protection coordinates their restoration directly.

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

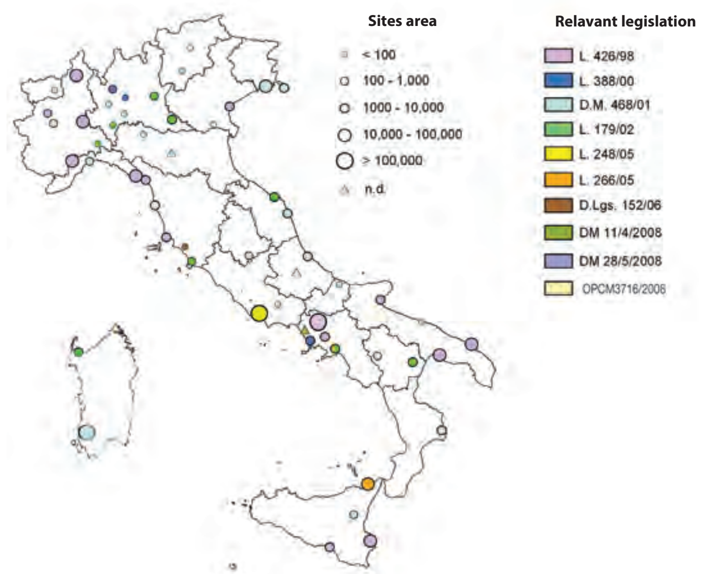

Figure 8.2: Localisation, dimensions and relevant legislation on Sites of National Interest (2008) [2]

There are about 15,000 potentially contaminated sites, of which more than 4,000 need to be reclaimed. These fall under the responsibility of regional authorities.

Some Sites of National Interest are particularly extensive (e.g. the Domizio-Flegreo Littoral, Agro Aversano area and the Sulcis-Iglesiente-Guspinese site) and/or characterised by historical contamination of soil and groundwater (e.g. Port Marghera). In these cases 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, some of them are called "megasites". In addition to Sites of National Interest, there are several other thousands 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". A separate topic is that of brownfield. These are abandoned, inactive or underused sites which have hosted productive facilities, generally industrial or commercial. Their utilization is hindered by

[2] Source: ISPRA

a real or potential condition of historical pollution. These sites are often located inside urban land and therefore have a high economic potential. In Italy, the regions with the highest number of brownfields are in the North, particularly in the regions of Lombardy, Piedmont and Veneto which experienced the highest industrial development in the past decades. The Centre and South of Italy is characterised, instead, by few but extensive industrial areas. These have witnessed concentrated development in a limited number of areas.

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 in soil have been reported near road infrastructures (Pb), in wine-producing districts (Cu) and intensive farming areas. Soils contaminated by organic compounds are found near industrial areas, particularly in the Campania region where pollution by PCBs, furans and toxins is a very serious problem. As regards pollution by nitrates, available data show a surplus of nitrogen and of phosphorous in almost all Italian regions. However, these have a progressively reducing trend. The highest levels are found in intensive farming areas, particularly in some regions of the Padan Plain.

Cases of diffuse contamination are found in almost every region but Italy still lacks a uniform national scale framework.

Another issue of great environmental and economic relevance is the phenomenon of soil erosion by water (i.e. the removal of topsoil, rich in organic matter, by surface waters). Damages caused by erosion are distinguished as on-site and off-site damages. On-site damages are generally classified as damages that occur in the same place where the phenomenon occurs, which lead to loss of soil, fertility, biodiversity, etc. Off-site damages occur far from where the erosion phenomenon takes place, causing floods, damages to infrastructures, contamination of surface waters (due to transport of pollutants by surface water flows), etc. Limiting these damages in many cases requires corrective operations especially in highly prestigious farmlands, economically relevant ones or, in any case, in areas where the erosion tolerance rate (factor T) exceeds the allowed values. The erosion tolerance rate (expressed in tons/hectare/year) enables a controlled productive and protective use of the soil. It should therefore be generally lower with respect to the soil formation rates

Erosion by water produces loss of soil, fertility and biodiversity.

(pedogenesis). Assessment of soil loss is carried out by using empirical models (e.g. USLE – *Universal Soil Loss Equation*) and physically-based ones (e.g. PESERA – *Pan European Soil Erosion Risk Assessment*). The models show that in about 30% of Italian soils the erosion risk is higher than the allowed values. These national-scale estimates, realised by means of models, are only based on approximate data. There are still few experimental stations that directly measure this process and would be able to validate the results obtained. However, a national framework of reference showing the actual situation, based on data collected at local level, is currently being finalised under the above

Loss of soil by water erosion is usually assessed by means of models. Although these estimates offer interesting information at national scale, they are affected by simplifications carried out when defining environmental parameters. Therefore, in some cases, their results can be substantially different from regional ones.

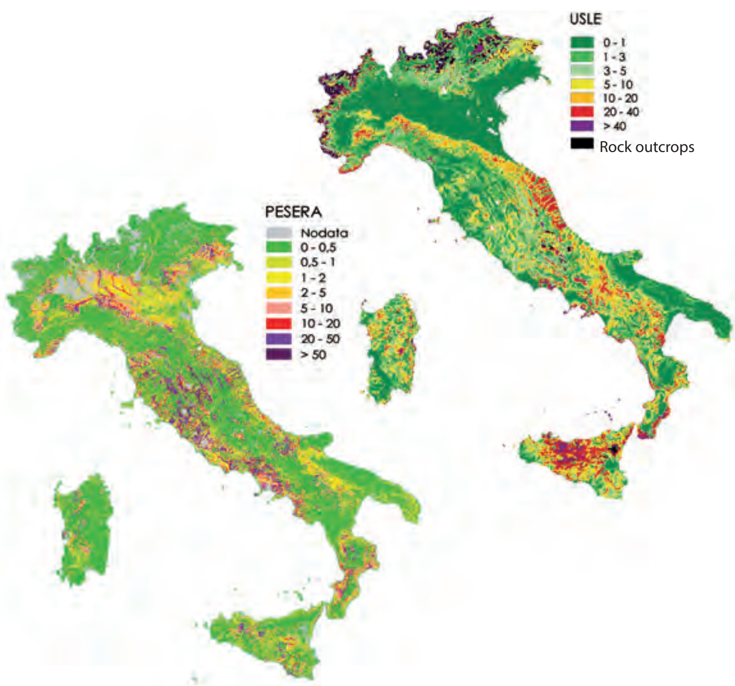

Figure 8.3: Actual erosion risk assessment *(t * ha^{-1} * $year^{-1}$)* according to USLE (1999) and PESERA (2004) models[3]

[3] Source: JRC - IES

mentioned project. Regional information is being harmonized in accordance with criteria provided under the INSPIRE Directive. The project is coordinated by ISPRA in collaboration with the CRA, JRC-IES and Italian regions (SIAS Project).

A particularly common phenomenon, especially in the coastal areas, is soil *salinization*. This refers to a an excess of salts in soil, due to natural and human causes. It can reach levels that can compromise productive and farming activities causing negative effects on the soil's biodiversity and on its resistance to erosion.

A national map indicating the extent and characteristics of salt-

Salinization is the accumulation of salts in soil in quantities that can compromise its vital functions.

Figure 8.4: Distribution of salt-affected soils in Italy (red areas) [4]

Soil salinization affects a large portion of Italian coastal areas and is particularly developed in Sicily due to the concomitant presence of natural and human causes.

[4] Source: C. Dazzi, (2007), La salinizzazione. In: *Il suolo , la radice della vita*. APAT

affected soils is still not available but a lot of information has been collected by Universities and regional soil services. A first survey at national scale was recently carried out by the University of Palermo. It highlighted that salt-affected soils are mainly located in the lower Padan Plain, along extensive Tyrrhenian and Adriatic coastal areas and on the coasts of Apulia, Basilicata and Sardinia (Figure 8.4). Sicily is worth mentioning on its own, since the problem of salinization involves 10% of its regional land.

Areas characterized by intensive farming can be prone to soil compaction process. Compaction, which is mainly due to the use of agricultural machinery, occurs when soil particles are pressed together, reducing the pore space between them. This induces important changes in the soil's structural properties and behaviour, such as the temperature and moisture regimes, the balance and the liquid and gas phases that form the soil. Apart from the topsoil layer, compaction is also frequently formed at the depth of cultivation (plough sole). The result is not only the reduction of soil functions but also a drastic reduction of water infiltration with subsequent *runoff* increase.

During intense and concentrated rainfall, there is frequent submersion of plain lands and superficial landslides near compacted layers of soil. This highlights that the problem is common in Italian farming areas, both plain and hilly.

Quantitative data are very few and limited to some analysed areas. The only national map that is available regards the natural susceptibility of soils to compaction. It was edit by JRC-IES but does not provide information on the actual extent of the problem (Figure 8.5).

Compaction is considered an important factor in the great floods that have affected different European countries.

At european level, compaction is considered an important factor of the great floods that have affected Northern Europe in the recent past.

At national level, there is a lack of studies on the actual effect of compaction on the flooding of Italy's main rivers.

Most Italian soils have a medium-high susceptibility to compaction. However, more detailed studies are required to asses the actual extent of the problem and its influence on the recent floods that have occurred in Italy.

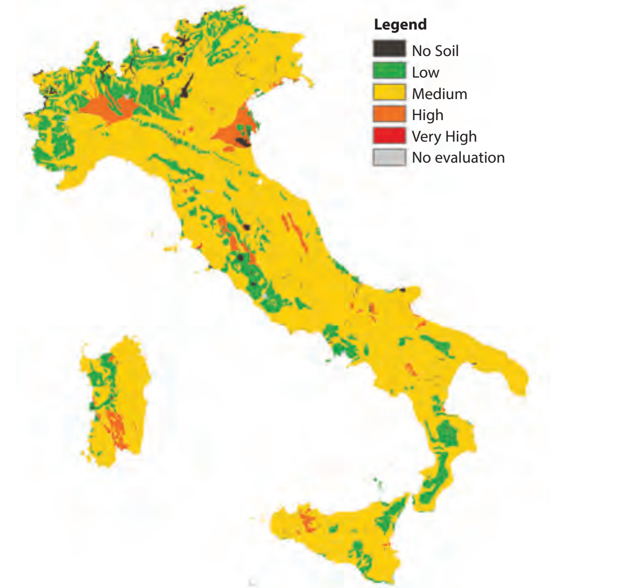

Figure 8.5: Soil compaction susceptibility (2007) [5]

The problem of soil loss due to urbanization is a particularly serious one and a matter of concern since it strongly compromises large areas of land, which are often characterised by soils with a high agricultural value. Soil that has been sealed for urban areas and infrastructures looses many ecological functions, some of which become practically irreversible. Comparison between Corine Land Cover data sets (1990 and 2000) has led to the identification of a trend in land use, even though the minimum mapping unit limit of 25 ha does not clearly show the development of scattered urban centres and of the minor road network. This highlighted that in Italy there is a progressive reduction of areas destined for agricultural use (-1.6%), a recovery of forest or semi-natural soils (+1.0%) and an increase of urbanized areas (+0.6%). On the coast, urban areas have increased, especially in Sardinia and Calabria. Italy, like the rest of Europe, is reducing agricultural land due to the effects of contrasting cultural abandonment and

Between 1990 and 2000, agricultural areas reduced by 1.6%, in favour of forest or semi-natural areas (1%) and urbanized ones (0.6%).

[5] Source: JRC-IES

Soil sealing prevents infiltration of meteoric water and is a factor of floods.

urbanization processes, with a progressive trend towards reduced and more specialised farming areas cultivated following the mixed traditional regime. Forest and especially urban areas, instead, have an expanding trend with an increased variety of use. Soil sealing, is the result of covering the soil with impervious materials, which partially or totally prevent it from performing its vital functions. The issue primarily concerns built-up areas, where the largest surfaces covered by buildings may be found, and areas covered by industrial plants, commercial buildings and transport infrastructures, but similar effects may also be observed in intensive farmland areas, due to the formation of compacted layers of soil, or in areas predominantly used for greenhouse farming or covered with plastic mulch films. These impervious layers form a vertical barrier between the pedosphere, the atmosphere and the hydrosphere.
Soil sealing limits/prevents water infiltration and the soil/subsoil's function of retaining the same, thus increasing the event of flash floods. The national map of sealed areas due to urbanization (Figure 8.6), is based on data from Corine Land Cover 2000, and shows that the highest values of this problem are found in Lombardy, Apulia, Veneto and Campania with higher concentrations near urban areas and along the main road axes.

In particular, the problem is assuming worrying proportions in the large plain areas, where urbanization is coupled with intensive farming.

The highest percentages of sealed areas are located near urban areas, near the main road axes and along the coast.

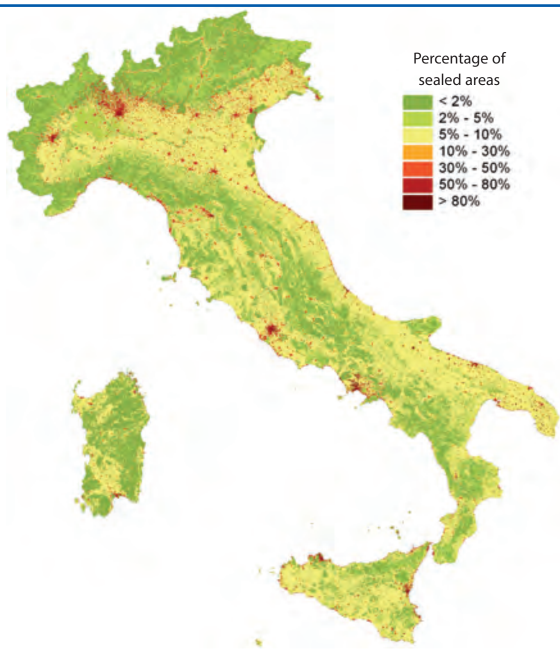

Figure 8.6: National soil sealing map (2006) [6]

Progressive loss of soil biodiversity is due to all the above mentioned factors.

Soil is a very complicated environmental matrix, providing habitat for a huge number of organisms. In the intricate three-dimensional matrix of soil, these organisms interact with each other within a very dense food web, giving life to a very complicated system of biological activities.

These organisms actively contribute to providing various services

Soil dwelling organisms play an essential environmental role, yet only a very small percentage of species is known.

[6] Source: ISPRA

that are critical to the ecosystem, such as: soil formation and water and nutrients retention capacity; decomposition of organic matter and therefore availability of elements contained therein; nitrogen fixation and carbon sink; suppression or induction of parasites and plant diseases; remediation through biological processes (bioremediation) of contaminated and degraded soil (by means of contaminant detoxication and recovery of physical, chemical and biological properties and processes).
Despite their importance, only a very small percentage of organisms living in soil has been identified and classified so far.
A census highlights that, compared to all other European countries, Italy hosts the highest number of soil invertebrates. This is summarised in the table below, which shows the number of Italian arthropod families and species. Currently, due to the absence of a specific monitoring network, their exact distribution and the intensity of their development has still not been identified. Areas subject to soil biodiversity loss in Italy mainly correspond to areas that are affected by previously described threats. Recent surveys have shown that inside protected areas there is a very high quantity of edaphic organisms.

Compared to all other European countries, Italy hosts the highest number of soil invertebrates.

Table 8.1: Number of Italian arthropod families and species, highlighting classes more related to soil[7]

Classes	Families	Species
Arachnida	351	4,618
Symphyla	2	19
Pauropoda	3	43
Chilopoda	11	155
Diplopoda	28	473
Protura	6	31
Diplura	5	76
Collembola	18	419
Insecta	623	36,853

Overexploitation, unsustainable management of soil resources and climate change contribute to increasing the environment's vulnerability to desertification. This phenomenon does not only occur

[7] Source: the Ministry of the Environment, Land and Sea, 2006. *Check-list* della Fauna d'Italia, by F. Stoch

in arid, semi-arid and dry sub-humid areas of the earth but also in other parts which are prone to chemical pollution, salinization and exhaustion of water availability as well as in areas where soil management is inefficiency. Desertification is a global process, but it has specific characteristics according to the different ecosystems. In its most extreme forms, it concerns over 100 countries threatening the survival of more than 1 billion people. The Mediterranean basin is the boundary between desertified areas and areas at risk of desertification.

In Italy, although the situation is not as dramatic as other parts of the world, this phenomenon is becoming more severe in at least five regions (Sardinia, Sicily, Basilicata, Apulia and Calabria) and negative signs are showing in other areas of Central and Northern regions. Assessing the intensity and extension of desertification is a difficult task due to the absence of a uniform and integrated methodology that can be adopted both at global and regional level. Estimates available in our country therefore vary according to the method of analysis used. They range from 5.5% of vulnerable areas in the country (preliminary map realised by the National Committee to Combat Desertification within the framework of the National Action Plan 1999) to 3% of highly sensitive and 32% of medium sensitive areas to desertification[8].

Most Southern regions are affected by more or less advanced desertification processes.

The recent National Atlas of areas at risk of desertification[9] analyses soil degradation in 11 regions of South and Central Italy (Sicily, Sardinia, Apulia, Basilicata, Campania, Lazio, Abruzzo, Molise, Tuscany, Marche and Umbria). The total area represents approximately 52% of the whole national territory. Applying the DPSIR model and using information obtained from several databases, the Atlas describes some indexes/indicators that can be used to estimate the risk of desertification. It was noticed that about 6% of the analysed area is affected by strong or moderate erosion phenomena while 9% of the land is vulnerable to desertification (i.e. showing potential risk of high erosion because it is thin and located on steep slopes).

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[8] Project: *Desertification Information System for the Mediterranean* coordinated by UNCCD, in collaboration with the European Environment Agency and the Applied Meteorology Foundation (FMA), 2004.

[9] *National Atlas of Areas at Risk of Desertification*, CRA-ISSDS and INEA, 2005.

Desertification is increasing in Sardinia, Sicily, Basilicata, Apulia and Calabria.

Figure 8.7: National Sensitivity to desertification map (2004) [10]

Extraction activities have temporary impacts and produce permanent amendments on land.

Primary and secondary mineral extraction activities (mines and quarries, respectively) represent an important sector of the national economy, which, however, also features a high environmental and landscape impact.
Besides the temporary impacts (noise, dust, pollution, etc.), these activities produce deep and irreversible changes in the landscape as well as a permanent soil loss, possible pollution of underground water and a series of problems related to the use of unadopted areas.

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[10] Source: *Applied Meteorology Foundation*, CNR-IBIMET, European Environment Agency and UNCCD

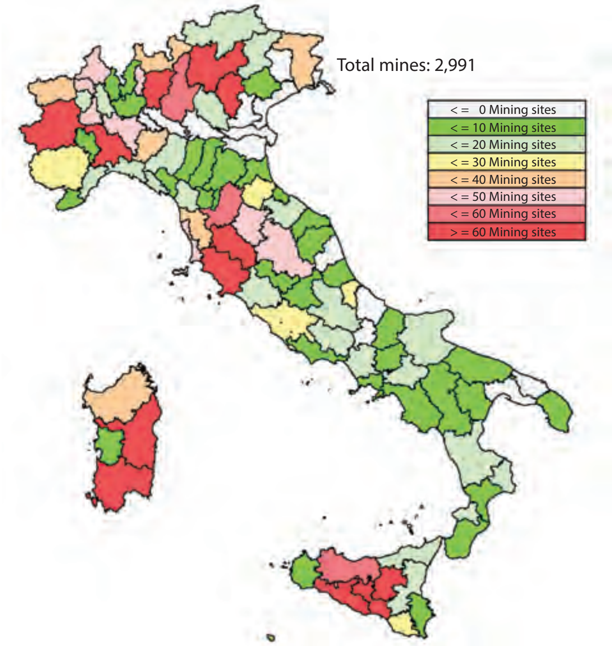


Figure 8.8: Registered mining sites in Italy (2006) [11]

In the period between 1870 and 2006 a total of 2,991 mines were active. A peak was reached in 1950 which registered 1,247 active mineral sites. Only 194 are now operating.

In the period between 1870 and 2006 a total of 2,991 mines were active in 88 provinces out of 103. Mining activities spread nationwide according to a growing trend up to the middle of the last century.

Currently, mining is residual and mainly related to the extraction of marl for cement, ceramic minerals and minerals for industrial use.

The progressive downscaling of mining activities, particularly those related to the extraction of metal ores which produce discards with a high concentration of pollutants, has certainly mitigated the pressure of mines on the environment.

However, the serious ecological, health, static and structural problems relating to the hundreds of abandoned mines have not yet been solved.

Mining activities have been scaled down with respect to the last century but problems related to abandoned sites are still unsolved.

[11] Source: ISPRA – Census of abandoned mining sites

Active quarries are distributed throughout the national territory. It is still not possible to make an outline of abandoned or illegal sites.

Data collected from relevant regional offices show that there are currently about 5,650 quarries operating in the country, of which more than 60% extract flood materials and carbonatic rocks.
Apulia (with an absolute predominance of limestone extraction), Padan regions (where the extraction of flood materials is particularly developed), the islands and Tuscany (which has the highest number of metamorphic rock quarries due to marble extraction sites on the Apuan Alps) are the regions with the highest number of quarries.
As at today, it is still not possible to make an outline of the thousands of unused or illegal quarries, which can be a source of serious environmental problems related to their intended use.

The regions with the highest number of active quarries are Apulia, Padan regions, the islands and Tuscany.

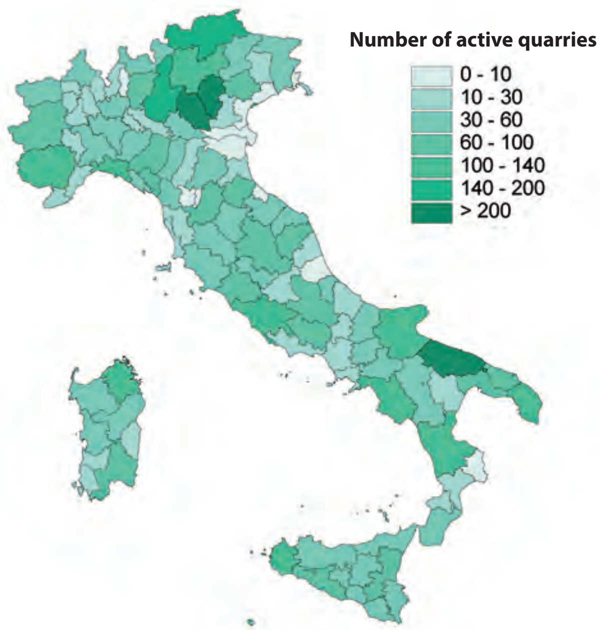


Figure 8.9: Active quarries in Italy (2008) [12]

[12] Source: ISPRA

The main causes of soil degradation

The various problems related to physical and biological degradation of soil in most anthropized areas (e.g. erosion, compaction, organic matter loss, etc.) are mainly caused by the great transformation suffered by the Italian territory during the last century, when economic development came into contrast with the soil's ecological functions.

The irregular expansion of urban centres, industrial development, springing up of infrastructures, extraction of raw materials and modernization of agriculture (focused on research and maximum productivity) exercised considerable and, at times, inevitable pressure on soil. A large part of the territory was therefore sacrificed to the society's development needs, often in an inconsiderate way. We have now reached a stage in which we can no longer postpone the protection of this resource and need to adopt policies for the sustainable management of land and soil.

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 some 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 8.10).

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

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.

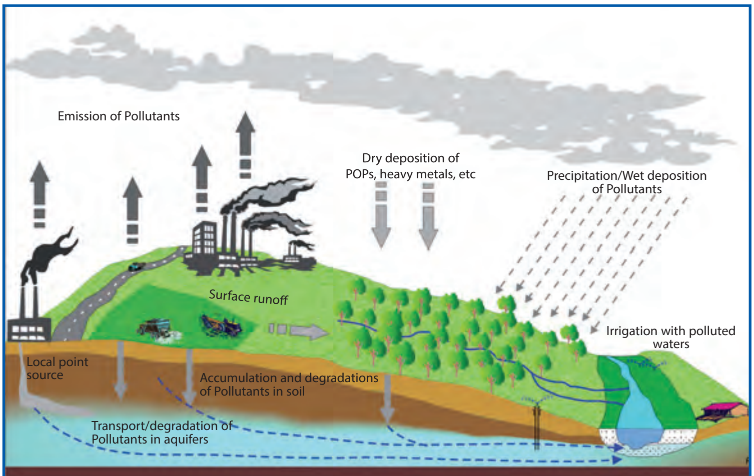


Figure 8.10: Diffuse contamination processes[13]

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

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.

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 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. In particular, an excess of nutritional elements can result in serious groundwater pollution and in eutrophication of surface water ecosystems, since nitrates are extremely soluble in water and not easily retained by soil.

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. 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.

[13] Source: www.eugris.info. Redraw by ISPRA

Finally, the high levels of certain contaminants in a number of environmental matrixes can have a natural origin[14]. 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 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 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.
Excessive concentrations or mixtures of pollutants have negative effects also on soil organisms, both directly (emigration or death of the most sensitive individuals or species) and indirectly (development of resistant and generalist organisms). For this reason, soil biodiversity is more and more utilised in soil and contaminated site monitoring programmes. It can be used as a useful biological indicator to integrate chemical and physical data collected during conventional soil analyses.
However, the causes of soil biodiversity loss are not limited only to the presence and persistence of pollutants. Intensive farming also may have a very negative impact. Heavy and frequent farming and the formation of compact layers often reduce the availability of a favourable habitat for soil biota.
Reducing the porosity of the so-called "plough sole" also reduces the diffusion of oxygen, water retention and nutrient migration, therefore producing changes in food webs particularly modifying the type and distribution of soil orgamisms. A serious biodiversity loss can also be caused by changes in land use, particularly involving soil sealing. Other threats come from decreases in

Some soils can have naturally high contents of contaminants.

In the case of heavy metals found in the soil, it is extremely important that the natural content (background value) be distinguished from that originated by human activities.

Pollution, intensive farming, erosion, compaction, salinisation, reduction of organic matter and sealing are also responsible for soil biodiversity loss and therefore reduce its vital functions.

[14] APAT-ISS: *Protocollo operativo per la determinazione dei valori di fondo di metalli e/metalloidi nei suoli dei siti di interesse nazionale*. June, 2006

organic matter supply or to its loss due to erosion or following fires. The availability of organic carbon is one of the main factors that determines the growth of soil organisms. Its reduction can inhibit biological activities.
Increase in salt or pH variations in soil are other factors that limit the presence of soil biota and change the structure of microorganism communities.
Finally, the casual or deliberate introduction of allochthonous species often causes invasive demographic explosions that damage autochthonous species, which are in harmony with the environment.

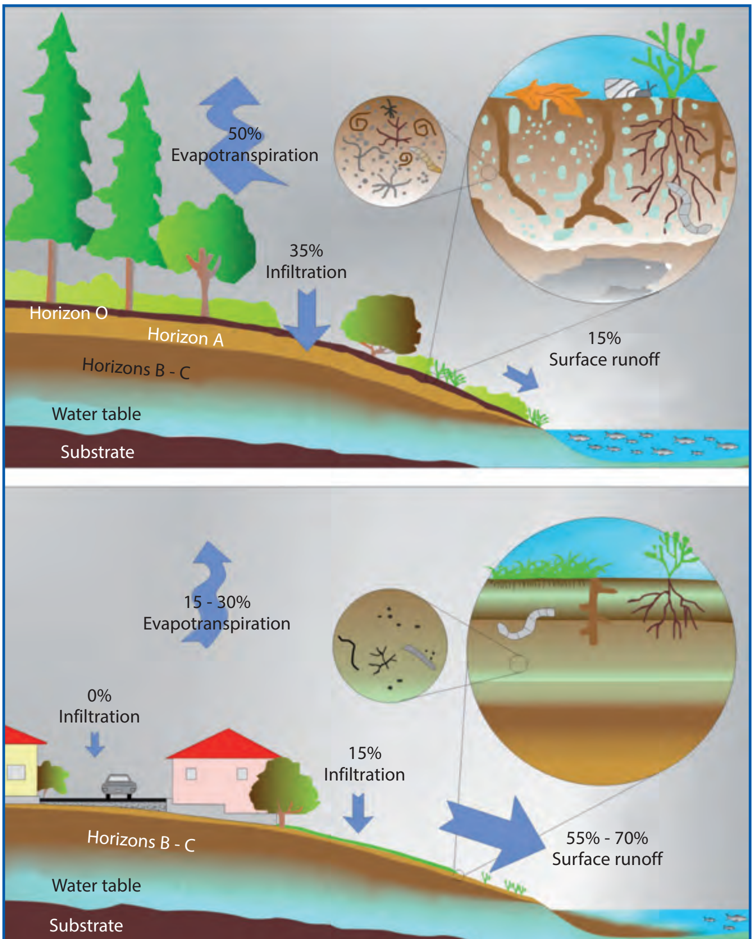


Figure 8.11: Indicative sketch of water movement on natural and anthropised soil[15]

Soil in its natural condition is able, thanks to its porosity, permeability and humidity, to retain a large quantity of water from rainfall, contributing to regulate the surface runoff. In an anthropised environment, on the other hand, the presence of impervious surfaces, the reduction of vegetation, the removal of the surface layer, which is rich in organic matter, and the onset of compacting result in a serious deterioration of the soil's function. 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 only indicative and can change significatly, depending on a variety of parameters (the physical and chemical characteristics of the soil, the topography and geology, as well as the duration and intensity of rainfall etc.).

[15] Source: USDA-NRCS, 2005. Urban Soil Primer. Redraw by IPSRA

Organic matter loss is related to transformation of soil's intended use and to intensive farming practices.

Biodiversity loss, which implies a progressive loss of the soil's functional capacities, is also related to the reduction of organic matter.
Organic matter (OM) loss is one of the most serious process of soil degradation.
This phenomenon is, on one side, related to land use and land cover changes at different times (impressive deforestation, conversion of forests or of permanent pastures to arable lands, etc.) and on the other side caused by the development of intensive farming practices. Indeed, a great anomaly in agricultural systems adopted during the last century is the breaking of the organic matter cycle, of which agricultural biomass is an important stage. In addition, traditional reintegration practices (especially with manure) were abandoned for a long time.
Therefore the *input* of organic carbon for soils used in these systems mainly relies on a more or less cautious management of crop residues and various other forms of exogenous organic matter supply.
Organic matter mineralization processes also depend on the climate and the type of soil. In the Mediterranean, the concentration of OM in soil is generally low. Therefore, in Italy, the speed with which soil problems related to OM reduction arise is clearly higher.

Agricultural practices focused only on productivity have triggered off serious erosion and soil compaction phenomena.

Agricultural practices aimed at supporting specialized and intensive farming have greatly transformed the agricultural landscape and have not been able to keep a balance between production needs and the environment.
The abandonment of hydraulic and agricultural facilities and of terracing plots, the leveling of lands, cultivation along steep slopes, excessive crushing of soil clods and the use of always heavier machinery have triggered off dangerous soil erosion phenomena which have caused a loss of surface horizons, rich in organic matter.
Heavy machinery also causes the most serious cases of soil compaction, particularly when used on wet soils. Excessive grazing also has a similar effect while prolonged ploughing at the same depth causes the formation of a compact layer in the soil (plough sole).

Results of a recent European Commission project (Sustainable Agriculture and Soil Conservation – SoCo project - http://soco.jrc.ec.europa.eu/) highlighted that there are no specific solutions to reduce if not cancel the effects of soil degradation caused by the application of inadequate farming practices. Conservative agriculture, which some people call “Blue Agriculture”, can be a solution.
But even in this case it is necessary to assess whether it can apply to the the soil’s specific nature, the type of farm and the production that is planned. Modern agriculture, also aimed at preserving natural resources, cannot avoid having a deeper knowledge of the same resources and studying the “territorialization” of farming management systems.
The SoCo project also highlighted the positive effect of the Common Agriculture Policy reform, which introduced “environmental conditions”. The implementation of measures on the “environmental condition”, “Mandatory Management Criteria (MMC) and “Good Agricultural and Environmental Practices (GAEP) are tools that can have a strong impact on the reduction of soil degradation phenomena.
Italy, like other countries of Mediterranean Europe, is particularly affected by salinization problems related both to factors that cause the formation and natural evolution of soil on particular parent material (primary salinization), factors induced by man (secondary) or the concurrence of both effects. In particular, secondary salinization of soils due to irrigation is a problem that is bound to worsen not only because of the strong competition in the use of water between cities, industries and countryside but also due to the overexploitation of water layers, the use of always less adequate water in agriculture (salty waters, civil and industrial refluent water) and the effects of climate change that increases aridity, reduce leaching and therefore increase salinization.
Areas that tend to have a hot and arid climate are therefore particularly exposed, such as the coastal areas, where excessive drainage (for agricultural, civil or industrial use) reduces water layers and increases the possibility of saline water intrusion.
The process of soil degradation is therefore related to different

Italian coastal areas are particularly exposed to salinization phenomena due to the drainage and use of water, which is becoming always more salty.

Desertification is the final stage of soil degradation.

factors caused by natural or human pressure. Desertification is the result of this complex system of interaction and takes place when degradation compromises the sustainable productive capacity of agricultural and forest ecosystems in an irreversible way.
Climate factors that mostly characterise this process are aridity, drought and rain erosiveness.
The main anthropic causes of desertification are, instead, related to socio-economic activities and their impacts: agriculture, zootechny, management of water resources, woodland fires, industry, urbanization, tourism, dumps and extractive activities.
All these activities produce a competitive use of natural resources (soil, water and vegetation/biodiversity) and their subsequent overexploitation with respect to their actual availability.

Soil degradation is related to factors caused by natural or human pressure.

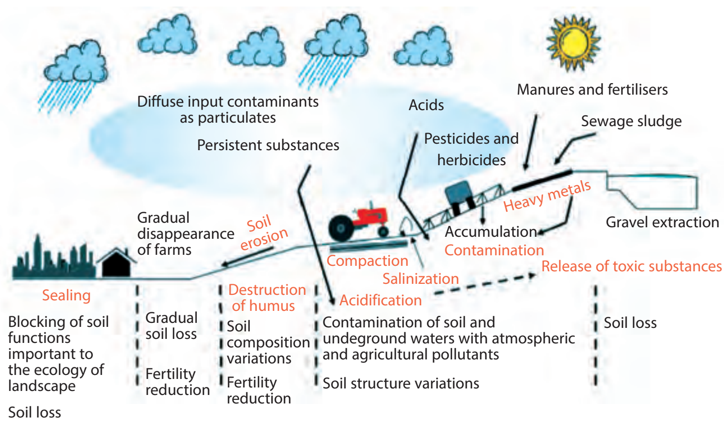


Figure 8.12: Diagram of threats that compromise soil functions. Desertification is the final degradation stage[16]

[16] Source: JRC - IES

Action aimed at soil conservation

At European level, the growing awareness of the environmental importance of soil and the need to: contrast its progressive degradation and function loss; reduce the development of desertification processes; mitigate hydrogeological instability and reduce human pressure on land has led to a substantial review of the legal framework. The 6th Environment Action Programme, the new Common Agricultural Policy (CAP; Reg. EU 1782/03 and 1783/03) and the directive proposal for soil conservation (COM (2006) 232) recognise the environmental function of soil and lay the foundations for the protection and conservation of this resource.

Due to problems caused by the application of the old CAP with respect to surplus production, excessive increase in community investments, the emergence of considerable environmental damages and progressive reduction of performance, the new agricultural policy (Agenda 2000) focuses on environmental sustainability.

The new Common Agricultural Policy lays the foundations for sustainable agriculture.

Based on the principles of Agenda 2000, the subsequent medium-term reform of the CAP (Fischler Reform) was a decisive turning point towards an agriculture that could be balanced as much as possible with the environment in order to guarantee productivity even in the future.

The Fischler Reform is based on four main points: *decoupling, modulation, conditionality* and *rural development.*

The principle of "conditionality" is of particular interest to soil conservation. According to this principle, farmers benefit from direct payments only if they observe a series of requirements related to the correct management of land (even in absence of farming). Among these requirements are food safety, respect of the environment, personnel safety, animal health and welfare.

"Conditionality" obliges European farmers receiving subsidies to guarantee correct soil management. Every year, the Ministry of Food, Agricultural and Forest Policies issues a Ministerial Decree containing the list of regulations that need to be respected.

Farms are therefore supported if they respect the Mandatory Management Criteria (MMC) and they keep the land in Good Agronomic and Environmental Conditions (GAEC). Every year, the Ministry of Food, Agricultural and Forestry Policies issues a decree with the full list of MMC and GAEC that need to be respected during the course of the subsequent year, giving single regional authorities time to issue implementation provisions that are more

adequate to each specific territory.
In particular, the MMC are legal provisions ("Acts") already in force deriving from the national and regional implementation of the corresponding community laws (e.g. Directive 86/278/EEC "Mud Directive" and Directive 91/676/EEC "Nitrates Directive"). GAEC ("Regulations") are established at national and regional level to guarantee the four priority objectives established by the European Union, namely:

- Protecting soil with adequate measures;
- Maintaining soil's organic matter levels by means of appropriate practices;
- Protecting the soil's structure by means of adequate measures;
- Maintaining minimum ecosystem levels and preserving habitats.

Regulations for keeping land in good agronomic and environmental conditions include: control of surface waters in sloping land; management of stubble and residue; efficiency of drainage networks for surface water flows; protection of permanent pastures; management of areas withdrawn from production; maintenance of olive groves and protection of the landscape's characteristic elements.

The Strategic National Plan for Rural Development provides addresses for the Regional Rural Development Plans.

The Fischler Reform further strengthens rural development with the introduction of new regulations and the allocation of new resources. The Strategic National Plan for Rural Development prepared by the Ministry of Food, Agricultural and Forest Policies provides addresses for the corresponding Regional Plans and provides four priority objectives for Axis 2 *"Improvement of the Environment and the Landscape"*. These objectives, which intend to strengthen "conditionality" provisions, are:

- Conservation of biodiversity, protection and diffusion of agro-forest systems with a high natural value;
- Qualitative and quantitative protection of surface and deep water resources;
- Reduction of greenhouse gases;
- Land conservation.

The fourth objective must be obtained by means of a series of interventions aimed at mitigating: water erosion phenomena; salinization; compaction; reduction of organic matter and biodiversity; soil consumption and sealing.

All regions/provinces have prepared their own Strategic Regional Plan, making necessary adjustments to the National Plan according to their local needs.
The Common Agricultural Policy reform was influenced by soil conservation addresses contained in the COM EC 179/2002 “Towards a Thematic Strategy on Soil Protection”, which underlined the great impact that agriculture has on the environment. In the EU 77% of land is used for agriculture. In particular, in 2000 intensive farming covered 37% of the territory.
In September 2006, the European Commission adopted the *Soil Thematic Strategy* (COM (2006) 231), the *Proposal for a Soil Framework Directive* (COM (2006) 232) and the *Impact Assessment* (SEC (2006)1165) with the aim of protecting European land. These documents confirm the environmental role of soil and identify the threats that can compromise its functions until its final degradation stage of desertification. They distinguish threats mainly caused by agriculture (erosion, compaction, salinization, organic matter loss and landslides) from local and diffuse contamination and sealing. They acknowledge the strong interaction between soils and their environmental matrices and the need to include a strong local component in protection policies due to their extreme variability. The Strategy also provides verification on the inclusion of soil protection and impact measures in Regional Action Plans. This is necessary to protect soil and comply with the minimum requirements to keep soils in Good Agronomic and Environmental Conditions, as provided by the CAP.
Member states must identify “agricultural threats” and areas at risk according to common elements, establish objectives to reduce the risk in the relevant areas and prepare programmes with measures required to achieve these objectives. Programmes can refer to national measures that have already been taken (such as “conditionality”), measures on rural development of the CAP, action plans provided by the Nitrates Directive, etc.
Member states can even freely decide to combine various other strategies to resolve concomitant problems.
Contamination is acknowledged as one of the “priority threats” against the soil’s functions. The main elements contained in the strategy are: definition of a common risk-based assessment of

The European Commission prepared a Thematic Strategy that led to the issuance of a “Proposal for a Soil Framework Directive” (COM (2006) 232).

“contaminated” and “reclamation” sites; implementation of a systematic procedure for identifying contaminated sites; realization of national registers of contaminated sites and introduction of “reports on soil conditions” as a useful tool during sale transactions of sites hosting potentially polluting activities. The Strategy also highlights the need for member states to define a “National Strategy for Land Reclamation”. This should include objectives (number of sites that need to be reclaimed), priorities and an implementation schedule.
This proposal is currently being discussed and reviewed.
At national level, there are many regulations to protect soil from pollution. These also involve other institutional departments.

Legislative Decree 152/06 regulates the reclamation process of contaminated sites and introduces the risk analysis concept.

The recovery of contaminated sites can be obtained by means of more or less complicated reclamation processes. In Italy, these are regulated firstly by Ministerial Decree 471/99, and then by Legislative Decree 152/06 (Part IV, Chapter V) and the relative Corrective Decree 4/08.
Legislative Decree 152/06, “Environmental Regulations” under Part IV, Chapter V “Reclamation of Contaminated Sites” contains new and important elements. Among these is the definition of a potentially contaminated site as: *a site in which one or more concentration values of polluting substances found in environmental matrices are higher than the Threshold Value of Contamination (TVC), while waiting to carry out characterization operations and site-specific risk analyses that would determine the actual contamination conditions on the basis of Risk Threshold Concentrations (RTCs).* Instead, a “contaminated site” is defined as: *a site in which Risk Threshold Concentration (RTCs) values are exceeded. RTC values are determined by applying the risk analysis procedure as per Annex 1, Part 4 of the said decree based on the characterization plan’s results.*
In the decision-making process of identifying and managing contaminated sites, the difference between the Threshold Value of Contamination (TVC) and the Risk Threshold Concentration (RTC) is therefore relevant. If the former is exceeded there is an obligation to carry out characterization and risk analyses. If the latter is exceeded then the site is considered “contaminated” and it is therefore submitted to safety or reclamation operations.

This recent provision introduced clear criteria for the definition of a contaminated site's reclamation objectives, based on a site-specific risk analysis. It therefore updated the definition of "contaminated site" contained in Ministerial Decree 471/99.
Currently, characterization and reclamation projects that were already started and/or approved follow the procedure established by Ministerial Decree 471/99.
However, the proposer can request to re-examine the documents presented. Projects presented after the issuance of Legislative Decree 152/06 follow the procedure established by the latter.
As regards Sites of National Interest (SNIs), ten years have passed since the issuance of the first regulation.
As at today, the percentage of recovered and/or reclaimed areas is still low and the progress of reclamation activities is rather unhomogeneous over the whole country.

As regards SNIs the percentage of recovered and/or reclaimed areas is still low.

In general, most reclaimed and/or recovered areas are found in the less complicated SNIs. In particular, it is noticed that procedures are faster in areas where highly profitable settlements are planned (e.g. redevelopment of areas for urban or residential use, new production plants, etc.).
Introducing public funding systems and other initiatives aimed at streamlining procedures for the reutilization of polluted areas by the private sector could lead to increased development of reclamation activities and to the productive recovery of contaminates sites for industrial use. This could be done through Legislative Decree 04/08 Art. 252-b) (*Sites of Prominent Public Interest for Industrial Reorganization)* which provides for the involvement of the Ministry of Economic Development.
Programme Agreements are another efficient tool to ensure concerted action between the various actors involved in reclamation activities and in the streamlining of administrative procedures. These have already been signed for SNIs in Brindisi and Eastern Naples.
As mentioned above, Ministerial Decree 471/99 provided that regions should endow themselves with a system of collection and updating of data on polluted sites. This must be done by creating "regional registers of sites to be reclaimed" and adopting the relative reclamation plans.

Contaminated sites must be inserted in specific "regional registers of sites to be reclaimed".

The realization of registers is definitely delayed with respect to the schedule provided by the decree. Those that have been prepared also show very strong differences due to the different criteria used to identify contaminated sites. Indeed, some regions require a preliminary verification for changes in the intended use of sites used for productive activities while others only register the more complex sites.

The establishment of registers was confirmed by Legislative Decree 152/06. However, the decree introduced substantial modification on site identification modalities which caused difficulties when comparing information collected in different periods. More generally, when identifying potentially contaminated sites (i.e. areas that host or have hosted potentially polluting activities and which need to be examined) criteria for inserting contaminated sites in regional registers often suffer from the lack of a systematic and homogeneous procedure valid for the entire country.

As regards brownfields, action is being taken in order to revitalize unadopted areas making them an active part of the urban territory. Many areas have already been recovered and generally assigned for residential use, public gardens, shops and public areas while activities for the reorganization of "megasites", especially those located in the Southern regions of Italy, are still very low with respect to actual potential.

In case of diffuse contamination, the most efficient action is to undertake preventive activities aimed at mitigating the pressure. This can be done by: improving controls of emissions to air and water; limiting the use and distribution of potentially contaminating substances; defining quality criteria for products used in agriculture and limiting the quantities of fertilizers used (according to their composition).

In case of diffuse contamination, the most efficient action is to undertake activities aimed at mitigating the pressure.

The quality of sewage sludge used in agriculture is defined by Directive 86/278/EEC. This was implemented with Legislative Decree 99/92 while Ministerial Decree MiPAF 19/04/99 "*Code of Good Agricultural Practices*" focuses on the correct use of fertilizers in order to avoid a surplus of nutritional elements. Legislative Decree 152/06, Part 3 "*Regulations for protecting soil, combating desertification, protecting waters from pollution and managing water resources*" provides indications on interventions

for mitigating water pollution from nitrates and establishes (Annex 7) the regional identification of Nitrate Vulnerable Zones (NVZ) as well as zones vulnerable to plant protection products. The definition of NVZs is a complicated process that derives from the intersection of soil's protective capacities and hydrogeological characteristics with respect to agricultural loads and water quality data (Figures 8.13 and 8.14).

These zones were identified at different times throughout the country.

Aosta Valley, Trento and Bolzano were excluded since they do not have this problem. An estimate, at basin scale, of contamination of water bodies including local and diffuse contamination phenomena is also provided by Directive 2000/60/EC (Water Directive).

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.

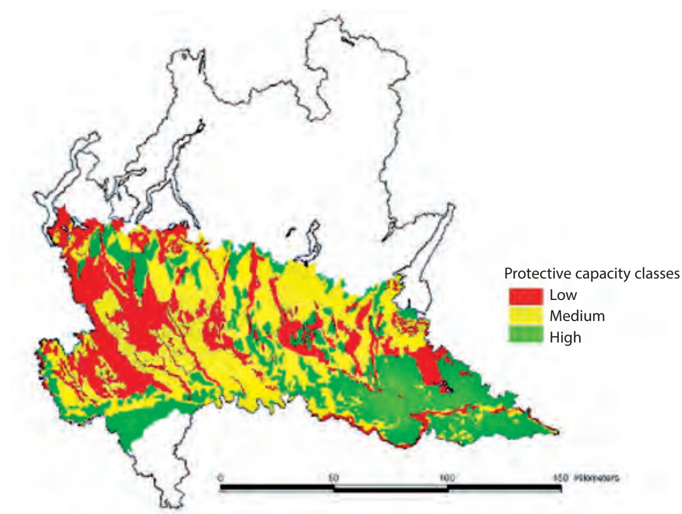


Figure 8.13: Map of soil protection capacity in the Lombard plain with respect to underground waters (2005) [17]

[17] Source: ERSAF (Ente Regionale per i Servizi all'Agricoltura e alle Foreste), Lombardy Region

In areas identified as "vulnerable", a series of provisions need to be applied. These regard the management of fertilizers and other agricultural practices as well as measures described in the Code of Good Agricultural Practices.

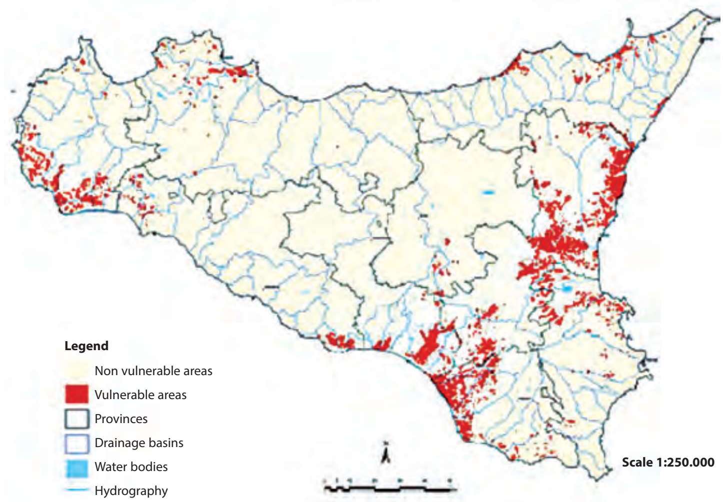


Figure 8.14: Regional map of Nitrate Vulnerable Zones of agricultural origin (2005) [18]

The United Nations Convention to Combat Drought and/or Desertification is an international legal tool that engages all signatory countries to cooperate in the fight against desertification.

With Law no. 170 dated 4 June 1997, Italy ratified the United Nations Convention to Combat Drought and/or Desertification (UNCCD) signed in Paris in 1994. The Convention is an international legal tool that engages all signatory countries to cooperate in the fight against desertification, with the aim of mitigating the effects of drought in seriously affected countries by means of an approach that improves the conditions of life of the local communities.
The Convention provides for "*the preparation of National Action Programmes aimed at ensuring sustainable development in order to reduce loss of soil productivity caused by climate change and human activities*". To comply with its obligations, with Deliberation CIPE no. 299/99, the Italian Government adopted the National Action Programme (NAP) to combat drought and desertification. This highlights that the problem is a matter of concern for the Italian territory particularly with reference to the role played by human activities associated to extreme climatic events, which are always more frequent.

[18] Source: Sicily Region

However, since no specific legislative measures aimed at the problem of desertification have been issued so far, Legislative Decree 152/06, Part 3, "*Regulations for protecting soil, combating desertification, protecting waters from pollution and managing water resources*" refers to this problem. Furthermore, the Prime Minister's Decree dated 26/09/97 established a National Committee to Combat Drought and Desertification, at the Ministry of the Environment, Protection of Land and Sea. This is an institutional organism composed of representatives of ministries, public institutions, research bodies and organizations that are institutionally involved in activities aimed at combating desertification.

With regard to mines, national regulations are based on the following legal references: Royal Decree no. 1443 of 29/07/1927 (on mine research and cultivation); Decree of the President of the Republic no. 128/59 (on controlling mines and quarries); Law no. 388 of 23/12/2000 (which provides an extraordinary plan for reclamation and environmental recovery also of former mineral extraction areas, on the basis of a subsequent Ministerial Decree); Law no. 179 of 31/07/2002 (which establishes a census of abandoned mineral sites) and Legislative Decree 117/2008 implemeting Directive 2006/21/EC (on the management of waste from extractive industries).

Discards from extraction activities (mines and quarries) are regulated by Legislative Decree 117/2008, implementing Directive 2006/21/EC.

Legislative Decree 117/08 establishes measures, procedures and necessary action to prevent or reduce as much as possible, any eventual negative effects on the environment and human health risks caused by the management of waste from extractive industries. The Decree obliges the person in charge of extractive activities to prepare a management plan of extraction waste. This is submitted for approval by the relevant authority. It also provides for the realization of a national inventory of abandoned mineral sites, which needs to be annually updated through the Institute for Environmental Protection and Research (ISPRA).
The decree also considers the management of waste from quarries. This is regulated by regional laws as established by the Decree of the President of the Republic no. 616 of 24/7/1977, which transferred these responsibilities to the regions.

Planning responsibilities are transferred to regions by means of Regional and/or Provincial Plans of extractive activities. But regions have different approval times and some have not even adopted them.

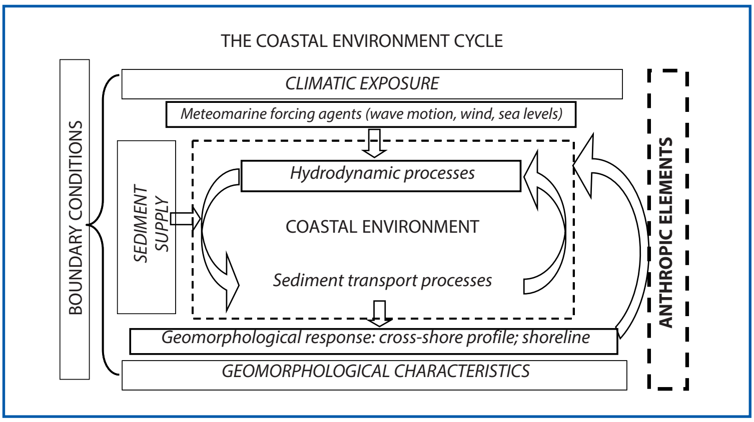
Planning of extractive quarry activities takes place by means of Regional (or Provincial) Plans of extractive activities. These plans contain: a register of active or unadpoted quarries, notes on identification and limiting of extraction areas (territorial areas subject to constraints); needs; extraction modalities; excavation times and recovery plans to be followed when planning single interventions (according to the different situations and morphological characteristics).
However, the situation is not homogeneous at national level. Regions have different approval times and some regions have still not adopted these plans.

CHAPTER 9

COASTAL AREAS

Introduction

The coast is a continuously evolving area. Its changes are more clearly visible near low and sandy shores, where there are adjustments of the seashore and land surfaces that emerge and are submerged by the sea. Coastline dynamics mainly depend on the sea's action (wave motion, tides, currents and storms), but they are also influenced by all those direct and indirect natural and human activities that intervene on the coastal balance changing its morphological characteristics. The extraction of inert material from riverbeds and the stabilisation of banks and mountain slopes reduce the flow of sediments at the river mouths when they should be naturally distributed along the coast. Urban and productive settlements in coastal areas as well as land and sea transport infrastructures and protection works invade the sea and the coastal areas interacting with their natural evolution.



The situation

Europe is affected by erosion phenomena.

All European coastal states are in some way affected by littoral erosion phenomena (Table 9.1). About 20,000 km of coasts (20% of European coasts) have suffered serious impacts. In most affected areas (15,000 km) erosion phenomena are in course partly due to the realization of protection works (2,900 km). Furthermore, other 4,700 km have been artificially stabilized (Table 9.2).

European coast situation.

Table 9.1: Types of coast by nation[1]

Nation	Total shoreline length	Non erodibile rocky coast	Erodible rocky coast	Beach	Muddy coast	Artificial coast	Other**
	km	%					
Belgium	98	0	0	66	0	34	0
Cyprus*	66	9	0	67	0	20	4
Denmark	4,605	1	8	65	13	12	1
Estonia	2,548	0	6	90	4	1	0
Finland	14,018	57	0	38	4	1	0
France	8,245	25	15	31	13	15	1
Germany	3,524	0	5	64	13	18	0
Greece	13,780	39	11	47	0	4	0
Ireland	4,578	56	1	39	1	3	1
Italy	**7,468**	**15**	**28**	**50**	**0**	**8**	**0**
Latvia	534	0	0	95	2	3	1
Lithuania	263	0	3	65	19	12	0
Malta	173	78	10	5	0	7	1
Poland	634	0	0	83	14	3	0
Portugal	1,187	29	22	44	0	5	1
Slovenia	46	0	53	30	0	18	0
Spain	6,584	18	43	28	2	10	0
Sweden	13,537	56	0	38	5	1	0
Holland	1,276	0	0	35	4	60	1
United Kingdom	17,381	42	18	25	9	5	1
Others (Bulgaria, Romania)	350	-	-	-	-	-	-
TOTAL	**100,925**	**34**	**11.7**	**40.7**	**5.3**	**6.4**	**0.5**

* only 20% reported
** other assesments (virtual lines)

[1] Source: Eurosion Project, 2004

Erosion phenomena are in course along 15,000 km of coast.

Table 9.2: Extension of coastal erosion by nation[2]

Nation	Total shoreline length	Eroding shoreline (2001)	Artificial protected shoreline (2001)	Eroding shoreline next to protected stretches (2001)	Total shoreline affected by coastal erosion
			km		
Belgium	98	25	46	18	53
Cyprus	66	25	0	0	25
Denmark	4,605	607	201	92	716
Estonia	2,548	51	9	0	60
Finland	14,018	5	7	0	12
France	8,245	2,055	1,360	612	2,803
Germany	3,524	452	772	147	1,077
Greece	13,780	3,945	579	156	4,368
Ireland	4,578	912	349	273	988
Italy	**7,468**	**1,704**	**1,083**	**438**	**2,349**
Latvia	534	175	30	4	201
Lithuania	263	64	0	0	64
Malta	173	7	0	0	7
Poland	634	349	138	134	353
Portugal	1,187	338	72	61	349
Slovenia	46	14	38	14	38
Spain	6,584	757	214	147	824
Sweden	13,567	327	85	80	332
Holland	1,276	134	146	50	230
United Kingdom	17,381	3,009	2,373	677	4,705
Others (Bulgaria, Romania)	350	156	44	22	178
TOTAL	**100,925**	**15,111**	**7,546**	**2,925**	**19,732**

It is estimated that 15 km²/year of surface area is lost or compromised.

It is estimated that 15 km²/year of surface area is lost or seriously compromised. Between 1999 and 2002, from 250 to 300 buildings were abandoned due to the imminent risk of coastal erosion and other 3,000 have lost at least 10% of their market value.

These losses are even insignificant if compared to the coastal flood risk caused by the destruction of dunes and collapse of barriers against the sea.

[2] Source: Eurosion Project, 2004

This problem involves several thousands of km^2 and millions of people. Over the last 50 years, the population living in European coastal communities has more than doubled, reaching 70 million inhabitants in 2001.
The total value of economic activities located within 500 m of the shoreline has multiplied reaching an amount of 500-1,000 billion Euros.
Considering climate change forecasts, we can say that erosion and flood risks for urban, tourism and industrial settlements, agricultural land and recreational areas are growing every year.
Due to the difficulty of combining population safety and business activities with the benefits offered by natural coast processes, there has been a substantial increase in coastal protection investments over the last 15 years.
The length of new coastal stretches safeguarded by engineering works has grown by more than 900 km and, since the 1990s, 63% of eroding coasts have within 30 km of artificially stiffened coast sections.
Protective action costs are growing. In 2001, public funds allocated for the protection of coasts against erosion and flood risks reached an amount of 3,200 million euros, while recent studies for UN IPCC estimated that by 2020 the cost of coastal erosion will reach an average of 5,400 million euros/year.
Coastal erosion has three different types of impact:
- loss of land having a certain economic value;
- destruction of natural sea defences (dune systems) as a result of even one single event causing hinterland flooding;
- failure of artificial protection systems that can potentially generate hinterland flooding.

The process of erosion and accretion of coastal areas has always existed and has contributed to moulding landscapes, creating a wide range of morphologies.
In some areas, the erosion of the hinterland caused by rain and landslides along rivers has created a considerable accumulation of sediments that are useful to coast dynamics.
These sediments, together with those deriving from coastal morphological structures (cliffs and marine sand banks), provide availability of material that is essential for the formation of

In 2001, 70 million inhabitants lived in coastal areas.

It is estimated that by 2020 the cost of coastal erosion will reach an average of 5,400 million euros/year.

There are three different types of impact.

Climate change influences the progress of coastal erosion and the increase of flood risk.

On the Italian coast, 4,863 km of low, sandy or delta coastlines are more vulnerable to sea action.

beaches and sandy dunes. Moreover, these *habitats* create a large number of benefits such as: the possibility of installing economic and recreational activities; protecting depressed areas from floods; absorbing wave energy during storms; reducing eutrophization of coastal waters, increasing biodiversity, etc.
Climate change has a significant influence on the progress of the coastal erosion phenomenon and on the evolution of marine flood risk levels of coastal areas.

The Italian coast has a length of 8,353 km, of which 4,863 km are low sandy or delta coastlines (Tables 9.3 and 9.4). From a physical point of view, the latter are more vulnerable to sea action and subject to intense geomorphological dynamics.
Indeed, in Italy coastal zone risks are mainly related to erosion phenomena and to storms or floods, which are mostly relevant for low and sandy coasts and for coastal alluvial plains.

Table 9.3: Distribution of Italian coast by type[3]

Type of coast	km	%
Natural	7,687	92
Artificial	314	3.80
Fictitious	352	4.20
TOTAL	**8,353**	**100**

Table 9.4: Distribution of natural coast by type[4]

Type of coast	km	%
High	2,824	36.7
Low	4,863	63.3
Natural	**7,687**	**100**

[3] Source: ISPRA
[4] Source: ISPRA

In the last century, the coastal system suffered a very strong anthropisation process that, in some areas, has considerably changed and altered the natural and environmental features of the territory.

The coastal system suffered a very strong anthropisation process.

Due to their accessibility, low coastal areas are more densely occupied by residential settlements and considerable business activities (even for tourism) as well as road and sea transport infrastructures. Indeed, in Italy more than 300 km of coasts host commercial and leisure port facilities.

In Italy, over 300 km of coasts host commercial or leisure port facilities.

According to surveys carried out by the National Statistics Institute (ISTAT), 16.8 million inhabitants permanently live in the 642 coastal municipalities, which represent about 30% of the total population. This gives an idea of how populated coastal areas actually are in Italy, given that both seasonal and tourism flows are not included.

About 30% of the total population lives in the 642 coastal municipalities.

Coast urbanization has transformed the evolution of littorals and has turned the natural phenomenon of coastal erosion into a serious problem, particularly near urban centres where homes, infrastructures and economic activities are at risk.

There are many human activities in coastal zones (industries, tourism, fishing, aquaculture, etc.). Problems arise when these activities tend to develop together on the narrow coastal strip and come into conflict both with each other and with the interest of protecting natural environments and landscape.

Data on land use collected by the Corine Land Cover 2000, covering an area of 10 km from the coast towards the hinterland (Figure 9.1), shows that 58.7% of land is used for agriculture and 6.6% is occupied by urban centres, industries and road, air and sea transport infrastructures. In other words, in Italy two thirds (over 65%) of land included within the 10 km strip from the shore, is used for human activities and is moulded even by invasive and irreversible human intervention on the environment (Figure 9.2).

58.7% of land included within the 10 km strip from the shore is used for agriculture while 6.6% is occupied by urban centres, industries and road, air and sea transport infrastructures.

Artificially moulded land in the area within the 10 km strip. The red areas show where the land is more densely occupied by artificial structures. These are located near the most important coastal cities (by number of inhabitants and commercial, industrial and maritime activities).

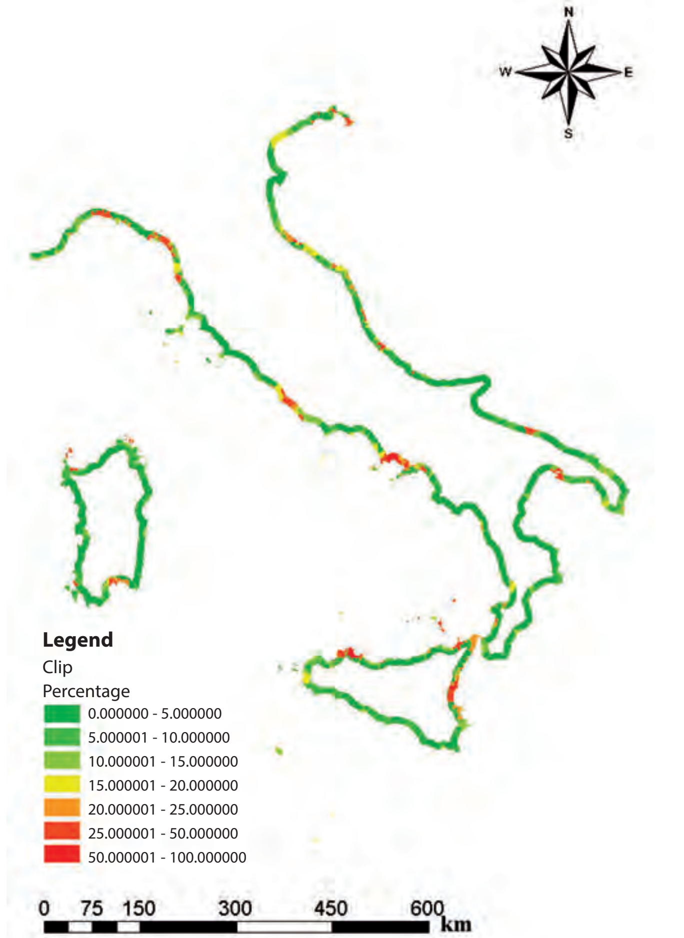


Figure 9.1: Percentage of artificially moulded land in the 10 km strip[5]

[5] Source: ISPRA

Over 65% of land included within the 10 km strip from the shore is used for human activities and moulded by invasive and irreversible intervention on the environment.

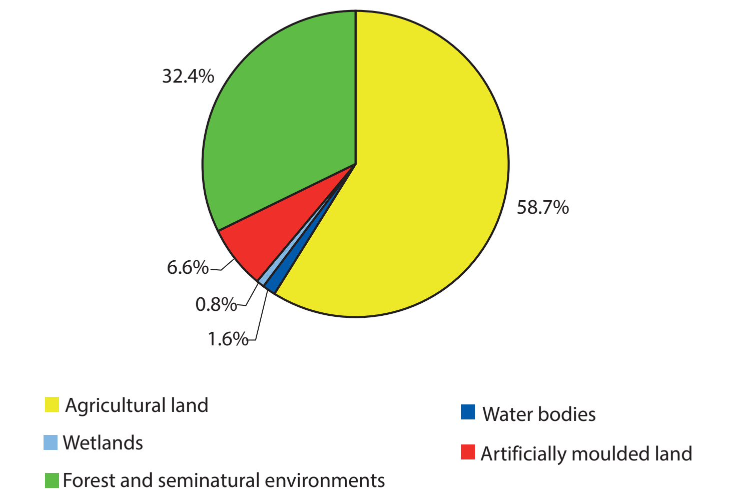


Figure 9.2: Land use in Italy in the area within 10 km from the shore towards the hinterland[6]

The concentration of activities in a reduced space has a considerable influence on the natural dynamics of coastal zones, with specific reference to sandy shores. These are further complicated by strong variations induced by tourist activities and by environmental pressure over the years. Indeed, with effect from the 1950s, the coast is not only considered an area for trading of goods and construction of ports facilities. In general it is not only used for maritime activities. It is also an area used for living, leisure and profit-making through tourist activities. This has caused an additional occupation of land, due to urbanization, and a further irreversible invasion of the coastal environment.

The coastal risk was identified as a serious national problem as early as the 1970s. Over the years, coastal erosion has become a very important social and economic issue for the country and has often been the theme of assessment studies and impact estimates.

The coastal risk is considered a serious national problem since the 1970s.

[6] Source: ISPRA

According to a study carried out by the "De Marchi Commission", erosion processes have involved the main river mouths and large sections of coast since the 1950s.

The national situation (1968-1969) of the erosion phenomenon (Figure 9.3) was analysed within the framework of activities carried out by the *Commissione Interministeriale per lo Studio della Sistemazione Idraulica e della Difesa del Suolo* (Interministerial Commission for the Study of the Hydraulic Arrangement and Land Protection known as the "De Marchi Commission"). Results highlighted that since the 1950s erosion processes have involved all of Italy's main river mouths as well as large sections of the coastal strip.

The Atlas of the Italian Beaches (1985-1997) confirms the persisting erosion of main river mouths and worsening of coast erosion phenomena.

Subsequent studies, conducted at national scale in the period 1985-1997, were published on the well-known Atlas of the Italian Beaches (CNR, MURST, 1997) (Figure 9.4). They confirmed that main river mouths are continuing to erode and that coast erosion phenomena are generally worsening. Mitigation cases were found almost exclusively near stretches of coast where local protection interventions had been planned.

Studies conducted in different periods show that erosion phenomena persist and worsen with time.

Figure 9.3: Map summarizing eroding coast sections[7]

Figure 9.4: Evolutionary trend of Italian beaches[8]

[7] Source: De Marchi Commission

[8] Source: Atlas of the Italian Beaches, CNR-MURST, 1997

A study conducted by ISPRA in 2005 identified the geomorphological features of Italian littorals and assessed shoreline variations over the last 40-50 years.
Based on uniform methodology and information at national scale, the outline of the coastline was traced and developed from colour zenital orthophotos obtained from flight IT2000 and compared to the coastline obtained from mosaics IGM 1:25,000.
As a result, Italy is among the countries having the highest risk of coastal erosion in Europe.
Table 9.5 summarizes the analysis of variations in the Italian coasts over the last 50 years. It shows that 30% of the littoral is subject to an intense geomorphological evolution.
Moreover, the study showed that only in the low coasts (Table 9.6) out of the 4,863 km of low and delta coasts in Italy, 1,170 km are definitely eroding. In other words, over the last 50 years 24% of sandy coasts suffered an average erosion of over 25m.

Italy is among the countries having the highest risk of coastal erosion.

Table 9.5: Stable and amended coast, both decreasing and increasing[9]

COAST	km	%
TOTAL	**8,353**	**100.0**
Stable	5,385	64.5
Amended	2,448	29.3
Unclassified	520	6.2
Amended	**2,448**	**29.3**
Decreasing	1,285	15.4
Increasing	1,163	13.9

Table 9.6: Stable and amended low coast both decreasing and increasing[10]

COAST	km	%
TOTAL	**4,863**	**100.0**
Stable	2,387	49.1
Amended	2,227	45.8
Unclassified	248	5.1
Amended	**2,227**	**45.8**
Decreasing	1,170	24.1
Increasing	1,058	21.7

30% of the coast is subject to an intense geomorphological evolution. Furthermore, over the last 50 years, 24% of sandy coast has decreased by an average of over 25 m.

Table 9.7 shows that the most affected regions are: Sicily (with as many as 313 km of strongly eroded coast); Calabria (208 km), Apulia (127 km), Sardinia (107 km), Lazio (63 km) and Tuscany (60 km). With regard to coast length, most decreasing beaches are found in Marche (38.6%), followed by Basilicata (38.1%), Molise (34.7%) and Calabria (32%).

The regions that are mostly affected by coast erosion are: Sicily (313 km), Calabria (208 km), Apulia (127 km) and Sardinia (107 km).

[9] Source: ISPRA
[10] Source: ISPRA

Table 9.7: Variation of Italian coast shorelines and surface areas[11]

Region	Total coast	Natural coast			Analysis of low coast modifications (variation > +/- 25m)											
					Shoreline										Surface area	
		Total	Low coast		Stable		Unclassified		Modified							
									Total		Erosion		Progress		Erosion	Progress
	km	km	km	%	km	%	km	%	km	%	km	%	km	%	km^2	
ITALY	**8,353**	**7,687**	**4,863**	**63.3**	**2,387**	**49.1**	**248**	**5.1**	**2,227**	**45.8**	**1,170**	**24.1**	**1,058**	**21.7**	**54.2**	**49.1**
Liguria	381	302	140	46.5	59	41.9	8	5.9	73	52.2	28	19.9	45	32.4	1.3	1.9
Tuscany	651	614	280	45.5	138	49.5	10	3.4	132	47.1	60	21.3	72	25.8	4.3	4.4
Lazio	384	356	273	76.8	117	42.9	13	4.6	144	52.5	63	23.1	81	29.5	2.2	3.1
Campania	509	450	224	49.8	116	51.9	6	2.7	102	45.5	55	24.7	47	20.8	2.4	1.6
Basilicata	65	64	40	62.3	7	16.3	0	0	34	83.7	15	38.1	18	45.6	1.4	1.4
Calabria	737	691	636	92.1	252	39.7	4	0.6	380	59.7	208	32.7	172	27	8.7	6.7
Apulia	965	893	689	77.1	431	62.6	33	4.8	225	32.6	127	18.5	98	14.2	3.6	2.9
Molise	37	33	33	100	10	30.8	0	0	23	69.2	12	34.7	12	34.5	1.2	0.5
Abruzzo	129	115	113	98.3	42	36.9	0	0.1	71	63.1	32	28.3	39	34.8	1.7	1.4
Marche	177	156	140	89.7	39	28.3	9	6.4	91	65.3	54	38.6	37	26.7	3.1	1.2
Emilia Romagna	181	162	162	100	11	6.5	58	35.5	94	57.9	41	25.3	53	32.6	4.7	5.0
Veneto	218	166	166	100	13	7.8	56	33.8	97	58.3	35	21	62	37.3	2.5	4.5
Friuli Venezia Giulia	120	74	74	100	29	40.1	1	1.2	43	58.7	20	26.6	24	32.1	0.8	2.9
Sardinia	2,180	2,106	785	37.3	580	74	29	3.7	175	22.3	107	13.6	68	8.7	2.8	4.6
Sicily	1,619	1,505	1,108	73.7	542	48.9	22	2	544	49.1	313	28.3	231	20.8	13.5	7.0

In Italy, over the last 50 years, 54 km^2 of coastline was subject to significant erosion.

According to findings of Eurosion (project commissioned by the General Directorate Environment of the European Commission) every year Europe looses about 15 km^2 of beaches. Only in Italy, over the last 50 years, as many as 54 km^2 of coastline were subject to significant erosion. The total balance between decreasing and increasing areas is, in any case, negative with a final coastal land loss of about 5 km^2. Entire beaches have disappeared or have been considerably reduced, with a land value loss both from an environmental and economic point of view. In many cases, the reduction of shorelines has created serious concern for the security of roads and railways, especially in the event of rough seas.

Considering the evolutionary trend of Italian littorals and the concentration of activities and urban settlements along the coast, it can be assessed that the area subject to potential flood risk

[11] Source: ISPRA

(RICE - Radium of Influence of Coastal Erosion[12]) (Figure 9.5) in coastal areas covers 954,379 ha. This is equivalent to 3.17% of the national surface and involves 5,276,535 people (9.12% of the whole population). It is also estimated that 336,746 ha of land (1.12% of the national surface) and 2,133,041 people (3.69% of the total population) are exposed to a medium-high and high risk.

The area subject to potential flood risk (RICE), in coastal areas, is equivalent to 3.17% of the national surface and involves 9.12% of the whole population.

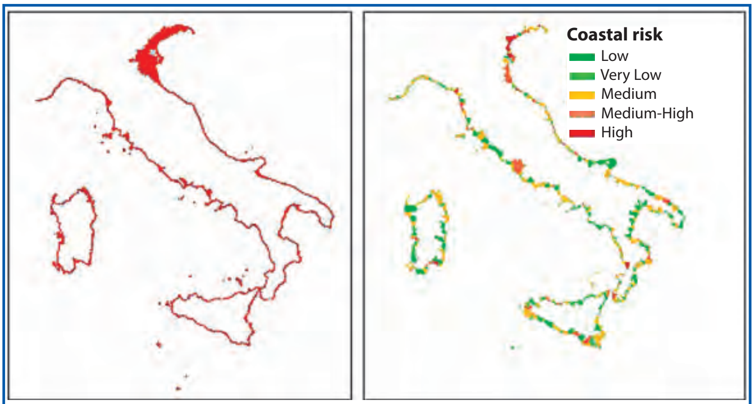


Figure 9.5: RICE area in Italy and map of coastal risk by municipality[13]

It is estimated that 336,746 ha of land (1.12% of the national surface) and 2,133,041 people (3.69% of the total population) are exposed to a medium-high and high risk.

Erosion is growing and is destined to worsen. Over the years, the expansion of areas subject to flood risk has motivated interventions aimed at controlling this phenomenon with the realization of works to protect the coastline. However, hard structures have not resolved the erosion problem, especially in the medium and long term. Indeed, in many cases they have contributed to

Protection interventions with hard structures have not resolved the erosion problem.

[12] The RICE area is defined as all terrestrial areas located: within 500 m from the coastline and extended to areas lying under 5 m* above sea level. (*) Taking into account that errors can be made when defining the DTM (Digital Terrain Model). To avoid underestimation of areas below 5m, 10m was considered the limit contour line.

[13] Source: ISPRA

increasing the process of artificialisation and marine/coastal habitat degradation. Only in the last decade have beach replenishing interventions taken place using sands from land and sea quarries, either soft or protected by hard structures.
Figure 9.6 shows the distribution of protection and harbour works over the whole national territory.

Distribution of protection and harbour works over the national territory. Sicily, where about three quarters of the coasts are low, has realised three times as many protection works as Sardinia. Two thirds of Sardinian coasts, instead, are high and rocky. For this reason it requires fewer protection works with respect to other regions on the Adriatic coast.

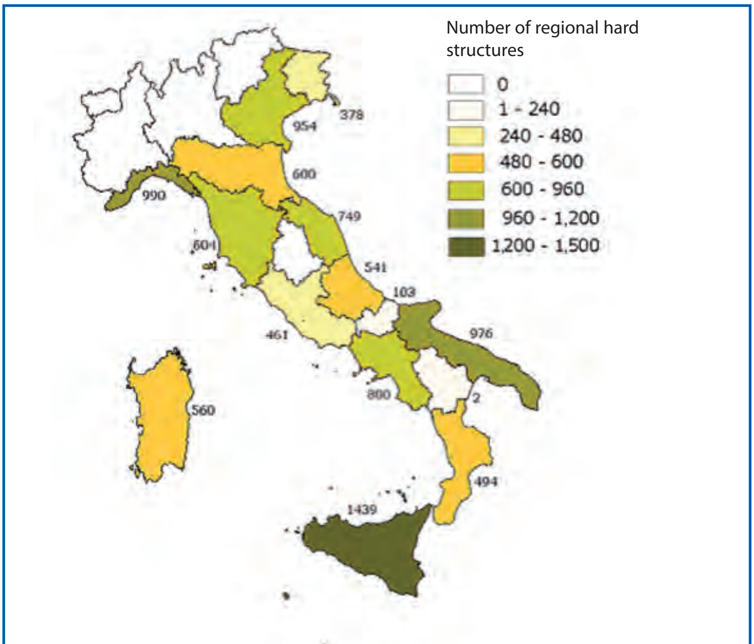


Figure 9.6: Distribution of harbour and protection works by region[14]

Decisions on the type of works to undertake and resources needed have been influenced by elements such as the geomorphological characteristics of littorals, exposure to meteo-marine events and the intensity of sea storms.

[14] Source: ISPRA

Adriatic regions such as Emilia Romagna, where the shores are mainly sandy, have an intense concentration of hard structures detached from the shore (submerged or emerged breakwaters). The Northern Adriatic coast is essentially protected by groins and natral rock revetments, built directly on the coastline or mixed solutions.

Adriatic regions, which have sandy littorals, have a high concentration of hard structures detached from the shore.

Thyrrhenian coasts are protected by breakwaters and mixed protection works. These marine protection works combine several types of protection structures or works which, after the initial design (following interventions of completion or lengthening) are currently considered unclassified.

Thyrrhenian coasts are protected by reefs and a combination of protection works.

The distribution of works carried out in Italy's two main islands, Sicily and Sardinia, is the clearest example of the direct relationship between the geomorphological nature of coasts and the use of economic and administrative resources required to control coast erosion phenomena.

Sicily, where three quarters of the coasts are low, has realised three times as many protection works as Sardinia.

Sicily, where three quarters of the coasts are low, has realised three times as many protection works as Sardinia. Two thirds of Sardinian coasts, instead, are high and rocky. For this reason it has fewer protection works than other regions on the Adriatic coast.

Unfortunately, on all sections of Italian coasts, the planning and execution of protection works mainly occurred without taking into account the dynamics of physiographic units and considering only the administrative limits of the executing body.

This approach, as well as the urgency of carrying out the works, has often affected results. Indeed, protection works limited to a short stretch of eroding coast can worsen the situation or even cause new erosion phenomena on adjacent non-protected shores.

Causes

In brief, the phenomenon of erosion on Italian coasts is constantly increasing due to:

The phenomenon of erosion in our country is constantly increasing.

- the reduction in the contribution of solid river sediments flowing towards beaches, either collected from riverbeds or caught up by slope stabilization, river control and dam works (due primarily to human activity, as opposed to natural action);

- sea storms occurring in concomitance with floods causing paroxysmal erosion phenomena at river mouths;
- the relative increase in sea level and concomitant lowering of land level due to natural and human-induced subsidence processes.

In ancient times, the large expanse of the Italian coast was due to deforestation caused by the intensification of trading and agricultural activities, first by the Italic and then by the Roman people. This activity increased the speed of land erosion processes in the countryside and in the hilly area, favouring the flow of large quantities of sediment through rivers to the sea. Many river mouths therefore benefited, receiving a great availability of sediment. This enabled the development of wide and branched deltas and favoured the structuring of coastal plains as well as the progradation of beaches. In recent times, this availability of sediment has lacked due to: control of water flows, urbanization of coasts (with the dismantling and hardening of dunal structures), cautious use of soil (to reduce loss of fertile soil) and stabilization of slopes. This has favoured beach regression and triggered off erosion phenomena in the whole peninsula. The blockage of sediment and the drainage of water for irrigation and reclamation works (which have created healthy soils in many coastal strips) have contributed to creating vast depressed areas subject to floods, which today are below sea level.
Coastal erosion and floods caused by average sea level variations and violent sea storms have a serious impact on the loss of biodiversity, of landscape and environmental heritage (coastal pine woods, dunes, beaches, etc.) and of areas where very valuable economic activities can be developed.
In coastal management, there is clearly a need to collect adequate information on: sea storm intensity; wave height, sea level, river and coastal sediment flow.

Response

Regulations

There is a greater awareness of improving coastal management.

In the last decades, following the growing occupation of coasts, the widespread practice of unlawful building and lack of land and coastal management criteria, there is a greater awareness of the

need to improve land management. Over the years, this has generated specific regulations at European level as well as national strategies, regional plans, studies, inventories and researches. Indeed, today many regulations and tools are applied, which contribute to protecting the coastal environment. In Italy the main regulations on coastal areas are indicated below.

The main regulations.

- The Marine Navigation Code, which regulates action on state maritime property.
- Law 431/85 (Galasso law) which establishes landscape obligations in the coastal strip within 300 m from the water's edge. However, these are very general, passive and insufficient in contrasting the growing coast transformation initiatives.
- Law 183/89 on land protection, since replaced by Legislative Decree 152/06, which gives the State the function of defining general approaches, criteria and administrative functions on the protection of coast in basins and areas of national relevance for the security of the State and maritime navigation. In other areas, administrative functions are carried out by the regional authorities.
- Legislative Decree 112/98 gives the state the function of defining general approaches and criteria for protecting coasts. Administrative functions related to planning and integrated management of interventions for the protection of coasts and inhabited areas are given to regional authorities. The subsequent Legislative Decree 96/99 also involves provincial authorities in the administrative part. Land protection and specifically coast erosion problems have contributed to increasing the awareness on the need to allocate resources and plan interventions aimed at preventing risks and taking emergency action.

In carrying out the functions conferred to them by Legislative Decree 112/98, regional authorities have issued regional laws for the preparation of action plans to protect the coastal strip. Some of them (i.e. Liguria, Emilia Romagna and Marche) have also adopted integrated coast management programmes to enforce European Parliament Recommendation of 30/05/02.

Regional laws have been issued for the preparation of action plans. Liguria, Emilia Romagna and Marche have adopted integrated coast management programmes.

Coastal environment planning and management activities are still weak and extremely fragmented due to the different duties conferred to a considerable number of different players.

Knowledge

Plans for managing coastal zones have been defined. Systematic activities that monitor and analyse vulnerable areas are being carried out.

Over the last few years, assessment of coastal risk and coastal management has acquired fundamental importance in defining environmental and civil protection policies.

Plans for managing coastal zones can only be based on systematic activities that monitor and analyse vulnerable areas in order to identify the most adequate provisions to protect sensitive and intensely exploited areas.

The need to face this problem at national, regional and local scale has generated sector studies promoted by the European Commission Environment DG and INTERREG programmes (EUROSION, SANDPIT, BEACHMED, MESSINA, CADSEALAND and BEACHMED-e). These have led many European countries to create increasingly consistent data bases that include essential variables for environmental characterisation focussed on assessing risks associated with coastal areas.

Crucial coast management problems.

Researchers are facing crucial coast management problems such as:

1) Reconstruction of the climate in the Mediterranean. These include trends and variability with different time scales, in which interaction between ocean and atmosphere and currents play a significant role. There is still insufficient in-depth knowledge of these issues;
2) Identification of climate change caused by the increase in human factors (emissions of CO_2 and other greenhouse gases, aerosol, etc.) and their impact on coasts.

To this purpose, it is necessary to continuously observe and document aspects such as: physical and geoenvironmental characteristics; the extent and dynamics of coast transformation; the progress of anthropisation and exposure risks due to natural processes or human activities.

The sea's physical characteristics are based on wave measurement buoys.

With regard to the sea's physical characteristics, in Italy wave observation is based on wave measurement buoys (Figure 9.7) and satellite systems. Both systems do not provide sufficiently long and geographically distributed time scales to identify the variability and trend of wave climatology.

Distribution of wave measurement buoys, which define the sea's physical characteristics.

Figure 9.7: Distribution of wave measurement buoys[15]

Data provided by wave measurement buoys have been generally available since the second half of the 1980s while satellite data have been available since the first half of 1990s. Knowledge of past events is based on simulation models which, however, are imprecise due to the inaccuracy of the "wind" variable. An analysis of available data shows that during the second half of the 20th Century there was a reduction in the average intensity of sea storms during winter months (Figure 9.8) and even a reduction of extreme events, although this is limited to a central strip of the Mediterranean which involves the South of Italy (Figure 9.9).

[15] Source: National wave measurement network (ISPRA)

During the second half of the 20th Century there was a reduction in the average intensity of sea storms in the Winter months and extreme events also reduced.

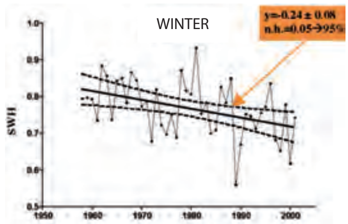


Figure 9.8: Average significant wave height: current trends[16]

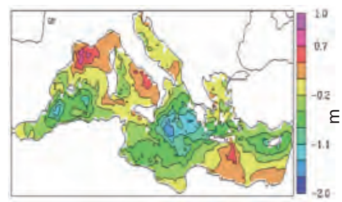


Figure 9.9: Extreme values of significant wave height: current trends, 44-year statistic of extreme winter events, ERA40 simulation[17]

Fewer problems are found with data on average sea level, due to the availability of sufficiently long time series.
However these are related to a limited number of areas (Figure 9.10) which are known for being critical.

Sufficiently long sea level time series are available for critical areas.

Figure 9.10: National Maerographic Network[18]

[16] Source: Lionello e Sanna, 2005
[17] Source: Lionello et al., 2006
[18] Source: ISPRA

The analysis of long-term sea level variability (Figure 9.11) can only be observed in Genova and in the Northern Adriatic, where both Marina di Ravenna and Venice, show behaviour mainly dominated by subsidence phenomena. These are induced by natural gas and water extraction activities in coastal alluvial plains. Trieste is not affected by this undesired influence. Between 1880 and 2000, both Genova and Trieste show a sea level variation trend of 1.2-1.3 mm/year, which is close to current global assessments.

Subsidence phenomena are found in the Northern Adriatic.

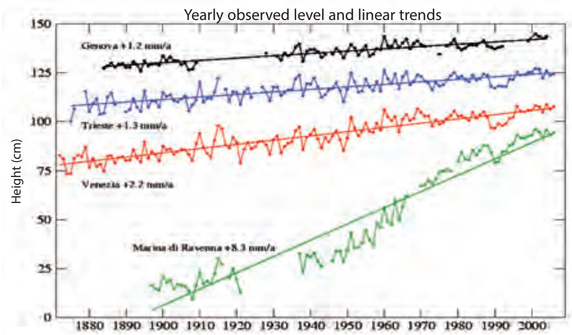


Figure 9.11: Italian historical time series[19]

The IPCC estimates that the average level of the Mediterranean will increase by about 35 cm in the next 100 years.

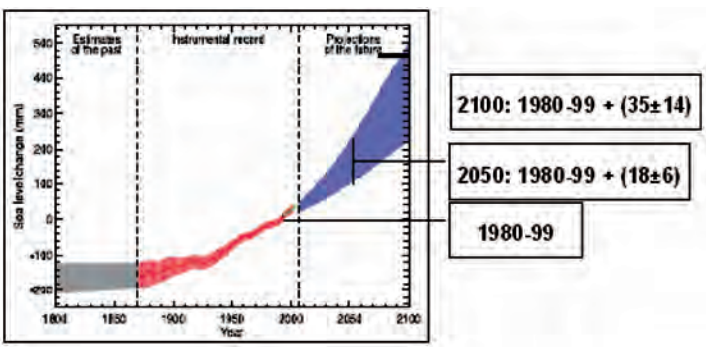


Figure 9.12: Increase in average sea level of the Mediterranean according to IPCC, 2007[20]

[19] Source: F. Raicich, WS CNCC 2007, Palermo
[20] Source: F. Raicich, WS CNCC 2007, Palermo

Mareographic observations enable the interpretation of past sea levels extrapolating future trends, provided that current climate trends are stable.

Considering the current limits in assessing variability of residual tide on a yearly and ten-year scale, mareographic observations provide tools for analysing and interpreting past sea levels and make it possible, in principle, to extrapolate results and compare them with periods for which sufficiently long time series are available. However, these results are only valid if current trends are stable and there are no climate changes, the effects of which can only be considered with the application of specific and adequate simulation models whose performances can be assessed only by comparing mareographic data available.

In order to plan adequate coast management activities on a multi-decadal scale the current uncertainties need to be drastically reduced. This can be done by producing a series of reliable simulations with models that, starting from a global scale and through a regional one focused on the Mediterranean, reproduce characteristics with sufficient details that enable the realistic calculation of wave and sea level climatology, with a sufficiently wide interval of forcing factors and their time and space variability. This is crucial for extreme events which substantially influence the assessment of risks related to erosion and flooding of coastal areas. Indeed, for extreme events considering trends and significant variations is particularly difficult.

The potential flow of sediment through rivers strongly depends on how and to what extent the society manages the territory (building speculation, deforestation, hydraulic works, farming practices, etc.). However, it also depends on the impact climate change has on the statistical distribution of rainfall not only with regard to average quantities but also, and especially, with regard to fluctuations which can cause important variations in the erosion potential of precipitation.

In order to make an (at least qualitative) assessment of erosion changes (caused by climate change) in various areas of Italy and therefore evaluate the impact on coast balance it would be advisable to use simulations of 20th Century climate models and 21st Century forecasts/scenarios, after having applied appropriate rainfall space and time downscaling techniques focusing (for example) on potential erosion changes.

This new work would have a great impact and could produce a complete map of Italy. Analysing the performance of the above models would also require the activation of a national programme for the measurement of solid and liquid flows through rivers, which would provide sufficiently uniform and long time series.

Action

Over the last decades, the increase in coast erosion phenomena and the expansion of areas subject to flooding have led to conditions of emergency which required the realization of protection works. Often, these have not resolved the problem in the medium and long-term and in many cases they have contributed to degrading the coastal and marine habitat. In the last ten years, authorities have decided to recover coastlines by means of beach renourishment interventions, using sand from land and marine quarries, either soft or protected by hard structures. However, reducing the vulnerability of Italian coasts with indiscriminate protection interventions along the 4,800 km of low sandy coast is not economically sustainable. Costs of interventions in this area, even limited to soft renourishment works only, are estimated around 1.5 and 2.0 billion Euro and involve a quantity of sediment between 150-200 million cubic metres.

In view of the above, a national plan is required in order to identify potential risk areas. The plan should include more efficient solutions that can enable each specific region to adapt to climate change. It should also include the principle of giving up the contrast between land and sea and finding different ways in which residential and productive settlements can coexist in coastal areas in harmony with natural values and dynamics.

A national plan is required in order to identify potential risk areas.

Possible responses aimed at the protection of human life and properties can be generally summarized into three categories:

Responses.

- Retreat: this does not involve any action to protect land from sea. The coastal area is abandoned and ecosystems either disappear or are transferred. This choice can be motivated

Retreat.

by the excessive economic or environmental impact of protections.

Protection.

• Protection: this provides for the realization of permanent protection structures (such as breakwaters) or softer solutions (such as the reconstruction of dunes, the introduction of stabilizing vegetation, renourishment works, etc.) in order to continue using the territory.

Accommodation.

• Accommodation: this implies that the population continues to use the area at risk without taking action on preventing erosion or flooding. This is done by constructing emergency protection structures, raising buildings, introducing forms of agricultural reconversion or fish farming.

Possible solutions to implement strategies.

Possible solutions to implement these strategies are:
• Withdrawal from areas respecting their natural evolution.
• Conservation and/or reconstruction of natural areas acting as a "soft" interface between land and sea, even by means of recovering the natural capacities of coastal sediment flow.

- Conservation and/or reconstruction of coastal dunes.
- Implementation of land planning strategies to avoid compromising the area further in terms of vulnerability (even by means of planning obligations).
- Continuation of the land-sea contrast favouring soft interventions (renourishment) rather than hard structures.
- Increase in the morphological resilience of emerged beach structures (dunes) and submerged ones (bars etc.).
- Regulations aimed at giving priority to coastal management plans with respect to municipal town plans and introduction of Strategic Environmental Assessment (SEA) when assessing coastal plans. Furthermore, the assessment system must be independent from the entity that is preparing it.

Regional Action Plan.

This implies a Regional Action Plan or even a plan at the sea basin scale. The plan should consider not only the impact of interventions in the area immediately next to it but also its interaction with the whole coastal system. It should be inspired by the principle that "interventions inducing erosion will no longer be funded". A national coordination system on coasts (research, monitoring, methodology, planning criteria, etc.) is also necessary in order that those operating at local level are not isolated from the general system.

Implementation of EC Recommendation on ICZM.

In view of the above, the implementation of the EC Recommendation on ICZM *(Recommendation of the European Parliament and of the Council, concerning the implementation of Integrated Coastal Zone Management in Europe* dated 30 May 2002) is even more urgent. National guidelines shared with local administrations and bodies in charge of planning need to be prepared. Interventions for the establishment of "Coast Plan" regulations are equally urgent in order to define its minimum extension on the basis of coast dynamics and not administrative criteria. The Coast Plan should have priority over municipal town plans and other planning instruments.

Regional initiatives

9 regions have implemented instruments extending to the entire coastline.

Out of 15 coastal regions, 9 of them have implemented instruments extending to the entire regional territory. Among these, 6 regions have a specific coastal protection plan and only Emilia Romagna and Marche have an approved integrated management plan of the coastal

strip. The other regions mainly have coastal protection intervention programmes and Regional Action Plans (POR), which are limited to defining a list of protection works to be carried out on short coastline stretches (Table 9.8, Figure 9.13).
The lack of guidelines and general policies at national level has determined the creation of plans of different legal nature (sectorial plans as per Law 183/89 and Legislative Decree 180/98; Landscape plans, Law 431/85, Legislative Decree 42/04), leading therefore to different methods of planning, compulsoriness and protection of the areas involved. However, a progressive acknowledgement of the principles of coastal integrated management is emerging, according to European Recommendation indications, and planning processes are speeding up.

Table 9.8: Regional coastal plans[21]

Region	Regional plan Type	Coastal protection plan period Status	ICZM Plan period Status	Protection interventions POR
Liguria	Yes Coastal Coordination Territorial Plan	yes 2000 approved		
Tuscany	Yes ICZM Plan for Hydrogeological Readjustment	yes 2004 published	yes	
Lazio			yes experimental	yes
Campania	Yes Erosion Transitional Plans			
Basilicata				
Calabria	Yes Hydrogeological Settlement Transitional Management (=Protection Plan)	yes 2005 approved Plan	yes 2006 editing -	yes Integrated Plan
Molise				yes
Abruzzo	Yes Organic Plan for vulnerable areas at risk	yes 2003 approved		yes
Marche	Yes ICZM Plan	yes 2005 approved	yes 2004 approved	yes
Emilia Romagna	Yes ICZM Plan	yes 1983 approved	yes 2005 approved	yes
Veneto				yes
Friuli Venezia Giulia				yes
Sardinia	Yes Landscape Regional Plan		yes experimental	yes
Sicily	Yes Hydrogeological Settlement Transitional Plan	yes 2004 editing		yes
Plans Total	**9**	**8**	**3**	**12**

[21] Source: Data of the coastal regions processed by ISPRA

Map indicating regional planning activities. The number was determined by assigning a weight to existing plans (regional, coastal protection, ICZM, POR). This was doubled if they are approved.

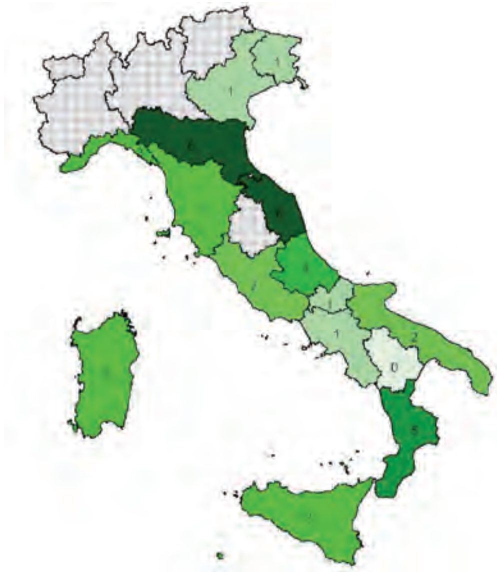


Figure 9.13: Regional planning activities[22]

Liguria Region

<u>*Liguria Region.*</u> The Coastal Technical Plan of Liguria Region, first example in Italy, intends to guarantee a greater stability to the coastline mostly affected by erosion through a set of organic interventions based on:

- arrangement of drainage basins and riverbeds with sea outlet to re-establish a larger supply of sediment to the sea, eliminate any material extraction from watercourses, intervene on the catchment basins reactivating their sediment supply function to the watercourses;
- planning and organization of protection works and renourishment interventions following homogenous methods for single coastline strips, in consideration of the quality of coastline areas, climatic characteristics, landscape and their distinctive naturalistic features;
- intervention on tourist ports; recovery of coastline strips with the presence of Posidonia.

[22] Source: Data of the coastal regions processed by ISPRA

Tuscany Region

Tuscany Region. In 2001, the Region of Tuscany approved the Regional Plan project proposal of Integrated Coastal Zone Management for Hydrogeological Readjustment, enclosing a programme of priority interventions for coastline recovery and readjustment and a regional investment plan. The project refers to contents of European Recommendation dated 30/05/2002, which Tuscany was first in interpreting and turning into action. The proposed plan provides:

- research and analysis of coastal dynamics and conservation of its balance;
- economical development in accordance with principles of sustainable development;
- assurance of balance between natural environment and anthropised areas;
- upgrading of natural systems and safety of residential areas and facilities;
- redevelopment of coastal ecosystem integrity.

The framework of sectorial transition plans was then set up for each regional basin plan.
A Morphodynamic sedimentary plan is currently being prepared by the Arno Basin Authority. The general principle that the region has tried to adopt is to define a “tolerance strip” for coastline variation, beyond which controlled renourishment interventions are activated.

Lazio Region

Lazio Region. The Regional plan for the Protection of Lazio Region Coastline places the attention on:

- coastal dynamics;
- coastal protection systems adopted on Lazio coastline;
- natural resources;
- legal aspects and jurisdiction;
- planning activities programme for 2002/2003/2004.

Regional law 53/1998 has introduced interesting innovations, preliminary to the Coastal Plan project. These establish that coastal protection works should be based on:

- protection of residential areas and relevant coastal facilities;
- limitation of erosion processes and re-establishment of the shores even through artificial renourishment;

• re-naturalization of the coastal strip, protection and re-establishment of coastal dunes.

The Coastal Regional Observatory was established for coastal monitoring, with the task of examining coastal dynamics and monitoring of interventions.

Since 1991, a research for marine sand quarries has been set up. On this issue Lazio region has promoted the project BEACHMED “Environmental recovery and conservation of eroding coastline utilizing marine sand deposits” and BEACHMED-e with the goal of further developing the issues already dealt with in the previous project.

Campania Region

Campania Region. The activities of the four Basin Authorities are coordinated within Campania Region under one specific project, extended also to the underwater relief sector (CARG Project). However, the situation continues to be very fragmented despite the region’s attempt to coordinate the initiatives of Basin Authorities (BA) under a joint activity.

The Coastal erosion transitional plan for the Southern strip is already at the implementation stage (BA Left Sele).

A preliminary research on the Central strip of Campania coastline is in due course both for the shores and for the collapse of the ridges (BA Right Sele).

The Northern strip of the coastline (BA Liri GV) is under research and the Erosion Plan is currently being edited.

Calabria Region

Calabria Region. A progressive acknowledgement of the ICZM principles can be seen. As a matter of fact, after having dealt with the coastal erosion problem within the scope of the Hydrogeological Settlement Sectorial Plan (adopting an initial risk analysis methodology), the region is now preparing to draw up an integrated management plan. The plan considers previous action as one of the elements functional to the construction of a broader conceptual plan.

Basilicata Region

Basilicata Region. The region has started a series of studies aimed at coordinating basin planning (with specific regard to the flow of river sediment, the extraction of gravel from riverbeds and the management of dam basin sediments) with coastal planning processes providing safeguard and conservation interventions for

the protection of the coastline, as well as actions directed to the re-establishment of the filling capacity of dams and the reactivation of the downstream sediment flows.
The following priority research activities were identified: erodibility characteristics of drainage basin soils and characteristics of sediment flows through rivers; related changes induced by natural phenomena and by the utilization of water resources; filling of dam basins; marine weather conditions to which shore sections are exposed.
Such activities will be conducted through the activation of monitoring systems of sediment flows, wave motion and evolving coastline trends.

Apulia Region

Apulia Region. Within the framework of the Apulia POR for the 2000-2006 period, the region provided for monitoring activities on the coastal protection interventions already performed and on coastal morphological evolution.
In July 2006, the Regional Council (implementing Regional law no. 17 of 23 June 2006, "Coastal protection and use regulations") took actions to regulate and plan coastal use. The following provisions were decided:

- Short-term provisions: to protect and safeguard the environment and permit accessibility and right for everyone to use maritime State property and territorial sea, simplifying administrative action and integrating the Public Authorities;
- Medium-term provisions: to draw up the Coastal Regional Plan (PRC) in order to regulate coastal activities and interventions. The PRC, in fact, must indicate: the state of Apulia's coastline; the existing facilities; the degree of utilization and anthropisation; the geological and hydrological risks as well as instability and criticality phenomena in general. Moreover, the PRC must be supplied with Technical Implementation Regulations, in order to provide certain rules in the management of the coastal territory and in processes and procedures for issuance of maritime State property authorizations, that have been missing so far;
- "in the long term", constitute the Coastal Regional Observatory, as a permanent structure for the control and integrated management of the coastal territory.

Molise Region

<u>*Molise Region.*</u> The region has established an agreement for coastal research with Molise University. The Basin Authority, in charge of a 31-km coastline, is drawing up the Integrated Coastal Management Plan.

Abruzzo Region

<u>*Abruzzo Region.*</u> Abruzzo was among the first Italian regions to acknowledge the importance of an integrated and sustainable management of the coastal strip, highlighting the possibility of promoting and supporting the development and management of an integrated process. In 1997, Abruzzo obtained from the EU the joint funding of RICAMA project (*Rational for Integrated Coastal Area Management*), within the framework of the LIFE programme. The RICAMA project is intended to respond to the needs of defining and employing new methodological and organizational tools to face the widespread coastal erosion, worsened by inadequate facilities and by a chaotic urban development. SICORA (Informative Support for Abruzzo Region Coastal area management) project was subsequently prepared and aimed at setting up a Decision Support System (DSS), operating constantly, which will enable the launching and development of the governance process of the coastal area, so that Public Authorities may supply effective and convincing answers in a short time.
Initially, the monitoring of vulnerable areas was carried out, followed by a feasibility study of protection interventions and management of the coastline strip on a regional scale. An organized plan was then prepared to evaluate the risk of vulnerable areas. Geomorphological and socio-economic risk levels have priority on interventions, even through coordination with neighbouring regions.

Marche Region

<u>*Marche Region.*</u> The Integrated Management Plan for Coastal areas, approved on 2/02/05, defines the following goals, actions and interventions:
a) renourishment and protection of the coastline from marine erosion;
b) optimization of marine works for the protection of the railway line, even through the reutilization of relict breakwaters;
c) harmonization of public use with tourism activities and recreational development of the coastal area;

d) protection and enhancement of coastal strips (both above and below sea-level) having a landscape, naturalistic and environmental value;
e) monitoring of coastline dynamics, waters and botanical ecosystem;
f) coordination with neighbouring regions.

The following elements were also identified: priorities of interventions on the basis of economical and environmental macro-indicators, reorganization of marine works and impact of ports and piers.

Emilia Romagna Region

Emilia Romagna Region. This region has been facing the problem of coastal protection for many years, analysing the causes that have determined a retreating of the coastline and marine transgression, issuing new laws to contrast these phenomena and applying innovative systems on environmental protection. The main research and analysis tools are:
1) Regional Plan for coastal protection, drawn up in 1981 and approved by the region in 1983;
2) Project Plan for sea protection and coastal environmental upgrading, drawn up in 1996;
3) Document entitled "*Stato del Litorale romagnolo all'anno 2000*" (Emilia Romagna coastline conditions in 2000) edited by ARPA Emilia Romagna.

In addition, Guidelines for an Integrated Coastal Zone Management (ICZM) have been drawn up. This project provides for the establishment of:
• coastal data bank;
• coastline evolution and morphodynamic c cartography;
• DTM of the coastline through LIDAR;
• infrastructures catalogue;
• sand grain size distribution;
• integrated digital terrain model;
• relation between subsidence and marine transgression;
• historical analysis of main sea storms;
• danger and risk documents.

Veneto Region

Veneto Region. Regional law 34/86 allocated to the coast consistent funds for intervention and research. In particular, the coastal

evolutionary processes were studied in three macro-areas (Piave - Tagliamento, Lagoon – the Po Delta and Brenta - Adige). In the lagoon area, research was also carried out by the Venice Water Authority. The Waters Protection Plan regulates extraction activities in areas subject to subsidence, where embankments have been constructed for coastal protection. As regards subsidence and eustasy, there are existing projects by CNR/ISMAR aimed at the Northern Adriatic sea. With reference to subsidence problems related to underground gas extraction, specific research has been conducted by AGIP.

Friuli Venezia Giulia Region

Friuli Venezia Giulia Region. As per Regional Law no. 16 of 3/07/2002, the region carries out coastal protection tasks through the regional services specialized in hydraulics and navigation. These are supported by ARPA Friuli Venezia Giulia. There are no plans or specific programmes.

Sardinia Region

Sardinia Region. The coastal erosion problem was included in the regional programme for the fight against desertification. Sardinia has actively taken part in carrying out the EUROSION project with the Coastal Erosion Information System of Cagliari University and a good level of research and risk evaluations.

Sicily Region

Sicily Region. In the 70's and 80's, following the substantial urbanization of the coastal strip, more widespread erosion took place along the entire coastline.
The only opposing action to this phenomenon was the construction of barriers above sea level and groins, which have protected the area lying immediately behind and shifted downstream the erosion phenomenon.
A new approach to coastal protection planning was started in 2000, both with the enforcement of the Environmental Impact Evaluation regulations and with the "Coastal area integrated protection" measure within the framework of the 2000-2006 Sicily POR, containing priorities in areas to be protected and the type of projects to adopt.
Sicily Region is preparing a Hydrogeological Settlement Plan (PAI) aimed at coastal protection and based on only twenty-one small territorial domains (physiographic units).

European Initiatives

Strategic projects for adapting coastal areas to climate change have been drawn up in Great Britain, France, Spain, Belgium and Holland.

In some of these countries, national projects and programmes on coastal conditions have been launched since 1980. The aim is to first of all provide basic knowledge and make it available to the whole country, secondly to develop instruments and methods to forecast scenarios and, lastly, to decide and apply adaptation options in a homogenous manner. Even if coastal planning tools are decentralized, like in Italy, there are common criteria, methods and guidelines that originate from national levels and are agreed among the players involved and the local authorities.

Significant experiences were analysed in order to observe how different countries follow different approaches to face climate change impact risks.

Belgium

Belgium. The Belgian part of the Northern Sea has been the subject of extended interdisciplinary research funded by the Ministry concerned and carried out by the Planning Federal Office, in charge of implementing a global national plan for the sustainable development of the coastal environment. The concept of sustainability has been introduced in Belgian legislation since 1999 (Sea protection law). Funded projects concern the climatic change impact and the most adequate responses in terms of adaptation. Primary impacts are the sea level rise, increase in number of storms, likely increase in rainfall, erosion, temperature changes, salinity, etc.

Spain

Spain. Spain has recently given the go-ahead to a national adaptation plan under the responsibility of the Oficina Española de Cambio Climático. This institute, operating under the Ministry of Environment, coordinates the participation of the different levels of local government and social parties. The Institute suggests operating programmes to the Climate Change Coordination Committee, which establishes action with the aim of implementing adaptation policies in Spain. The national plan faces many issues like industry, tourism, transport, ecosystems and fishing, deser-

tification, health, coastal areas, agriculture etc., and is aimed at the creation of national cartography to establish risks and impacts related to various scenarios. The projects provide for the involvement of experts, national institutions and private parties. Moreover, in 2003, Spain gave the go-ahead to the ECCE project (Climate change effect in Spain) with the purpose of integrating and updating current research on climate change in the country and deepening knowledge on the country's conditions.

Holland

Holland. The adaptation plan promoted by the Dutch government is part of a national programme for the scientific evaluation and analysis of the climate change policy. This programme has the purpose of collecting and analysing the current scientific knowledge of the sector, required to develop policies and implement action in this field. Adjustment priorities determined for the Dutch coastline, starting from 2005, indicate that the choice of implementing structural protection interventions is very costly, therefore specific action oriented towards the improvement of resilience of coastal contexts has been examined. The dunes and wet areas are considered fundamental elements to fight coastal floods and salt intrusion. Lastly, great attention is directed to the monitoring of climate change impacts and the natural environment response.

England

England. Since the mid 80's, the United Kingdom started national programmes on evaluation and mitigation of coastal vulnerability. During the same time, programmes at different government levels were set in motion to support the development of strategies and policies on climate change. Many institutions are involved in supporting or carrying out climate change adjustment policies. Among there are: *Office of Climate Change* (OCC) and DEFRA (*Department for the Environment, Food and Rural Affairs*). DEFRA, which holds the global political responsibility for flood and coastal erosion risks in England, ensures that the risk is efficiently managed by the competent authorities. It also issues guidelines aimed at this purpose.
The basic principle is that damages caused by floods and coastal erosion can be reduced and managing the risk is possible by

means of careful planning of land use, suitable building projects, increased information and greater involvement of individuals and specialized organizations.

France

France. In France there are specific laws on the coastline. In 2001 ONERC (National Observatory on global warming due to climate change) was established to provide new adjustment and mitigation measures with the aim of preparing territorial climate plans, which also provide for long term impact evaluations. Since 2004, numerous scientific programmes have been started to acquire the necessary knowledge for such plans. However, over the last few years, a new awareness is growing among local communities, which tend to leave the coastline free from urbanization and limit the excessive impact.

CHAPTER 10

WASTE CYCLE

Generation

In 2006 total waste generation increased by about 91% with respect to 1997.

In 2006 total waste generation reached approximately 167 million tons, suffering an increase of about 91% with respect to 1997 (Figure 10.1).
After many years of high growth, stabilization in waste generation was noted between 2006 and 2007 actually reaching 32.5 million tons (only 40,000 tons more than the previous year, marking an increase of approximately 0.1%).

Between 1997 and 2006 total waste generation increased from approximately 87.5 million tons in 1997 to 167 million tons in 2006.

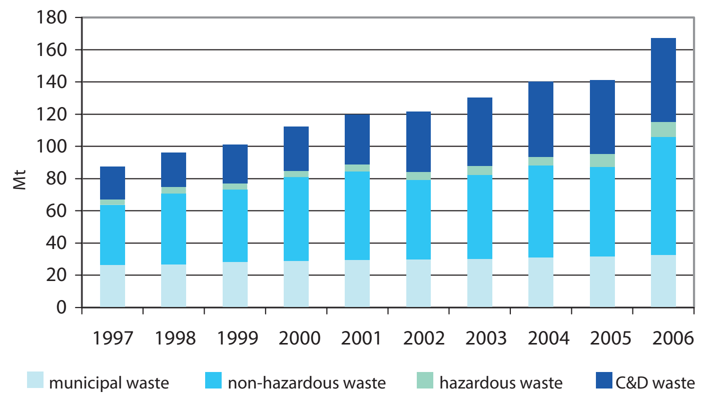


Figure 10.1: Distribution of total waste generation[1]

In 2007, for the first time in several years, municipal waste generation had a lower growth with respect to GDP and household consumption growth (+0.1% against +1.5% and +1.3%).

Waste generation is known to be strictly correlated to socio-economic indicators, like GDP and household consumption. However, between 2004 and 2006, the increase in municipal waste generation was practically double with respect to the increase of socio-economic indicators (+4.3% against +2.4% for GDP and +2% for household consumption). In 2007, instead, for the first time in several years of study, a lower growth was registered with respect to GDP growth and household consumption (+0.1% against +1.5% and +1.3% respectively).
Such positive progress may be explained taking into account that hazardous and non-hazardous waste deriving from commercial,

[1] Source: ISPRA

craft and production firms located inside the city was collected as municipal waste, in a more or less prominent way depending on the various territorial contexts.

The latest regulations, introduced by Legislative Decree no. 152/2006, amended in January 2008 by Legislative Decree no. 4/2008, have limited the possibility of collecting municipal waste with hazardous and non-hazardous waste. This aspect may have affected, not in a minor way, the stabilization of the result related to absolute generation of municipal waste. A further slowdown factor of municipal waste generation is the introduction of specific prevention measures in some territorial contexts.

Over the last few years, several public administrations (especially the most efficient ones in terms of organization of waste integrated management systems) have in fact promoted incentives for the prevention and minimization of waste generation. Initial positive effects of this new management policy have therefore been noted.

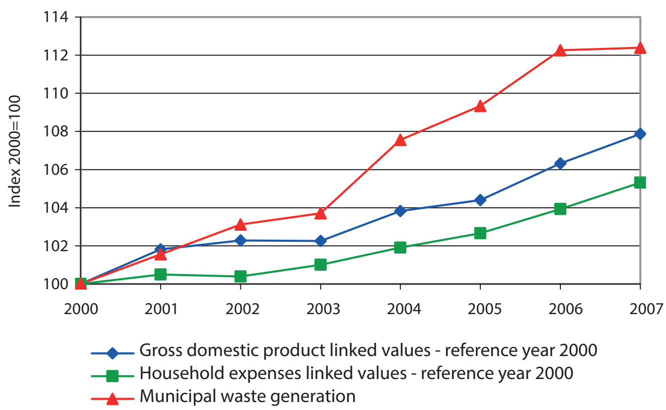


Figure 10.2: Progress of municipal waste generation and main socio-economic indicators[2]

In 2007, the growth of municipal waste generation was lower than the GDP and household consumption increase (+0.1% against +1.5% and +1.3% respectively) while a definitely higher growth was registered in the previous three-year period.

In order to separate production from resident population levels, *per capita* generation needs to be assessed. In 2007 this showed a contraction with respect to 2006. As a matter of fact, in 2007

The analysis of per capita waste generation is aimed at separating generation from population levels. In 2007 per capita waste

[2] Source: ISPRA

generation reached 546kg/inhab.

national *per capita* generation of municipal waste reached 546 kg/inhabitant per year against a value of 550 kg/inhabitant per year, registered in 2006.

In this regard, it is worth noting that the reduction of *per capita* generation was substantially affected by the official number of the resident population, which increased by 488,033 people (+0.8%) between 31 December 2006 and 31 December 2007. Therefore, the population increased more with respect to the waste generation value.

In 2007 the highest generation values were recorded in the Central area, (with approx. 630 kg/inhab.) and the lowest values in the South (508 kg/inhab.). The North produces about 539 kg/inhab.

In 2007, like previous annual surveys, the highest values of municipal waste generation in the three geographical macro-areas were noticed in the Central area, with approximately 630 kg /inhabitant per year. The lowest ones were registered in the South, with approximately 508 kg/inhab. per year. In particular, *per capita* municipal waste generation with respect to the previous year dropped by 1.1% in the Centre (-8 kg/inhab. per year) and by about 0.2% in the South (-1 kg/inhab. per year).

As for the North, it produces approximately 539 kg/inhab. per year, -0.9% with respect to 2006 (-5 kg/inhab. per year).

The analysis of regional *per capita* generation values in 2007, like in previous years, highlights that higher production values were found in Tuscany (with over 694 kg/ inhab. per year), Emilia Romagna (673 kg/ inhab. per year), Umbria (639 kg/inhab. per year), Liguria, (610 kg/ inhab. per year), Lazio (604 kg/ inhab. per year) and Aosta Valley (601 kg/inhab. per year).

It is worth noting that the *per capita* generation value is calculated according to the number of resident citizens in each single geographical area. Therefore, it does not take into account the so-called fluctuating population (linked for example to the flow of tourism), which could even substantially influence the level of absolute generation of municipal waste and therefore make the *per capita* production value rise. Moreover, this value may also be affected by the phenomenon of assimilation whereby the total amount of municipal waste also includes waste resulting from the production cycle and therefore not directly connected to the resident population consumptions.

In the long-term, generation of hazardous and non-hazardous waste also continues to grow increasing from 83 million tons in 2000 to

approximately 135 million in 2006. In 2006, the total quantity of hazardous and non-hazardous waste generated in Italy was equivalent to 134.7 million tons.

Of these, 125.5 million tons was non-hazardous waste (including Construction & Demolition) and 9.2 million tons was hazardous waste. Waste from C&D amounted to over 52 million tons.

Analysing results points out that in the two-year period 2005-2006 non-hazardous waste increased by 23.6% and hazardous waste increased by 16%. However, due to amendments in regulations (lifting of obligation to provide the Italian MUD environmental declaration for all producers of this type of waste) non-hazardous waste values in 2006 were estimated on the basis of specific production coefficients of the various industrial sectors. This resulted from a specific research conducted by ISPRA. Values referring to the various years of reference are therefore not fully comparable.

Information on hazardous waste generation, instead, entirely derives from the MUD data bank.

In 2006, hazardous and non-hazardous waste generation *per capita* was equivalent to 1,397 kg/inhab. per year (excluding waste from construction and demolition). Of these, 1,241 kg were non-hazardous waste and 156 kg were hazardous.

The greatest share of total generation of hazardous and non-hazardous waste comes from the construction industry with around 40% of total generation. Followed by the manufacturing industry with over 37% of total generation.

A separate analysis of the flow of non-hazardous and hazardous waste shows that the larger quantity of the former comes from the manufacturing industry (43.6 million tons, equivalent to 59.4% of total, excluding non-hazardous waste from construction and demolition).

The waste treatment industry follows with 16 million tons, 21.8% of total non-hazardous waste. The service industry, instead, produces 7.6 million tons, equivalent to 10% of total non-hazardous waste.

Similarly to non-hazardous waste, the greatest share of hazardous waste comes from the manufacturing industry (6.5 million tons, equivalent to 70.1% of total), followed by production from the

In the long-run, special waste production continues to grow, increasing from 83 million tons in 2000 to approximately 135 million in 2006. Of these, 125.5 million tons was non-hazardous waste (including C&D) and 9.2 tons was hazardous waste.

40% of total hazardous and non-hazardous waste generation comes from the building industry followed by the manufacturing industry with over 37% of total generation.

service industry, with approximately 1.4 million tons, equivalent to 15.1% of total.
In the manufacturing industry, the greatest share belongs to the chemical sector, with 3.1 million tons (approximately 48.3% of total), followed by the metal, alloys and metal product industries, with about 1 million tons (24.7%).

Management (Response)

The new Framework Directive 2008/98/EC on waste of the European Parliament and of the Council, dated 19 November 2008 declares, under Art. 4, that waste management must be carried out in accordance with the following priorities:

- quantity and quality prevention of waste;
- preparation for re-use of products which have become waste;
- recycling;
- other types of recovery (e.g. energy recovery);
- disposal.

Separate collection provides a positive response to the pressure exercised by waste on the environment. In 2007 it reached a nationwide percentage of 27.5% of total municipal waste generation. Although this value highlights a further growth with respect to the value registered in 2006 (25.8%), it still turns out to be lower than the 40% target to be achieved by 31 December, 2007.

Separate collection provides a positive response to the pressure exercised by waste on the environment. In 2007, it reached a nationwide percentage equivalent to 27.5% of total municipal waste generation. Although this value highlights a further growth with respect to the value registered in 2006 (25.8%), it still turns out to be lower than both the 35% *target* provided by Art. 205 of Legislative Decree 152/2006 of 31 December 2006, and the 40% *target* of 31 December 2007 introduced by Law no. 296 of 27 December , 2006.
As pointed out many times in previous editions, the situation is undoubtedly different from one macro-area to the other. As a matter of fact, while the North widely exceeds the 2007 target with a 42.4% separate collection rate, practically achieved already in 2006 (39.9%), the Centre and South (with percentages of 20.8% and 11.6% respectively) are still definitely far from this target (Figure 10.3). In absolute terms, between 2006 and 2007 separate collection at national level increased by over 580,000 tons, a lower value with respect to the 700 thousand-ton-growth recorded between 2005 and 2006. In 2007 (like the previous year), the greatest contribution to the overall waste generation

growth was shown by Northern regions (approximately +380,000 tons, equivalent to +6.5%), where the collection systems had already been established since few years.

The situation is undoubtedly different from one macro-area to the other. As a matter of fact, while the North exceeds the 2007 target with a 42.4% separate collection rate, the Centre and South (with 20.8% and 11.6% respectively), are still far from this target.

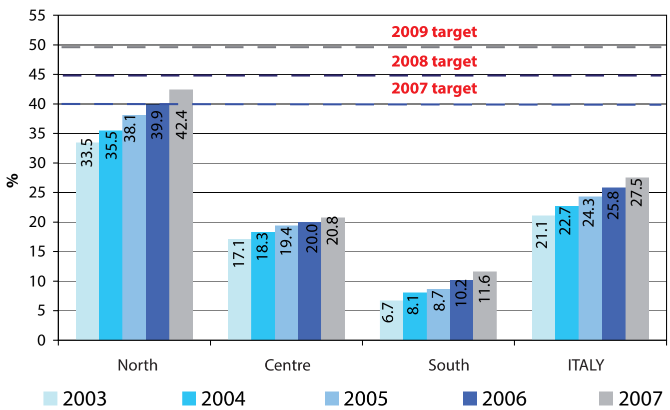


Figure 10.3: Percentage of separate collection of municipal waste[3]

Among the various waste fractions, cellulose and organic ones represent, as a whole, more than 62.5% of total waste collected separately. If added to textile and wood waste, they make up the so-called biodegradable waste, for which Legislative Decree 36/2003 introduced specific landfill disposal reduction targets.

In 2007, the quantity of biodegradable waste collected with the separate collection was equivalent to over 6.3 million tons, with a percentage growth of approximately 7.5% compared to 2006. In terms of *per capita* values, the quantity of this type of waste produced is approximately 106 kg/inhab. per year, marking a growth of over 6.5 kg/ inhab. per year with respect to 2006, and of 31.5 kg/inhab. per year compared to 2003. As far as glass is concerned, in 2007 the total value of separate collection reached nearly 1.3 million tons, of which just below 93%

[3] Source: ISPRA

Between 2006 and 2007, the highest percentage growth in separate collection was recorded for wood (+10.6%).

In 2007, Trentino Alto Adige and Veneto registered separate collection percentages of 53.4% and 51.4% respectively, reaching the target fixed for 31 December 2009 two years in advance.

was used for packaging.

Between 2006 and 2007, the highest percentage growth in separate collection was recorded for wood, with an increase of +10.6%, corresponding to an absolute value increase of just below 62,000 tons.

The separate collection of plastic marked an increase of about 9.4% (approximately +43,000 tons), which (according to data received) was almost entirely made up of packaging waste.

In 2007, Trentino Alto Adige and Veneto regions reported separate collection percentages of over 50% (specifically 53.4% and 51.4% respectively), reaching the target fixed for 31 December, 2009 two years in advance.

This means that over half of municipal waste generated in these two regions was collected separately. This operation has a primary importance in the subsequent recovery of the various types of waste.

Remarkable progress was registered also in Piedmont (44.8%) and in Lombardy (44.5%).

In the Centre, Tuscany exceeds the threshold of 30%, with a separate collection rate of approximately 31.3%. Umbria and Marche respectively reported separate collection percentages of 25% and 21%.

Lazio's separate collection level is of approximately 12.1%. However, only Rome and Latina provinces exceed 10%, with lower separate collection rates in the other three provinces of the region (Viterbo 9.3%, Rieti 4.5%, Frosinone 4.1%).

In the Southern macro-area, Sardinia recorded a separate collection rate of 27.8%.

Following the activation of specific separate collection systems in several provinces, even at household level, between 2005 and 2007 this region marked an increase of about 18% in the collection percentage rate (in 2005 the separate collection percentage was in fact less than 10%).

In 2007, Abruzzo's separate collection rate almost reached 19% and Campania 13.5%.

However, in Campania very different situations are found according to the province. Avellino and Salerno, in fact, have separate collection percentages of over 25% (25.3% and 25.2% respectively),

Benevento reaches 15.9% while Naples and Caserta (which have problems related to persisting emergency conditions for collection and management of municipal waste) have percentages of 10.3% and 7.1% respectively.
Instead, several regions of the South (Molise, Basilicata, Apulia, Calabria and Sicily) show values lower than 10%. In 2007, Molise had a separate collection percentage of 4.8% and Sicily of 6.1%.
An analysis of municipal waste management data of 2007 shows a reduction of 2.4% in the use of landfills compared to 2006. In quantitative terms, this corresponds to a reduction of over 614,000 tons, which can mainly be attributed to the North of Italy.
A total of 16.9 million tons of waste are directed to landfills. More limited variations are found in the Centre (-1.9%), with a reduction of approximately 95,000 tons of waste. The South, however, still shows a disposal increase of over 180,000 tons of waste. This corresponds to an increase of 2.5% in waste disposed through landfills.
In 2006 the number of operating landfills was reduced by 34 units. Of these, 23 are in the South (-15 in Sicily and -5 in Calabria).
On the other hand, the landfill situation appears to be substantially stable in the Centre (-6 plants) and in the North of Italy (-5 plants).
Lombardy holds the respectable leadership for being the region with the lowest percentage of municipal waste in landfills (10% of total), recording a consistent contraction with respect to 2006 (-11%).
Excellent results, in terms of disposal reduction, have also been achieved in Friuli Venezia Giulia (which disposes 28% of waste in landfills), Veneto (29%) and Trentino Alto Adige (28%) where the rate of separate collection has reached noteworthy levels.
In the South, improvements have been observed in Calabria and Sardinia, which dispose in landfills less than 60% of total waste generated in the regions (respectively 55% and 58%). Molise, Sicily and Apulia are the regions with the highest percentage of waste disposed in landfills with respect to the total amount

In 2007, the use of landfills for municipal waste was reduced by 2.4% compared to 2006. This result is mainly visible in the North of Italy.

Lombardy holds the respectable leadership for being the region with the lowest percentage of municipal waste in landfills (10% of total), recording a consistent contraction with respect to 2006 (-11%).

generated (respectively 95%, 93% and 91%).
Not too far from these values is Lazio, with approximately 2.8 million tons disposed and a percentage of 83% over total generated. In 2006, the city of Rome alone disposed 1.4 million tons in landfills, against the 2 million of the entire province. Waste is, in any case, always submitted to preliminary treatment.
As far as other management methods are concerned, incineration involves 3.9 million tons of waste.
This represents 10.3% of the waste managed in 2007, a similar result to 2006. However a reduction of these operating plants can be noticed (from 50 to 47), due to the shutdown of three incinerators located in Verona, Siena and Taranto provinces.
The ratio between the incinerated quantity and the related generation of municipal waste (12.2% in 2007) is still stable with respect to 2006 (12.1%).
The 44 operating plants equipped for energy recovery have recovered approximately 3 million MWh of electric energy and 1.1 million MWh of thermal energy.
In general, an efficient integrated management system complying with Community policies must make ample use of biological treatment.
This enables the recovery of materials from waste and is also fundamental for reaching targets on the biodegradable waste landfilling within the optimal management areas, as provided by Art. 5 of Legislative Decree no. 36/2003.
In this context, composting from selected biodegradable waste after separate collection is also essential.
This recorded a 4.8% increase with respect to the previous year.
Quantities directed to anaerobic digestion plants also increased by 34.2%, going from 172,000 tons in 2006 to 231,000 tons in 2007. This is also due to the opening of new plants.
As regards mechanical biological treatment of mixed waste, quantities treated in 2007 reached 8.8 million tons, with an increase of 7.6% with respect to the previous year.
In 2007, the overall capacity (equivalent to over 14 million tons), showed an increase on a national basis of approximately 2.4 % with respect to 2006.
This development was particularly noticed in the Central regions

and in the South, where increases of 5% and 7.5% were recorded. In the Northern regions, instead, the total capacity reduced by 3.6% (Figure 10.4).

An analysis of data related to 2007 highlights a reduction in landfill disposal (-2.4%) and an increase in mechanical biological treatment (+7.6%) and composting from selected waste (+48%).

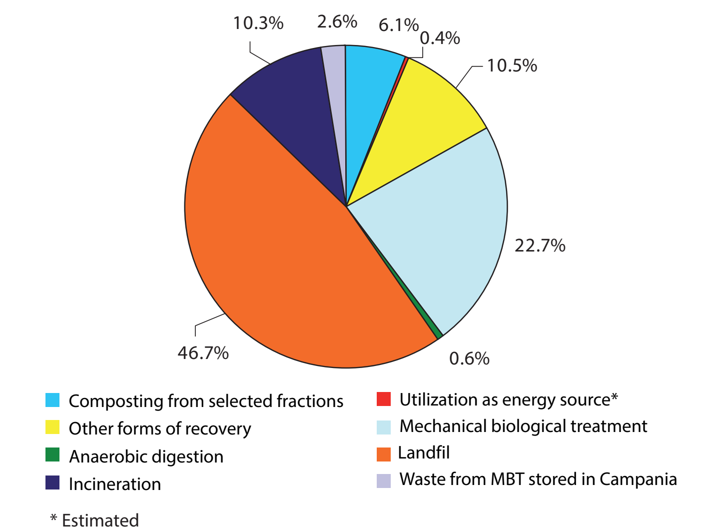


Figure 10.4: Municipal waste management (%) 2007[4]

Over 117 million tons of hazardous and non-hazardous waste was globally managed in 2006, against a generation of over 134.7 million tons, 91.6% of which consisting of non-hazardous waste and the remaining 8.4% of hazardous waste.
When analysing the values (Figure 10.5), it is worth noting that the predominant management method for hazardous and non-hazardous waste is represented by material recovery operations, with approximately 57.7 million tons (49.3%). On the other hand, the use of landfills remains the most common disposal operation, with approximately 19 million tons (16.3% of total managed waste). The quantity of waste destined to storage amounts to a total of 13.4 million

The analysis of values, excluding the quantity destined to stockpiling, points out that recovery of material (49.3%) is the most common management method.
Landfills still are the most widely used disposal method, representing 16.3% of total waste managed.

[4] Source: ISPRA

tons (which are respectively 2% and 9.4% of total waste managed). This type of waste treatment is carried out by plants performing other recovery and/or disposal operations. Therefore, in these cases, there is an overestimate in the total quantity of waste managed.
In general, it should be pointed out that in 2006 the amount of waste directed towards recovery operations increased by 3.3% with respect to 2005, corresponding to approximately 2.3 million tons.
Such a growth can be attributed to the increase of waste destined to "recycling/recovery" operations of other inorganic materials (+4.5%), for an absolute value of 1.5 million tons.
Among other disposal operations, it is worth noting that between 2005 and 2006 chemical-physical and biological treatments recorded a considerable increase (+25%), corresponding to over 4 million tons of waste treated by chemical industries.

The total quantity of hazardous and non-hazardous waste managed in 2006 amounts to approximately 117 million tons. Of these, more than 60 are destined to recovery, over 43 to disposal activities and almost 13.4 to storage (R 13 and D15).

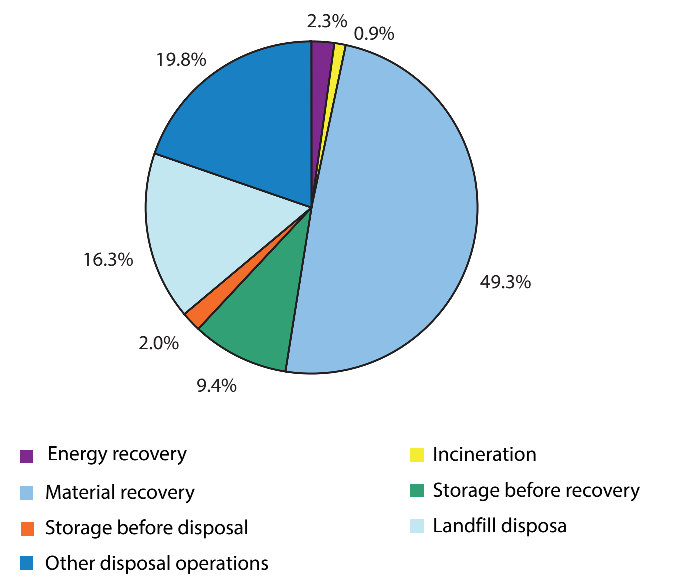


Figure 10.5: Hazardous and non-hazardous waste management including storage (2006) [5]

[5] Source: ISPRA

CHAPTER 11

INSTRUMENTS FOR ENVIRONMENTAL KNOWLEDGE AND AWARENESS AND INTERFACE WITH THE MARKET

Dissemination of environmental information
Environmental Education and Training Programmes
Instruments for improving environmental services

Introduction

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

This chapter is meant to present an overview – concise and definitely not exhaustive – of the different cognitive 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, with a view to raising the general level of knowledge regarding environmental issues, making it easier to adopt life styles that prove eco-compatible.

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

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

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.

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. A process of growth has therefore proven necessary in terms of heightened awareness and responsibility regarding the anthropic component influencing large-scale changes.

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

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, 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]

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

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 citizenship capable of understanding the complexity of relations between nature and human activities. 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.

In September 2005, UNESCO approved the International Imple-

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[1] 1977 – The Tbilisi Declaration of UNESCO.

mentation Scheme for the UN Decade of Education for Sustainable Development (2005-2014), indicating the priority implementation strategies on the basis of the four major thrusts of education for sustainable development:

- improving access to quality basic education;
- reorienting existing education programmes;
- developing public understanding and awareness;
- providing training.

At present, the primary objective of environmental education is the process of maturation through which all citizens gain a new awareness that translates into a capacity to modify forms of environmental behaviour.

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. "*For this reason, a strong alliance is needed between all the subjects responsible for education, in its broadest meaning as a lifelong learning process involving schools, universities, institutions, vocational training centres, businesses, associations, as well as the media, art and culture, leisure and recreational activities. A systemic synergy must be developed between all the stakeholders that - directly or indirectly –determine the skills, values and models of cultural behaviour of both individuals and communities*"[2].

The tools selected for presentation in this chapter include reporting activities and their products, telematic equipment for accessing environmental data/information, library services and environmental training in the strict sense of the term, plus initiatives which, through the enactment of the European EMAS and Ecolabel regulations, aim to reconcile environmental improvement with the demands of the competitive market.

The key tasks of environmental authorities include reporting activities.

The key tasks of environmental authorities include reporting activities, meaning the systematic collection and publication of data

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[2] UNESCO Italian National Commission – Rome, Palazzo Firenze, November 2007.

on the environment, accomplished primarily through a system of information and monitoring . In Italy the Ministry of the Environment, Land and Sea, the regional governments, the ISPRA and local environmental protection agencies are responsible for such activities. The web, a powerful global instrument for the dissemination of information, has proven to be an essential tool in providing increasingly widespread environmental information. Its flexible, dynamic nature is particularly well suited to the transmission to a vast and varied public of documents that sometimes prove voluminous, in terms of contents or complexity of images, as in the case of environmental reports.

Services offered by the network of libraries and documentation centres specialised in environmental topics supply a valid alternative to the more technological instruments, when it comes to distributing environmental information through traditional channels, providing, among other services, access to past data that would otherwise be impossible to consult. The ISPRA library, as well as many other libraries of the Network co-ordinated by the Institute, handle this important sector of the environmental information distribution. As regards educational activities and environmental training in the strict sense of the term, significant efforts have been made by the Agencies System, which has grown constantly in recent years. Last but not least, sustainable production and consumption are further expressions of an environmental culture with widespread roots in civil society. The EMAS and Ecolabel regulations of the European Community are voluntary instruments that make possible the reconciliation of environmental improvement with the demands of the competitive market.

The Network of libraries and documentation centres specialised in environmental topics, co-ordinated by the ISPRA, provides access to past environmental data otherwise unavailable for consultation.

The topics briefly addressed herein are meant to provide a rough but meaningful indication of the different types of instruments available, as well as the different segments of society that can be involved.

Dissemination of environmental information

The progressive recognisance of the citizen's right to receive information, to participate in decision-making and to obtain justice on environmental questions, a right based on the principles of the Aarhus Convention, is sanctioned by several European Community measures (Directive 2003/4/EC "on public access to envi-

Systematic data collection and processing activities related to the various environmental issues have led to an ever-increasing

comprehension of environmental questions, encouraging citizens to develop informed modes of behaviour, in order to contribute to increasing the general public's environmental culture.

ronmental information", Directive 2003/35/EC "on public participation in the formulation of plans and programmes regarding the environment", Regulation (EC) No. 1367/2006 "application of the provisions of the Aarhus Convention on Access to Information, Public Participation in Decision-Making and the Possibility of taking Legal Action on Environmental Questions") and by national legislation (Legislative Decree No. 195 of 19 August 2005). A key activity, when it comes to facilitating the exercise of this right, is the dissemination of environmental information.

The growing attention being paid by the citizens to environmental matters has helped to create a significant demand for information, further stimulated by the media on the occasion of environmental emergencies. Also demanding information are policy-makers, in order to reach decisions on environmental issues.

The Agency System's development of reporting activities and use of traditional communication tools (publications, conferences, etc.), together with the promotion of initiatives supported by the mass media (press, radio, television) have made it possible to meet this demand for knowledge in an increasingly appropriate, effective manner.

Over the years, the local Agencies have consolidated relations with their surrounding territories through activities involving the control and monitoring, study and analysis, of environmental issues tied to specific local situations, for the purpose of drawing on knowledge of the latter in implementing environmental prevention and protection policies.

In conclusion, systematic data collection and processing on the environment issues – with the significant contribution, in the last decade, of the Agency System - have led to an ever-increasing comprehension of environmental issues, encouraging citizens to develop environmentally aware forms of conduct, so as to promote the spread of environmental culture among the general public.

Environmental information through reports and the mass media

The designation by legislators of a specific technical-scientific structure, the ISPRA, to manage environmental information is definitely one of the factors that has enabled Italy not only to reach the level of many European countries, but also to accelerate the formulation of environmental policies long held back by a noteworthy knowledge gap that hampered effective planning and control of interventions, diminishing the results of participation in extra-national conferences and activities.

Italian legislators have designated the ISPRA to manage environmental information.

Information management is a key precondition to suitable performance of the crucial function of environmental reporting, in the broadest sense of the term.

In the case of our country, reporting activities can be classified into three main groups:

- those aimed at meeting specific obligations to communicate data, in order to fulfil Italy's commitments under extra-national agreements and European Community directives (reporting duties), as is the case of the Kyoto Protocol or the European Air Quality Directives;
- those meant to promote the dissemination of data on the state of the environment, through reports on multiple sectors and individual topics, such as the Annual Report on Environmental Data, the Report on Urban Environment Quality, the Waste Report, Climate in Italy;
- those aimed at promoting the all-encompassing, harmonised production of environmental information, as well as its subsequent dissemination.

As regards "reporting obligations", it should be remarked that, starting from the 90's, the number of treaties and conventions on a global level has grown constantly, due to increasing awareness of the fact that concrete objectives in terms of environment protection – an issue that, by its very nature, extends beyond boundaries - can only be achieved through a joint effort of the global community.

As a result, efforts have multiplied to monitor compliance by individual states with the commitments they undertook by signing agreements, and therefore with obligations to commu-

nicate the data required for compliance control. In Italy, ISPRA is one of the main subjects responsible for data collection and reporting activities.

Proper information provides the foundation for effective environmental policies.

The dissemination of environmental information is one of the ISPRA's main functions. Proper environmental information is of key importance in undertaking and optimising effective policies and initiatives.

The aim is both to provide the competent authorities with the objective information needed to formulate and implement wise and fruitful environmental policies and to help heighten the level of knowledge and awareness among the citizens, with a view towards promoting increasingly responsible participation in environmental prevention and rehabilitation programmes.

Given that so many bodies, at different levels of jurisdiction, are required to present environmental data and information, procedures of dissemination should be standardised and harmonised. The ISPRA prepares manuals and guidelines for environmental reporting.

Finally, due consideration must be given to the standardisation and harmonisation of procedures for the dissemination of environmental information, a subject on which the ISPRA prepares manuals and guidelines. The large number of bodies required, at various levels of jurisdiction, to present environmental data and information can lead to confusion in interpretation, or even to disinformation, when the environmental conditions of different geographic and socio-economic contexts are compare without adhering to any common rule for the dissemination of such information.

For a number of years now, the ISPRA, through publication of its Environmental Data Yearbook, has made known the results of the monitoring 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.).

In 2007 (Figure 11.1), the most widely used reporting product of the Environmental Agency System was the "thematic report", roughly a hundred of which have been published in total. These reports focus on a particularly critical environmental issue and/or are meant to convey the results of a study or project.

The individual local Agencies tend to give preference to the "thematic report" in their policies for the dissemination of environmental data/information.

It is also a valid instrument for presenting activities performed

by the Agencies within their territories to increment knowledge. In the case of the combined "yearbook/report" type of product, roughly ten are published in any given year, while the number of "manuals/guidelines" and "proceedings of conference" published each year has consistently been in the dozens.

Table 11.1: Enrivonmental information through reports and publications 2007[3]

Agency System		Environmental Data Yearsbooks	State of the Environment Reports	Manuals and guidelines	Thematic Reports	Conference proceedings
				n.		
ARPA/APPA	Piedmont	1	1	0	15	6
	Aosta Valley	0	0	0	3	11
	Lombardy	2	1	-	-	2
	Bolzano	*1*	*1*	*2*	*4*	*3*
	Trento	*1*	*0*	*4*	*0*	*2*
	Veneto	1	3	6	5	0
	Friuli Venezia Giulia	1	0	0	5	0
	Liguria	0	1	1	0	2
	Emilia Romagna	1	0	0	0	2
	Tuscany	0	1	2	2	0
	Umbria	1	0	1	1	1
	Marche	1	1	5	22	4
	Lazio	0	1	0	2	0
	Abruzzo	0	0	0	0	0
	Molise	0	0	0	0	0
	Campania	0	0	0	2	0
	Apulia	0	1	1	0	0
	Basilicata	1	0	0	1	1
	Calabria	0	1	0	0	1
	Sicily	1	0	2	1	3[a]
	Sardinia	0	0	0	0	2
ISPRA, former APAT		1	0	0	24[a]	3
ISPRA, former INFS		0	0	5	1	0

[a] Including publications also available in electronic format and on CD

In 2007, the "thematic report" was once again the reporting product most widely used by the Environmental Agency System, with a total of nearly one hundred publications.

[3] Source: ARPA/APPA data processed by ISPRA

Mass media play a key role in defining how environmental issues are perceived by society.

Mass media play a key role in defining how environmental issues are perceived by society, influencing processes of understanding. The printed press and television are seen by the citizens as the main sources of environmental information.

Law 150/2000, "Regulations Governing the Information and Communication Activities of Government Bodies", has led to several initiatives aimed at enhancing communications in all public structures, resulting in major efforts to facilitate more direct relations between the Public Administration and citizens with regard to environmental issues as well.

Positive effects of the enactment of the law include, within government, a significant increase in the number of press offices and structures responsible for communications, as well as the presence of increasingly qualified personnel assigned to external relations.

Nevertheless, citizens have not yet reached the elevated level of environmental awareness that is indispensable, if they are to undertake initiatives favouring their right to receive information: a level that would enable them to play an active role.

In the "*White Paper on European Communication Policy*", of 2006[4] the EC highlighted the key role of the media in any European communication policy, while underlining that media coverage of European issues remains limited and fragmented.

According to the "*White Paper*", the main actions to be carried out for further development of information include, besides taking advantage of the potential of new technologies, improving communication on the national, regional and local levels, thus making available to European citizens a steady flow of shared information. In conclusion, as regards the spread of information on European issues, the media are key players in the formulation of a communications strategy aimed at promoting *active European citizenship* while developing a *European public sphere*[5].

In 2007, the presence of the local Agencies in the printed press and on TV and radio networks (Figure 11.2) generally confirmed the levels of the previous year, though it should be remembered that this presence is influenced to a significant extent by the envi-

[4] COM (2006) 35.
[5] COM (2006) 568.

ronmental events that occur during the year in question.
As for the ISPRA, it has further consolidated its position in the printed press and on radio and television. An upward trend has also been registered in the number of articles published in daily newspapers and periodicals (280, including articles in the periodical “IdeAmbiente”) and the number of appearances in the press (1,182, including press releases). The increase over 2006 can be traced to the “National Conference on Climate Change - 2007”, in which ISPRA was significantly involved.

In 2007, as in 2006, mentions an contributions of the local Agencies in the printed press and on radio and TV have numbered in the tens of thousands.

Table 11.2: Activities carried out through the mass media (press, radio and television networks) (2007)[6]

Agency System		Press release	Articles in newspapers and periodicals	Press Conferences	Presences in the press	Presences in radio stations	Presences in tv stations
		n.					
ARPA/APPA	Piedmont	22	7	6	1,660	143	92
	Aosta Valley	1	5	5	15	1	5
	Lombardy	45	20	2	1,400	50	110
	Bolzano	*85*	*128*	*25*	*400*	*700*	*200*
	Trento	*25*	*1*	*0*	*120*	-	-
	Veneto	50	50	10	1,200[a]	20	30
	Friuli Venezia Giulia	80	13	9	510	1,570	440
	Liguria	13	5	4	365	180	150
	Emilia Romagna	35	100	10	800	150	50
	Tuscany	21	5	7	1,600	-	-
	Umbria	30	15	4	861	15	80
	Marche	81	70	4	70	35	16
	Lazio	10	0	3	1,607	6	10
	Abruzzo	15	40	3	80	0	6
	Molise	25	25	5	140	25	25
	Campania	15	28	2	61[a]	32[b]	
	Apulia	20	23	3	426	40	93
	Basilicata	31	31	1	250	10	10
	Calabria	55	313	0	1,527	28	42
	Sicily	2	3	2	180	4	-
	Sardinia	0	0	0	-	1	1
ISPRA, former APAT		92	280[c]	37	1,182[d]	50	100

[a] - *Estimated data*
[b] - *Global estimated data for radio and TV stations*
[c] - *Including articles from "IdeAmbiente" (periodical published by ISPRA)*
[d] - *Including media releases*

[6] Source: ARPA/APPA data processed by ISPRA

Environmental information and communications on the web

The importance of Internet as an instrument for disseminating environmental information is constantly rising, due to its flexibility and dynamism. It also provides a way of overcoming the constraints faced when printing and distributing documents on paper. 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.

An analysis of the data shows that the supply of environmental information provided by the agencies over their websites has remained steady. As can be seen in Figure 11.1, there was growth in several services, such as periodical bulletins and databases. The latter have increased from 15 in 2003 to 21 in 2007, confirming the growing importance of databases as tools for providing environmental information both to the general public and the technical-scientific sectors.

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

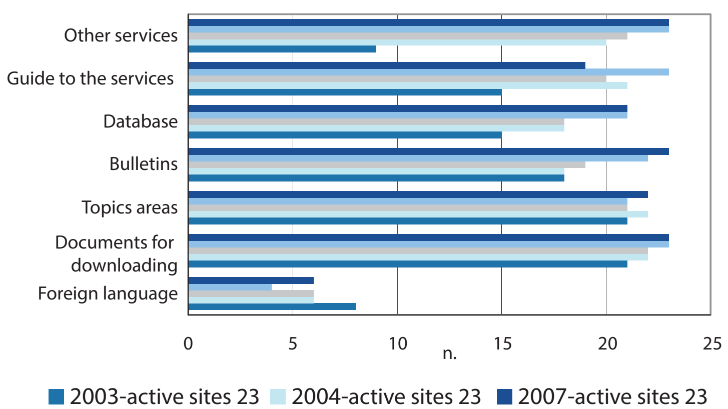


Figure 11.1: Statistics on environmental information on the web[7]

[7] Source: ISPRA

As regards interactive communication services available to users, an analysis performed within the Agency System shows that the levels reached last year have been maintained. Of particular note, as illustrated by Figure 11.2, was the attention paid to maintaining direct relations between users and pertinent offices through e-mail news releases or events relevant to environmental issues, as well as on-line registration forms for participation in events, seminars or conferences. 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.

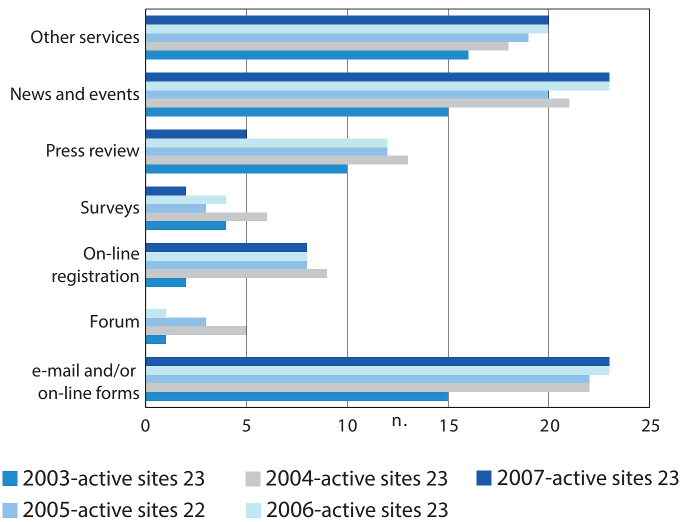


Figure 11.2: Statistics on environmental information on the web[8]

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.

[8] Source: ISPRA

Library Services and Resources for Users

As for the information services and resources available to users in libraries and/or documentation centres specialised on the Agency System environmental topics, data analysis continues to show uneven distribution of services and less than uniform levels of operating effectiveness within the national territory. The overall trend is unchanged, with certain local situations even having worsened. Many agencies were found to seem to have no library at all or do not provide any documentation service (in Piedmont, Aosta Valley, Bolzano, Trento, Umbria, Abruzzo, Basilicata, Calabria and Sicily). In other cases, the situation is essentially the same as in the previous year, although some increases in acquisitions have been registered. The former ICRAM, INFS and former APAT libraries are now part of the ISPRA network.

Environmental Education and Training Programmes

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

In Italy the supply of environmental education initiatives and training courses, both face-to-face and remote, is particularly extensive. It is provided by various subjects - both institutional and non-institutional - including the Agency System, in accordance with the principle of co-operation and integration that underlies the previously mentioned "Decade of Education for Sustainable Development" proclaimed by the UN for the period 2005-2014.

The Italian National UNESCO Commission is the national co-ordinating body responsible for facilitating and overseeing the implementation of the Decade, with the support of a National Committee whose members include numerous entities – both institutional and non-institutional – involved not only with the environment, but also with various aspects of sustainable development (the Ministry of the Environment, Land and Sea, the Ministry of University Affairs and Research, the ISPRA and the 21 ARPA/APPA, the regional scholastic offices and other agencies, networks and associations). Every year the UNESCO Commission organises a National Week of Education for Sustainable Devel-

The Italian UNESCO Commission has organised three editions of the annual "National Week for Education in Sustainable Development", devoted to Energy, Climate Changes and Waste.

opment, granting the “DESS” logo (for “Decade of Education for Sustainable Development”) to all those initiatives that contribute to achieving the objectives of the Decade.
Since 2006, the year in which the National Committee began its activities, following the signing of the “Joint Commitment of Individuals and Organisations to the Decade of Education for Sustainable Development”, which sets the priorities and guidelines for the Italian campaign, three editions of the DESS National Week have been held on the following topics:

- Energy (2006);
- Climate Change (2007);
- Waste (2008).

Environmental Education and Training offerings

In recent years, both the Agency System and its member organisations have promoted a number of different initiatives meant to raise awareness and provide education on environmental sustainability. In May 2008, the Federal Council approved the “Potenza Charter”, creating the Inter-Agency Workgroup for Education towards Sustainability (SOE), which takes the place of the CIFE Group, continuing its activities in even closer accord with the underlying principles of the decade. The SOE Workgroup is specifically meant to promote reflection on issues relating to education towards sustainability, from both an epistemological and methodological point of view, broadening the points of contact and exchange with other subjects of the educational system, on both the national and local levels, and with the INFEA System in particular, as well as with local bodies and universities, in order to help to create a national network that provides education towards sustainability in an increasingly effective manner that truly has an influence on society. In determining the Yearbook indicators, the environmental education initiatives promoted by the Agency System have been grouped in two categories: environmental education projects and specific activities for heightening 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.
A total of 489 environmental education initiatives were recorded for 2007 by the Agency System, of which 290 were projects and 199 were individual activities designed to heighten awareness and provide environmental information and education. Of the projects, 36 (12%) were multi-year initiatives and 133 (46%) were developed as co-planning efforts, in co-operation with other entities and subjects. In terms of the target, 238 (49% of the total number of educational initiatives – specific projects and activities) regarded schools, while 257 (52%) were aimed at the adult population, showing a very positive trend, in keeping with the principle of “life long learning”, meaning learning that extends through every phase of life, by means of different methods and procedures. The final objective is always the exercise of active, responsible citizenship, a yearning felt with increasing intensity and rendered especially possible in situations participatory territorial planning.
The topic most frequently addressed is the sustainable use of natural resources (air, water, soil), followed by lifestyles, including sustainable behaviour and informed consumption (critical consumption, corporate social responsibility, responsible tourism, etc.) and waste.
The Agency System provides training programmes designed to increase and consolidate the skills and know-how of professionals, researchers and other stakeholders operating in the environmental sector. 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.
Training courses are also an effective instrument of response to the obligations set forth in Community and national regulations. To this end, in the second half of 2008, the ISPRA held two chemical safety training course, in accordance with EC Regulation No. 1907/2006 (REACH).
Underlining the importance of this training initiative is the need

Training initiatives allow technicians active in different environmental spheres to share their methodologies and instruments of application.

for a methodological approach for courses to be held on a national scale, in order to enable local bodies and businesses to comply with the new system of registration, evaluation and authorisation of chemicals .
Since 2003, the ISPRA has also held environmental training initiatives, at times in response to specific requests from the Ministr y of the Environment, Land and Sea, for technicians of environmental agencies and other public bodies. These courses – which were given UNI EN ISO 9001:2000 cer tification in Januar y 2008 – have focussed on topics of environmental protection and restoration, new methods and tools for risk assessment of polluted sites, environmental reclamation techniques, environmental regulations, as well as instr uments for the sustainable management of the territor y and for the management of environmental emer gencies. To increase the dissemination of technical knowledge on the environment, the ISPRA publishes the technical-scientific contents of the courses on its website for environmental education and training (www.for meducambiente.apat.gov .it).

During the period 2003-2006, the Agency System promoted 861 training initiatives. There were more than 25,000 participants in the courses.

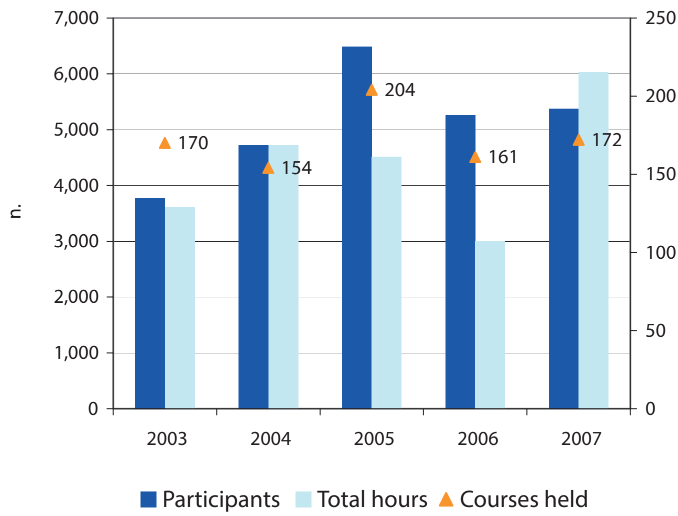


Figure 11.3: Environmental training supply (2003-2007) [9]

Environmental training activities provide opportunities for contact and exchanges of experiences in the field of environmental protection, at times through initiatives of international cooperation. As part of a joint project involving the APAT and the Egyptian Environmental Agency (under a bilateral agreement between the Italian Ministry of the Environment, Land and Sea and the Egyptian Ministry of Environmental Affairs), an effort begun in 2005 and scheduled for completion in the first six months of 2008, training workshops were held for the reinforcement of technical, specialised skills and know-how regarding environmental protection.

A similar initiative was undertaken as part of the twinning project formally inaugurated in 2005 between the APAT and the Moroccan Ministry of the Environment, with specific workshops organised for the development of technical skills meant to improve the management of environmental policies.

During the period 2003-2007 (Figure 11.3), 861 training initiatives (for a total of 21,864 hours) were organised by the Agency System,

[9] Source: ISPRA

with more than 25,000 participants taking the courses. In the year 2007, 172 training initiatives were organised on specific topics involving environmental protection and sustainable development, with approximately 5,300 participants attending the courses. An analysis of the statistics shows that each regional Agency promotes different amounts of training activities , based on the tasks assigned to them under their legislative acts of foundation.
It is important to note 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 Veneto, Tuscany, Marche, Lazio and Apulia, meaning that they are authorised to issue training credits for the courses held. A number of agencies, including the ISPRA – as already mentioned - have obtained certification demonstrating compliance with the UNI EN ISO 9000-9001 standards.
Among other training initiatives, the Agency System promotes undergraduate and graduate internships on environmental topics as well as on environmental education and communication for the promotion of sustainable development, under agreements with universities or training providers. An analysis of collected data shows that, as a whole, the Agencies and ISPRA organised more than 760 *stages* and internships in 2007.

The agencies and the ISPRA organised more than 760 undergraduate and graduate internships in 2007.

Operational effectiveness of the local environmental education network

The positive responses obtained for indicator "Operational performance in the local environmental education network" point to the increasing integration and active participation of the Agencies in their respective local systems (regional and provincial) of environmental education, at times with tasks of coordination (or of participation in co-ordinating groups) assigned and exercised under an institutional mandate within the regional/provincial educational systems (normally involving the INFEA network). Another area of activity where the ARPA/APPAs play a significant role, and where their contribution has increased over the years, is the supply of technical and methodological support for the activation and performance of participatory processes of local sustainability (first and foremost, local Agenda 21), including promotional activities, the dissemination of informa-

tion, the heightening of public awareness, education and communication regarding environmental conflicts etc., all as part of a long-standing relationship of mutual knowledge and trust with the territory in which they operate.
In conclusion, it should be noted that all these initiatives are part of a process – one which many agencies have already implemented or are implementing at present – designed to reinforce the sense of responsibility and overall consistency of the Public Administration through projects aimed at promoting good practices of sustainability within government structures.

Instruments for improving environmental services

Improvement of the environmental quality of companies, organisations and products can be achieved under principles of sustainable production and consumption that lead to the creation of a "green market".

The growing awareness that the protection of the environment must necessar y involve all interested parties, specifically through the establishment 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.
The EMAS (EC Regulation no. 761/01) and Ecolabel (EC Regulation no. 1980/2000) tools reflect 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 noteworthy value of the above regulations as tools for 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 tools 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 scope 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 way of producing and consuming. 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 summarise 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 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.

In line with the approach referred to earlier, on 16 July 2008, the European Commission approved the Proposals for the Revision of EMAS III and Ecolabel III and sent them to the Council for further approval, together with a new communication on GPP, all in compliance with the new policies for sustainable production and consumption.
From 1997 (the year in which EMAS and Ecolabel Regulations became effectively operative in Italy) to the present, the penetration of the two programs has grown constantly, showing significant annual increases (Figures 11.4 and 11.5).

From 1997 to the present, the penetration of the EMAS Regulation has grown constantly, showing significant annual increases.

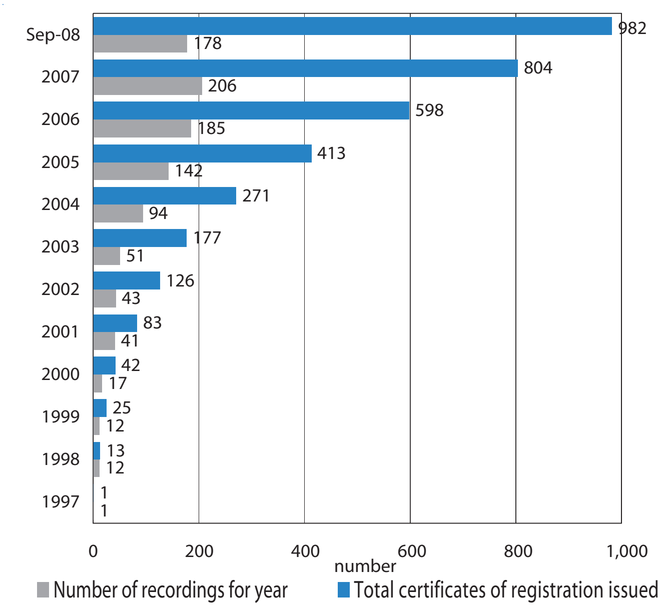


Figure 11.4: Number of EMAS registration certificates issued in Italy over time [10]

In Europe, Italy ranks third in terms of number of EMAS registrations, coming after Germany, while Spain ranks first, followed by France and Denmark, in terms of number of Ecolabel Licences. The most virtuous regions (Central/Northern Italy), in terms of the number of EMAS registered organisations, are: Emilia Romagna, Tuscany, and Lombardy, followed by the region of Campania, showing a certain amount of attention on the part of Southern Italy. The largest number of Ecolabel licenses is registered in Trento 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 by attending EMAS and Ecolabel schools (Master course),

The most virtuous regions in terms of the number of EMAS registered organisations are: Emilia Romagna, Tuscany, Lombardy, Campania and Veneto, while Apulia and Sicily respectively rank sixth and eighth, showing a certain amount of attention on the part of Southern Italy. The inconsistent development within the national territory reflects different levels of awareness and/or incentives from one region to the next.

[10] Source: ISPRA

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.
Still, this growth, though it places Italy among the European leaders, is not yet structural in nature, with development being inconsistent within the national territory, as a result of levels of awareness and/or incentives that differ from one region to the other, 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 No. 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.
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 tool.
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 tissue paper. Nevertheless, the largest increase during the last two years occurred in

Between 1998 and 2008, a total of 145 Ecolabel licences were issued, making for 1,827 products/ser vices labelled. The trend was positive for both licenses and products/ser vices. Last year, the largest increase was registered in the tourism accommodation sector.

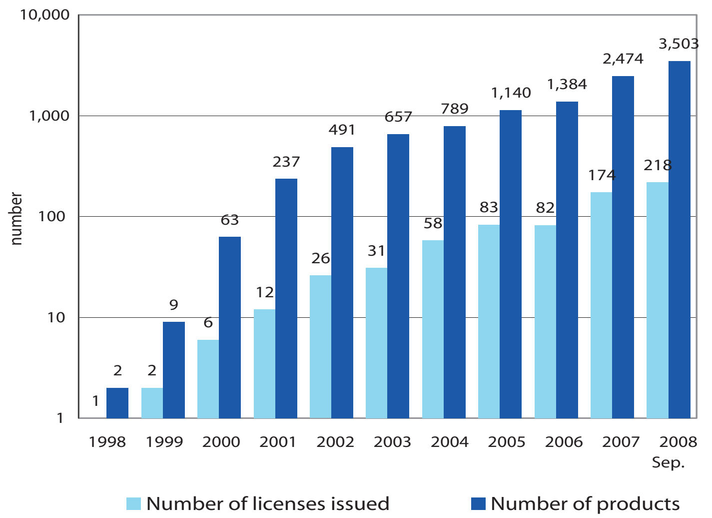
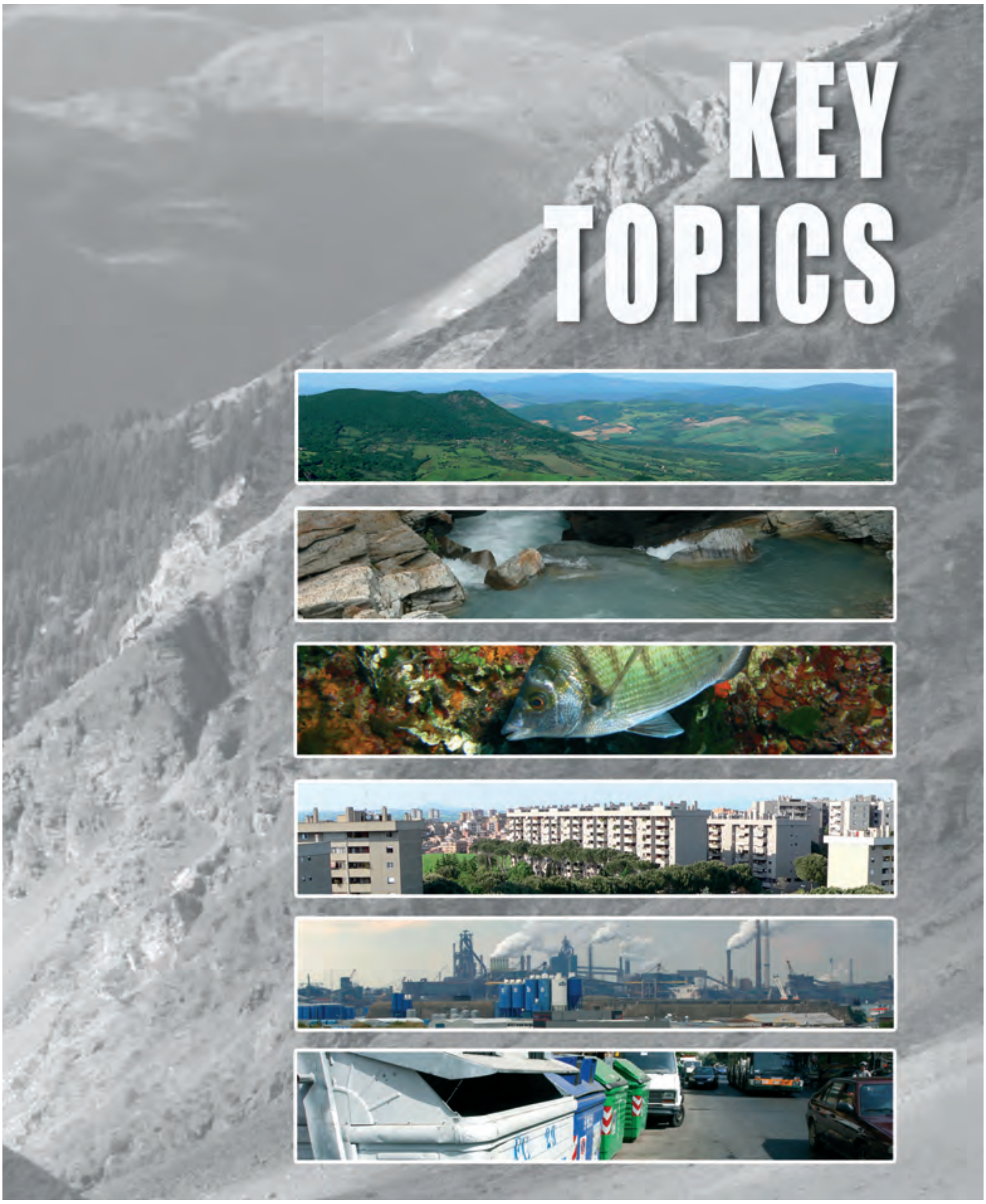


Figure 11.5 : Number of Ecolabel licenses and products/ser vices in Italy over time [11]

the tourism accommodation sector, where a far-reaching promotional effort throughout the territory, plus incentives offered by a number of local public administrations, have stimulated the demand for joining the EU Ecolabel scheme, increasing the number of licenses more than three-fold.

It should be noted, however, that even though more than 3,503 certified products and ser vices 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 unable to move the market in the direction of “green market” status.

[11] Source: ISPRA



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
AISCAT	Italian Association of Motorway and Tunnel Concessionaire Companies
AM	Italian Air Force
ANCI	National Association of Italian Municipalities
ANMP	Natural Protected Marine Areas and Marine Natural Reserves
ANPA	National Environmental Protection Agency (formerly the APAT, now the ISPRA)
APAT	Environmental Protection and Technical Services Agency (now the ISPRA)
APPA	Provincial Environmental Protection Agency (only autonomous provinces)
ARPA	Regional Environmental Protection Agency
ASL	Local Healthcare Enterprise
BAT	Best Available Techniques
BCAA	Good Agronomic And Environmental Conditions
CAP	Common Agricultural Policy
CARG	Geological Cartography
CBD	Convention on Biological Diversity
CCM	National Centre for Diseases Prevention and Control
CCTA	Carabinieri Police Command for the Defence of the Environment
CECOM	Communication of the European Commission
CEHAP	Children's Environmental Health Action Plan
CFS	State Forestry Corps
CIA	Italian Farmers' Confederation
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 Co-ordination for Defence against Electromagnetic Fields
CONECOFOR	Control of Forest Ecosystems
COP	Conference of the Parties
CORINAIR	Coordination Information AIR
CSC	Contamination Threshold Concentrations
CSR	Risk Threshold Concentrations
CTN	National Topic Centre
DAISIE	Delivering Alien Invasive Species Inventories for Europe
DBMS	Database Management System
DISMED	Desertification Information System for the Mediterranean
DPSIR	Determinants – Pressures – Status – Impact – Responses
EAP	Environmental Action Plan
EC	European Commission
ECC	European Economic Community
ECOEHIS	Development of Environment and Health Indicators for EU Countries
EEA	European Environmental Agency
EFSA	European Food Safety Authority
EIA	Environmental Impact Assessment
ELF	Extremely Low Frequency
EMF	Electromagnetic Fields
ENAC	Italian Civil Aviation Authority
ENEA	Agency for New Technologies, Energy and the Environment
EoI	Exchange of Information
EPER	European Pollutant Emission Register
ER	Exposure Ratio
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 Organisation of the United Nations

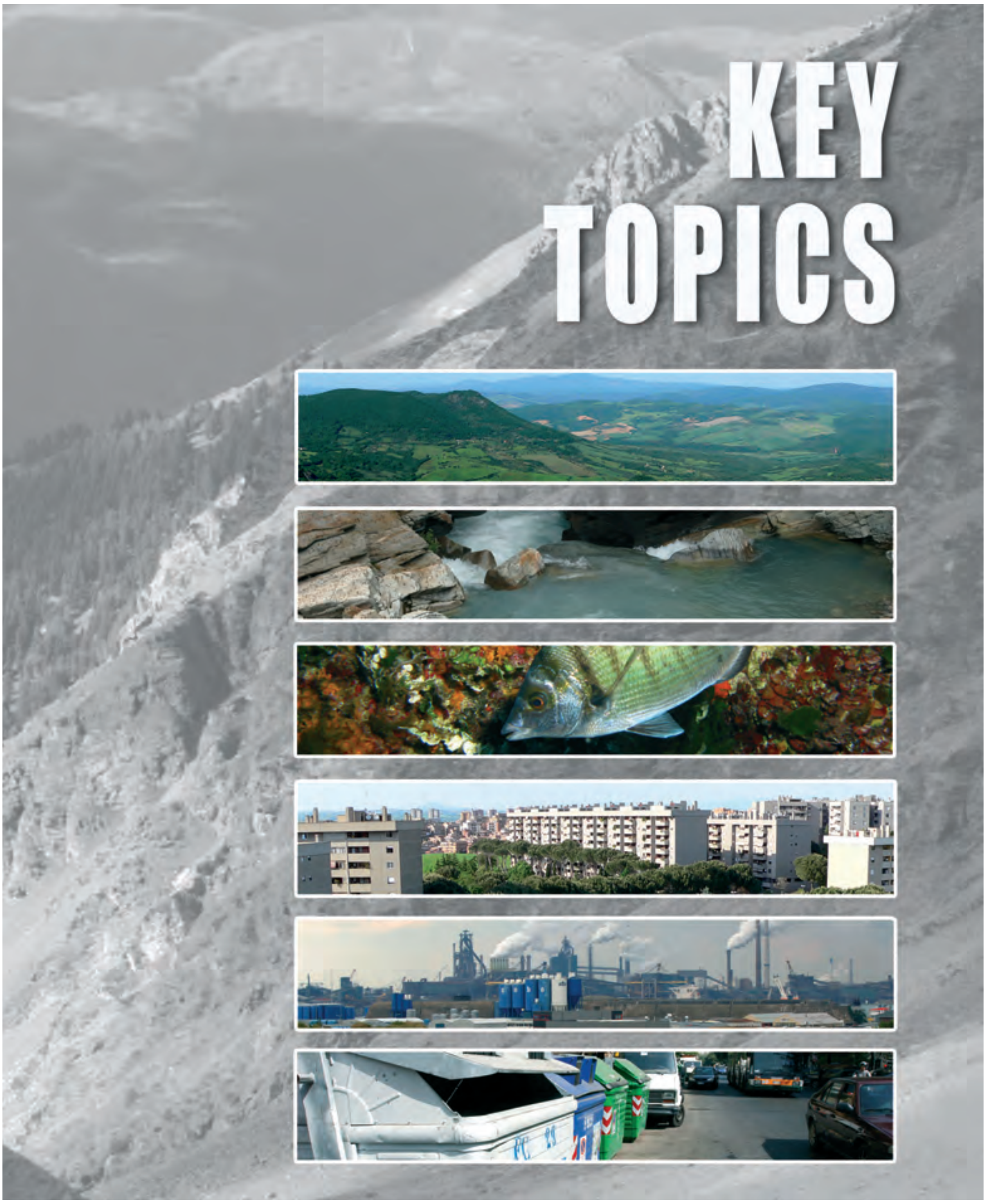
FSC	Forest Stewardship Council
GDF	Italian Treasury Police
GDP	Gross Domestic Product
GFS	Sustainable Forestry Management
GIS	Geographic Information Systems
GNDT	National Earthquake Defence Group
GPP	Green Public Procurement
HEV	Hepatitis E Virus
IAEA	International Atomic Energy Agency
IARC	International Agency for Research on Cancer
IBE	Extended Biotic Index
ICDM	Sea Defence Service of the Ministry of the Environment
ICNIRP	International Commission on Non-Ionising Radiation Protection
ICRAM	Central Institute for Research on the Marine Environment (now ISPRA)
IEA	International Energy Agency
IFFI	Inventory of Landslide Events in Italy
INES	National Inventory of Emissions and their Sources
INFC	National Inventory of Forests and of Forest Reservoirs of Carbon
INFS	National Institute for Wildlife (now ISPRA)
INGV	National Institute of Geophysics and Volcanology
IPCC	International (o 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	Water Research Institute
ISPRA	Institute for Environmental Protection and Research
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	International Union for Conservation of Nature
LCA	Life Cycle Assessment
LDCs	Least Developed Countries
LIM	Level of Pollution from Macro-Descriptors
LPG	Liquid Propane Gas
LULUCF	Land Use, Land Use Change and Forestry
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
MMC	Statutory Management Requirements
MUD	Consolidated Environmental Declaration Form
NAP	National Action Plan
NAPA	National Adaptation Programmes of Action
NEHAP	National Environment and Health Action Plan
NFP	National Focal Point
NIR	No Ionising Radiation
NORM	Naturally Occurring Radioactive Materials
NUZ	Nitrate Vulnerable Zones
NYMEX	New York Mercantile Exchange
ODP	Ozone Depleting Potential
OECD	Organisation for Economic Co-operation and Development
OGM	Genetically Modified Organisms
OPR	Oasis for the Protection and Refuge of Fauna
PAI	Plan of Hydrogeological Array
PEFC	Pan European Forest Certification
PESERA	Pan European Soil Erosion Risk Assessment
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
PYLL	Potential Years of Life Lost
R&D	Research and Development
RBS	Radio base station
REACH	Registration, Evaluation, Authorisation of Chemicals
RF	Radio Frequency
RFI	Italian Railway System
RICE	Radium of Influence of Costal Erosion
RID	Italian Dikes Register
RNA	Ribonucleic Acid
RNR	Regional Nature Reserve
RNS	State Nature Reserve
ROD	Reporting Obligation Databases
RSA	Report on the State of the Environment
RTV	Radio and TV media
SAC	Special Area of Conservation
SCALE	Science, Children, Awareness, Legal Instrument, Evaluation
SCAS	Chemical State of underground Waters
SCIs	Sites of Community Importance
SCN	Nature Preservation Service
SEA	Strategic Environmental Assessment
SECA	Ecological Status of Waterways
SEIS	*Shared Environmental Information System*
SEL	Ecological Status of Lakes
SIMN	National Service for Study of Waters and Seas
SIN	Contaminated Sites of National Interest
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
SPA	Special Protection Area
SSN	National Seismic Service
ST	Total Surface Area
SWH	Significative Wave Height
TAF	Agrarian and Forestry Territory
TERM	Transport and Environment Reporting Mechanism
TOFP	Tropospheric Ozone Forming Potential
TSP	Total Suspended Particles
UAA	Utilised Agricultural Area
UMTS	Universal Mobile Telecomunications System
UN	United Nations (Organisation of the 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
UNFCCC	United Nations Framework on Convention Climate Change
US-EPA	Environmental Protection Agency
USLE	Universal Soil Loss Equation
UV	Ultraviolets
VVF	Fire Fighters Corps
WFD	Water Framework Directive
WHO	World Health Organization
WMO	World Meteorological Organisation
WWF	World Wildlife Fund


KEY
TOPICS



ANNEX

Environmental Yearbook Indicators Database
(http://annuario.apat.it/)

Introduction

Environmental information management and dissemination are among the most important functions performed by the ISPRA (formerly the APAT).
The strategies adopted by the ISPRA (formerly the APAT) underline its far-reaching efforts to disseminate statistical information on-line.
In this context, the *Environmental Indicators Database* - created by the APAT in 2004 -plays an important role. Its two-fold function is to provide operational support to the production process of the Environmental Data Yearbook and to supply information for consultation.
The Database – which currently contains 270 indicator fact-sheets subdivided by themes (atmosphere, biosphere, hydrosphere, waste, etc.) – is one of the widest-ranging and complete environmental data collections available in Italy.
The design of the indicator fact-sheet was arrived at after a review and analysis of existing national and international literature on the standardisation and harmonisation of environmental reporting tools. The structure can be divided into two parts:

- Meta-data on the indicator
- Data associated with the indicator.

The Environmental Indicators *Database* presents the same characteristics as those indicated by SISTAN for Statistical Information Systems, with the result that it has been included in the National Statistical Programme for 2008-2010.
Website access statistics are positive: in 2008, there were 24,000 “miscellaneous visitors” [1], 36,000 visits, 400,000 pages and 1.2 million accesses, 80% of which were direct accesses or “bookmark accesses”.
Together with the preparation of the 2008 Yearbook, a new release of the *Environmental Indicators Database* was drawn up, in order to further increase ease of operatoon, while streamlining processing and making the information collected easier to consult.

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[1] The heading “miscellaneous visitors” represents the number of visitors during a given day. If a user visits the website more than once in a day, the number of visits and pages increases, but the number of “miscellaneous visitors” remains the same.

Prospects for development include, among other improvements, a new mode of consulting, referred to as "Systematisation" as well as the internationalization of the Database.

Structure of the Yearbook Database

The Yearbook Database is a web-based application designed to support the preparation of the Yearbook of Environmental Data. It can be consulted on the Internet site http://annuario.apat.it or accessed directly e from the homepage of the site www.apat.gov.it.

The site is a web application that can be utilised 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 co-ordinate the preparation of the Yearbook.

Basic users access the application with a browser, having first entered their username and password on the on-line registration form.

Consultation

The database can be accessed to search for individual indicator fact-sheets containing both meta-data and data, or consolidated indicators can be consulted using filters based on: year of publication of the Yearbook desired[2], thematic area and specific theme. Figure A.1 shows the application's homepage.

[2] The indicator fact-sheets of the Environmental Data Yearbook are available from the 2003 Edition on.

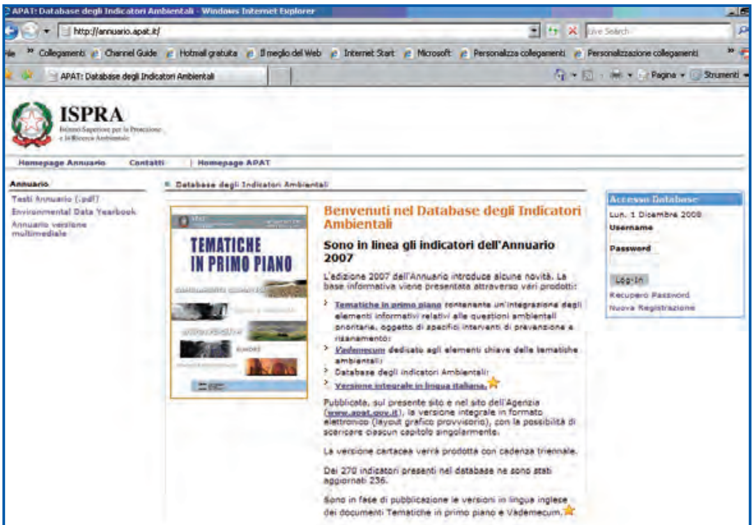

Figura A.1: ***Homepage*** **Annuario**

The application interface is simple, 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.

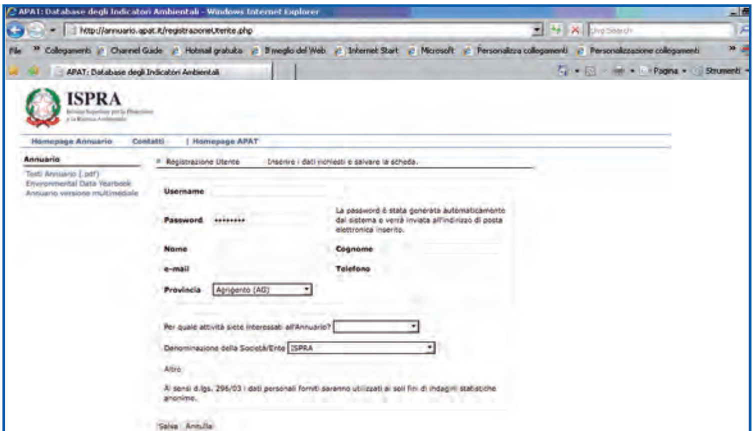

Figure A.2: "User Registration" Form

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 that sends the access credentials out once again, after the e-mail address used for registration has been entered. Figure A.3 shows the initial page that appears to the basic user after the login.

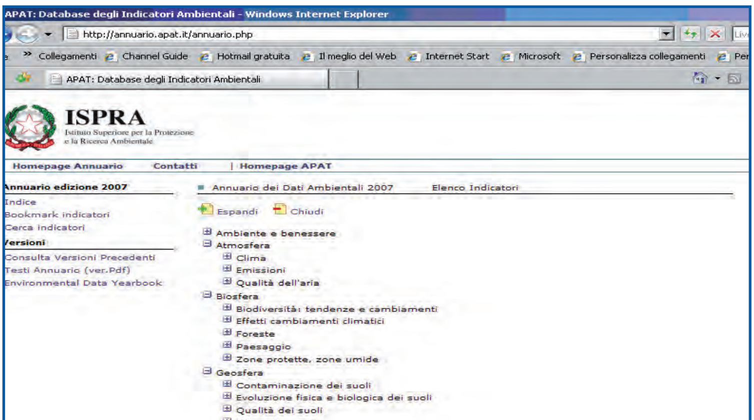

Figure A.3: The Homepage of the basic user

The published Indicators for the different editions of the Yearbook stored in the system can be consulted on this page.
After the desired edition of the Yearbook has been selected, the indicator can be browsed by pressing the “Index” key.

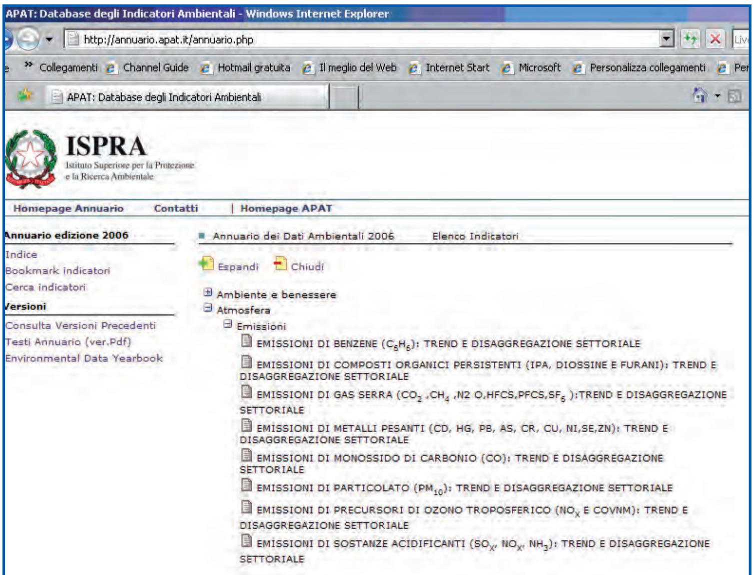

Figure A.4: The “Indicators List” interface

This page can be used for a simple search of the indicators, by clicking on the topic area and the related subsections (Figure A 4).

Advanced searches are performed by clicking on “*Cerca Indicatori*” and filling out, on the new search page (Figure A 5), one or more of the input boxes found on the indicator fact-sheet, based on:
- indicator’s name, or keywords;
- words matching part of the “description” entry;
- words matching part of the “purpose” entry.

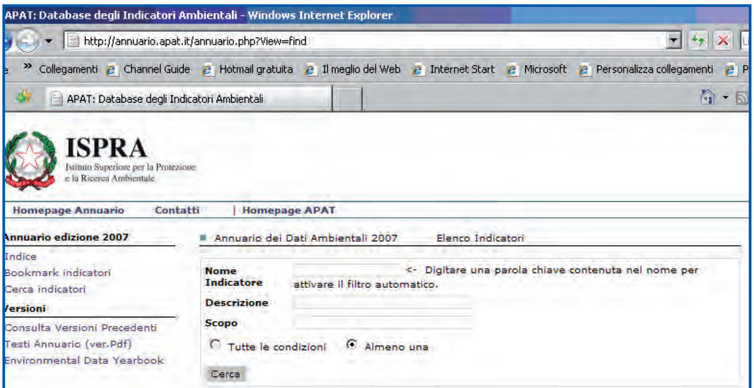

Figure A.5: The “Search ” Engine

The outcome of the search is a list of indicators matching the keywords specified in advance by the user.
The fact-sheet for each indicator (meta-data and data) can be viewed.

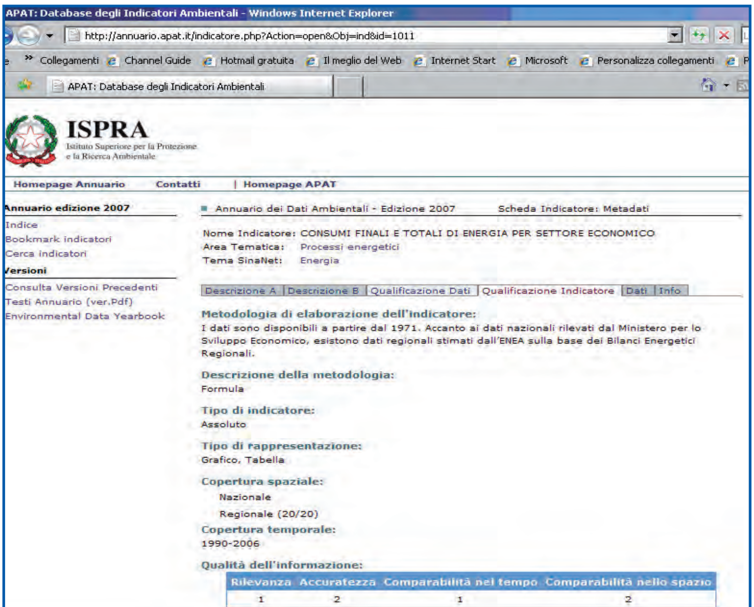

Figure A.6: “Meta-Data Fact-Sheet” Interface

The indicators can be selected using the “Add to Bookmark” function, which makes it possible to create a report (in Html version) with the same structure and information found on the indicator fact-sheets of the Yearbook.

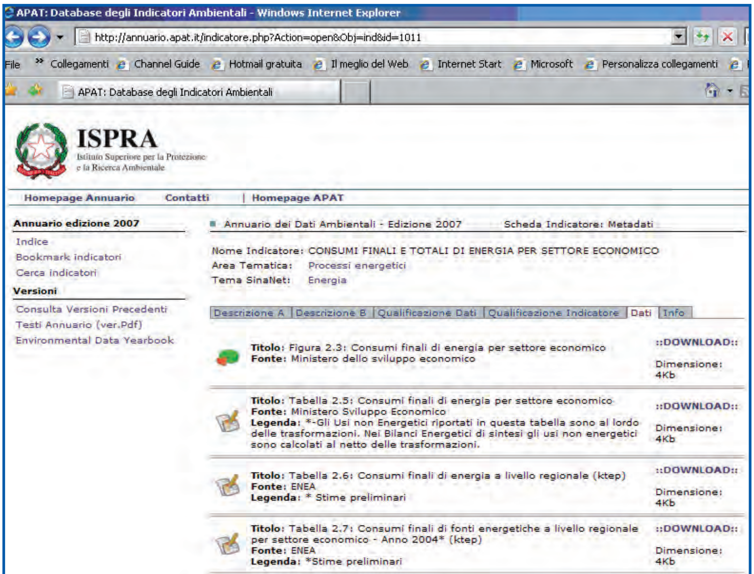

Figure A.7: “Data Section” Interface

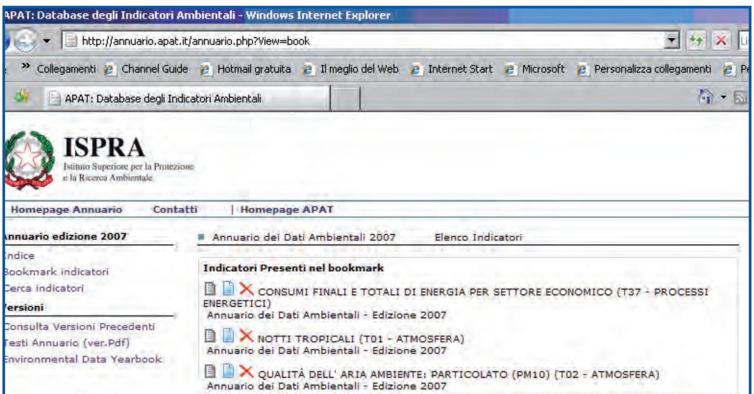

Figure A.8: “Indicators Bookmark” Interface