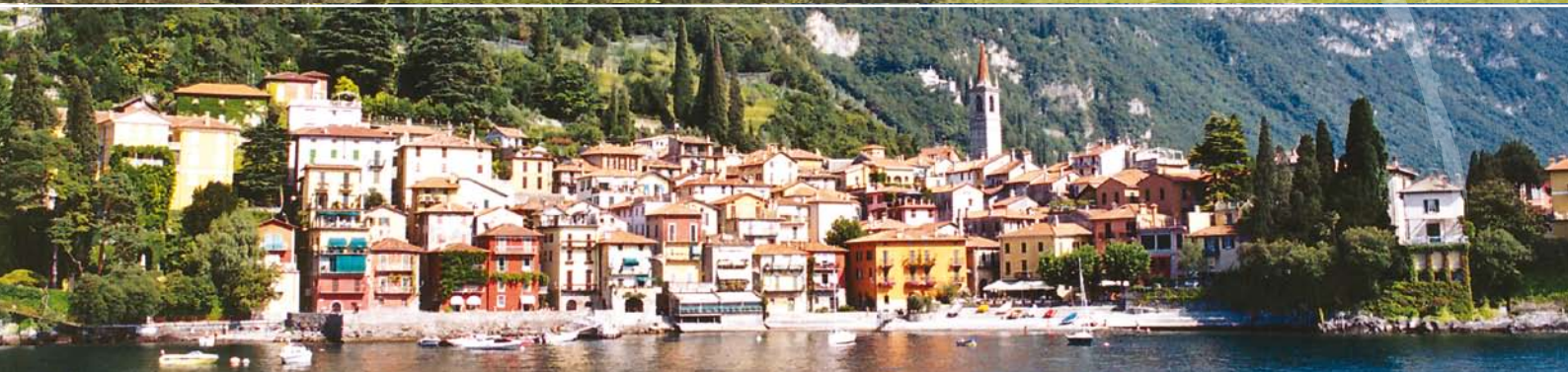




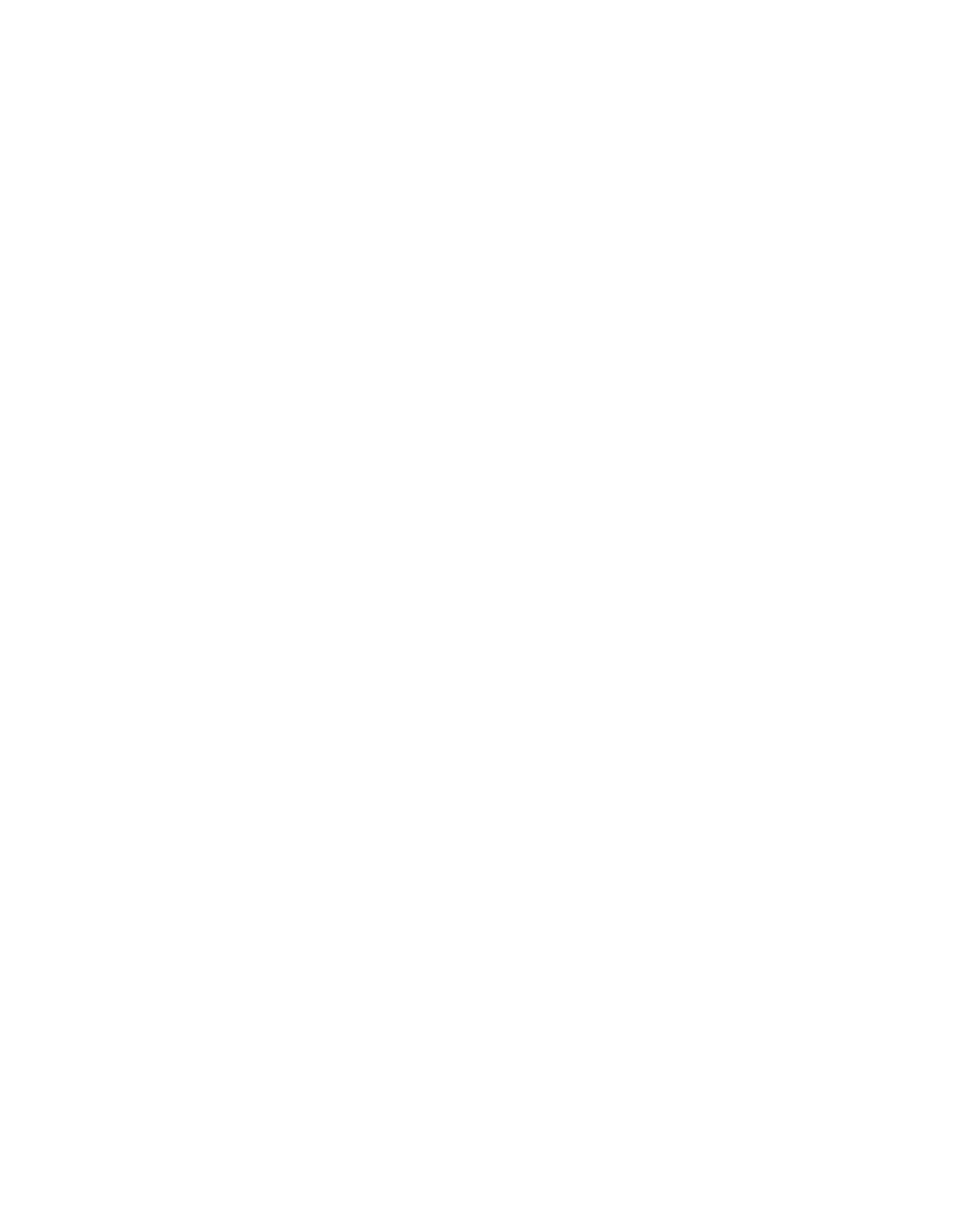
Regione Lombardia

*Reti, Servizi di Pubblica Utilità
e Sviluppo Sostenibile*

blue book



water protection and management in Lombardy



blue book

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Blue Book – Protection and Management of waters in Lombardy
2008

Regione Lombardia
Direzione Generale Reti e Servizi di Pubblica Utilità e Sviluppo sostenibile

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A thorough, updated and realistic picture of the current situation to inform on what we did, what we are doing and what we must and can still do through a shared approach involving institutional authorities and civil society stakeholders within the region.

This is the reason why the second edition of this Blue Paper – describing in details the outstanding water resources in Lombardy Region – is not just for information. It can be considered an operational tool that allows looking ahead with a true investment programme, where water is a resource to make the most of, with positive and sure results for citizens and their quality of life, as well as for the correct restoration of the best environmental conditions.

As a matter of fact, we have adopted a solution where rigorous scientific evidence is combined with a language intelligible to all, thus meeting the needs of experts and curiosity of citizens.

I hope that in these pages we can lay the foundations of a common Lombard culture to improve co-operation among citizens, Local Bodies and the Region.

Regional Councillor

Responsible for Public Utilities,
Networks
and Sustainable Development



1 Water protection



1. Environmental quality of surface water

A few major rivers, namely Ticino, Adda, Oglio, Chero, Chiese and Mincio, run through the Lombardy region flowing into and out of large lakes. As a result, these rivers maintain a fairly stable flow regime throughout the year, with periods of higher or lower flow but without no-flow periods. Other watercourses such as Olona, Lambro, Brembo, Serio, Mella as well as those flowing down the Apennines must be classified as streams as they may record extremely low flows and no-flow periods. The Lombardy region also comprises a large number of lakes including five of the largest Italian lakes (Garda, Maggiore, Como, Iseo and Lugano) as well as several smaller lakes such as Annone, Pusiano, Monate, Garlate, etc... In addition, there are a number of artificial water bodies for hydroelectric power production being mostly located in the mountain areas.

The plain is characterised by a network of canals stretching for about 40,000 Km (almost as long as the circumference of the Earth). Indeed, the whole Lombard plain has been framed by the land reclamation works which have been made to drain excess water from wetlands unsuitable for farming and to irrigate, that is to bring sufficient water for crop growing where necessary.

This area also represents a considerable portion of a basin rich in groundwater: the Po Valley.

The particularly abundant water resources of Lombardy region are associated with and partly responsible for densely populated settlements and industrial areas. As a matter of fact, the water system must meet the needs of a population of 9 million inhabitants, with an average density of over 300 inhabitants/sq. km and peaks of 2000 inhabitants/sq. km in the Milan area. Maximum urban concentration means also industrial concentration and, consequently, water demand (though slightly reduced compared to the past) and load of chemicals that cannot be always re-absorbed by the water system.

Agriculture and, most of all, animal farming – reaching its peak in the provinces of Brescia, Mantua and Cremona – show a different concentration. Livestock population in Lombardy region is large: about 5 million pigs and 2.5 million cattle, mainly dairy cows.

It is quite difficult to maintain the environmental quality of the Lombard waters not only because of the huge area involved but also because of the significant pressures this water system is exposed to.



Lake Como – Bellagio

1.1 Watercourses

According to a 5-level scale ranging from excellent to very poor (*Figure 1.1*), the quality status of the Lombard watercourses has proved to be good only in the case of Ticino river and a few stretches of Adda river downstream of the lake; water quality of Brembo, Serio, Oglio, Mincio and Chiese rivers is, on the contrary, just sufficient.

Watercourses flowing near areas with the highest degree of urbanisation and industrialisation show a critical condition: this is the case of Lambro river and Olona river, in the Milan area, and Mella in Brescia area.

Even the Po river is adversely affected by Lambro river and its water quality becomes poor just downstream of the point of confluence with the latter.

The overall situation has not remarkably changed over the last years, except for Lambro river that has significantly improved and passed from “very poor” to “poor” rating thanks to the completion of wastewater treatment facilities in Milan. However, it seems there is little scope for further improvement in the water quality of these rivers, apart from restoration resulting from their self-purifying capacity. The Milan urban concentration is almost unequalled in Europe, while any further improvement seems to be very unlikely due to the size and torrential nature of these rivers.

In a way, water quality greatly depends on the volume and nature of current discharges but it is also closely related to the actual quantity of water available in watercourses: in the last few years, such availability has repeatedly decreased and has not contributed to quality improvement in circulating waters though wastewater collection and treatment infrastructure has been largely developed throughout the region.

Surface water monitoring

Lombardy Region has selected the water bodies to be monitored and has decided number and location of abstraction points according to:

- Typology of water bodies and size of the relevant catchment basin;
- Morphology of the hydrographic network, land use and water resource use;
- Positioning of wastewater discharges over the territory and point of confluence of the main tributaries.

The monitoring system provides not only information on the features of major water bodies but also an overview of Lombard waters. For this reason, monitoring of water quality is not restricted to the main water body of each district but also involves its major tributaries or other watercourses that may have an impact as to load, use or naturalistic significance – these being important elements to characterise the main water body.

The monitoring network includes 260 sampling and measurement sites, covering 175 surface water bodies as follows:

- 136 sites located in natural watercourses and 77 in artificial watercourses for a total of 213 sites;
- 37 sites located in natural or enlarged lakes and 10 in artificial lakes for a total of 47 sites.

Monitoring is still carried out in compliance with Legislative Decree No. 152/99 and subsequent amendments while awaiting the definition of new criteria provided for by Water Framework Directive the transposition of which into Italian law is underway. In particular, the surveying phase has been completed: its objective was to assess the environmental quality status of each water body in order to define what measures had to be included in the Programme for Water Use and Water Protection to reach or maintain the target quality level. We go on now with standard monitoring in order to follow the environmental quality evolution of water bodies in time and to assess the benefits resulting from actions underway.

The method used for watercourse classification is in compliance with the provisions of Legislative Decree No. 152/99 that sets the indicators needed to analyse the environmental and ecological conditions of waters, according to which possible gap with respect to target quality levels is to be measured. The Ecological Status is defined by basic physical and chemical parameters measured on the water matrix and related to oxygen balance and trophic state (Pollution Level by Macrodescriptors, hereinafter referred to as M.P.L.) as well as by the composition of the macrobenthic community in running water (Extended Biotic Index, hereinafter referred to as E.B.I.). M.P.L. is the sum of 7 macrodescriptors: oxygen saturation, BOD₅, COD, NH₄, NO₃, total phosphorus and *Escherichia Coli*. E.B.I. value corresponds either to the average of values measured over the year during seasonal measurement campaigns or in line with the most suitable hydrologic regimes.

The Ecological Status of a watercourse is defined by the worst of the two indices.

Lake environmental quality depends on several factors: transparency, chlorophyll concentration, algal blooms, etc. which are all more or less indirectly related to the concentration of nutrients.

Lakes are usually analysed only with reference to the water matrix classification. Samples of water are taken twice a year (on a 6-monthly basis) under particular seasonal circumstances: at the beginning of spring, when water mixing reaches its peak, and in September-October, that is the end of summer stratification period.

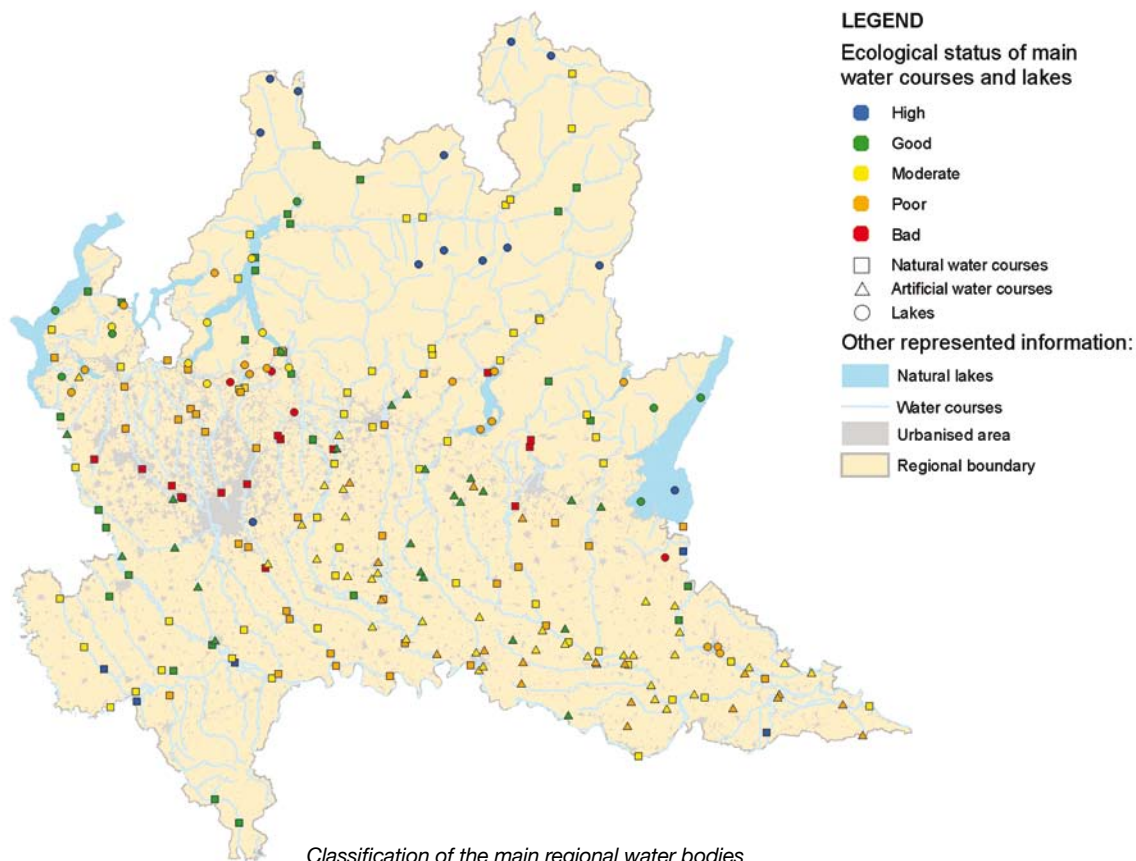
In the case of artificial lakes, these two annual sample takings are subject to the operating modes of the reservoir and in any case they are performed when water level is the highest and lowest, that is in spring and early autumn.

The number and the positioning of sampling stations depend on the lake shape and surface area and samples are taken along the water column, with respect to depth. If lakes are shallow, <5 m, only two samples are taken along the column, on surface and at the bottom). Sub-alpine lakes are mostly characterised by a vertical mixing in late winter which may only partially involve the water column. To get a better understanding of the modifications in the vertical structure of a water mass, temperature and oxygenation have been regularly measured along the whole column at different stations. Sampling frequency varies depending on lake basin features and it is planned for all large lakes on a monthly basis.

Moreover, the role of sediments in the biogeochemical cycle has been analysed in order to assess lake “health” condition. Indeed, a number of toxic substances – traces of which were found in water – tend to be generally present in sediments, even in high concentrations. Sediments, therefore, act as centres of accumulation and release of such substances.

Finally, it must be highlighted that contaminated sediments may have harmful or undesired effects not only on benthic organisms but also on all the other related elements of the food chain.

Fig. 1.1



The situation of minor watercourses is very diversified: around Milan, in particular, they show the same features as larger rivers and, therefore the same unstable quality condition mainly resulting from urban and industrial loads. In the lower part of Mantua plain, the status of rivers is also very critical due to high loads from livestock farming associated with a very poor water change as a result of poorly sloping ground and sub-critical flow. In the mountain areas, the quality status of watercourses is nearly always good. Sometimes rating value may drop from “good” to “moderate” because of the particular ecosystem where living organisms may suffer from water shortage.

The Programme for Water Use and Water Protection has implemented a more detailed rating system which has

Framework Directive “WFD” 2000/60/EC

Water is vital for human beings as it meets all their basic needs through agriculture, fishing, power generation, industry, transports and tourism but it also plays a vital role for nature and environment. Yet, a lot of human activities, including water-related ones, may pollute water bodies.

The European Union has issued a number of “directives” to try and tackle and solve the problem of pollution affecting rivers, lakes, oceans and groundwater, so as to ensure conservation of these natural resources for our future generations.

Water Framework Directive (WFD) 2000/60/EC:

- protects all water bodies, namely rivers, lakes, oceans and aquifers, from pollution arising from all sources such as agriculture, industrial activities, urban areas, etc.;
- provides for a new river basin management plan, where the river basin is the portion of land drained by a watercourse both directly or through its tributaries;
- listens to the opinion and ask for the co-operation of all stakeholders, as we all use water in our daily private and professional life (at home, in the office, at school, etc.);
- ensures “polluter pays” principle.

This Directive establishes an extremely different procedure to evaluate and classify watercourse environmental quality: watercourse quality is defined by comparison with a reference environment having a quality status close to natural level.

Moreover, such comparison does not only take into account physical and chemical water matrix features but also biomass, sediment and hydro-morphological conditions of water bodies. Such comparative methodology requires identification and definition of optimum environments and organisms both in water and riparian zones.

The development of this complex monitoring and classification system based on ecological aspects has required the setting up of an inter-calibration process. This process has been developed on an European scale in order to define the parameters to be monitored, reference conditions, class boundaries and comparison among classes inevitably based on different populations of organisms that cannot always be compared. This process has not been finalised yet, and the definition of the new European classification system is still under way. At present, Italy has first of all defined the parameters to be monitored and sampling procedures for biological parameters, but reference conditions and classification methods are still to be agreed upon.

Integrated watercourse characterisation

The integrated watercourse characterisation aims at portraying the overall ecological status of watercourses under investigation.

The focal point of this characterisation is a cognitive-descriptive system comprising all key aspects of a river system, thus complementing the more traditional quality-based system with geo-morphological, biological and hydrological elements, as stipulated by Water Framework Directive (WFD 2000/60/EC).

This system records the main features of watercourses, such as water quality, hydrologic regime, areas suitable for morphological evolution and natural overflowing, vegetation, artificialisation level, etc., and then summarises them into a concise assessment. This assessment measures the “natural value” of a watercourse. In other words, a watercourse is analysed taking into consideration factors such as its ecological integrity, alteration due to anthropogenic impact as well as biological, morphological and aesthetic peculiarities. The rating system is a 5-level scale ranging from “excellent” to “very poor” (Figure 1.2)

Based on the assessment of “natural value”, the environmental condition of major Lombard rivers – where either particularly critical or good preservation conditions are to be found – has on average proved to be “moderate”. Only the mountain part of Staffora river and a stretch of Ticino river have been rated “excellent”. Ticino river, indeed, has shown a “good” condition along the remaining course. “Good” are also the medium basin of Staffora river, the mountain basins of Mella, Chiese, Serio and Brembo rivers, as well as the Adda river, in the area between Lake Como and the confluence point with Brembo. More restricted areas rated “good” can be found along Mincio and Oglio course. The majority of Lombard rivers are classified as “moderate” regardless of their typology (Adda river upstream and downstream of the lake, Serio river, Brembo river, Oglio river upstream and downstream of the lake, and Chiese river downstream of the lake). The first half of Adda river above the lake, Mincio river flowing out of Lake Garda and Mantua lake as well as a few stretches of Serio river near the town of Bergamo are “poor”.

The northern Lambro and Olona, the southern Lambro, except for their initial parts, and the medium part of Mella river are classified as “very poor”.

proved to be ahead of the European regulations on water body quality assessment. This system, which has also taken into account riverbed and bank features as well as water and aquatic environment features, detects the critical points of those stretches where soil conservation measures have been particularly destructive (Figure 1.2).

1.2 Lakes

Over the last year, Lakes Maggiore and Garda have been rated “good”, Lake Como “moderate” tending towards “good” whereas Lakes Iseo and Lugano have been still rated “poor”. Small lakes in the mountain area are generally in a good status, whereas those located at the foot of the mountains are often in a poor condition on account of the maximum urban concentration. (Figure 1.2).

Lombard large lakes have improved their condition in the last few years as a result of the completion of wastewater

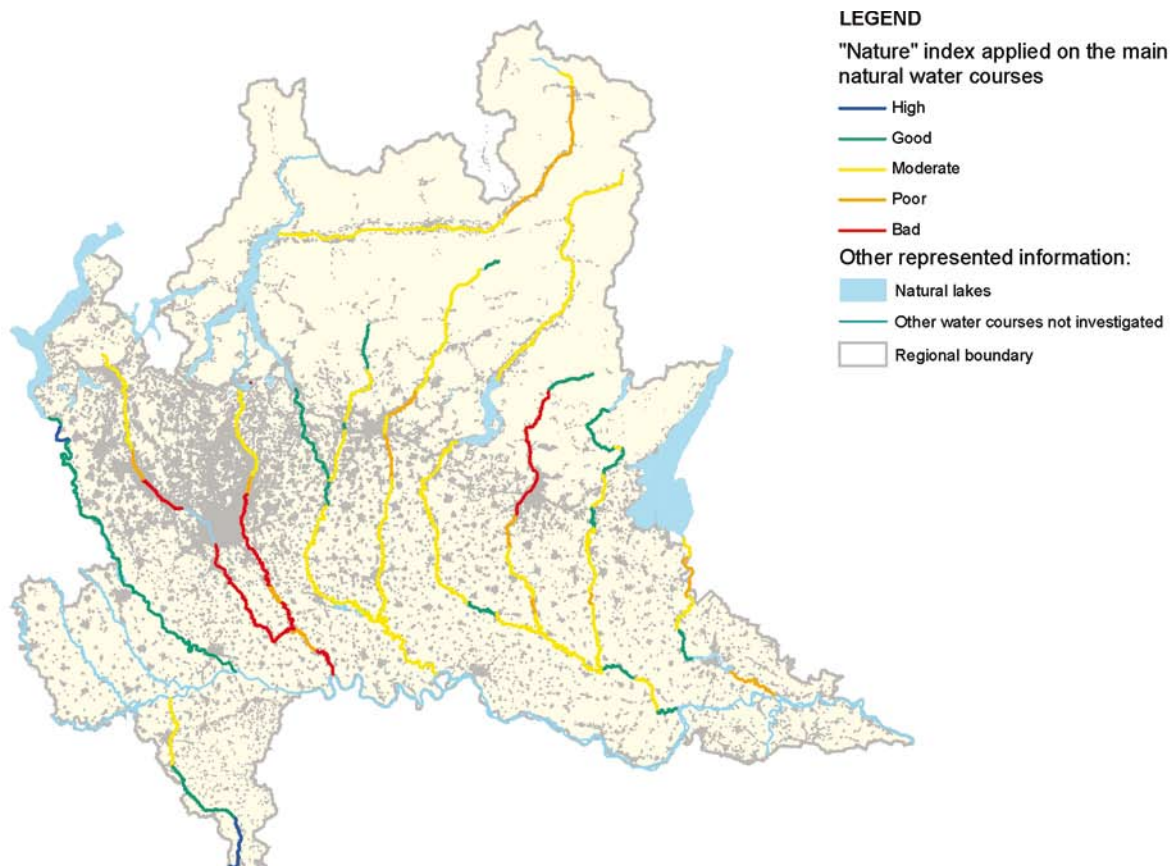


Fig. 1.2

Integrated classification of the main regional water bodies

collect systems and treatment plants. However, restoration time of lake basins can be very long due to inertia of huge water mass and internal dynamic properties of the water body.

In smaller lakes the situation may be more critical because of the accumulation of pollutants possibly generated in the past, and it can be restored with difficulties because water change is very slow.

1.3 Suitability for fish life

Freshwater fishing dates back to ancient times and has been a main source of food along with hunting. Both amateur and professional fishing activities are still well developed in Lombardy region. About 160,000 resident fishermen renew their licence every year thus proving that fishing has not only a social impact as a leisure activity but also represents a major cultural and historic heritage. For this reason, a thorough scientific research on fish stock in Lombard waters has been carried out for some time now by Lombardy Region and, most of all, by its Provinces.

Provinces have been working on Provincial Fish Plans for some time now. These plans, some of which have been now almost completed, provide a detailed description of water body features and aim at defining:

- Areas devoted to fish protection, conservation and restocking;
- Stretches of water bodies that allow improving, increasing and protecting fish fauna;
- Stretches where fish restocking programmes are carried out on a regular basis, using autochthonous species.

As a matter of fact, diversions modifying watercourse flows, obstacles to water circulation, major works changing riverbeds and hydrogeological instability are responsible for a decrease in fish species in particular stretches of the watercourse. In these cases, fish stock recovery measures must be taken according to the biogenic capacity of the specific environment.

Since 1993 the Region has taken measures to designate and protect those waters which are potentially suitable for fish life. During the whole subsequent period, the designated water bodies or their stretches have proved to be

Suitability for fish life and fishing maps

Water bodies suitable for fish life were designated in the Regional Executive Resolution No. 45652, dated December 21st, 1993. According to the directive 78/659/CEE this resolution makes a distinction between "salmonid" and "cyprinid" waters for each designated water body.

Apart from some monitoring measure deficiency, compliance assessment based on analytical data referring to 1999-2003 period, has always been favourable.

Moreover, through the enactment of Regional Act No. 12, dated July 30th, 2001 ("Regulations on fish stock increase and fishing activities in Lombard water bodies"), Lombardy Region has focused on fish fauna protection and water ecosystem quality protection. This Act stipulates that the Region and Provinces perform specific functions as regards management of fishing activity: the Region makes laws and sets guidelines each Province must abide by to directly manage fishing within its territory. In particular, the Region is competent as for the relationships with UE and the State, development of planning lines, co-ordination of all functions and relevant supervision (article 2, paragraph 1). Provinces have administrative and managing functions concerning issues such as fish restocking plans, exclusive fishing rights, aquaculture or fish farming licences, fish protection areas, control programmes on fish-eating species, etc..

In compliance with the above-mentioned Regional Act No. 12 of 2001, the Regional Regulation No. 9, dated May 22nd, 2003, was approved. This regulation lays down rules on fishery and, in particular, on:

- amateur, professional and underwater fishing as well as fishing competitions;
- Fishing in type A, B or C waters;
- Management of exclusive fisheries zones;
- Fishing licences.

It is very important to define what tasks a Province has in fish fauna and fishing management, with particular reference to:

- extension, reduction or suspension of fishing ban periods;
- possible changes in minimum measures;
- additional restrictions on fishing methods and catch limits of most valuable fish species;
- extension of fishing hours as regards traditional species;
- possible modifications to fishing instruments allowed
- control programmes on harmful fish species;
- identification of areas devoted to boat fishing and underwater fishing ;
- definition of professional fishing tools and how to use them, and classification of waters devoted to this activity;
- approval and supervision of exclusive fishing programmes;
- authorisation for Private Fishing Centres;
- information on procedures to obtain tourist fishing licences and areas devoted to this activity.

As Lake Maggiore, Lake Ceresio and Tresa river border on Switzerland, their waters are subjected to the constraints stipulated by Act No. 530, dated November 22nd, 1988, known as "Italy-Switzerland Convention".

In addition, mention is to be made of Regional Executive Resolution No. 7/16065, dated January 23rd, 2004, regulating in detail compatibility of water diversions with protection of fish fauna and aquatic habitats.

Finally, Regional Act No. 12/2001 has provided for the drawing up of a regional technical document guiding on topics like fishing management, water restoration measures to protect and develop fish fauna, autochthonous and allochthonous species, scheduling and financial resources.

2. Groundwater

A large amount of water flows through the porous subsoil of the Po river valley. Some groundwater reservoirs can also be found in other areas such as the bottom of alpine valleys or karst massifs. At a regional level, the characteristics of the aquifers in the plain are well known, while there is very little information available on aquifers in the mountain areas as regards both their quantity and quality.

Groundwater environmental condition is assessed not only by water quality and chemical pollution but also by the balance in water quantity. Surface water and groundwater are balanced and aquifer depletion may dramatically change the distribution of surface water-related environments, such as wetlands. Aquifers are a water reserve that should never be depleted by a too intensive exploitation, otherwise existing environments might be seriously affected.

Water quantity is, therefore, of the greatest importance to evaluate aquifer “health” condition.

The situation regarding water availability in the plain areas of this region is still favourable, as compared to the over-exploitation carried out in the 70s and 80s. Groundwater level is rising almost everywhere and needs to be kept under control in urban areas where foundation and infrastructure occupy progressively larger and deeper underground spaces. (Figure 1.3)

In Lombardy region, aquifers feature an increasing complexity from north to south. As for their chemical quality, they show signs of anthropogenic pollution caused by solvents and hydrocarbons in the area north of Milan and in Milan area, where high loads of nitrates are recorded probably resulting from a poor wastewater collection system.

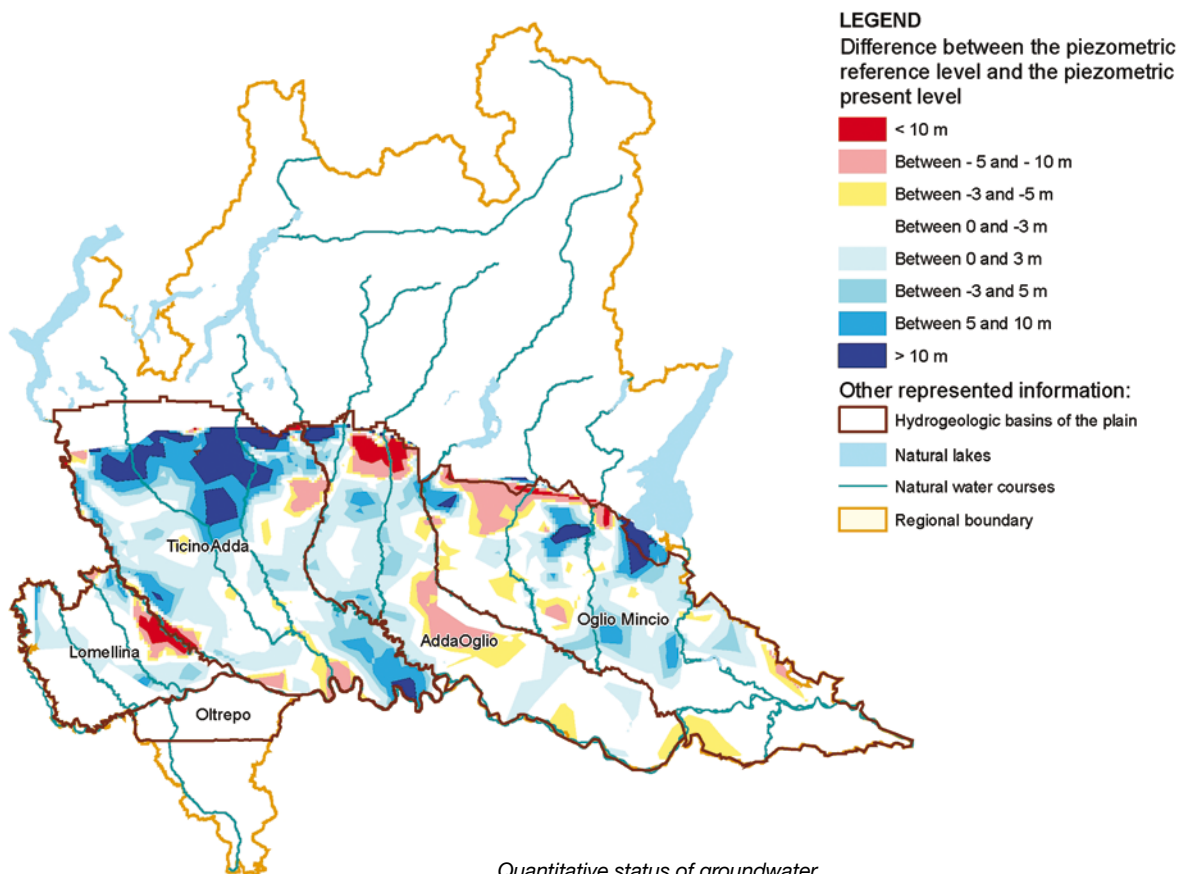
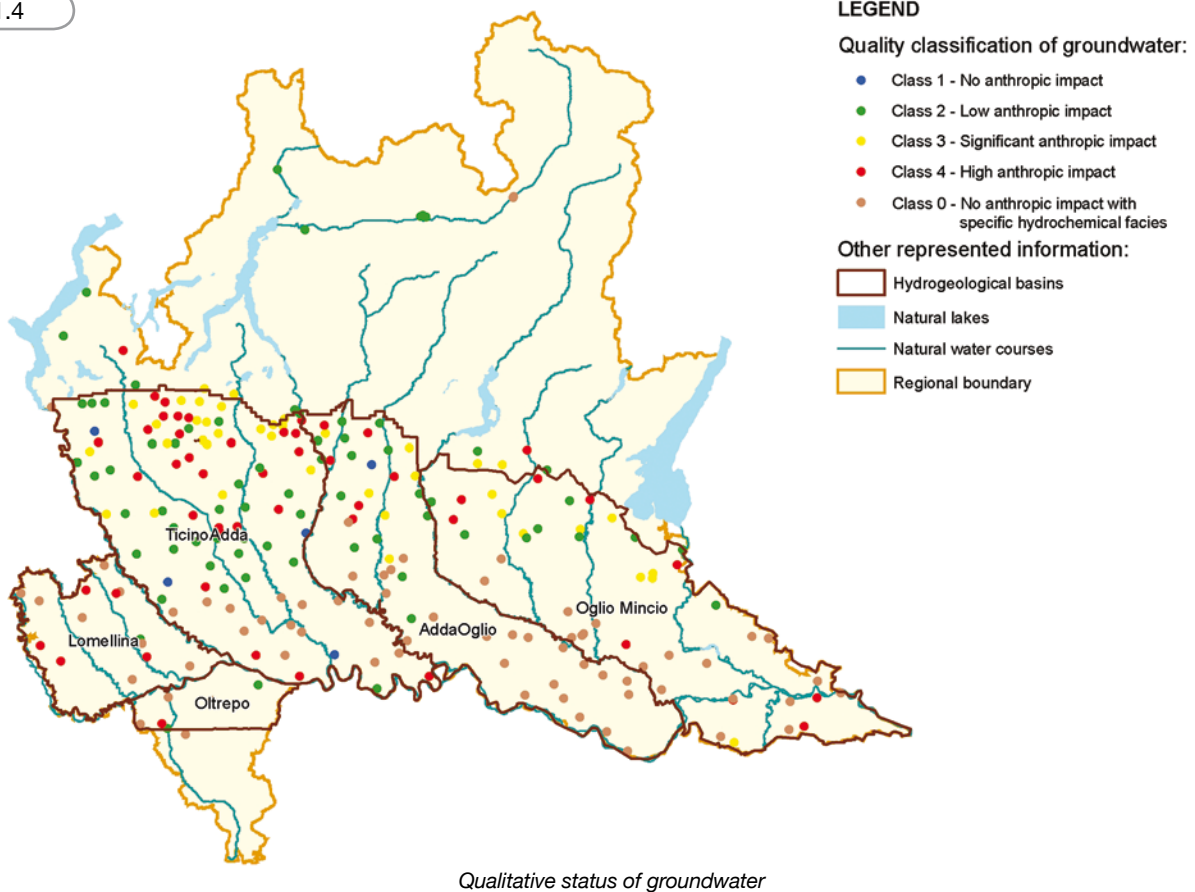


Fig. 1.3



Nitrate loads are also high in a few agricultural areas of the upper and medium plains of Brescia and Bergamo. In the southern part of Lombardy region, deep aquifers contain unwanted substances such as iron and manganese, or even pollutants such as ammonia and arsenic. However, such substances are linked to the characteristics of the aquifers water flows in and not to anthropogenic impact. Throughout the plain, we can also find localised pollution traces caused by plant protection products in more superficial aquifers (Figure 1.4).

Fig. 1.4



Fossalta channel



Lake Garda

Groundwater monitoring

The current methods for groundwater monitoring are in compliance with Legislative Decree No. 152/99 while waiting for the definition of new criteria for data collection as stipulated by Water Framework Directive 2000/60/EC and Directive 2006/118/EC on the protection of groundwater against pollution.

According to Legislative Decree 152/99 that has basically predated the two European directives, groundwater quantity condition must be defined taking into consideration both the characteristics of the aquifer and its exploitation over a long period of time (ten years at least). There are several ways to make this long-term comparison and they all require fairly large sets of data.

A first assessment on the balance of groundwater availability in the Po river valley was carried out by the Region in 1996. On that occasion, a comparison was made on the basis of abstraction and recharge estimates per hydro-geological basin section in the plain area. A similar balance was made with data updated to 2003.

In addition to such criteria, piezometric level and piezometric trends are considered the main indicators for the sustainable use of a water resource. By identifying a reference level in the Lombard plain area, data on piezometric level modifications in time can be analysed and the relevant trends can be ascertained.

By comparing the piezometric trends (mainly due to natural stresses) with the availability/consumption ratio, we can define the quantity condition of bodies of groundwater and then make a classification as indicated in the above-mentioned decree, where water sustainable use is closely related to the anthropogenic impact.

In order to check sustainable conditions and plan the necessary actions, parameters of the piezometric trend, as well as the results of the comparison between current piezometric level and an optimum reference level, have been considered. This reference level has been selected considering we need to maintain water availability in the plain without, however, interfering with the underground infrastructure of the more densely populated areas. The assessment of current piezometric level with respect to reference level and of the evolutionary trend referred to the last 10 years, provides additional information about the sustainability of water resource conservation vis-à-vis water use.

In the area where the volume of analysed data is larger and therefore more meaningful, i.e. Adda-Ticino area, a good water availability can be generally observed. The central part of this area shows an emergency condition due to the high level of the aquifer.

It can be said that the anthropogenic impact connected with groundwater abstraction in the plain area is usually negligible and that there are hydrogeological balance conditions in most of the Lombard plain, with the exception of Bergamo, Brescia and Mantua areas where groundwater abstraction is greater than recharge.

The situation around Milan is very peculiar because, despite the lack of balance between abstraction and recharge, the aquifer level has risen thus causing problems with the underground infrastructure which were built when the aquifer level was lower.

Groundwater quality condition is assessed according to the methods defined in the Legislative Decree No. 152/99. Classification is made depending on concentration values of 7 basic chemical parameters. Besides basic parameters, concentration values of additional parameters, namely organic and inorganic pollutants, are taken into account. If the concentration of organic or inorganic pollutants exceeds the threshold values, the quality status is immediately classified as "very poor" (significant anthropogenic impact and poor hydro-chemical properties). A special class is assigned if the excess concentration is due to inorganic pollutants of natural origin. The classification methods are very similar to those recently indicated by the European Directive on groundwater 2006/118/EC.

According to an analysis on water quality carried out in various areas, 32% of groundwater in the Lombard plain belongs to this special class. This kind of water contains pollutants of natural origin, namely iron, manganese and ammonia, and there is little scope for quality restoration. However, since this water is naturally intended for human consumption, it must be properly treated before its distribution through the water supply system.

In the northern Milan area, groundwater pollution is caused by – besides industry-related pollutants namely solvents and chromium – plant protection products in the agricultural areas of Pavia and Mantua, and by nitrates in all the provinces of Milan, Lecco, Como and Varese, with nitrate concentrations ranging from 25 to 50 mg/l.

Drinking water

In Lombardy region, drinking water supply comes almost entirely from groundwater and just a little quantity from surface water – a situation seemingly in contrast to the extraordinarily rich variety of watercourses and reservoirs. However, historical background can easily explain this trend. In the past, all over a wide area of the plain, groundwater from more superficial aquifers could be used without any effort in drawing it because it could reach the surface without the help of a pumping system – being the water in the aquifer slightly under pressure – and originated rich and crystal clear freshwater resources throughout the year: the well-known “Fontanili” (natural groundwater emergence).

On the contrary, watercourses were mostly treated as waste receivers and distributors of urban loads – that in the past were just nutrients – over the land where these could also be used as crop fertilisers.

For this reason, in people’s mind, drinking water is only the clear and cool water springing out of the subsoil simply by drilling up to a depth of a few dozen metres, whereas surface watercourses are human waste collectors and give their significant contribution to crop growing.

Time has noticeably altered the situation: since the end of the 18th century, regional industrialisation has caused the spreading of undesired and often hazardous substances over both surface water and groundwater. As a result, drinking water quality has dramatically changed. Pollutants have increasingly contaminated the most superficial aquifers. Moreover, due to water abstraction that increased further during the industrial age, natural groundwater emergence stopped as water pressure in surface aquifers decreased and so water had to be drawn by pumping systems.

The advantages of using groundwater for drinking are now considerably fewer than in the past . As a matter of fact, to avoid pollutants from the surface, progressively deeper wells had to be drilled thus reaching aquifers containing “older” water, with reduced permeability and a much slower water change time, and therefore rich in undesired elements.

In any case, the historical trend being recorded is still confirmed: 94% of the regional drinking water supply comes from groundwater, as compared to an average of 80% and 57% recorded at national and European levels, respectively.



Pontoon bridge across the Ticino river



Lake Como – Bellagio (Pescallo)

1. Drinking water supply from surface water

In Lombardy region, there are currently 33 authorised fixed abstraction points from surface water for potable use (Figure 1.5). Most of the water comes from lakes, in particular Lake Como, where the largest amount is abstracted, and Lake Garda where the majority of abstraction points are located.

There are only two abstraction points in Lake Lugano and one in Lake Iseo supplying the built-up area on the island of Monte Isola. There are two artificial reservoirs which supply water for potable uses: Palabione at Aprica and Valvestina reservoir that supplies the village of Gargnano.

The remaining surface water abstraction points are located at streams in the mountain area. Surface water quality intended for human consumption is always very high but there may occasionally be events of microbiological pollution.

Temporary surface-water abstraction points can sometimes be put into operation in the dry seasons and in case of damage to pipes and plants. If this occurs, quality checks are carried out more frequently.

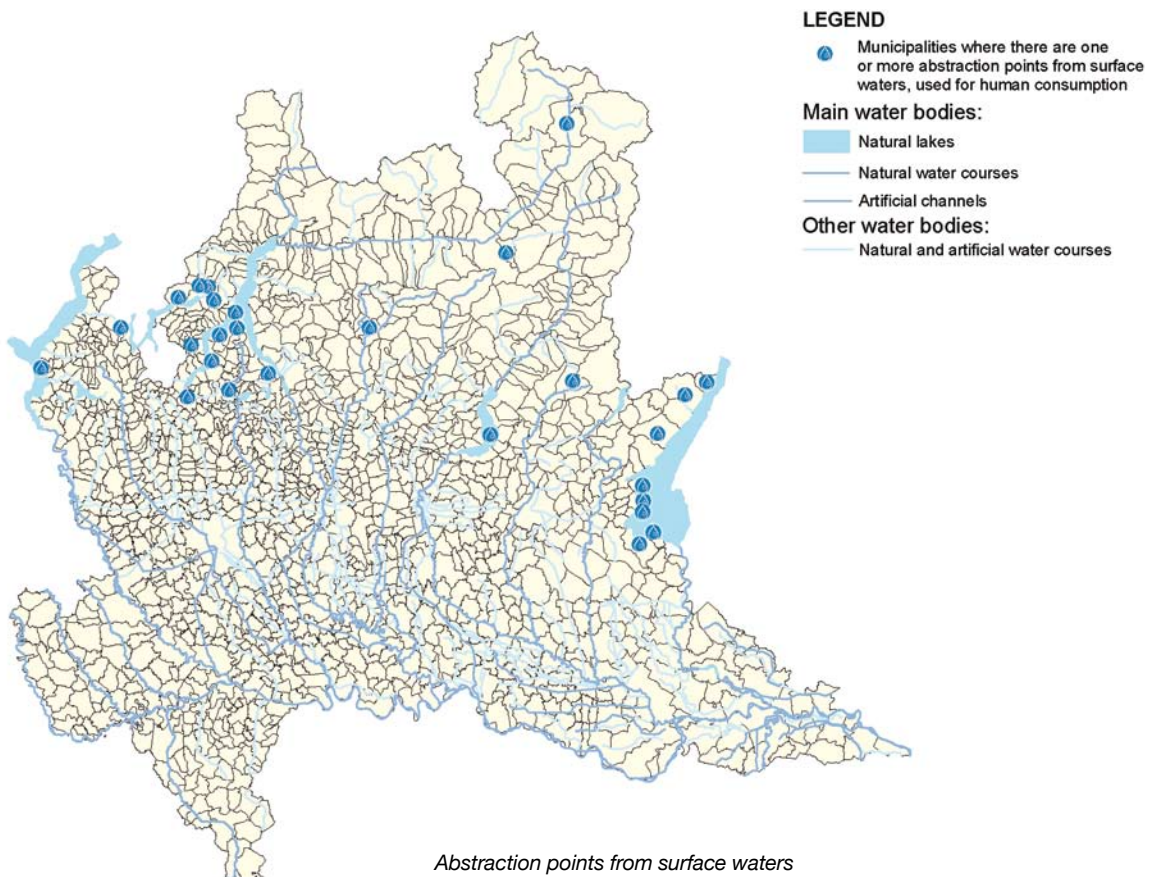


Fig. 1.5

Abstraction points from surface waters

2. Drinking water supply from groundwater

Groundwater, especially if deep, has a very low risk of microbiological contamination by pathogens, and disinfection mainly aims at preserving water quality on the long way water runs once on the surface, after abstraction. In the upper plain, groundwater from the most superficial aquifers is often polluted by solvents, chromium and hydrocarbons (see red dots in figure 1.6). These pollutants can only be removed by treatments based on activated carbon filtration, stripping columns and reverse osmosis. About 70% of the drinking water distributed in Milan has been treated in this way. These kinds of treatment plants are also very common in the Milan hinterland area. Nitrate contamination is another frequent occurrence in the upper plain. Nitrates are a kind of organic pollution either linked to diffuse loads from livestock or sewage leaking and spreading into the soil (see yellow dots in figure 1.7). Nitrate contamination practically never exceeds the levels set by law. And when nitrate concentration is below legal limits, it can be easily removed by mixing water coming from a different source.

The best quality water can be found in the central area of the plain. In the lower plain, following a series of contaminations caused by plant protection products in the 80s and 90s, progressively deeper aquifers have been used as sources of water supply. The natural chemical composition of this water, however, is not particularly suitable for potable use: ammonia and arsenic can be found in addition to undesired elements such as iron and manganese responsible for blackish and rusty streaks on sanitary ware users are certainly not happy with. The process to remove arsenic is complex and expensive. In Lombardy region, there are already several arsenic-removal plants so the arsenic concentrations in distributed water comply with the strict European regulations on this matter.

Fig. 1.6



3. Sources of natural mineral water

This region hosts several mineral water sources approved by the Ministry of Health. A number of springs and bottling facilities are located in the mountain area (Figure 1.7).

Assessing natural mineral water features means considering a series of aspects: water geological, hydro-geological, organoleptic, physical and chemical, microbiological and possibly pharmacological and clinical features.

All Lombard natural mineral waters can be classified as low mineral content water, with very low sodium content and therefore suitable for low-sodium diets. As most of them have a mineral component due to calcium bicarbonate, they are considered “hard” (in terms of average dry residue) though they stimulate digestion. Just true alpine water does not show this feature and its dry residue is very low.

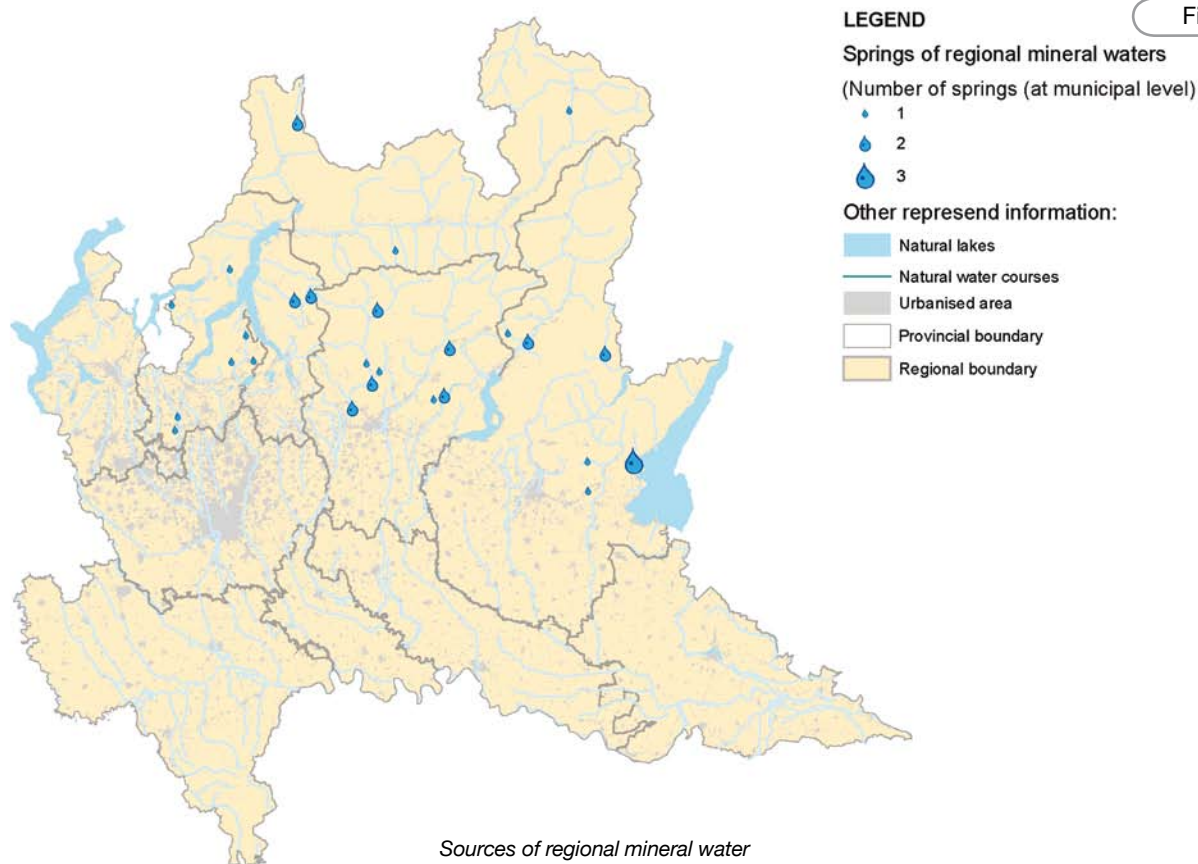


Fig. 1.7

Natural mineral water

Natural mineral water is a type of water that – depending on the time it gets in contact with the rocks it percolates through and depending on rock mineral and chemical features – has acquired a particular chemical composition and has become suitable for therapeutic purposes. All spring waters have their own properties and therefore they can be used for different treatments, in different ways.

On account of the above-described process, mineral waters are classified in Italy among subsoil assets, as mineral but renewable resources. As a result, this is a public property no longer freely available. Until 1970, mineral waters were a state property, then they became inalienable property of the Regions and can only be exploited under licence (see Regional Act No. 44, dated April 29th, 1980). Therefore, marketing of mineral waters must be authorised. Companies must obtain a concession first to search for a mineral water source and then, after evaluating water quality, quantity and suitability for exploitation, to move to the industrial phase, i.e. extraction, bottling and selling.

With the Regional Act No. 1/2000 (article 2), Lombardy Region has delegated its administrative competence on research, exploitation and licence. For some time now, Lombardy Region has also fixed a tax to be paid on bottled water quantity, which is in line with European directives on water even though it is not envisaged by the national legislation. This tax is levied by the Provinces and is used to finance suitable measures to protect mineral water basins and improve knowledge on water sources and their vulnerability (see Regional Executive Resolution No. 8/2600 dated May 24th, 2006, on “How to use concession fees paid relating to natural bottled mineral waters and/or thermal waters: a directive addressed to the Province”).

Natural mineral water must be recognised as such by the Ministry of Health before being marketed. Such recognition is granted after evaluating geological surveys, bacteriological analyses and physical and chemical analyses, as well as clinical and pharmacological tests, in accordance with Legislative Decree No.105 of 1992 that has incorporated the European legislation on the matter (EEC Directive No. 80/777/CEE). Marketing must be authorised either by the Region or Province after on-site inspections and controls on abstraction points, facilities and industrial plants.

By definition, natural mineral water originates from groundwater, is bottled at source, maintains its original bacteriological purity and stable chemical properties and it may have beneficial effects on health. Mineral and thermal waters (under Italian law, the difference lies in the presence of certain substances and consequently in its final use) can be classified according to the various parameters (therapeutic, chemical, physical and physico-chemical properties).

Depending on their chemical composition (deriving from a long, underground ‘self-filtering’ process through mainly calcareous and siliceous rocks), natural mineral waters may show different values of “dry residue” (corresponding to the quantity of salts obtained after water evaporation at 180°C) and they are thus classified as slightly mineralised, low in mineral content or rich in mineral salts. Italian regulations are particularly detailed and accurate and regulate all bottling-related activities.

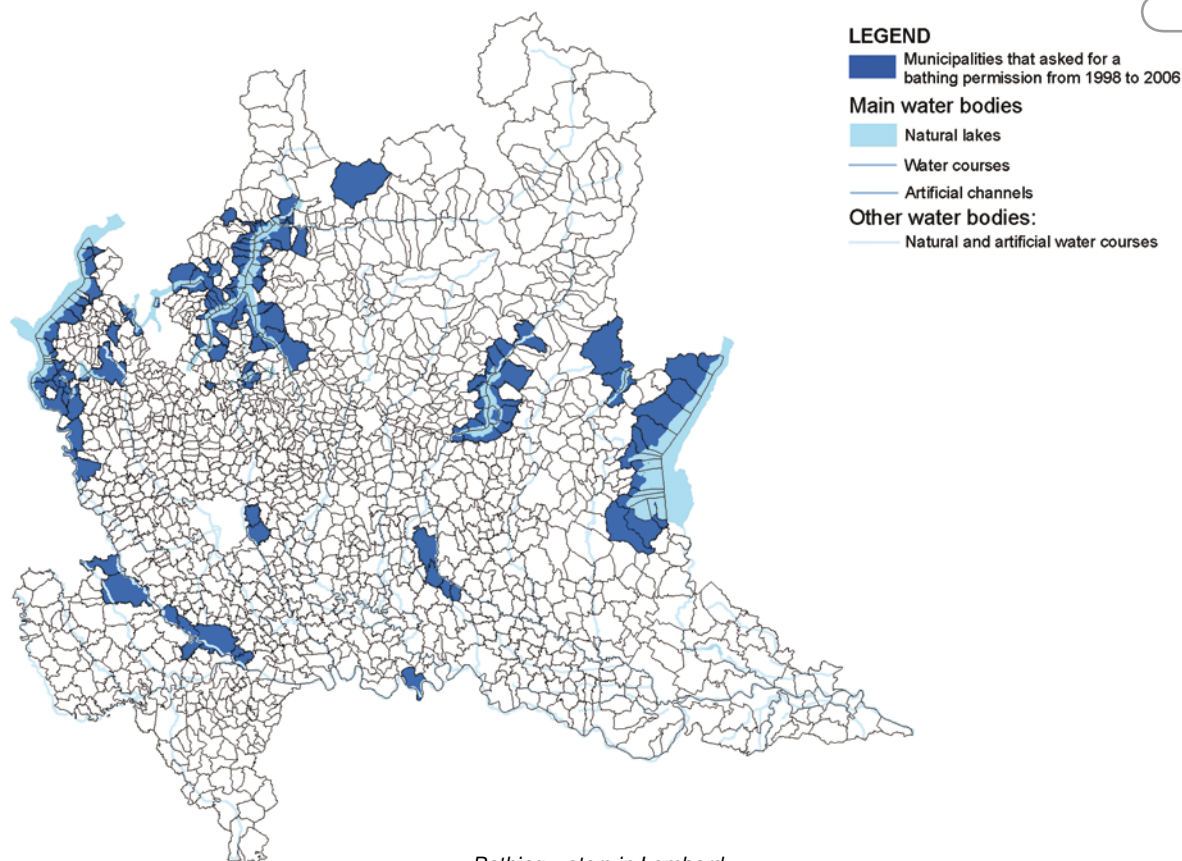
As for health-related properties, they must be confirmed by clinical and pharmacological experimentation by officially acknowledged hospitals or universities and their wording on labels must be in accordance with legal provisions.

Water used for bathing purposes must meet the requirements laid down in the European regulations that indicate not only the parameters to control but also timing and procedures of sample collection. If a site proves to be unsuitable for bathing two seasons in a row, monitoring is suspended until improving measures are taken to remove the sources of pollution. Moreover, Italian law has implemented the EU directives on this matter in a restrictive way: the European directive introduces an intermediate category of bathing waters, of borderline “sufficient quality”, that is not provided for in Italian regulations, excluding it a priori.

In Lombardy region, several parts of lake shoreline are checked for bathing purposes (*Figure 1.8*). Data regarding the suitability of individual points are not very meaningful as they are linked to local circumstances but they can greatly help define the necessary measures to be taken to remove the sources of pollution. The results of all samples and tests carried out in various areas of a water body may provide a more accurate description of its quality. For each water body, the number of monitored areas is indicated along with the number of sites suitable for bathing and the relevant percentage on total requests.



Beach of Pavia



Bathing waters in Lombardy

Bathing

In Italy, bathing is currently regulated by Presidential Decree (DPR) No. 470/88 that has transposed European Directive 76/160/EEC on bathing water quality. The new European Directive 2006/7/EC has been recently approved and aims at harmonising and simplifying the various national laws currently in force in Member States.

At present, 12 parameters are to be monitored to meet bathing requirements in Italy (Directive 76/160/EEC included 19 parameters). Out of these 12 parameters, 5 are biological (total coliforms, faecal coliforms, streptococci, salmonella and enterovirus – the last two parameters being searched for only upon request of the controlling authority, when suspecting their possible presence in particularly critical situations), 5 are chemical and physical (including pH value, oxygen saturation, phenols, mineral oils and surfactants) and 2 refer to water colour and transparency.

Unlike other European countries, when transposing Directive 76/160/EEC indicating for each parameter both a guide value that can be regarded as a quality objective to achieve and a mandatory value to strictly comply with, Italy has adopted most precautionary measures by enforcing a single value that is often much stricter than the European mandatory value.

Bathing criteria laid down by Regional Law No. 470/88 are rather complicated and variable. Waters are usually classified as suitable for bathing when they are continuously compliant: in general, bathing is not automatically banned when a single water sample fails to meet quality requirements. Bathing is temporarily forbidden only when at least other two samples of the 5 the laboratory in charge has to take, give unfavourable results. If a site proves to be unsuitable for bathing two bathing seasons in a row, monitoring is suspended until measures are taken to remove the sources of pollution.

Directive 76/160/EEC is still in force but will be repealed by the end of 2014. Meanwhile, it will be gradually replaced by Directive 2006/7/EC which became effective in March 2006 and shall be transposed by all Member States by March 24th, 2010.

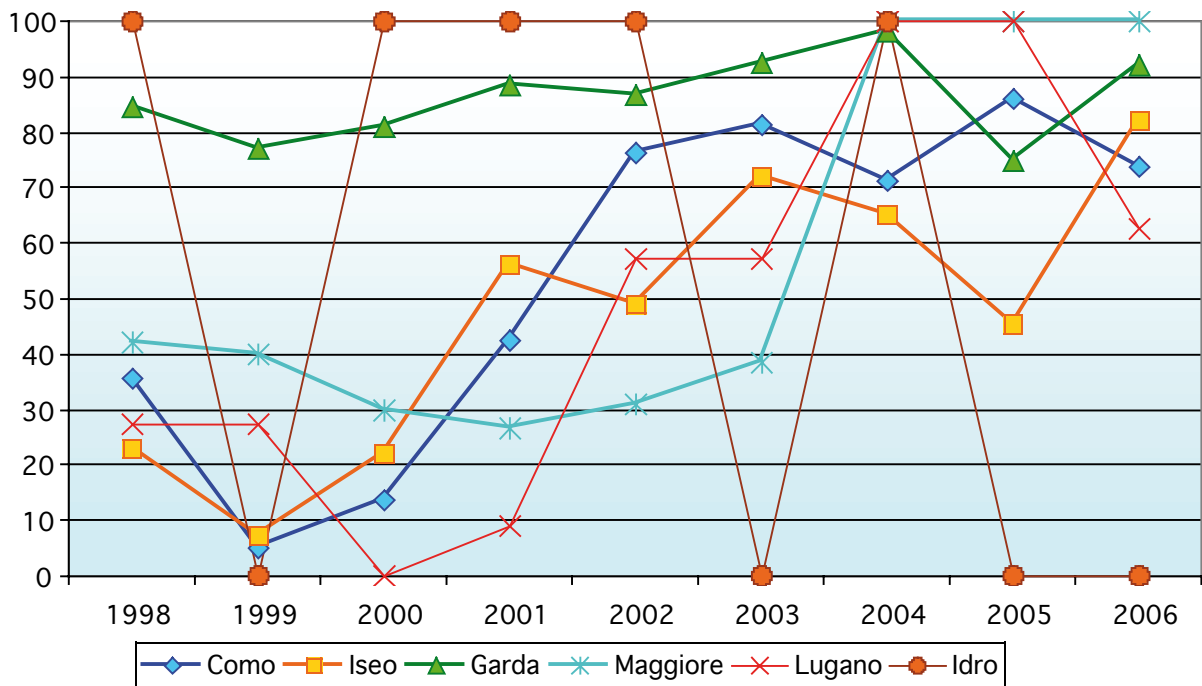
The new European directive is based on the latest epidemiological studies and researches carried out by World Health Organisation and aims at reinforcing the principle of bathing water management by introducing a water “profile” (to be established by March 24th, 2011) which defines and analyses possible sources of pollution that may jeopardise water quality.

Also this directive complementing directive 2000/60/EC is public-oriented. Member States must inform the general public about the quality of bathing waters and give people the possibility of getting access to information processes and participating with their comments or suggestions. According to this directive, bathing waters are divided into 4 quality levels: excellent, good, sufficient and poor, following just two reliable bacteriological parameters – intestinal enterococci and *Escherichia coli*. Quality classification is based on threshold values and percentile evaluation. Besides these two main parameters, additional investigations are laid down by the directive when there is a potential for proliferation of cyanobacteria, macroalgae and phytoplankton, in order to limit risks for bathers. Moreover, adequate management measures must be taken when through visual inspection, tarry residues, glass, plastic, rubber and any other waste are found.

In Italy, this directive has only been partially transposed by Legislative Decree No. 94/2007, which has cancelled dissolved oxygen from those parameters used to assess quality level of bathing water.

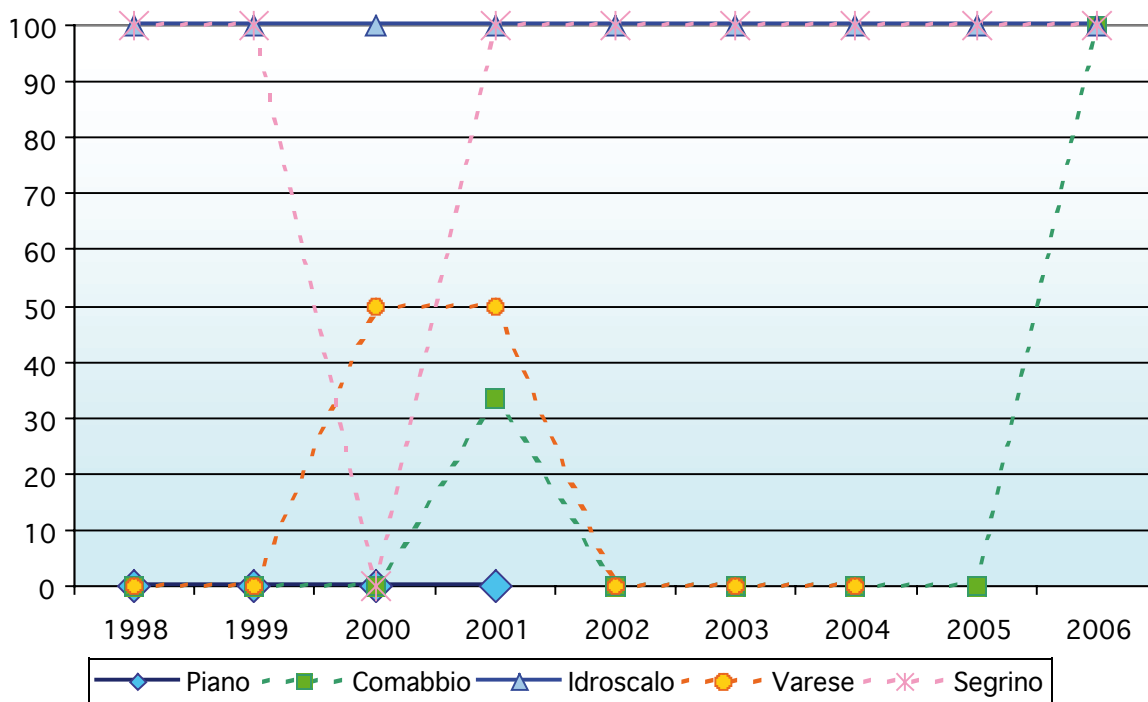
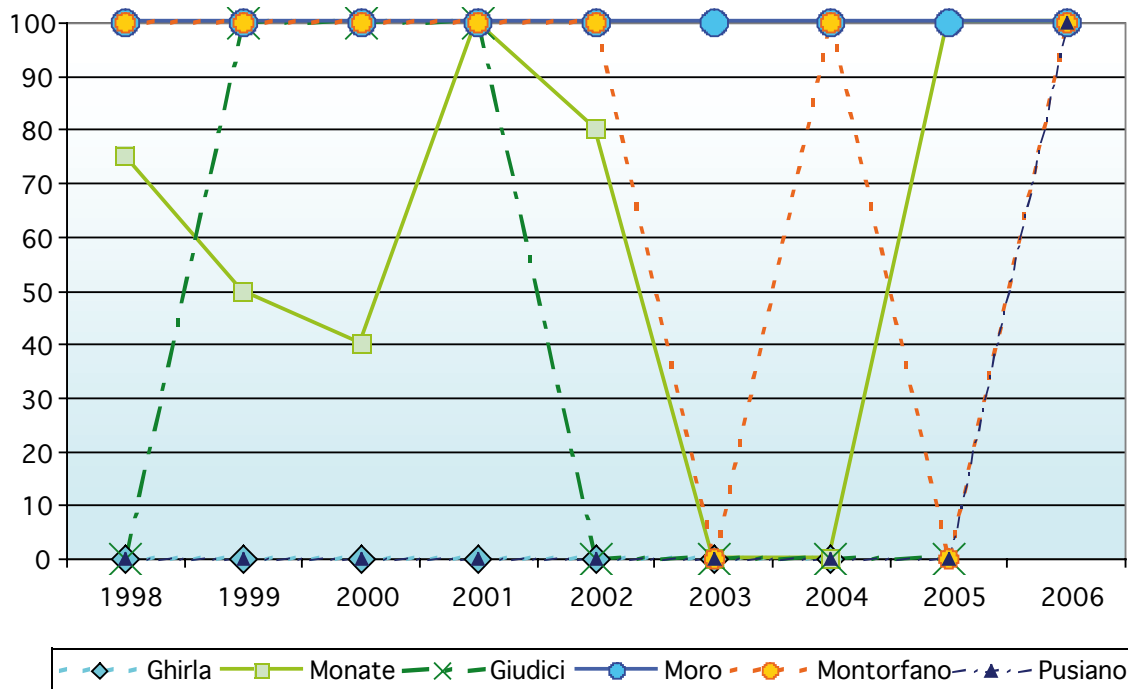
Data show an undisputed improvement trend in bathing quality of all major lakes (Figure 1.9). Lake Garda is the best with over 70% of bathing sites and a positive trend over the last 4 years. After a slight decrease in the years 2000 and 2001, the number of Lake Maggiore bathing sites is now slowly increasing. Lake Como and Lake Iseo showed a remarkable improvement in the period 1999-2003 when the percentage of bathing sites rose from less than 10% to over 70%. After the lowest score in the year 2000 (no bathing site at all), Lake Lugano has recorded an increase in compliant sites, up to over 50% in the last two years. Analytical data on Lake Idro show a very swinging trend with values ranging from 100% to 0%: all monitored sites proved to be suitable for bathing in the years 1998, 2000, 2001 and 2002 but not in 1999 and 2003 (a pH value higher than 9 in most of the water samples was the impairing factor in both years). The situation of small lakes is slightly different and the percentage of bathing sites is on the increase (Figure 1.10). In some cases, these smaller water bodies maintain their suitability for bathing at long term while in others, after a single flood event, bathing and in general water quality can only be restored after a whole year.

Fig. 1.9



Data trend regarding bathing about the main regional lakes

Fig. 1.10



Data trend regarding bathing about other regional lakes

To complete the overview on water resources to be protected in Lombardy region, thermal water must be mentioned. It is produced by geo-thermally heated groundwater, rich in mineral salts taken from the rocks it has percolated through, which reaches the surface as steam or hot water. Depending on the original composition and solubility value of the rocks it has run through as well as time and distance, thermal water changes its chemical composition (mineralisation level) along the way.

Thermal water is classified according to various parameters (therapeutic, chemical, physical and physico-chemical properties).

Depending on saline composition, thermal water classification includes: arsenical or ferruginous water, saline water (if containing sodium chloride), sulphurous water (with various combinations of sulphur), bicarbonate water, carbonic water, bromo-iodine salt water or radioactive water (if minimum traces of elements such as radon are found).

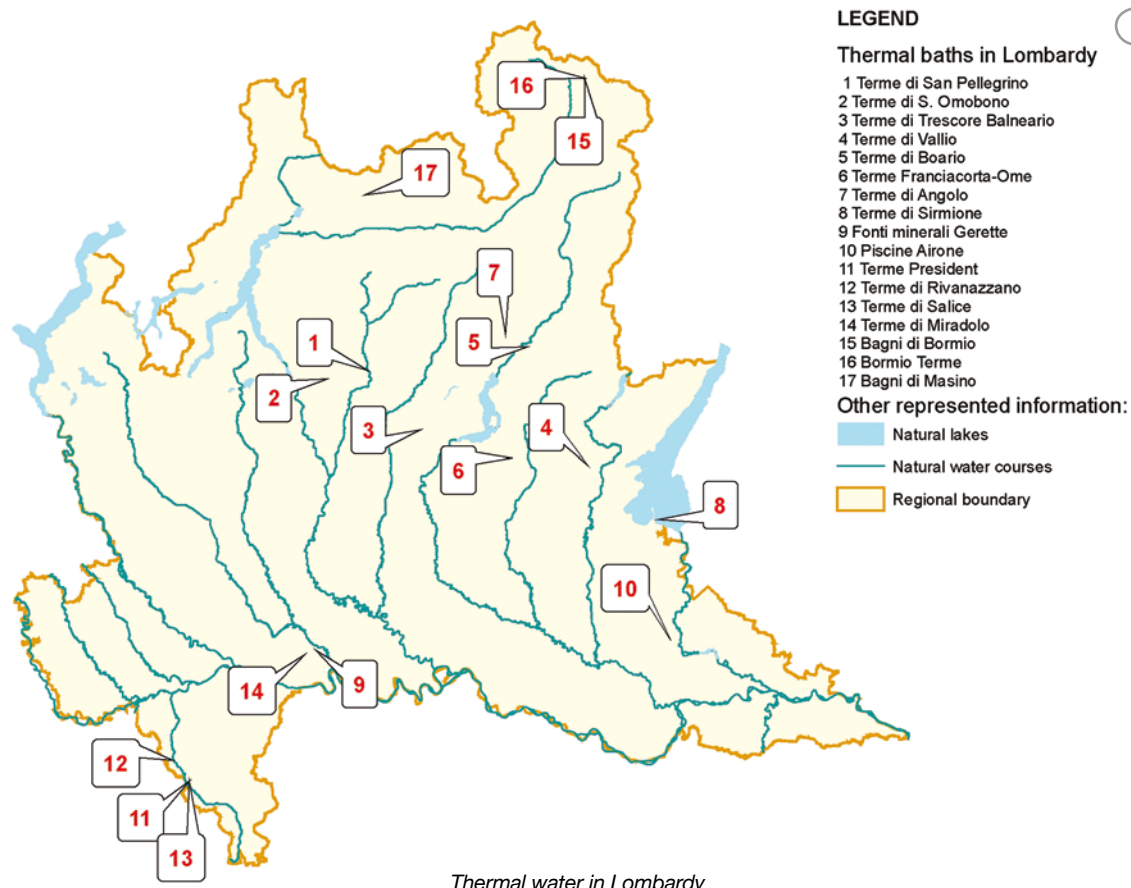
In particular, bicarbonate thermal water from calcareous rocks and sulphur-rich water can be found in the Lombard alpine and pre-alpine areas, whereas highly mineralised water rich in sodium chloride and other minerals as well as sulphurous water are very common in the Po river valley.

Based on the above classification, Lombard thermal water can be used for drinking, irrigation, bathing, inhaling or other therapeutic uses associated with other mineral or organic substances (*Figure 1.11*).

Water basins supplying hot springs are often located in the most marginal mountain areas and therefore naturally protected. However, the creation of infrastructure or territorial changes may jeopardise thermal water flow which must therefore be kept under observation.



Lake Iseo



Thermal water

In the Mediterranean basin, the use of thermal water in hydrotherapy was known in ancient times, as evidenced by archaeological finds, literary and scientific writings as well as many epigraphs.

The ancient Greeks used to take baths in hot water and they thought that hot water and steam coming out from the ground had a supernatural meaning.

It is no accident that famous temples stood in thermal places, such as the Olympia temple and the well-known Apollo temple in Delphi, where Pythia, shrouded in fumes, used to prophesy the future with mysterious words.

The ancients thought that the presence of Gods explained the therapeutic effects and typical properties of thermal waters. Hippocrates himself promoted the use of thermal baths and in his treatise "The Use of Liquids" he sang the praises of mineral water and hot spring properties.

The Romans exploited water both for hygienic and healing purposes, until bathing turned into a refined pleasure. So thermal baths became a meeting place just like the forum, and walks, parks, gardens, museums and libraries were built around the establishments.

The fall of the Roman Empire, facilities falling into decay, the strengthening of the Christian religion recommending to avoid taking earthly pleasures and visiting places other than churches, led to the decline of thermal baths as a social and cultural event.

During the Middle Ages, thermal baths were exclusively used for therapeutic purposes. In this period scientific research on the benefits of hydrotherapy was mingled with empirical and popular beliefs associating a particular thermal water to a specific effect.

From the 16th century on, thermal places slowly changed from healing into leisure centres thus attracting people from all parts of Europe and taking the shape of real resorts. This had an impact also on the architectural features of these resorts where mansion houses, hotels, parks, gardens were built. In modern times, thermal therapy was characterised by an innovative approach to experimental research on treatments which were, however, only available to a restricted 'elite' of users.

During World Wars I and II, the number of guests in thermal resorts dropped significantly and rose again in the post-war period when thermal therapies became affordable also to common people thanks to recognition and support by the National Health Service.

Thermal water is classified according to various parameters: general characters (colour, smell, taste, clarity, colloids), chemical and physical analysis (temperature, density, refraction index, freezing-point depression, osmotic pressure, pH value, conductivity); chemical analysis (dry residue at 100°C, at 180°C, ammonia, nitrites, nitrates, oxygen, hydrogen sulphide, H₂S content per litre, hardness, alkalinity, arsenic, ozone, catalytic action, benzidine hydrochloride reaction, gas).



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2

Water: an important resource to be managed



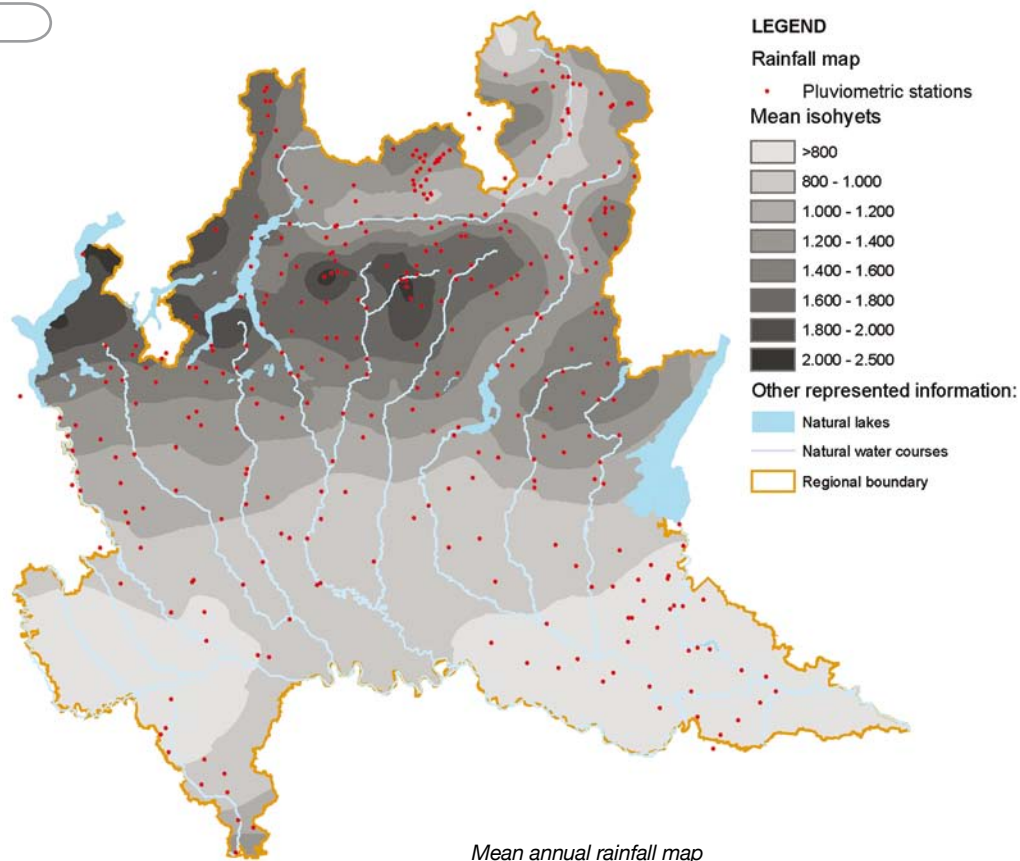
1. The favourable situation of the region

The regional area is around 24,000 km², with 42% covered by mountains and 13% by hills. Mean annual precipitation is about 1000 mm/year – a value that varies a lot within the region, with peaks exceeding 2000 mm/year in Varese area, basin of Lake Maggiore and Orobic ridge (*Figure 2.1*).

Volume of average annual flow deriving from rainfall is thus around 27 billion cubic metres. To this amount, we have to add a volume of water reserves (meant as non-renewable resources) stored in the region of approximately 120 billion cubic metres in lakes, around 500 billion cubic metres in groundwater and about 4 billion in alpine glaciers. Annually-renewable precipitation volume is the real resource as it can be used again and again. Additional volumes are regional reserves, i.e. the amount that in a sustainable development context should be harmoniously preserved for future generations and thus maintained or restored when used.

Unfortunately, some water reserves are difficult to preserve: for many years now, alpine glaciers retreat

Fig. 2.1

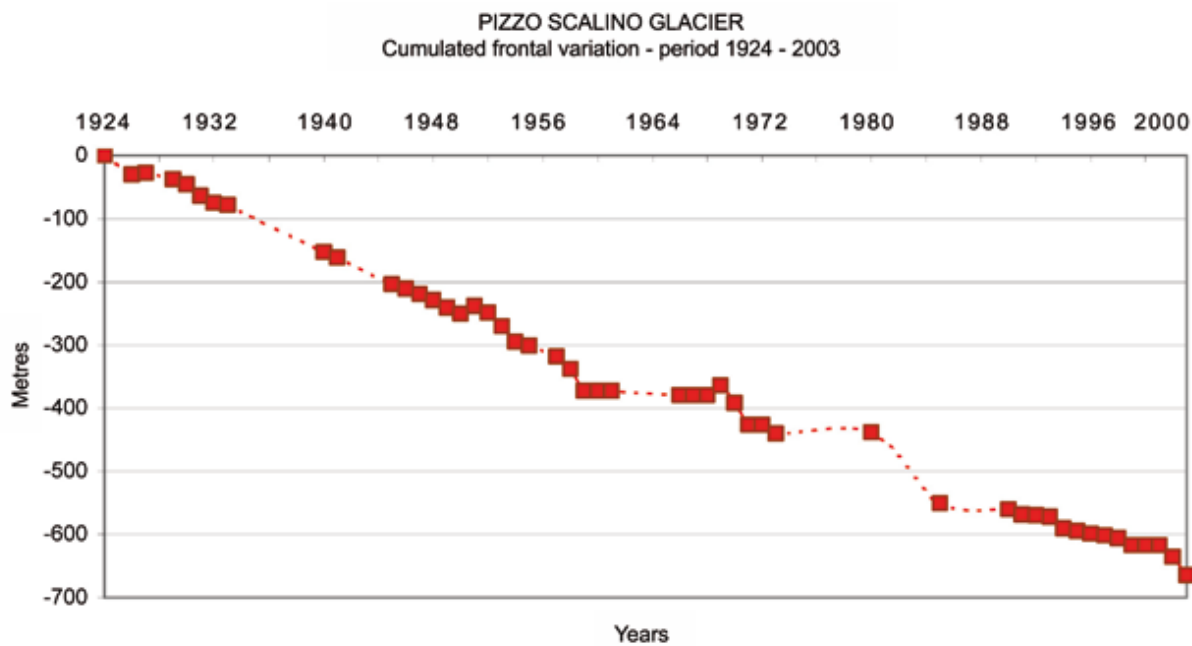


and actions to control such phenomenon are very complex (Figure 2.2). In the alpine area, the Swiss Advisory Body on Climate Change (OcCC) estimates a 75% reduction in the glaciated area by 2060. In Switzerland, possible actions are tested where protective synthetic sheets cover the glacier. However, this type of action is only justified when protecting infrastructure that could be damaged by melting-caused instability.

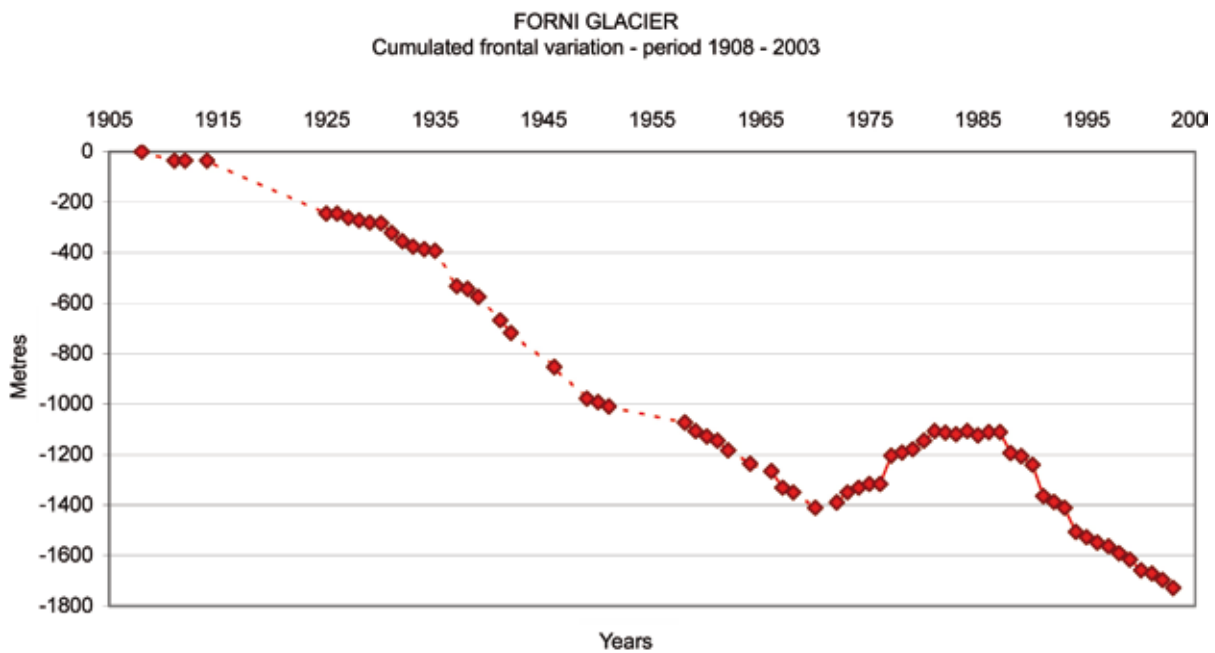
Undoubtedly, the greatest importance must be given to management of lake water and groundwater – an inestimable heritage and richness for our region.

Measuring precipitation amount in relative terms and not only in absolute terms, is also of use (Figure 2.3). The alpine area is frequently surveyed with respect to the surrounding areas. It is the most rainy area in the Eurasian

Fig. 2.2



Frontal variations (time-distance curve) of Pizzo Scalino glacier from 1924 to 2003

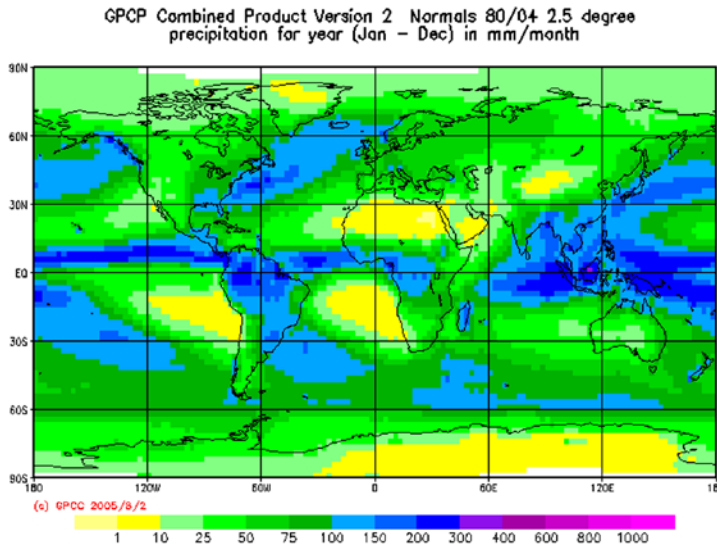


Frontal variations (time-distance curve) of Forni glacier from 1908 to 2003

(Source: Progetto Kyoto Lombardia)

continent, with the valuable contribution by snow as a “frozen” volume – not only in a metaphorical sense – that is made available over a long period of time instead of flowing rapidly away. In a reference system on an European scale, we clearly observe that the central area of Alps features heavy rainfall, thus favouring the development of one of the richest agricultural areas in Europe (Figure 2.4).

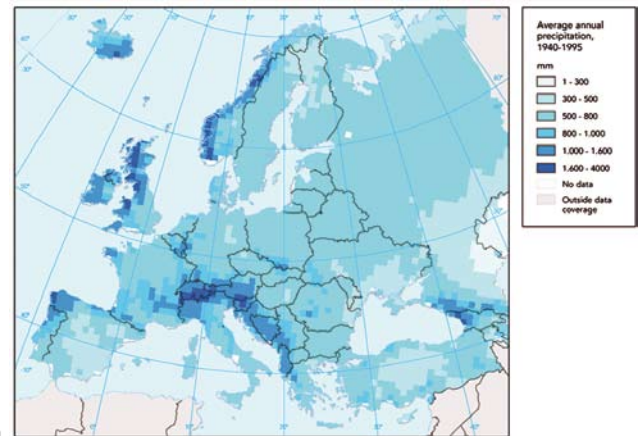
Fig. 2.3



Global distribution of rainfall

(Source: Global precipitation climatology centre)

Fig. 2.4



Mean annual rainfall in Europe

(Source: Global precipitation climatology centre)

2. Climate changes

Evidence for global climate change is now generally shared. Historically, climate has already changed several times and important past civilisations probably collapsed because of the difficulties to adapt to new scenarios. For this reason, together with initiatives to minimise the anthropogenic impact leading to climate deterioration, priority is to be given to implement a strategy for adaptation to changes and passage to new scenarios.

In some Countries – first of all EU Member States – institutions and communities are preparing themselves to face

Climate in Lombardy region

The economic development in Lombardy Region is strictly related to its outstanding water resources. This is a story that originates with the Etruscan population settling in the region and first embanking Po river and Oglio river to protect fertile land from major river flooding. These first activities are then enriched and defined by Roman land division (centuriation) that makes slopes more regular and favours water flow. Then, a true “hydraulic civilisation” of monastic origin establishes itself between the 11th and 12th centuries, during Middle Ages.

The enormous effort to control, restore and manage available water quantity has involved generations of technicians who studied and came up with a number of alternative solutions. Some solutions were implemented, others were left behind or pending. Some solutions are impracticable today, others could be reconsidered. In other words, Lombardy region has an incredible heritage – water, canals and ideas on how to develop and manage water resources.

However, in Lombardy region the water use system has been fully organised during the last 1000 years – a period featuring a cold humid climate and called “Little Ice Age”. Irrespective of the factors responsible for the climate changes we have been experiencing over the last 10 years, it is obvious that, in a not too remote past, even Lombardy region went through different climates. And during the period coming before the “Little Ice Age”, known as “Medieval climate optimum”, it is believed snow and ice accumulations were no longer present on the southern side of the Alps – a valuable resource for water supply to alpine streams during summer.

At our latitudes, apart from warming phenomena, there is evidence of a general reduction in precipitation and consequently of a decrease in water resource availability for traditional uses. This trend turns into a concrete situation where dry seasons came one after another over the last years, starting from the year 2000. Therefore, considering a general increase in demand linked to increased public uses (bathing, navigation, fishing) also due to life quality improvement, regional water availability – even though considerable – actually becomes insufficient.

Scientific evidence of diminished water availability is a constant aspect during the last years. Climate changes are now hard to deny and their effects on future water availability require that we review water use logic consolidated when many sources of supply were available and water resources were thought to be endless.

this challenge, by setting up policies to adapt structures and life styles to environmental and territorial changes that will undoubtedly occur.

The main effect of the climate change under way refers to temperatures: in Italy, since the 80s, average annual temperatures have continued rising (Figure 2.5). This rising trend seems to confirm data on a global scale, as well as longer-term world trends.

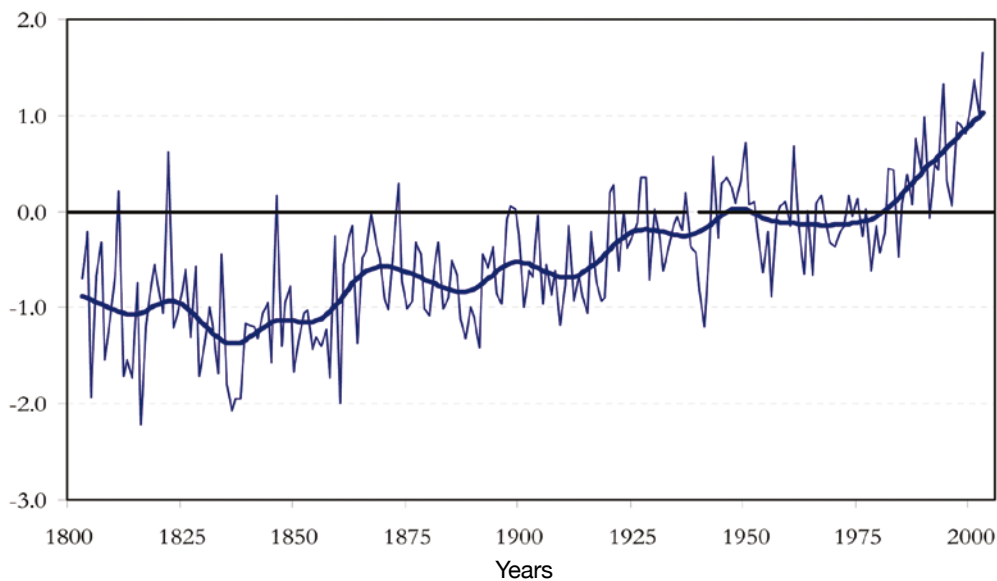
A correct definition of the precipitation trend seems to be more difficult as significant quantity variations are argued not to have occurred yet. However, a shared opinion is that storm conditions heavily changed (Figure 2.6), with a manifest rainfall concentration in autumn periods.

When dividing up the region in various areas, different and not fully homogeneous trends come up (Figure 2.7). In the entire region, there is a clear reduction in precipitation with respect to long-term averages in winter and spring periods, while the summer period features a more complex trend and autumn shows an increase in precipitation practically all over the region. Over the last years, the trend has been mainly characterised by impressive and concentrated events that produced important flood conditions, with huge mass of water moving through rivers and rapidly reaching the sea. Snowfall has decreased all over the Alpine region. With such a rapid water run-off and poor snow storage, it is unlikely to have the right conditions for groundwater recharge and lake basin replenishment – groundwater and lake basins representing water reserves.

Therefore, we have to assume that even though regional water flow is not experiencing a sharp reduction, seasonal variation in precipitation patterns will anyway lead to a crisis in water use system the Lombardy Region have developed over centuries, because of different climate conditions.

In Lombardy region, water use system has been fully organised during the last 1000 years: the whole period featured a cold humid climate also described as “Little Ice Age” that followed a period know as “Medieval climate optimum”, during which it is believed snow and ice accumulations were no longer present on the southern side of

Fig. 2.5



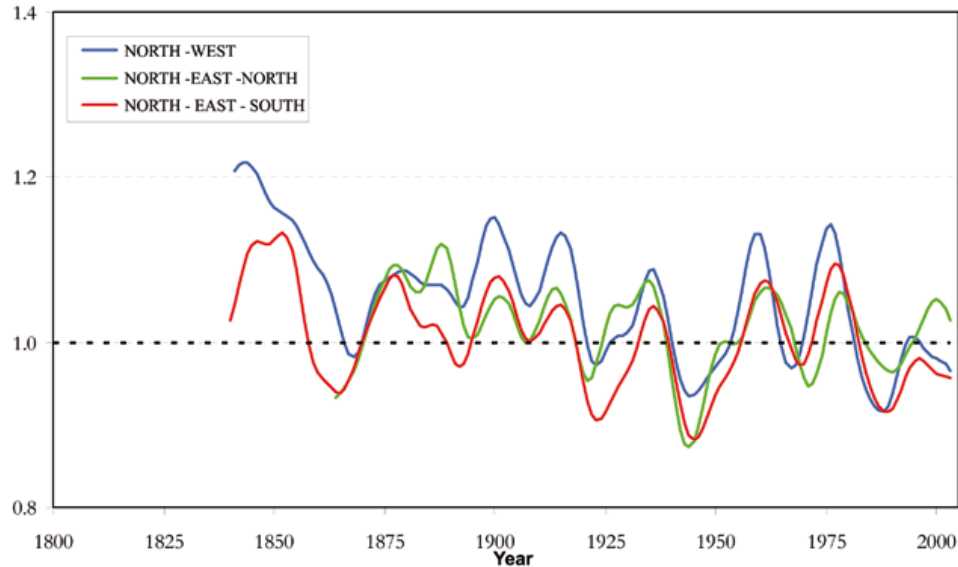
Mean annual temperature of the period 1803-2003 concerning the Italian mean series. Data are expressed as anomalies in comparison with the period 1961-1990. (Source: “Progetto Kyoto Lombardia”)



Mud cracks – shore of Po river

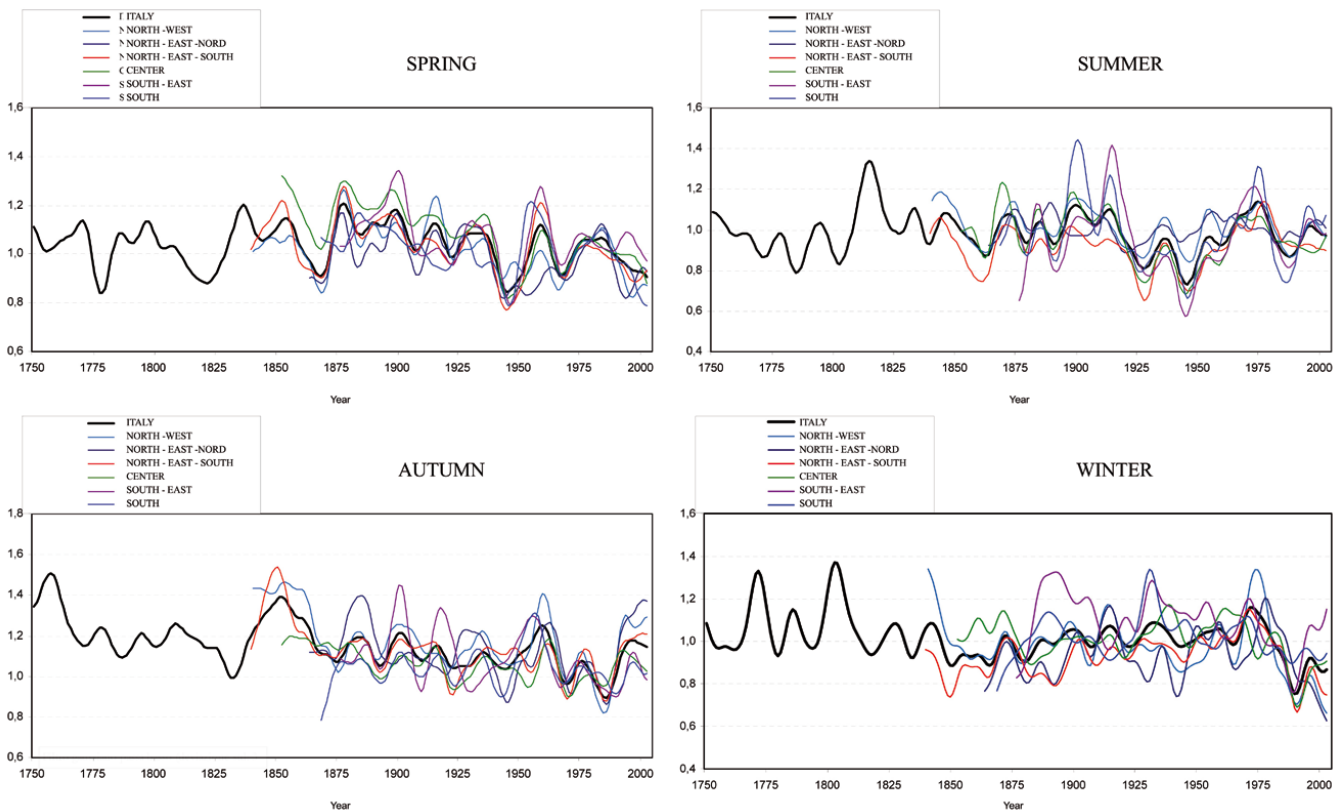
the Alps – a valuable resource for water supply to alpine streams during summer. Climate changes will have an impact on future water availability within our region and so reviewing the logic of water use is required as the system consolidated when many sources of supply were available and water resources were thought to be endless.

Fig. 2.6



Annual rainfall series concerning three areas (NW, NEN, NES) of Padana plain. Data are expressed in comparison with the mean values of the period 1961-1990. The NEN area represents Lombardy region. (Source "Progetto Kyoto Lombardia")

Fig. 2.7



Annual rainfall series concerning six stations representative of the region. Data are expressed in comparison with the mean values of the period 1961-1990. (Source "Progetto Kyoto Lombardia")

3. Prospects for water storage

Considering that water availability will remain substantial in time but water supply will concentrate in limited periods of time, it is essential to store water during its maximum flow and make it gradually available during the long period coming after.

This is again peculiar to the water management system that have been developed over the years.

The large lakes located in the Lombardy region have always been a natural flood control reservoir system, i.e. basins that reduce peak flood flows of watercourses upstream of the lakes. During a flood event, the lake area is an ideal flood retention area, with a non-excessive level rise. This function was exploited over the last century: large Lombard lakes became huge flood storage basins and through a complex regulating system – yet based on simple principles – they have supplied controlled flows during low water periods to support main uses downstream.

Over the last century, all barrage works to dam up lake basins were built, in order to regulate water levels along the shoreline.

As a whole, controlling large lakes means regulating about 1.2 billion cubic metres of water that we can make flow in

Level management in large lakes

The large lakes located in Lombardy and neighbouring regions have always been a natural flood control reservoir system, i.e. basins that reduce peak flood flows of watercourses upstream of the lakes. This function was exploited over the last century: large Lombard lakes became huge flood storage basins and through a regulating system based on simple principles, they have supplied controlled flows during low water periods to support emissary water uses.

Thanks to lake level control, the water quantity that can be stored within lake surface variation limits is made available according to users' needs. Generally, this implies filling the lake in the periods of most abundant flow (spring and autumn) and emptying it in the periods of low water (summer and winter).

Lake name	Lake surface (km ²)	Catchment basin surface (km ²)	Max level (m. above sea level)	Min level (m. above sea level)	Max volume (Mm ³)	Lake total Volume (Mm ³)	Max depth (m)	Perimeter (km)	Water change time (years)	Level control started in
Como (Lario)	145	4508	198,59	196,89	247	22500	425	170	4,5	1946
Garda (Benaco)	368	2360	65,78	63,98	666	49031	350	165	26,6	1951
Idro (Eridio)	11,4	617	369,25*	366,00*	35	684	122	24	0,99	1923
Iseo (Sebino)	61	1785	186,25	184,85	85	7600	251	63	4,1	1933
Maggiore (Verbano)	213	6599	194,37	192,37	420	37500	370	170	4,1	1943

* referred to Idro water-gauge values.

Level control is managed by dedicated bodies, with different legal status according to when level regulation started, acting according to the provisions of the concession contracts. A general feature of these bodies (almost all of them) is that of representing those users who are authorised to use emissary water (for irrigation or hydroelectric power production) and of including representatives of interested state ministries. Usually, also lakeshore and emissary local bodies (municipalities and provinces) are represented. Instead, Regions (which since 2002 are in charge of managing the public water domain) are almost never represented, since they did not exist when these bodies were set up during the 30s. The role of the users having a concession to use the water of emissaries benefiting from lake level control is important, because, generally, they pay the running expenses of the level regulating body and also because in periods of severe water shortage, when it is necessary to agree on the management of available water on a daily basis, the meeting of the demand for irrigation water in summer depends on the co-ordination of downstream uses. Over the last few years, lake level control bodies have had (and been able) to take up responsibility for new environmental needs linked to level control – we do not have to forget that practically all emissaries from controlled lakes are river parks – and also to the needs of the people living on the lake shores, who, following the start of important tourist activities, are becoming increasingly demanding in terms of keeping the level required for navigation and guaranteeing shore quality for bathing.



Lakes of Segrino

Dams and reservoirs

Lombardy Region – through its Territorial Offices – is competent for project approval, control on construction works, testing and surveillance on operation of small dams, i.e. those dams that are up to 15 m high and with a reservoir capacity up to 1 million cubic metres (Regional Act No. 8/98). To date, in Lombardy region there are about 600 barrages and storage basins that can be defined small dams. Reservoirs are mainly used for hydroelectric power production in Bergamo, Brescia, Como and Sondrio Provinces, while they are mainly used for irrigation in Pavia province, namely with earth dams.

The Italian National Dam Office (Registro Italiano Dighe) is instead in charge of “large dams”, i.e. those dams with greater height and reservoir capacity.

Lombardy Region was the first in Italy to adopt an “Administrative Regulation” on small dams in 1986, following Val di Stava tragedy (Trentino), and to pass a law on “small reservoirs” in order to guarantee public safety, in particular for the population directly concerned by works, as well as territorial preservation and safety. At the same time, rules were prescribed for design, surveillance and control on existing or future barrage works.

The experience on assessing projects gained by Lombardy Region in 1986-2000 period, led in March 2001 to the approval of directives to implement the regulation, in order to have clear guidelines for project approval and construction, operation and decommissioning of small dams, as well as to favour the assessment “on a case by case basis, with respect to dam technical features” provided for in case of small dams by the Italian National Regulation for dams since 1931. The directives concern both the construction of new works and existing reservoirs: they are guidelines for technical orientation to guarantee their being in safety conditions. As a matter of fact, from the technical and administrative point view, Lombardy Region has been mainly involved not in assessing projects for new dams but in regulating existing small dams, handed over by the State – Ministry for Public Works.

With Regional Act No. 8/98 and the Directives, we also introduced the “risk” concept in works, which is useful to identify dams subject to expedited approval and to scale surveillance requirements during operation.

Today, the construction of major works is strongly conditioned by growing environmental awareness, as for the impact these works have. This is the reason why when applying for water use concessions, the constructions of dams with considerable capacity is rarely envisaged, to minimise impact on environment and landscape.

the quantity needed and in due time.

Besides this storage opportunity, the regional mountain area hosts a series of reservoirs that are managed for hydroelectric power production purposes and can hold water at a higher altitude, thus further slowing down overland flow (*Figure 2.8*).

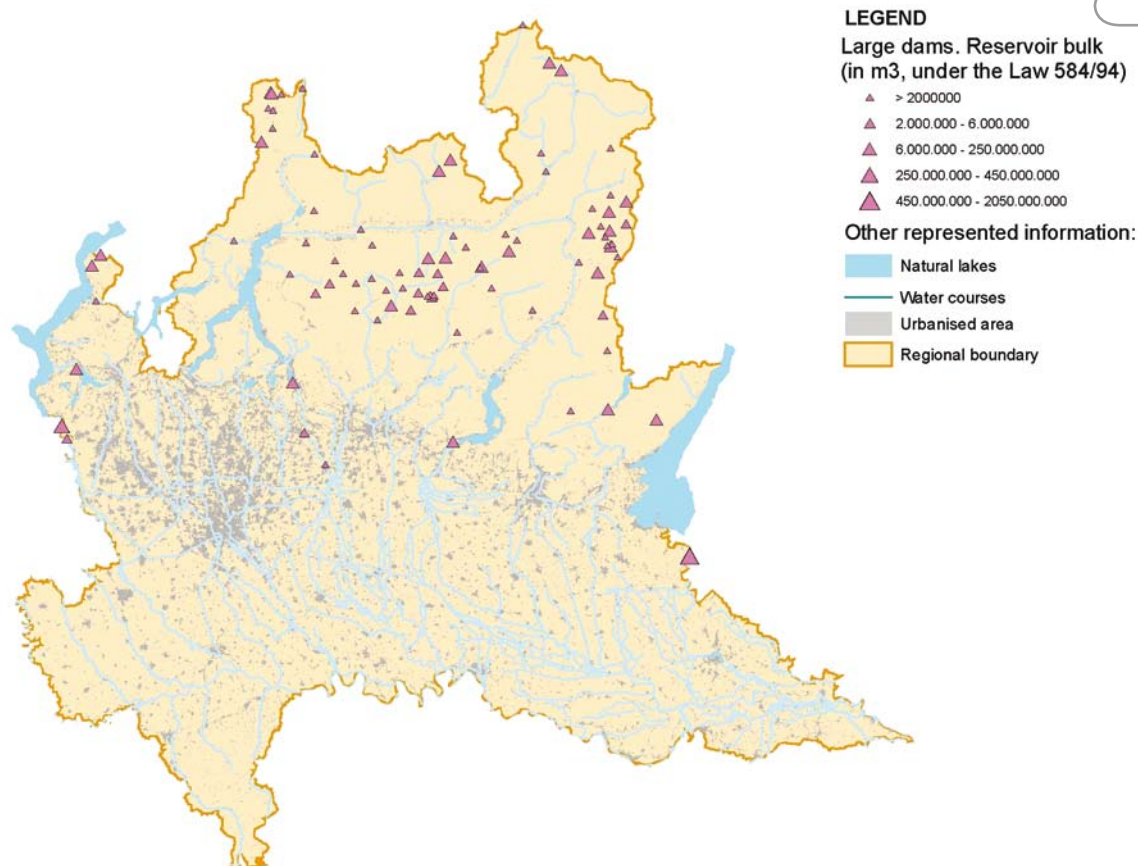
These reservoirs are obtained by building large dams. These dams were built over the last century, too. Sometimes, they substantially change Lombard alpine landscape and almost become a typical feature. However, as they often are waterfall dams, they are the best way to use water resources several times. In Adda river valley, storage capacity of hydroelectric reservoirs is at least twice the lake basin capacity. Of course, these figures cannot be considered as usable net volume because of technical limits in building reservoirs, discharge systems, as well as for reasons relating to the management of each reservoir featured by specific problems. As these are reservoirs in series, management is further complicated, yet being an extremely outstanding resource.

4. A complex management system

An analysis on water uses within the region has highlighted a situation that is partly the result of the great availability consolidated over the centuries, as well as of the great ability to ensure multiple uses by Lombards who could be seriously defined as “hydraulic civilisation”.

If we analyse the amount of water assigned by the Region, we observe a total quantity of about 130 billion cubic metres a year. Of course, water concession is for a quantity usually higher than the actual amount being abstracted and used. However, we can observe that the quantity is significantly higher than average annual flow deriving from precipitation, being estimated around 27 billion cubic metres. If we use water volumes granted in the concession as a measure of the quantity being abstracted and as an indicator of the pressure exerted on water resource status, the regional WEI (Water Exploitation Index, defined by the EEA, European Environment Agency) amounts to 500%. Even though we deduct the quantity used for energy production – as the entire water volume being abstracted is returned and is thus available for other uses – and we take all necessary precautions considering poor significance of concession volumes with respect to the real amount of water being abstracted, the WEI approaches 100%, a value far above the 30% limit used to indicate an overexploitation condition.

However, such water exploitation in Lombardy region is considered not as a negative aspect but rather a show of Lombards’ ability to use this important resource. As we have already seen, water is mainly used for hydroelectric power production, with a percentage value not even comparable with what we have in other Italian regions. Among other uses, significant amounts of water are used for irrigation and cooling of thermal power stations, in particular the oldest generation of plants continuously needing considerable amounts of water. When making water use balance, water used for energy production is deducted – as the diverted water fully returns to watercourses – and then you can assess actual proportions among the other uses that permanently abstract water from a water body, even though they give at least part of the water back to another water body.



Localisation of large reservoirs in Lombardy Region.

Such analysis shows a considerable amount of water is abstracted from natural watercourses for irrigation purposes. Anyway, the Lombard plain has by now consolidated a landscape formed by a network of irrigation canals, and irrigation systems have always been an optimum system to recharge aquifers, both superficial aquifers resurfacing in the low mid part of the plain to be used again and deep aquifers being the regional reservoir for drinking water supply.

Canals have a mixed function, as they are used for irrigation and drainage (on average, they account for 70% of Lombard irrigation network). These are open canals – often earth canals – where water is discharged during irrigation season to be drawn by farmers directly.

In Lombardy region, high water-consuming irrigation methods are still the most widespread – namely basin and flood irrigation (*Table 3 and Figure 9*).

Therefore, in Lombardy region on the one hand we can estimate high water losses along the network and poorly efficient irrigation methods are prevailing, but on the other hand:

- such methods have no energy cost, as just the force of gravity is used to convey and distribute diverted water,
- poor efficiency refers to the percentage of water taken up by crops, while method efficiency as groundwater recharge is not considered,
- the consolidated system exploits the recharge made by irrigation activities in the upper plain, to use it again in the lower plain,
- aquifer recharge ensures the basin intended for potable use within the region, i.e. groundwater reservoir, is maintained.

If we consider water needs measured to meet water potential of crops and we compare these data with the volume diverted from main watercourses, we can easily verify that just 60% of water demand is covered by river diversions.

The above percentage increases if we add reuse by means of drains and “Fontanili” (natural groundwater emergence). In “normal” conditions, such reuse accounts for approximately 20%, while in “water-deficient” conditions, this value decreases up to about 15%. To this reuse we can also add groundwater abstraction amounting to less than 10% and water contribution – difficult to quantify – by capillary rise from areas with superficial aquifers and clay soil.

Above-mentioned data show that water diverted from rivers is basically used more than once, even just for irrigation.

1. Actual uses

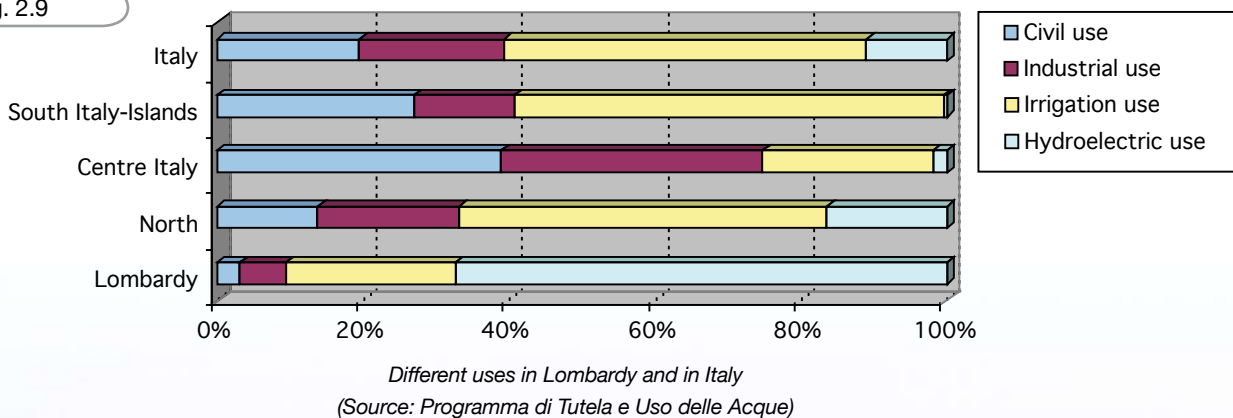
A real evaluation of water needs is rather difficult. In principle it should be based on the planning of the true needs of each user, but the assessment of actual uses or rather of the request for actual use, based on the needs perceived by the user, is much more realistic. The remarks that follow are therefore based on data extracted from the register of water concessions, considered as the most comprehensive source. This important clarification being made, it is interesting to start with a statement that somehow has already been announced through data in the previous chapter: the main use within the region is for hydroelectric power production, with a percentage value not even comparable with what we have in other Italian regions (*Figure 2.9*).

Among other uses, irrigation is certainly significant, while industrial use in the strict sense is definitely negligible. Another important use linked to energy production refers to cooling of thermal power stations, in particular the oldest generation of plants (*Figure 2.10*).

In such a scenario, you can easily understand why summer water crises in the Po River basin do not seem to be a concern as for possible problems in drinking water supply or even more for damages to crops, but they first of all pose a problem in energy supply.

Energy uses have anyway an advantage: usually, apart from small mountain basins, waters diverted from a watercourse, are then returned downstream of the diversion. In case of diversions for hydroelectric power production, the quality of diverted water is not in the least altered. Instead, cooling systems for

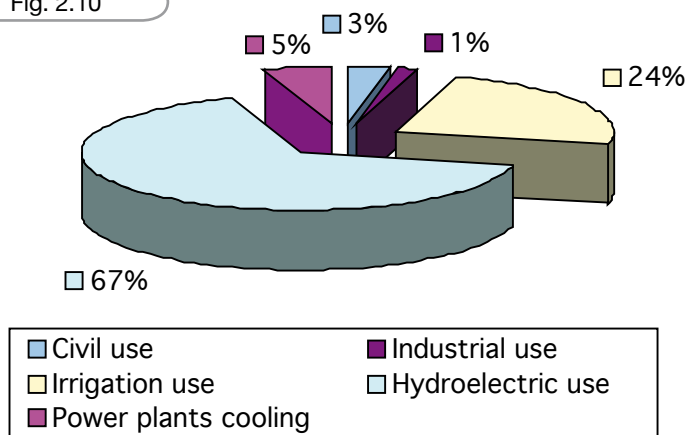
Fig. 2.9



thermal power stations can have a considerable impact on local ecosystems. Many efforts were recently made to minimise such impact, reducing it almost to zero.

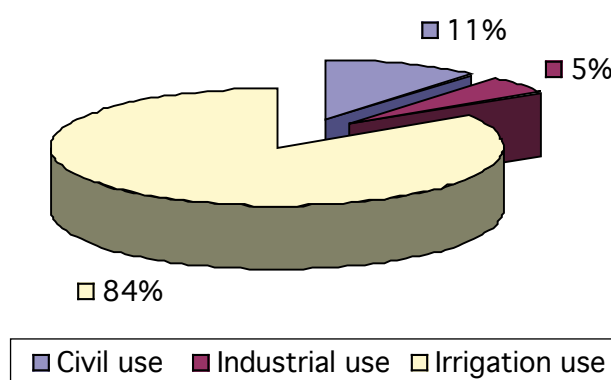
Therefore, a water use balance can be made by cancelling these two types of use and assessing the real proportions of the other uses that somehow “permanently” abstract water from the diverted water body, even though they often end up returning at least part of the water to another water body (Figure 2.11).

Fig. 2.10



Water uses
(Source: PTUA)

Fig. 2.11



Real water uses
(Source: PTUA)

Register of Water Users (in Italian CUI)

The Register of Water Users (in Italian CUI) organises, in an alphanumeric database with geo-referenced cartographic data, information relating to the over 27,000 users of public surface water (surface diversions) and groundwater (wells and springs) located within the region.

For each user, specific administrative and technical data are reported: name and relevant personal and fiscal data, water use, allowed quantity, features on abstraction and on the diverted water body, location and geographical co-ordinates.

Data concerning small diversions are input by Provinces, data concerning large diversions are input by regional offices.

This information tool enables single management of water diversions by the Region and Provinces. Moreover, by using these data, it was possible to start collecting in a rational and organic way the fee the Region has been charging since the year 2000 for public water use.

Information reported in the register is also functional and essential for regional planning activities and can be a useful database supporting study and research activities on water use in Lombardy Region.

2. Use for hydroelectric power production

Surface water use for hydroelectric power production purposes has always been well developed in Lombardy region and basically covers over one fifth of regional energy demand. As a matter of fact, the region hosts some of the first Italian hydroelectric power stations that came into operation at the end of the nineteenth century.

Use for hydroelectric power production fully returns water resource unaltered in terms of flow and quality. However, in certain mountain areas where the main reservoirs are concentrated, this use produced a strong alteration in natural flow and ecological balance of watercourses, and has increasingly required to restore acceptable ecological conditions and to guarantee a mi-



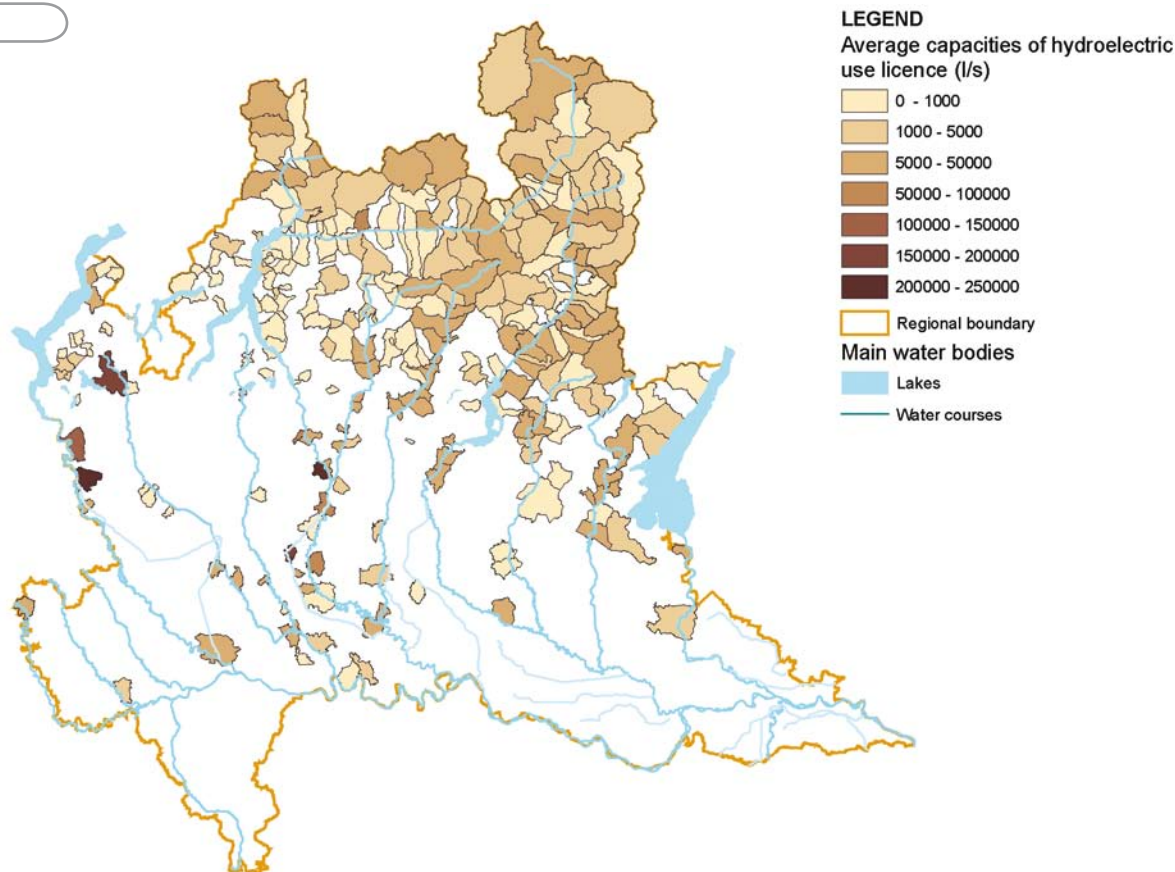
Adda river – Robbiate

minimum flow regime to maintain river life integrity even downstream of the most important abstraction points: the so-called Minimum Vital Flow.

In Lombardy region, the amount of water licensed for hydroelectric power production is 2,751 cubic metres per second corresponding to 2/3 of the overall concession volumes within the region. Bodies of surface water are the exclusive source of supply, and the most considerable diversions are concentrated in Adda river basins upstream and downstream of the lake (41% of the amounts of water granted in the concession) (Figure 2.12).

Abstractions for hydropower are extremely widespread in mountain areas, while in the plain concentration is at main watercourses (in particular, Ticino river and Adda river).

Fig. 2.12



Localisation of main diversions for hydroelectric use

Minimum Vital Flow

Annex B of Resolution No. 7 dated March 13th, 2002, made by the Institutional Committee of Po River Basin Authority, defines the Minimum Vital Flow as “the flow regime required in a natural watercourse downstream of water abstraction points to maintain vital ecosystem functions and quality conditions”, in line with water resources naturally present.

Therefore, the Minimum Vital Flow is the instantaneous flow to be calculated in each homogeneous stretch of watercourse, which has to guarantee the protection of:

1. physical features of a water body, i.e. maintaining its natural morphological and hydrological evolutionary trends even when there are artificially induced variations in water depth, flow rate and sediment transport;
2. chemical and physical features of water, i.e. maintaining in time water quality status in line with the quality target levels provided for by articles 4, 5 and 6 of Legislative Decree No. 152/99 and subsequent amendments, as well as natural self-purifying capacity of watercourses;
3. the biocenosis featuring local natural conditions, i.e. maintaining in time the biotic communities in the reference area, also considering the various life stages of each species.

Despite high water exploitation levels within the region, surveys carried out to formulate the Programme for water use and water protection, showed that in the network of major water bodies, the Minimum Vital Flow as defined by the Po River Basin Authority, is not present in the river bed just in a few cases.

However, within the activities carried out for the Programme for water use and water protection, we found that the pressure exerted by pollutant loads discharged to watercourses requires an increase in watercourse flow that in this case becomes a modified vital flow. To this effect, the Programme has already introduced a compulsory factor multiplying Minimum Vital Flow value, to be applied to new concessions and when renewing expiring ones.

To date, by approving the Programme for Water Use and Water Protection (Regional Executive Resolution [DGR] No. 8/2244 dated March 29th, 2006), Lombardy Region has defined methods and deadline (by December 31st, 2008) to conform to Minimum Vital Flow by public water users, large and small diversions under concession in watercourses within the regional territory.

3. Use for irrigation

Water diverted for irrigation and distributed over about 700,000 irrigated hectares of utilised agricultural area (UAA) is mainly surface water (89%) and is concentrated in large diversions. The rest of the demand is covered by groundwater abstractions from wells (11%).

In Lombardy region, the most widespread irrigation method is flood irrigation while sprinkler irrigation is less popular (Figure 2.13). In flood irrigation, at least 50% of the water applied to the land is not directly used by crops but flows again to drains and percolates down to groundwater tables. The water system in the plain makes it possible for such water to recharge aquifers and “Fontanili” or to return to canals and rivers from where it is used again for irrigation and sometimes for other purposes.

Rivers with major diversions for irrigation are Ticino river downstream of the lake in the Lombard part (Canale Villoresi, Naviglio Grande), Adda river downstream of the lake (Canale Muzza, Canale Vacchelli), Oglio river downstream of the lake and Po river. In these rivers, diversion licences for irrigation are for amounts close to average natural annual flows (Figure 2.14).

SIBITER (Information System for Land Reclamation, Irrigation and Rural Territory)

In compliance with the provisions of Regional Act No. 7, dated June 16th, 2003 (paragraph 9, article 17), the S.I.B.I.Te.R., Information System for Land Reclamation, Irrigation and Rural Territory, collects, organises and spreads information needed to know and improve planning and managing activity by reclamation and irrigation organisations.

In 2005, Lombardy Region started reorganising the information system. This system consists of:

- “network of canals and editing process distributed via web”, concerning the geographical infrastructure component (canals and manufactures) of the network for irrigation and reclamation
- “planning and monitoring of the actions financed”, gathering all the strategic actions taken to manage the reclamation area and monitoring the financing process of such actions.

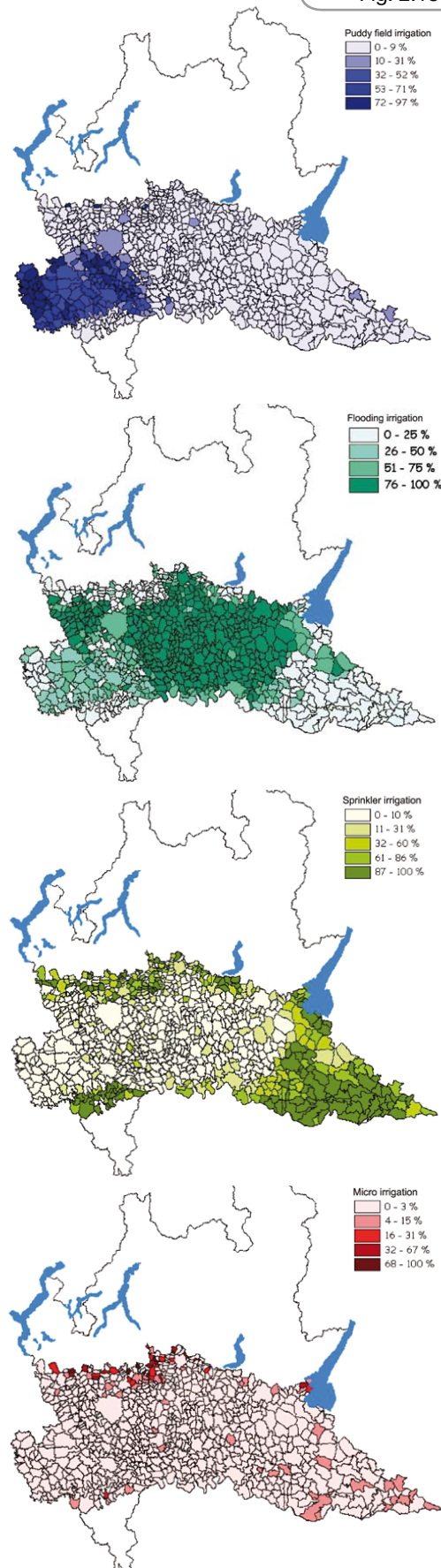
As for the first aspect, system reorganisation aims at obtaining a network of canals through which describing water circulation in view of both irrigation and reclamation, in order to support water resource management. At the same time, using an editing process distributed via web means having a system that is shared among and certified by the Region and Consortia and that is constantly updated.

The second aspect aims at monitoring the processes for the financing assigned by the Region following the various regulations, and at improving irrigation and reclamation activities through a more efficient use of financial resources. At the same time, a shared management by the Region and beneficiary bodies allows us to have a constantly updated planning of actions.

Future system development as for “network of canals and editing process distributed via web” focuses on the implementation of areas concerning reclamation and irrigation, in order to connect water circulation in the canals with the areas where such water is carried away or distributed.

As for the development in “planning and monitoring of the actions financed”, we are planning to implement localised actions to assess their strategic importance and to gather a series of technical information to be used within the network of canals.

Fig. 2.13



Main irrigation methods, percentage of irrigated area (ISTAT, 2000)

(Source: Ricerca sui consumi irrigui e le tecniche di irrigazione in Lombardia, 2003)

Lombard irrigation system

Lombard plain territory has been divided into 21 reclamation areas. In most of these areas, Consortia have been established to manage water resources for agriculture. They are also involved in soil protection and hydraulic problem solving. Consortia are bodies of public law and carry out their activity in line with the objectives defined by the Region. They are managed by consortium members directly interested in regulation, use of water and soil conservation.

The regional irrigation system is managed to irrigate 557,752 hectares of utilised agricultural area (UAA) accounting for 79% of potentially irrigable surface, out of which 72% is supplied with surface water.

78% of diverted water comes from large diversions located along main watercourses, while the remaining 26% comes from small diversions, minor watercourses, "Fontanili" (natural groundwater emergence) or wells. In Lombardy region, the most widespread irrigation systems are flood irrigation, followed by basin irrigation and sprinkler irrigation and then microirrigation.

Reclamation land is heavily populated: about 75% of Lombard population live there. In the reclamation areas, farming activities are carried out and are among the most important ones in Europe as for both crop yields and quality.

Reclamation consortia take care of irrigation in the areas they are competent for. However, the situation varies a lot. As a matter of fact, in some areas, land improvement co-operatives and private associations manage independent diversions. In certain cases, the reclamation consortium supplies water to associations of users managing their own water supply system and distributing available water to individual farm. The largest amount of water used for irrigation comes from the regulated lake emissaries. However, about 40% of the irrigated land can use water from several basins – a typical situation in those areas with an older irrigation structure where there are close-packed networks of canals.

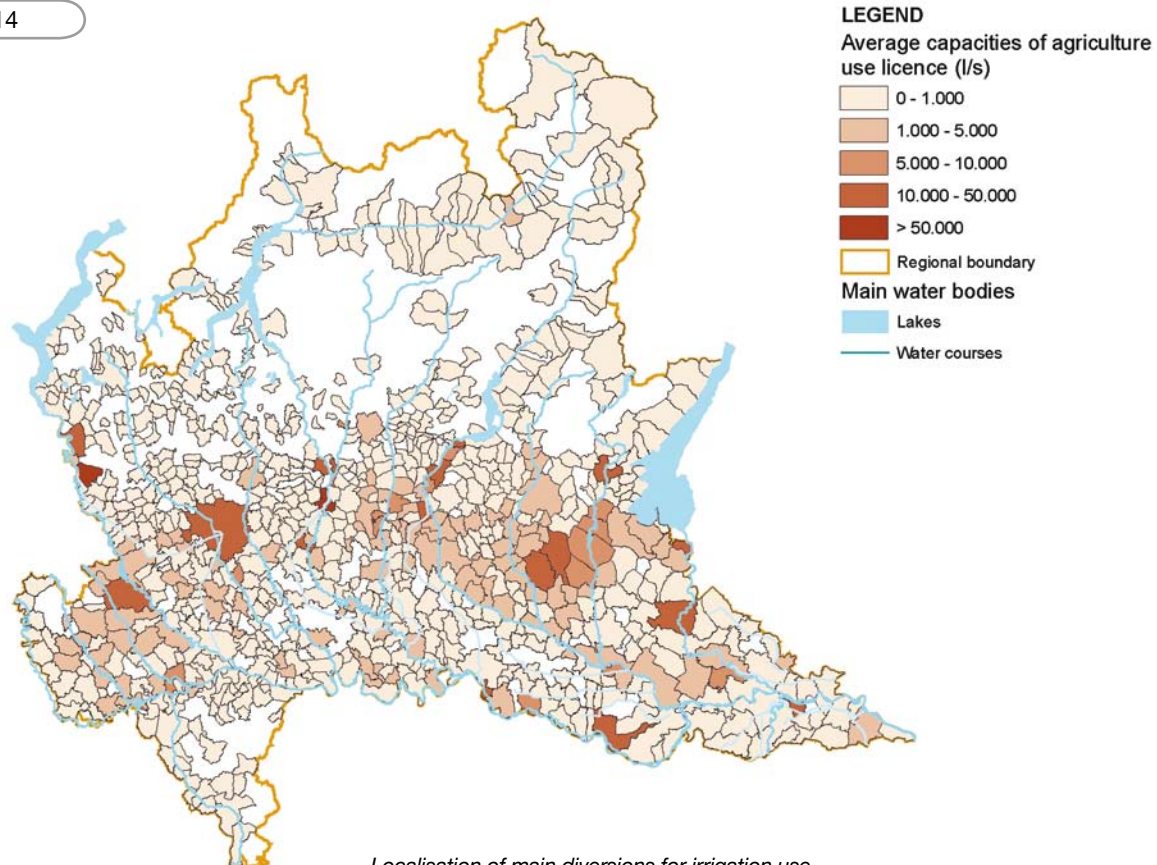
River diversions are by gravity in the upper plain, exploiting natural sloping ground and not implying any energy consumption. On the contrary, in the lower plain, we need to have water raising from watercourse beds.

Reclamation consortia take also care of carrying surplus water away by drainage, as well as land protection.

Soil erosion and salinisation are phenomena strictly linked to the hydrologic regime. In Lombardy region, soil salinisation (typical of coastal areas) is not observed and despite high presence of surface water, soil erosion due to the hydrologic regime and reduced organic matter, has lightened effects with respect to overall national scenario: at regional level, average value of soil erosion is 2.4 t/ha/year versus a national average value of 3.11 t/ha/year. Provinces having values quite above regional average value are Lodi, Milan and Pavia (all of them are affected by Po and Adda rivers), while the provinces of Como and Lecco have a soil erosion level even below Community average. Besides river effect, in Sondrio and Pavia the value recorded is also due to the presence of steep slopes in part of the provincial territory.

Among the various actions that can be taken to control soil erosion, developing agro-environmental practice – in particular practice linked to organic farming – can give a limited but significant contribution in border areas. In Lombardy region, 2.3% of total UAA has recourse to organic farming measures. Such value is lower than both national and Community average values and is the result of extremely diversified trends if analysed at provincial level. Provinces with the greatest organic farming area are Como (13%), Pavia (7%), Lecco (6%) and Varese (2%) – all of them with a remarkable presence of hill and mountain areas – while in the other provinces the value of UAA with organic farming is close to or lower than 1%. This differentiation is to be correlated with different production orientations within the region, where the presence of arable land and animal farming limits the spread of organic farming methods.

Fig. 2.14



Localisation of main diversions for irrigation use

4. Civil use

Civil uses mainly include water intended for human consumption (drinking water), health/hygiene use and related uses. Fire fighting and animal farming are also included even though the amount of water abstracted is limited. Civil water consumption changes depending on the size of urban areas, economic welfare and population lifestyle. Over the last decades, average rate of daily available water per capita have increased mainly because water service quality improved and average income of the population increased.

Water supply for civil uses takes place especially through wells (84%), with a significant contribution by springs in the mountain areas (10%). Just 6% of the water supply for civil sector is through bodies of surface water (surface diversions from rivers and lakes).

An analysis on the distribution of the amounts of water for civil potable use (*Figure 2.15*) shows that the areas with major exploitation are in the Milanese area and in general in the most urbanised areas (large urban centres, usually provincial capitals and neighbouring municipalities). In particular, Milan municipality stands out: request for water concession for potable abstraction provides for a 8,000 l/s flow.

By examining historical data, we can obtain water consumption trend in potable use in Lombardy region over the last 30 years: requests have remained more or less stable in time, with a slight increase in the 90s and a subsequent reduction over the last few years.

I fontanili

The “Fontanili” (natural groundwater emergence) consist of an ecosystem typical of Lombard plain – an area that has always been extremely fertile and particularly suitable for agriculture thanks to the abundance of water. The Fontanili have a strong draining action on groundwater, as they feed a close-packed network of canals.

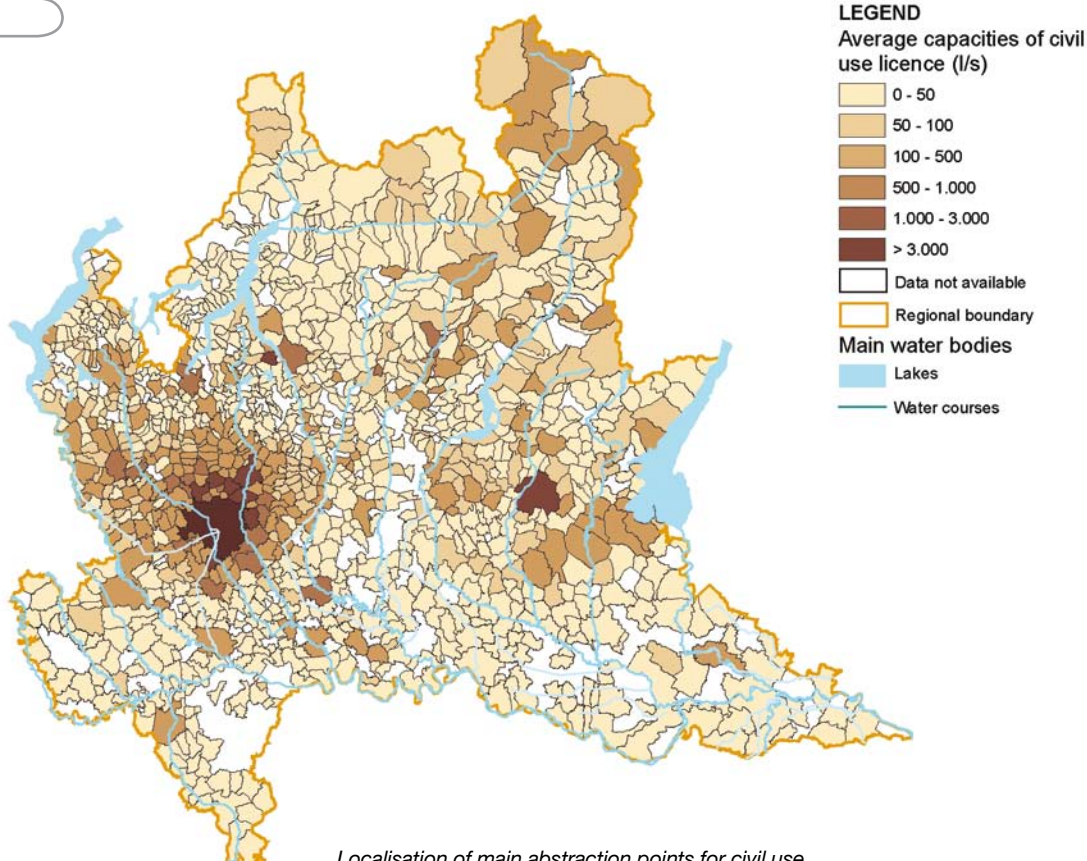
Water springs from the Fontanili head and, as it comes from the groundwater table, has a constant temperature all over the year (around 10/14 °C). Consequently, water does not freeze during winter. Another aspect is that constant temperature, clarity and steady regular flow of resurgence water make it possible to develop unique aquatic plants and an extremely rich and varied fauna. Therefore, besides being an important water resource, the Fontanili are also a naturalistic heritage we need to protect. The Fontanili are located in a transition strip of land between upper plain and lower plain, where deep water moves upwards until it emerges on the surface at natural depressions or depressions specifically created to favour groundwater emergence, sometimes by also driving wooden barrels in the past or concrete or steel pipes more recently. The presence of Fontanili and their action depend on several factors, such as a change in subsoil lithology creating an obstacle for groundwater flow and thus a rise of the piezometric surface.

Starting from 1950-60 period, we have had a strong reduction in the number of Fontanili due to anthropogenic factors. Such reduction can be caused by various factors:

- soil sealing that has remarkably reduced the amount of meteoric water reaching the aquifer;
- considerable abstraction of groundwater to support increasing industrialisation and urbanisation;
- giving up of traditional farming methods and in particular permanently irrigated meadows (Marcite);

However, starting from the 90s, large industrial sites closed: we have had a groundwater rise and so the Fontanili are once again of topical interest.

Fig. 2.15



Localisation of main abstraction points for civil use

5. Industrial use

An analysis on the distribution of licensed amounts of water for industrial use highlights that the main abstractions in terms of quantity are those used to cool thermal power stations. These abstractions concentrate along the main watercourses: Po river (36%), Adda river (24%) and Ticino river downstream of the lake (18%). Water needs are mainly met by diversions from bodies of surface water (81.5%). Other centres with considerable water abstraction for industrial uses are the industrial areas close to Milan, Brescia and Mantua (*Figure 2.16*).

To deal with this topic in a more correct way, we think it better to make a clear distinction between the two different purposes water can be used for within a production process, in particular between process-related uses and cooling-related uses.

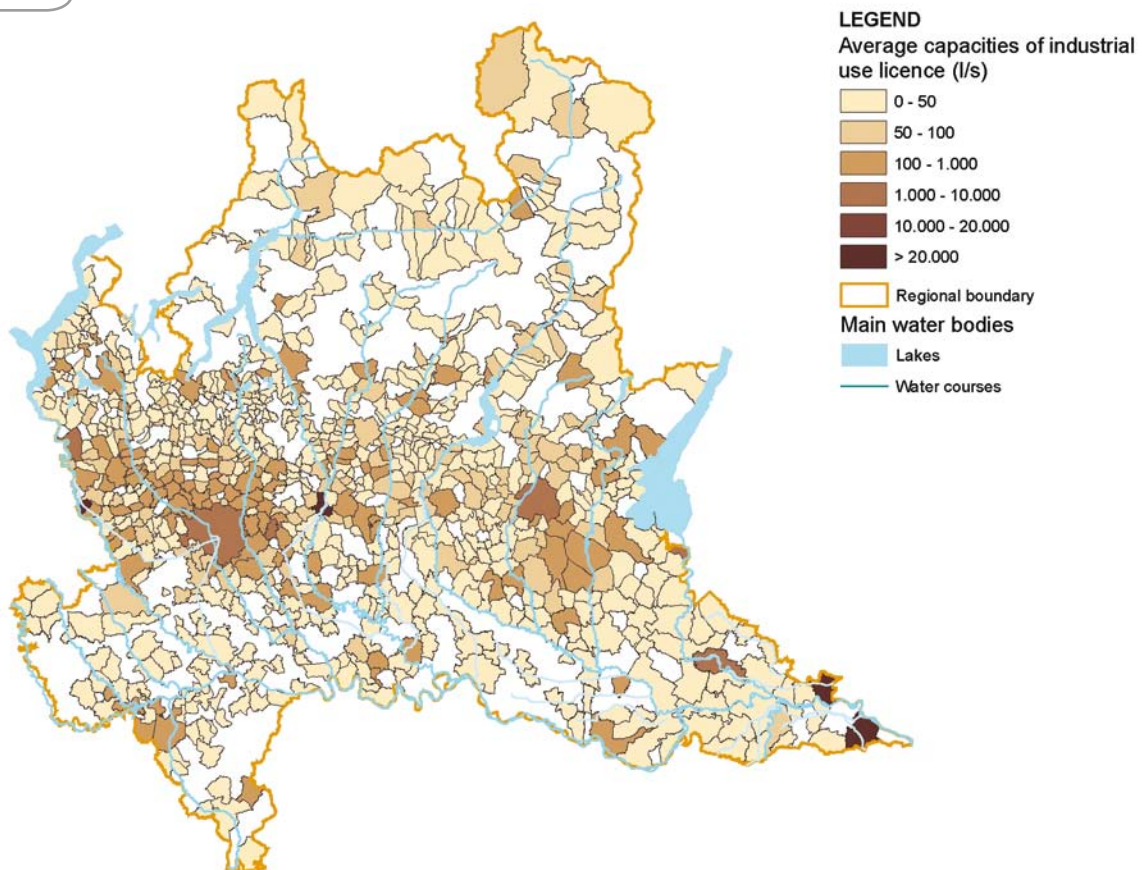
Within industrial use, the most considerable abstractions are for cooling of thermal power stations, and diversions from bodies of surface water are used as exclusive source of supply. These diversions are concentrated within the territory of 6 municipalities and are used to cool 7 thermal power stations in the Lombard area. The entire amount of water used for cooling returns to the water system (when discharged both to a natural water body or to an artificial canal used for irrigation) even though with an altered quality as for the temperature parameter.

Excluding the amounts of water used to cool thermal power stations, the territorial distribution of concession volumes for industrial use changes: maximum licensed amounts of water are in the suburban areas. In these areas, concessions granted account for almost 50% of the regional total amount, precisely where the areas with a higher urbanisation level are located. Unlike uses for cooling purposes, water demand for industrial process-related uses is mainly covered by aquifers (84%).

Industrial water demand varies depending on the industrial sector concerned: in Lombardy region, among the most water-consuming industries we find metal and mechanical industry, textiles, leather and shoes, rubber, plastic, furniture and fittings. Water demand by Lombard industrial sector has decreased over the last years, due to a gradual reduction in some specific production activities in favour of the provision of services, but also to a considerable increase in water rates paid for industrial use over the 90s.

According to data on major diversions, the trend of requests for water concession on the entire Lombard territory shows a steady reduction in demand for process-related industrial uses in 1970-2002 period (*Figure 2.17*).

Fig. 2.16



Localisation of main abstraction points for industrial use

To confirm even more the industrial evolution under way in Lombardy region, we mention the groundwater rise in Milan area, which started at the end of the 80s. This phenomenon is now openly known and has caused problems to public and private foundation and underground structures in Milan.

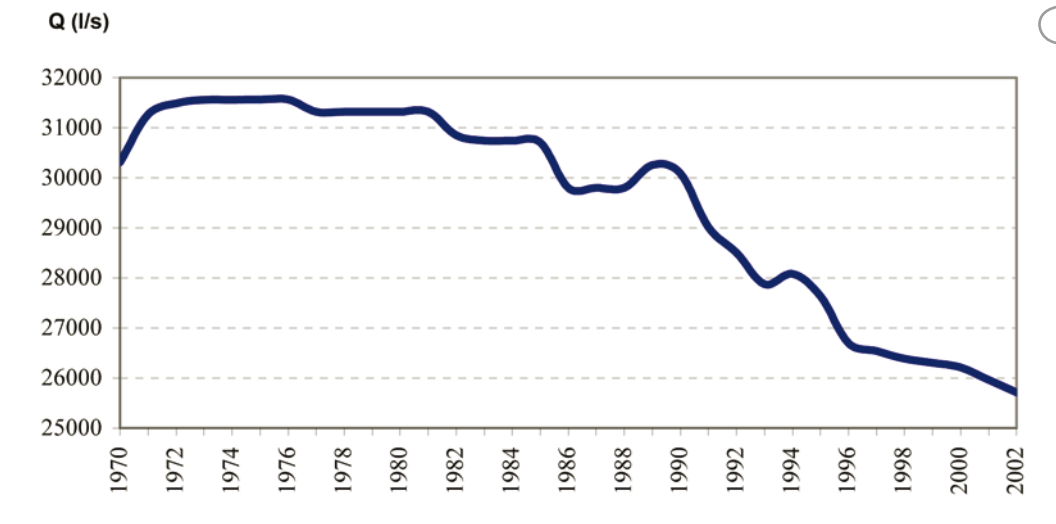


Fig. 2.17

*Trend of the average capacities of industrial use licence in the period 1970-2002 in Lombardy
(Source: Catasto Utenze Idriche, 2003)*



Pavese canal



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3 Managing a precious resource



1. The integrated water service: watering and collection services

The integrated water service is the re-organisation of the management of public waterworks, sewerage and treatment services, according to the provisions of Act No. 36 dated January 5th, 1994 “Provisions in the field of water resources” known as “Galli Act”.

These legal provisions consider water as a natural monopoly and set the following main objectives:

- overcoming management fragmentation;
- overcoming management by Municipalities based on their own people and means;
- setting a rate to finance the investments needed to guarantee adequate service levels;
- protecting consumers by clearly separating planning and control tasks from management tasks.

To reach these objectives, planning and management structures shall be re-organised and new institutional bodies called Area Authorities (*Figure 3.1*) shall be set up. These Authorities are in charge of drawing up an action plan, according to criteria and guidelines set by the Region, to identify the works needed to reach set service levels, as well as a financial plan and the relevant business model. These closely inter-related tools contribute to the drawing up of an industrial plan, the Area Plan, which is the main reference point for setting the integrated water service rate and its changing in time and drawing up service management agreements.

The organisation of the water service in Lombardy region is based on the compulsory separation between investment management and service provision to users.

The adopted organisational model is according to art. 113 of Legislative Decree No. 267/2000, stating that in managing local public services, it is possible to separate network management from service supply.

Area Authorities are complying with the regional organisational model by guaranteeing that the management of the infrastructure which ownership is yielded by local authorities to management companies shall be according to European and national laws regulating public contracts.

To perform the management contract, two thirds of the Municipalities members of the Optimal Territorial Area (in Italian ATO) must have a stake in such companies and yield to them the ownership of the infrastructure necessary to manage the water service. If it is not possible to reach the two thirds threshold, the ATO is authorised to adopt one of the following alternative solutions: either in-house entrustment, according to the recent rulings of the European Court of Justice, or a public tender. Joint ventures are excluded (as per art. 113 of Legislative Decree No. 267/2000).



Serio river

Fig. 3.1



Local authorities may also have an indirect stake in the management company, through associated companies, provided that these have already become owners of the infrastructure and have separated the relevant company branch. Even if these companies have meanwhile been privatised by transferring a minority interest to a third party,

Infrastructure

The water supply system covers almost all the population resident in Lombardy region and, within the regional territory, 1,226 waterworks have been identified, of which 952 – equal to 78% of the total – are municipal and 274 inter-municipal.

Groundwater plays a major role in the use of water resources for potable purposes, with a volume abstracted from wells equal to 84% of the total; whereas surface water has an integrating function that is sometimes relevant in terms of percentage. Abstractions from springs are 3,090 (with an abstracted volume of 206,084,740 cubic metres/year); abstractions from surface water are 45 (abstracted volume 41,077,107 cubic metres/year) and from wells 3,580 (abstracted volume 1,633,664,430 cubic metres/year).

There are over 1,000 treatment plants, where 75% of treated water is just disinfected and the remaining 25% is subject to more complex processes aiming at removing organic micro-pollutants, iron, manganese, ammonia, etc.

Water supply networks are 43,785 km long. Daily water availability is around 250 litres, with peaks of 500 litres, attributable mainly to big cities.

Considering a built-up area as “an area with sufficient concentration of population and/or economic activities enabling the collection and channelling of urban wastewater towards an urban wastewater treatment plant or a final discharge point”, in Lombardy region there are 440 built-up areas with a potential higher than or equal to 2000 PE, generating a load equal to 13,180,249 PE, of which 501 (sic), equalling 11,980,390 PE, are treated. Plants with a potential higher than 100,000 PE are 27 and account for 60% of the total treatment potential of the built-up areas considered.

In Lombardy region, there are 17 built-up areas with a potential higher than 150,000 PE, generating a load equal to 7,194,153 PE, and a high number of built-up areas (272) between 2,000 and 10,000 PE, generating a load of 1,210,862 PE.

In between, there are 120 built-up areas with a potential between 10,000 and 50,000 and generating a load equal to 2,347,063 PE and 31 built-up areas between 50,000 and 150,000, generating a load of 2,428,171 PE.

The sewerage system covers great part of the urban areas, with 99% of municipalities totally or partially served and 92% of the resident population served.

As for the types of systems, combined sewerage system prevail, even though over the last few years an increasing number of separate sewerage system have been created, mainly in urban expansion areas.

1,639 sewerage systems have been identified within the regional territory, 27,169 km long.

Information on water distribution, collection and treatment services is drawn by the survey on works carried out by the Provinces and the territorial Area Authorities in 2003 and subsequent updates.

The Optimal Territorial Area and its planning

The Region has divided the regional territory into 12 Optimal Territorial Areas (in Italian ATO), 11 corresponding to the administrative boundaries of Lombard provinces and 1 to the city of Milan, constituting the basic reference points for governance and the organisation of water service management.

According to Act No. 36/94 (Galli Act), included in the recently approved Leg. Decree No. 152/06, ATOs must draw up the Area Plan, which is not only a tool to plan and implement investments within the ATO, but also an economic-administrative tool, or rather a real industrial plan reporting guidelines, activities and operating modes of the future Area manager or managers for the whole length of the concession contract.

The Area Plan is a study including, besides an accurate representation of infrastructure, service provision modalities and guidelines, an investment plan and the relevant timetable, the calculation of management and investment costs and the subsequent service rate and is also a tool to monitor the service manager to make sure that it implements the provisions of the Area Plan effectively and efficiently.

The service proceeds are mainly the turnover of the integrated water service made up of the rate collected by the service manager and provided for in the Area Plan.

The implementation of the provisions of Leg. Decree No. 152/06 on this topic is hampered by the current rate method, because Local Authorities fear that the shift from a system where rates were not linked to costs (the current system before the reform) to the new system could exceed the socially acceptable limit or lead to abandoning works needing heavy investments.

they may have a stake in the company managing networks and plants, provided that the networks and plants transferred to them are conferred just in kind and with the statutory obligation to exclude private partners from future re-capitalisations aimed at increasing their stake in the company.

The provision of services to users, that is to say, the use of the infrastructure for the operational management, shall be entrusted by the ATO to another entity, to be chosen through a call for tenders. This entity, for a period that does not need to be too long, given that this company is not responsible for any investments to be amortised, shall be in charge of managing networks and plants, of ordinary maintenance and of invoicing the service to users and shall set aside a percentage of generated cash flows for the company responsible for investing in networks and plants.

The regional act excludes from adopting the compulsory regional organisational model: the ATO – Municipality of Milan, the only case in Lombardy region where Municipality and Area Authority coincide, and those ATOs which on July 10th 2006 had already formally entrusted the management of the service, according to the so-called Galli Act (No. 36/1994), or had already approved the Area Plan and formally decided to entrust the management of the integrated water service through a call for tenders.

Hence, the reform shall lead to the setting up of as many companies provided with funds as the ATOs, excluding Milan, thus reducing the number of companies involved and increasing the average size of the companies responsible for investments.

The regional government, in charge of regulating the sector and guaranteeing that the laws in force are abided by and the objectives provided for are attained, shall fulfil the task of providing all necessary instruments for involved subjects to organise themselves and take the necessary steps to face change. To step up this aggregation processes, the Region, in case of infringement or delay on the part of the local authorities involved, may exercise specific substitute powers.

Meanwhile, strictly connected with this objective, there is the need to realise infrastructural investments in the water system of Lombardy region for service levels to meet the minimum standards accepted by the European Community.

Integrated water service rate

The integrated water service includes waterworks, sewerage and treatment services. Users pay one single rate to use the integrated water service and this rate covers the activities of both water supplier and owner of the water supply system, the so-called service provider. Even though usually users are mainly aware of the action of the water supplier, it is worth knowing that “behind the scenes” there is the important work of the service manager, who is responsible for the realisation of the plants needed to provide the water service. The single rate paid by each user has three components, each covering the costs of waterworks, sewerage and treatment services respectively, according to the quantity of water used. Besides these three components, there is a small fixed rate that does not depend on the quantity of water used. These four components vary according to the type of users: for instance, the treatment service component of an industrial user is higher than that of a domestic user, according to “the polluter pays” principle included in Leg. Decree No. 152/06 and in Community regulations. In general, the rate calculation method must guarantee that all the costs borne by both supplier and manager to have the integrated water service are covered. It is worth underlining that if the supplier or the manager earns money from other services, such as new connections, transfer of contracts, replacement of meters, etc., this money is used to cover borne costs and indirectly leads to a reduction of the components of the water service rate and of the single rate paid by users.

Also in this case, guidance on the part of the regional government is needed, along with adequate tools to favour investments to develop a service of economic-general interest. Being part of the national system, over the last few years, the Integrated Water Service has suffered from under-capitalisation and lack of significant investments; hence, if only pressing needs were to be met and the costs of those investments had to be totally borne by ATOs, rates would increase too much and would not be sustainable. According to Lombardy Region estimates, the best way to proceed is financing the major investments needed during the first years of management of the service through a credit to be paid back over the life of the management contract, by using the financial instrument provided for in Regional Act No. 26/2003: the Public Utilities fund, according to the criteria laid down in the economic and financial plan of the Area Plan project.

The Public Utilities Fund

The best way to proceed is financing the major investments needed during the first years of management of the service through a credit to be paid back over the period of the concession, according to the modalities laid down in the economic and financial plan of the Area Plan project.

From an operative viewpoint, the Region commitment will be conceived so as to foster directly the implementation of investments in water infrastructure by means of the financial instrument provided for in the Reform Act, i.e. the setting-up of the Public Utilities Fund (Regional Act 26/03, article 11).

Lombardy Region is therefore supporting the interested ATOs by creating the economic conditions that will allow the funding of their respective Area Plans. In particular, such support has focused on two pilot projects. First of all these projects will help the stakeholders to start the change process in their territory. Subsequently, the results and lessons learned from the pilot projects will be transferred to the whole Lombard territory. The actions planned for the starting-up phase are the following:

1. Support to the first «pilot ATOs» (Pavia and Como) for the creation of Area Plans eligible for bank credit, through agreement protocols between ATO and the Region Government. In the following phase, the results obtained will be transferred to the whole Lombardy system.
2. Utilisation of Finlombarda to assure a consistent economic/financial support (re-formulation of Area Plans so as to make them eligible for bank financing) as well as technical/legal advice (making sure that the pathway chosen is viable from a juridical and administrative viewpoint).

The funding operation is actually a transfer of capital from the Region to Finlombarda for a first amount of funds.

Through the acquisition of an international rating, such capital in Finlombarda will be used to finance the first pilot ATOs, by means of further funds obtained on the financial markets from institutional investors. Such further funds will make up the budget of the Public Utilities Fund.

Getting an international rating is an extremely important step, that will make the whole financial model more efficient. The presence of a rating will demonstrate the merit of credit of the Public Utilities Fund, thus making it easier to access financial markets. The better conditions reached will allow a higher financial lever and better interest rates, to the benefit of the fund recipients, with a low impact of funding on tariffs.

Therefore, the Public Utilities Fund as such is not a grant, since the economic and financial plans - to be used as regulating tools for the Area Plan projects - will generate a return on investment through Finlombarda, both in terms of capital share and interests. They will also allow the fund to be increased in the following years, so as to be able to allocate further financing for other ATOs and similar projects in other sectors. Hence, the implementation of the ATO system will help the “self-feeding” process of the fund.



Lake Garda



Adda river – Airuno

2. Water protection: managing wastewater

Typically, Regions are in charge of water protection according to the planning instruments provided for in Legislative Decree No. 152/06. Regions identify the main pollutants and their effect on the quality of water bodies through Water Protection programmes and River Basin Management Plans.

According to Leg. Decree No. 152/06 and Regional Regulations No. 3 and 4, dated March 24th, 2006, Provinces are in charge of issuing the authorisations to discharge into surface waters (rivers, streams, irrigation ditches, lakes, channels and canals), into the soil or the surface layers of the subsoil and into aquifers, the following types of wastewater:

- domestic and assimilated wastewater;
- first and second rain meteoric runoff water and external areas washing water;
- urban wastewater (municipal sewage systems);
- (industrial) process water;
- cooling water and water used in heat exchangers (heat pumps).

Information relating to wastewater is collected in data bases enabling the identification and localisation of all discharges to know the potential pollution sources and the main polluting agents of receiving water bodies.

To better manage authorisations, Provinces sometimes take a census of all discharges into surface waters and investigate to identify all discharges into the different watercourses. The aim of these investigations is identifying all existing discharges and determine their origin, nature, location, owners and authorisations.

By identifying the owners of the discharges and checking their authorisations through technical controls and inspections in situ, public officials are able to find out any new or irregular discharges and proceed with their regularisation. Identified discharges are then input in a cartographic database making it possible to check their relations with the whole water network. This enables to link discharges density within a basin with basin quality and to identify the maximum bearable loads for each waterway. The same type of discharge, even with concentrations within the limits set by the law, can contribute just slightly to the quality of the watercourse or can heavily affect it. Clearly, this type of relation depends on the size of the discharge and the watercourse, their flows, periodic variations and many other factors.

3. Water management: water use rights

Water balance has been set by Basin Authorities and, in the future, it will presumably be defined by District Authorities. According to this analysis and in an attempt to reach the quality objectives provided for in national and European regulations, Regions, within the framework of their Protection programmes and District Plans, adopt measures relating to the management of surface water and groundwater resources, considering:

- Needs and available resources,
- The minimum vital flow to be maintained in the riverbed,
- Aquifer recharge capacity,
- The uses of the resource according to its qualitative features.

The concessions to use surface water and groundwater and their renewal are managed according to the content of planning documents.

Water diversion governance is structured as follows:

- As for large diversions (about 300 of which 90 are hydro-electric diversions), the Region is responsible for issuing concessions and performing related administrative duties through its Territorial Offices, co-ordinated by the DG for Networks and the Utilities and Sustainable Development Services (in Italian SPUSS); since this is a strategic activity of supra-provincial and sometimes even inter-regional relevance.
- As for small diversions (about 25,000), Provinces are responsible for issuing concessions and performing related administrative duties.

The body in charge of issuing the concessions analyses the application to check the correct and rational use of water and asks for the opinion and approval of the relevant Technical Offices.

In case of groundwater, while the request is being analysed, the applicant is granted a one year authorisation to excavate the well. During this period, the application remains pending. At the end of the excavation works, the applicant provides the necessary technical documents (e.g. stratigraphy, terrestrial co-ordinates, reference level, certificate of regular execution of works, pumping tests, both hard copies and files) to the authorising body, specifying the average flow, in l/s. Also in this case, these data, input in a dedicated database, enable to reconstruct water collection conditions in different areas affected by different pressures.

The concession is granted according to a set of rules describing the applicant's obligations, including the obligation to pay an annual fee depending on the type of use and the flow.



Lake Segrino

4. The areas pertaining to lakes and rivers: use rights on public property areas

Public property includes all immovables and movables belonging to public territorial bodies. These movables and immovables are inalienable, not purchasable by usucapion, with indefeasible right of ownership and cannot be expropriated. Traditionally, public property is divided into: necessary public property, accidental public property, regional public property and municipal public property.

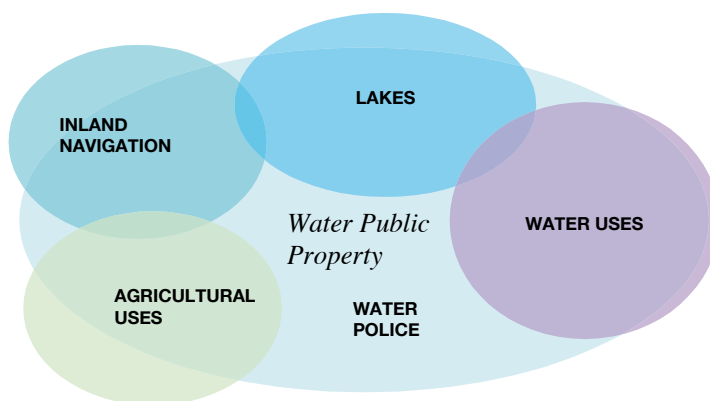
Public water, sea and military domains make up the State necessary property, that is those movables that are public by nature.

The state public water domain includes river and lake water and the land hosting them, that is: riverbeds, basins and their banks and rivers inner banks, i.e. the areas flooded by ordinary floods. Public property refers not just to the good itself, but also to its appurtenances, that is those areas, buildings, structures or other destined to lastingly serve the good (e.g. towpath along a navigable waterway).

The national government, from the 70s to Legislative Decree No. 112, dated March 31st, 1998 (Bassanini Act), progressively delegated public water domain competences to Regions, usually maintaining the property of these goods, with the exception of lake harbours and some important canals, such as Pavia ship canal (Naviglio Pavese).

Regions have kept part of these competences and delegated others to Provinces and Municipalities, according to the subsidiarity principle.

Fig. 3.2



Graph representing the water public property

Public water domain management includes different technical-administrative duties (*Figure 3.2*), the most important being:

- Use of public water: water diversion concessions (Royal Decree No. 1775/1933).
- Public lake domain and inland navigation management: Public lake domain licences and authorisations (Navigation Law).
- Water police along the public watercourse domain: licences and authorisations to occupy public watercourse domain areas (Royal Decree No. 523/1904).
- Water police along drainage canals: licences and authorisations to occupy drainage network areas (Royal Decree No. 368/1904).

Public water domain management

Public water domain management includes different technical-administrative duties, the most important being:

- Public lake domain and inner navigation management: public lake domain licenses and authorisations (Navigation Law). The issuing of licenses concerning the public lake domain and harbours (Navigation Law) was delegated to coastal municipalities (who set up consortia) according to Regional Act No. 22/1998. Rates are collected by the Consortia who keep 60% to cover management costs and invest in the enhancement of the public domain. The remaining 40% is transferred to Lombardy Region.
- Public inner navigation domain management: it is the management of the entire public waterway domain and the navigable canals linked with inland navigation (competences of the former Regional Agency for Cremona and Mantua harbours). According to Reg. Act No. 30/2006, the Province of Cremona is responsible for managing Cremona harbour and Pizzighettone quay; the province of Mantua is responsible for managing Valdaro harbour and AIPO is responsible for managing the public inland navigation domain and navigation along the public waterway domain and navigable canals.
- Water police along the public waterway domain: licenses and authorisations to occupy areas pertaining to the public waterway domain (Royal Decree No. 523/1904). Water police administrative functions within the regional territory are detailed in Reg. Act No. 1/2000 [art. 108, paragraph 1, letter i) and art. 114, paragraph 1, letter a)] as follows: The natural water network (rivers, streams, drainer ditches, brooks and natural watercourses in general) was divided, according to Regional Executive Resolution No. 7868, dated Jan. 25th, 2002, into “main” and “minor”. The same Resolution also drew up a first list of drainage canals. Technical-administrative functions concerning the “main” water network are distributed as follows:
 - AIPO: is responsible for performing technical functions in the part of the main water network previously managed by the former Po Authority. It issues technical opinions and hydraulic authorisations, whereas licenses are issued by the Region.
 - The Region, through its Territorial Offices (and in Milan the DG for housing and public works) performs technical-administrative functions in the remaining part of the regional main water network.
 - The identification of the minor water network and the performing of the relevant technical-administrative functions (hydraulic authorisations, permits and licenses to occupy areas pertaining to the public domain) are the responsibility of municipalities, who collect the relevant rates.
- Water police along drainage canals: licenses and authorisations to occupy areas of the drainage network (Royal Decree 368/1904). The Region, with Regional Executive Resolution No. 7868/2002, subsequently updated by Regional Executive Resolution No. 20552/2005, according to art. 10, paragraph 5 of Regional Act No. 7/2003, has identified the water network drainage authorities are responsible for. Water police technical-administrative functions along the drainage network (authorisations, permits and licenses to use areas within the drainage network) are performed by the Drainage Authorities, who collect relevant rates.

5. Hydraulic risk management: floods

Owing to the historical vulnerability of Lombardy region to hydraulic and hydro-geological upheaval, increased by the high level of urbanisation and by increasingly frequent violent atmospheric phenomena with destructive effects, prevention and protection of the territory are essential.

These activities must be based on thorough knowledge of the territory and are implemented through basin and local planning and the planning of actions to protect the territory.

Over the last few years, Lombardy Region has launched a structured process to implement and spread knowledge, with particular attention to geologic aspects: developed activities relate to the creation of territorial information systems and to the co-operation with universities and research centres, also within the framework of European projects, to carry out studies and researches from which to start to plan actions.

The numerous calamities that have hit the region over the last decades and the related high costs borne by the community have led the regional government to tackle the issue of preventing hydro-geologic risks through territorial planning, including the preventive analysis of the compatibility of planned actions with geologic and hydro-geologic settings and the seismic conditions of the territory.

Prevention of hydro-geologic risk is managed first of all at the level of the river basin: the general guidelines for hydro-geologic settings to be implemented within Lombardy region, which is almost entirely located within the Po river basin, are set in the Draft plan for the risk management of the Po River (in Italian PAI), drawn up by the Po river Basin Authority. The PAI is a territorial plan for the sector and is the fact-finding, regulatory, technical-operational tool used to plan actions and directions for use concerning the hydraulic and hydro-geologic settings of the river basin.

Further analyses, assessments and directions for land use have been adopted also at provincial territorial planning level (PTCP), thus guaranteeing a view of the territory increasingly functional and consistent with the Po river basin PAI.

The Risk management Plan

To reach the objective of guaranteeing a suitable safety level within the whole basin against hydraulic and hydro-geologic upheaval, the Risk management Plan (in Italian PAI) provides for a number of actions both structural (hydraulic works and maintenance of sides) and non structural (land use regulations and restrictions) to be taken in the main plain and valley floor hydrographic network, in the hill-mountain hydrographic network and in mountain area sides.

Non structural actions are mainly land use regulations, monitoring activities and actions to preserve settings.

As for the main plain and valley floor hydro-graphic network, the PAI marks the boundaries of river areas (area A, B, C) and reports the regulations on land use within these areas: in particular, it reports guidelines and rules concerning the design of interfering infrastructure, artificial drainage networks discharges, public works and works of public interest according to risk conditions compatibility criteria. By marking the boundaries of river areas, the PAI aims at making the territory less vulnerable and restoring or maintaining naturally flooded areas, thus identifying the areas that can be freely flooded and those that need to be protected by realising hydraulic works.

As for sides and the hill-mountain hydrographic network, land use is regulated by specific rules applicable to the areas with a very high hydro-geologic risk and the disrupted areas (landslides, avalanches, mass transport on cones, torrential overflows) reported in the Hydraulic and Hydro-Geologic Risks Atlas, including the Po river basin, approved in 2001 and constantly updated. According to the regulations in force, Municipalities are responsible for the update (according to the instructions issued by the Region) and must carry out specific analyses within the framework of geologic studies to support municipal urban planning tools.

In Lombardy region, this action is part of a path started in 1993 and subsequently defined by Reg. Act No. 41/97 and currently by Reg. Act No. 12/05 concerning risk prevention through territorial planning. This path has contributed to consolidating the practice of pre-assessing urban and territorial choices at the local level, on the basis of the geologic, hydro-geologic and seismic knowledge acquired by municipal territories, and, over the last 14 years, around 75% of Lombard municipalities have undertaken geologic studies to support their planning choices, to identify and prevent risks while favouring balanced urban and socio-economic development.



The Pavia covered bridge

As for the main hydrographic network of the plain and valley floors, the PAI pursues safety objectives by safeguarding and where possible enlarging watercourse naturally flooded areas and limiting artificial flood containment works, preferring controlled flood retention actions to protect built-up areas. In Lombardy region, high population density has transformed many stretches of the main hydrographic network into an “artificial” hydrographic system, heavily affected by hydraulic works and the constraints placed by human settlements, road infrastructure and productive activities: here, the PAI must acknowledge the situation and guarantee the safety of human settlements and infrastructure by making structural hydraulic works, such as banks or riverside protections.

Along with planning activities, the Region is also in charge of the emergency management of floods and of organising the procedures for civil defence.

Civil defence includes all the activities carried out by the national government, regions, provinces, municipalities and mountain communities, according to their rules and competences, in collaboration with public bodies, scientific research institutes and groups and any other institution and organisation, also private, citizens and groups of volunteers. Activities include forecasting and preventing situations of risk, relief of affected populations and any other actions that cannot be delayed and are necessary to tackle the emergency.

The regional civil defence system is based on all the planning and management tools used to co-ordinate the activities of Municipalities, Provinces, territorial offices of the Region, bodies belonging to the regional system according to Regional Act No. 30/2006 and voluntary organisations involved in preventive activities, relief of the population and reconstruction, following public calamities. This system is integrated and works to protect people from the risk of accidents or disasters, through actions reducing or preventing the loss of human lives, the destruction of tangible goods and environmental damage. The regional civil defence system is made up of:

- a) Municipal and provincial civil defence systems;
- b) The regional organisational structure in charge of civil defence, with the regional civil defence operations room and the bodies involved in the regional system according to Regional Act No. 30/2006;
- c) Voluntary organisations working at the regional level in the field of civil defence;
- d) Technical-operating structures that, in carrying out their activities, affect the safety levels of the territory.



Grosina valley



Oglio river

6. Water shortage management: low water

Since 2003, the plain and the whole Po river basin have suffered from periods of water shortage. Namely, summer irrigation seasons when water availability could not meet the demand. The analysis of meteorological-climatic data has not yet explained if this was due to a net reduction in precipitation volume or to a concentration of precipitation over a shorter period. The effects of this type of changes call for a review of the water use rationale.

The analysis on uses highlights that, excluding those returning used water to watercourses, a high quantity of water is taken from natural watercourses. However, the Lombard plain landscape is characterised by the network of irrigation canals and irrigation systems have always been an optimal system to recharge aquifers, both those nearer to the surface and re-emerging in the mid-lower part of the plain to be re-used, and the deepest aquifers, constituting the regional drinking water supply reservoir.

In Lombardy region, drinking water consumption that, according to the regulations in force, must be considered the priority use of the resource, has never been competing with any other types of uses, because it exploits a resource, groundwater, which is scarcely used for other purposes and is currently fed by the water used for irrigation. Over the last few years, there have been shortages only in the mountain areas, where aquifers are small. In normal conditions, water supplies are sufficient to meet the needs of small settlements. However, increasingly frequent winters with reduced snowfall put water supply system at risk of water shortage. Hence, the importance of identifying alternative sources of supply and connecting them to the distribution network.

This problem is tackled by assessing meteorological conditions in winter months, when there are water shortages likely to need being managed as a “water crisis”.

For example, 2006 data highlighted a precipitation average lower than the average of the previous 5 years (2001-2005). At the beginning of 2007, therefore, the water stored was far less, due to the scarce precipitation of the previous years (clear reduction in the size of glaciers and snowfields).

In the short term, the situation was faced by setting up a restricted Emergency Group (“Control Room”) made up of: Lombardy Region, Po river Basin Authority, Italian National Dam Office, ARPA, URBIM, Farmers’ Associations, Consortia in charge of lake level control and big hydro-electric diverters.

The group has worked using available tools and according to their competences, hence, with a co-ordinating function, with reduced possibilities of direct action.

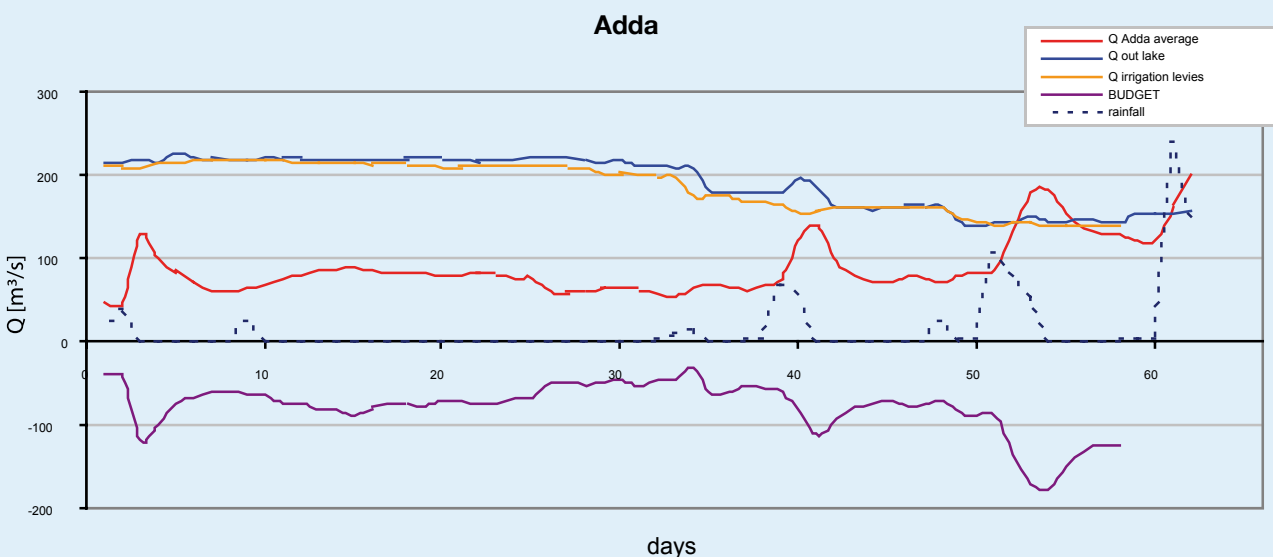
However, the Region wishes to solve this situation of permanent emergency and start managing water resources consciously and in an integrated way. Following the spreading of a culture of water and with the support of all stakeholders, the Region is drawing up an Action Plan, enabling real water management in the future. This plan is called Water Deal, it is shared by the main stakeholders and structured in strategic topics.

Working groups are developing a plan for the long term with the possibility of debating both competences and the

measures to be adopted over a suitable period of time and calculating the economic resources needed. Each year, the Region undertakes to manage the 12 month period, starting the first assessments already in December and setting up, in case of risk, a “regional control room” to monitor the progress of the phenomenon, and co-ordinates its activities with the basin and at the national level. The state of emergency, approved in 2007 and extended until June 2008, has increased the importance of regional action by setting up regional groups reporting to a national crisis management group made up of the Presidents of the Regions or their delegates.

Analysis on 2007 event

An analysis on the event (carried out by the Lombardy Functional Centre) that has occurred this year can help the region understand how the system made up of all surface water and groundwater within the basin really works.



Comparison between the flows flowing down Lake Como (blue line), diverted by Consortia (yellow line) and flowing down at the basin closing section (red line).

From a first analysis, interesting remarks can be the following:

- flows flowing down the lake are practically all diverted,
- flows flowing down at the closing section, and thus contributing to Po river flow, are entirely linked with a “hidden” contribution,
- this contribution is partially connected to filtering directly dependent from rain,
- but mainly deriving from groundwater.

The Region has been trying for quite a long time to identify the exact quantity contributed by groundwater and in particular its evolution in time. The analysis on the event that has occurred this year could lead to a more exact definition of these parameters, which in turn could contribute to demonstrating that the feeding of the groundwater reservoir is a resource protection measure and not an inefficient use, as one could think.

7. Navigation

Navigation has marked the development of many Lombard towns over the centuries and the regional territory features imposing hydraulic works. For a long period, navigation has been the most rapid and effective way of moving men and goods. Only over the last two centuries has the growth of terrestrial means of transport reached such levels that water transport has become less economical. However, presently, road traffic and safety, along with the lack of railway networks, have led to the re-discovery of waterways as possible alternative means of transport.

Also tourism, with the re-discovery of historic canals, is re-proposing in a new form the ancient commercial routes that used to link our towns.

Currently, used navigable waterways in Lombardy region make up a network stretching for over one thousand kilometres and, considering also those stretches only seasonally navigable or with obstacles that could be removed if appropriate actions were taken, the network could reach 1,500 kilometres.

This is a considerable network, considering its links with the networks of Veneto region and Emilia region.

There are both natural navigable watercourses and the network of artificial canals built over the centuries, which in Lombardy region is particularly long and has an extraordinary historic importance. This network stretches for 250 Km, is recognised among the European TEN networks and is part of the waterway system of the Po valley and Veneto, declared of national interest. The supporting axis is the Po river, all navigable from the barrage of Isola Serafini. From the Po river the network branches off including: Mantua - Venice navigable canal (Fissero-Tartaro-Canalbianco), Pizzighettone – Cremona navigable canal, Mincio river, from Mantua to where it meets the Po river. Moreover, some of these waterways are part of an international navigable network.

Lombardy region also has a large number of minor navigable waterways, used for tourist purposes. The most important Lombard ship canals (Navigli) are around Milan, within the provinces of Milan, Lecco, Pavia and Varese. Other navigable stretches are found along the main rivers of the region: Po, Ticino, Adda, Mincio and Oglio.

Considering their size, the five Lombard large lakes can be classified as class VII waterways and therefore have a strong nautical vocation. They are one of the main development opportunities for inland navigation. There are 460 km of regular navigation routes, but cruises and the most modern hiring services are just starting being developed.

In Lombardy region, in total, besides the five major lakes, there are 16 minor basins with reasonable yachting, 158 lake municipalities with 183 public harbours and over 6,000 km of navigable lake shores.



Lake Como

Where to sail

In Lombardy region, there is a regular navigation service in the five largest lakes: Iseo, Lario, Garda, Maggiore and Ceresio. The service, though very much seasonal, has all the characteristics of local public transport and is irreplaceable, both for coastal communities and tourist mobility. The service is managed by:

- On lakes Garda, Como and Maggiore, NAVILAGHI – Governmental management for navigation.
- On lake Iseo, the Consortium for the Shared Management of lakes Iseo, Endine and Moro, using its own management company N.L.I. Srl for ordinary service management.
- On lake Ceresio NAVILUGANO – lake Lugano navigation company.

MANAGING COMPANY

Lago Maggiore
Lago Garda
Lago Como
NAVIGAZIONE LAGO ISEO
NAVILUGANO

TELEPHONE

0322-46651
030-9149511
031-579211
035-971483
004191-9715223

INTERNET SITE AND/OR E-MAIL NAVILAGHI

infomaggiore@navigazioneelaghi.it
www.navigazioneelaghi.it
infocomo@navigazioneelaghi.it
www.navigazione lagoiseo.it
www.lakelugano.ch

Tourist navigation is managed by professional operators mainly offering:

- Cruises of several days with full board service; only river cruises
- Daily cruises
- Boat hiring with helmsman
- Boat hiring without helmsman.

Yachting is also particularly developed in Lombardy region; along Lombard navigable waterways there is the highest boat density per kilometre of coast than in any other Italian region.

Goods transport takes place mainly along the Po river and the waterway system of the Po valley and Veneto region and is used by local industries and for exceptional transport. Lake transport essentially meets the needs of the businesses located along its shores and includes ferrying of motor vehicles. All police forces incessantly operate along all Lombard navigable waterways: Financial Police, Carabinieri and Police, with different types of patrol boats, sometimes with the help of Municipal Police forces with their nautical control and rescue means. Moreover, river/lake rescue activities are guaranteed by the Fire Brigades, the Civil Defence and, on lake Garda, the Coastguard (experimental service).

1. Environmental monitoring and information collection tools

Environmental monitoring is useful to decision-making processes and enables to build the knowledge basis needed to define policies and check their effectiveness.

Each environmental monitoring system has specific features and aims reflecting the needs of its users: a continuous relation is established between decision-making processes and monitoring, on the one hand, enabling decision makers to acquire data and information useful to their activities and, on the other, enabling monitoring to produce the data and information necessary for assessments.

Independently from the matrix used to collect information, the creation and management of the monitoring system includes the following steps:

- Definition of information needs, also according to legal requirements, if any;
- Network design, including choosing the areas to be monitored, which have to represent the whole system to be assessed, and defining number, type and location of monitoring stations, according to territorial features;
- Identification of the parameters to be measured and of the frequency of measurements;
- Setting up of the network;
- Start-up of data collection and processing centres;
- Network management (definition of sampling and data transmission protocols, technological equipment maintenance, quality assurance).

Monitoring networks may be either manual or automatic: in case of manual networks, operators carry out analytic surveys at monitoring stations according to set frequency; in case of automatic networks, analytic instruments at monitoring stations periodically record the value of chosen parameters (in some cases, directly sending processed data).

A general principle to be considered is that of the territorial level of the network: the different institutional levels create networks according to their information needs and their action capacity within the territory. Hence, monitoring network means an organised system of measurements repeated in time made, either manually or automatically, in different locations, identified according to criteria suitable to characterise the status of the environmental matrixes of an area.

ARPA (the Regional Environmental Protection Agency), providing technical-scientific support to the in-



stitutional authorities dealing with environmental issues, manages numerous monitoring networks, representing different environmental matrixes or issues.

Management, either direct or in collaboration, concerns:

- network of emission monitoring systems
- regional air quality monitoring network
- surface water environmental quality monitoring network
- monitoring network of fresh waters needing protection and improvement in order to support fish life
- monitoring network of surface waters intended for the abstraction of drinking water
- monitoring network of bodies of groundwater
- meteorological-hydro-pluviometric monitoring network
- snow-meteorological network
- artificial radioactivity monitoring network.

ARPA also manages monitoring of geologic risk and seismic monitoring.

Information systems enable us to acquire, update, process, show and spread data and information, better if geo-referenced to the regional territory. Small scale information bases are obtained by reducing and generalising contents, so as to have information consistent with its location in space.

1.1 Monitoring

ARPA Lombardy works daily for prevention and environmental protection, co-operating with regional and local bodies in many activities.

As for reducing pollution in bodies of surface water and groundwater and preventing further deterioration of water resources, Lombardy Region, through ARPA Lombardy, has created a network monitoring the most significant bodies of surface water and groundwater (see also Chapter 1).

Currently, as for surface waters, monitoring is based on chemical, microbiological and biological parameters and enables to determine a classification index taking into account the general characteristics of water quality. Thanks to the future development of monitoring systems, an increasing number of ecological features will describe the quality of the whole water body, not just of water.

As for groundwater, monitoring and the subsequent classification mode refer just to chemical parameters and do not take into consideration the possibility of underground life forms.

A system monitoring all regional water bodies and granting the opportunity for updating their classification to provide updated information to citizens, is the first step towards sharing water knowledge and solving the problem of fragmented information sources often confusing and hindering a common strategic vision.

1.2 Information collection tools

In a situation characterised by a rapidly changing relation between public administration and citizens, information integration is of strategic importance. Which is why Lombardy Region has started setting up the Observatory on Resources and Services.

The Observatory aims at:

- organising existing knowledge about water, that currently cannot be adequately used because data are scattered and there are compatibility problems between the systems used by many different bodies,
- having the information necessary to correctly plan and check actions aiming at reclaiming, protecting and enhancing the regional water heritage,

Observatory on Resources and Services

In Lombardy Region, the Observatory on Resources and Services (ORS – www.ors.regione.lombardia.it), set up according to Reg. Act No. 26/03 and subsequent amendments and integrations, was created as a tool to inform about and promote the activities of the Directorate General for Networks, Utilities and Sustainable Development. Its functions are:

- Portal of the Directorate and the Service Authority,
- Means to publish and spread data, acts, funding calls for tenders, regional planning, regulating and financing documents on: uses, consumption, disposal and re-use of water – energy – waste – technological networks,
- Permanent information tool on: water – waste – energy – technological networks and related services (support to Local Authorities entrusting services, identification of market trends, service quality and efficiency indicators, monitoring of the European, national and regional legal framework in the sector, benchmarking of service charters, etc...),
- Shared and integrated management platform of the databases of different bodies (other regional Directorates General, Area Authorities, Provinces, ARPA Lombardy, etc...).

Hence, the Observatory, on the one hand, performs a monitoring and information function on the management of public services targeted at meeting some well defined primary needs of Lombard citizens and businesses, on the other, through dedicated sections on environmental education targeted at consumers and young people, it is an information source able to actively involve its readers along the path towards effective environmental protection and long-lasting and sustainable development.

- harmoniously and consistently co-ordinating policies and actions developed by the different bodies operating in the sector, paying particular attention to the harmonisation of actions at basin level,
- streamlining and making more transparent the procedures to be followed to obtain the necessary authorisations and concessions to use and manage water and to make works affecting river and lake environments, while guaranteeing adequate safety levels and effective protection of water and related environments,
- offering to citizens clear and readily available information on the status of water resources and favouring the development of a culture of water by enhancing knowledge and awareness,
- granting effective control on the service level really offered by the managers of the integrated water service.

The Observatory is a system to share the data collected and produced by interested bodies, to overcome administrative, sector and territorial divisions and tackle the problems linked with water resource management in an integrated way.

Its creation involves two fundamental issues:

- The definition of common standards enabling all the people involved in the system to use and read the system information,
- The issue of periodic reports, thematic services and documents on the status of Lombard waters and the quality of the services offered to citizens.

The Observatory is the main working tool of the Service Authority, who uses it to collect the information needed for its activities. This information is then re-processed and given back to citizens.



Dugale Delmona

2. Regulatory and planning tools

Considering the evolution of the legal framework drawn by European sector directives and by Water Framework Directive 2000/60/EC, the Region, since 2002, has been elaborating: strategic guidelines for the water use and protection policy. This document recognises the primary function of the resource and the importance of a comprehensive action to protect and enhance it and highlights the need for re-organising sector regulations and developing a “culture of water” through the acquisition of relevant information and environmental data, their organisation and spreading and the participation of stakeholders in the definition of environmental quality objectives and in the planning and regulation activities. This document was followed by the drafting and approval of Regional Act No. 26/2003, dealing for the first time with the comprehensive regulation of services of general economic interest. The Act sets the rules, valid for all services, regarding the general principles of consumer protection, access to services, quality of services and management entrustment and defines: rules and regulations for the sectors of waste, energy, subsoil and water resource management. As for water resources, the Regional Act:

- defines how competences have to be distributed between the different administration levels,
- regulates the water service,
- regulates safe management of dams and access to environmental data,
- defines regional planning tools and introduces the “River basin management plan” including “Guidelines for water policy” (approved by the Regional Council) and a “ Programme for Water Use and Water Protection ” (in Italian PTUA) drafted and approved by the Regional Executive and reporting operating measures. The first draft of this plan constitutes also the Water Pro-



Mount Sasso Rosso

tection Programme provided for by Legislative Decree No. 152/99.

- Identifies implementing regulations.

Legislative Decree No. 152/2006 on “Environmental regulations” transposes Directive 60/2000 at national level and re-asserts the objectives and contents of the Water Protection Programme, postponing possible drafting deadlines. The work carried out creates an organic set of reference regulations and forms the information basis for subsequent updates, also according to the above-mentioned Legislative Decree.

The Programme for Water Use and Water Protection was finally approved in 2006, together with some implementing regulations, provided for also by Regional Act No. 26/2003, linked with the programme technical rules. In particular:

- The regulation on water use, saving and re-use streamlines the process to obtain the necessary concessions to use water, by applying resource saving and valuable water protection criteria,
- The regulation on the discharge of first rain water aims at reducing water body pollution caused by the runoff of rainproof surfaces used in specific activities such as: chemical industries, service areas, scraps depots, waste depots.
- The regulation on the discharge of urban wastewater defines the authorisation procedures and the discharge limits of treatment plants, assessing the attainment of set quality objectives, according to the type of receiver and the capacity of the plant.

These regulations are accompanied by a great number of technical guidelines supporting the administrations in charge, which are necessary to take co-ordinated actions and reach set quality targets.

Lombardy Region uses also other planning tools interacting with water resource planning:

- The Hydro-Geologic Settings Plan (in Italian PAI), basin draft plan regarding soil protection drawn up by the Po River Basin Authority,
- The Regional Territorial Plan,
- The Rural Development Plan 2007-2013.

2.1 Water protection programme and River basin management plan

The Programme for Water Use and Water Protection includes all information currently available on water. Information, objectives, regulations and organisation rules ensued from the work carried out have led the way to the enhancement and protection of Lombard water resources, being aware that water is a precious, available, abundant asset subject to increasing pressures.

The guidelines aim at reaching the following strategic objectives:

- promoting a rational and sustainable use of water resources, in particular drinking water;
- guaranteeing quality water at an affordable cost to users and meeting water demand in terms of quantity;
- restoring and safeguarding the environmental features of river bank areas and water environments;

- promoting initiatives to increase the availability of water resources in time.
- Considering these objectives, the guidelines leave to the Programme for Water Use and Water Protection (PTUA) the task of defining:
- conditions of bodies of surface water and groundwater;
 - quality objectives to be pursued;
 - measures necessary to reach the objectives, divided into general and specific;
 - water bodies used for specific purposes and the relevant quality objectives;
 - tools to build and share knowledge on water;
 - plans and actions to spread the culture of water;
 - distribution of responsibilities and co-ordination of the different water management levels.

For each of the above-listed topics, the guidelines draw the general lines the PTUA has to follow to identify actions, timetable and implementation rules.

The PTUA of Lombardy Region is a programme for the integrated safeguarding of the qualitative and quantitative aspects of water bodies “important” to reach or maintain minimum environmental quality objectives and of the water bodies with specific functional uses.

The PTUA is structured by river basins and specific sub-basins, topics or water categories and directs future action and management strategies. Since it outlines the policies to be detailed in the Basin Plans, it also deals with territorial development and sector actions planning. Moreover, the PTUA:

- reports guidelines, action and water management strategies to reach the objectives set in the Regional Development Plan of the 7th and 8th term of office of the regional government, by the Po River Basin Authority and in Legislative Decree No. 152/99;
- identifies the (significant) water bodies to which environmental quality objectives apply;
- identifies the areas object of special protection (divided by basins and sub-basins, specific problems or types of water);
- sets environmental quality target levels and the target levels for water bodies with specific uses and defines the actions necessary to reach them (or to maintain them, if they have already been reached);
- identifies integrated quality and quantity protection measures, co-ordinated by river basin;
- defines the set of measures necessary to reach environmental quality objectives according to the classification (environmental quality status) of each significant or interesting water body;
- defines the plan to analyse the features of the river basin and the impact of human activities on bodies of surface water and groundwater.

The PTUA drafting milestones have been the following:

- identifying the object of planning (significant water bodies and the relevant river areas) and monitoring their quality and quantity;
- linking and co-ordinating the objectives to be reached;
- identifying the measures (structural and non structural: actions, restrictions, incentives, etc.) to be adopted to draw up action plans, that is the planning choices necessary to reach set objectives;
- identifying feasible plans and the relevant timing;
- analysing the cost-effectiveness of each plan (using forecast mathematical models);
- providing for an action monitoring plan to check actions effectiveness and change them, if they are not effective.

Lombardy Region availed itself of the technical-scientific advice of sector experts and of experts in regulations, river reclamation and Strategic Environmental Assessment, co-ordinated by the Regional Research Institute of Lombardy – IRER, which dealt with collecting and assessing basic information and carried out all the scientific and technical activities linked with the drawing up of the PTUA.

Water Protection Programme

With the implementation of the Regional Act No. 26/2003, in the course of 2004 the drawing-up of the River Basin Management Plan was started. In particular, in July 2004, the Regional Council approved the Guidelines for water use and protection policies in Lombardy Region, outlining the regional strategic objectives in this field. Towards the end of the year, the Regional Executive then adopted the draft for the Programme for Water Use and Water Protection, that focuses on availability, impacts and quality of resources, and defines the measures to be taken to reach the objectives set.

This first formal adoption of the draft for the Programme for Water Use and Water Protection was then followed by a long investigation stage during which:

- the document was advertised, reviewed and published on the www.ors.regione.lombardia.it portal;
- a presentation conference and several meetings on the territory were organised;
- the observations received between February and June 2005 from 93 different bodies were protocolled in 146 notes and examined, and changes were carried out in the Programme accordingly;
- the whole amended project was then adopted and sent to the competent Basin Authorities for their opinion, as required by Legislative Decree No. 152/99.

The final Programme for Water Use and Water Protection was then adopted in 2006, together with some of the implementation regulations set out also in the Regional Act No. 26/2003, thus creating an organic set of rules which includes also the technical provisions for the Programme.

2.2 Regional Territorial Plan

The Regional Territorial Plan (in Italian PTR) identifies environmental protection and safeguarding areas. The enhancement of environmental, landscape, natural and ecological resources contributes to further strengthening regional competitiveness and enables each territory to develop its potential. The improvement of the quality of life of citizens also depends on the creation and strengthening of a quality territory, also from the point of view of the landscape, the environment and the social enjoyment of spaces.

Among the areas linked with the presence of water bodies, the Plan has identified the strengths driving their development and constituting their essential character, namely:

- Po river banks area;
- glaciers;
- large lakes;
- ship canals, drainage canals and irrigation network.

The areas of the PTR (Regional Territorial Plan) (1)

The Po river bank area

The big river of the Lombardy plain and the surrounding territory have become identity elements and at the same time driving factors for a competitive development of the Lombardy Region.

In this territory the actions of the regional government are to be seen in a wider, inter-regional reference scenario. In this respect, an important role is also played by the effective implementation of the River Basin Plan, according to the guidelines recently agreed at European level set-out in the Proposal for a EU Directive on the assessment and management of floods.

More than half (52%) of the 100,000 hectares of the Po river basin falling into categories A and B, as defined in the Plan for the Hydro-geologic Settings of the Po River (in Italian PAI), are within the Lombardy Region boundaries. These territories tend to change in time, with a reduction of natural vegetation zones and an increase in areas for anthropic use, mainly agriculture. In this respect, there has been a decrease in orcharding with single-crop lands prevailing, and a reduction of surfaces covered with water, with a lowering of the riverbed and the running-out of water from oxbow lakes and high-water beds.

As a result of such changes the plain landscape has become monotonous, a visible sign of a naturalistic impoverishment and a reduction in biodiversity.

The competitiveness of these territories is based on the right balance between agricultural production, environment quality and anthropic use, and is directly linked to the availability of water and flood risk.

As for the latter aspect, the approach in the construction of protection infrastructure has changed in the years. In the past, containment embankments were built, whereas today a major role is given to projects that would give back space and breath to the river, allowing for flood control and temporary storage. Also, environment-friendly techniques are now increasingly used in making containment works.

The maintenance and recovery of a "naturalness" standard for the river areas, also in those inhabited territories with no protected zones, is an aim to be pursued not only to protect environmental situations at risk, but also to promote a seamless integration among the elements of the river landscape. In addition to that, a better usage of the river, the direct involvement of farmers and the recognition of their social role are important objectives for keeping a common identity of the river territory.

The Agreement Protocol for the protection and enhancement of the territory and the safeguard of the Po valley populations, drawn up in May 2005 and promoted by the Po River Basin Authority and the provincial administrations along the Po river banks, stresses the importance of those objectives and defines the strategic actions for safety, maintenance, recovery, environment-friendly agriculture, environmental impact assessment and buffer zones, local development, environmental education and navigation.

Also the Programme for the management of the Po sediments has been set up by the River Basin Authority with the aim of providing a management tool that would help in regulating the sediment distribution along the riverbed. The programme envisages specific measures to bring the river stream and the river-bank zones back to their natural condition, promoting a better distribution of the sediments and filling up the big gap in the restoration of many stretches of the river in the Lombardy territory.

The areas of the PTR (Regional Territorial Plan) (2)

The glaciers

Glaciers are one of the “live” features of mountains, advancing and retreating in the course of their history, with lakes and alpine passes that change in time and new forests covering the abandoned moraines – all factors that have always influenced the life of the populations on the mountains and in the subalpine valleys.

Glaciers are part of the glacial landscape and are characterised by their capacity to shape valleys and slopes. We can distinguish between epiglacial phenomena, taking place on the surface itself of the glacier (ice-tongues, moraines), and the typical erosion actions caused by the downward movement of the glaciers towards the valley (e.g. glacial valleys with shoulders, cirques and other minor formations).

Glaciers are a typical feature of the alpine landscape, now endangered due to global climate changes. They are a unique resource and a critical element for the environmental balance of the high mountain system, within the water system and water cycle. Therefore, the deterioration of glaciers is a potential source of instability and risk for safety.

In view of the high degree of naturalness of glacial areas, actions should be taken to protect and safeguard not only glaciers and their morphological and hydrographical features, but also all plants and animals depending on them or present in such areas.

Glaciers have often been idealised and mythicized, in particular in the era of the first alpine explorations and discoveries. The memories and witnesses of such man’s endeavours are a precious heritage to be protected and enhanced, also as a sign of respect and proper attitude when confronted with the mountains.

Mountain climbing, hiking and tourist activities are to be oriented towards safeguarding the naturalness conditions. Plans for new ski slopes and new hiking trails must be carefully evaluated, and always rejected in the most natural areas.

The use and enjoyment of mountain areas must take into account the sustainability of the whole system, making sure that special attention is given to a unique and identity-oriented feature of the Lombardy landscape.

The large lakes of Lombardy region

The great Insubric lakes (Maggiore, Como and Lecco, Lugano, Iseo, Idro, Garda) and the Mantua lakes are a highly valuable and renowned landscape and environmental resource, and a unique landmark of the Lombard territory.

Their surroundings boast the most celebrated, described and depicted landscapes of the Region. The beautiful Lombard lakes have been praised in the literature of all times, in the descriptions of the Grand Tour travellers and in the most famous tourist guides, thus receiving an increasing attention world-wide. The Insubric lakes, surrounded by breathtaking alpine scenarios, are blessed by a mild climate that favours the growth of distinctive plants and crops. Being close to the main cities of the Po valley, many prestigious villas have historically been built along their shores, with stunning architectures and gardens - a sight not to be missed when navigating on the lakes.

From a naturalistic and landscape perspective, the Mantua lakes are a unique landmark in the Lombard plain, and together with the city of Mantua they embody the close relationship among water, agriculture and human settlements that has historically characterised the Mantua territory and many areas of the irrigated plain.

In recent years, the Lombardy lakes have been affected by some significant changes, mainly the development of real estate for tourism and leisure and the increase in related services and infrastructure along the shores. The special configuration of the different lakes and their environmental balance have suffered the pressures coming both from the increase in building sites and tourism, and from climate changes, namely the recurrent water crisis.

Therefore, an active protection policy is needed in order to redefine the integrated strategies for a sustainable and long-lasting development of these territories, envisaging feasible actions to guarantee the right quality and quantity of water, as well as clear protection objectives for the safeguard of this incredibly rich cultural and natural heritage. Moreover, actions should be planned to protect the network of symbolic and perceptible relationships that has shaped in the centuries that specific and unique landscapes and made them famous all over the world, playing an important role in the image of quality now associated with Lombardy region.

For the protection of the environment and the landscape a co-ordinated action is needed, with the involvement of all the different bodies and authorities, including lake-side municipalities, so as to enhance these areas without impairing their invaluable environmental, landscape and cultural value. First of all, a careful sustainability assessment must be carried out on the development plans underway, in order to assure the co-ordination of local programmes in line with the objectives and priorities for landscape protection and enhancement set at regional level.

Ship canals, drainage canals and irrigation network

The system of navigation canals (the so called “Navigli”) and waterways is one of the most peculiar feature and landmark of the Lombard territory. These very ingenious waterworks have historically shaped our settlements and the countryside organisation in the Lombard plain, thus assuring water for irrigation and transportation and playing a major role for the economic and social system.

Carefully designed and built, the main ship canals of Lombardy have become reference points not only for productive and agricultural activities, but also for the dwellings of the noble. These canals have always been the strength of many historical cities they run through of nearby, and more recently have become a tourist resource around which leisure time itineraries are designed.

The safeguard and enhancement of the waterway and channel network and of the individual waterworks, as well as the defence of the natural and rural context and historical settlements in their surroundings has become a strategic action to protect the landscape and the historical-cultural heritage, to promote sustainable tourist activities and, in certain cases, to recover the landscape of large areas of the Lombard plain.

To this respect and with reference to the main ship canals, the assessment of tools for environment and landscape protection is deemed very important, in order to evaluate possible integration needs and to assure the best co-ordination in local management.



rice-fields near Pavia

2.3 Rural development plan

The 2000-2006 planning period strategy was developed in a period when the agricultural sector in Lombardy region was suffering from strong competition with impacts on production, economic and social dynamics.

The 2007-2013 Plan draws the lines for developing the competitiveness of the rural system and supporting a sector in which social and environmental issues are considered as important as production issues.

The Plan strategic choices take into account the needs emerged in the rural areas of the region and aim at speeding up the sustainable development process already under way in regional farming and at reducing the gap between different rural areas in terms of economic and residential appeal and development of human and social capital. Regional planning, according to EC Reg. No. 1698/2005, identifies 4 pillars of action:

- Pillar 1: Increasing the competitiveness of the farming and forestry sector by supporting re-structuring, development and innovation,
- Pillar 2: Enhancing the environment and natural spaces by supporting territorial management,
- Pillar 3: Improving the quality of life and promoting the diversification of economic activities,
- Pillar 4: Increasing local governance effectiveness and efficiency and creating local employment and diversification opportunities.

To pursue these pillars of action a more rational use of water resources is needed, to reduce both the competition with other sectors for the use of the resource, including civil use, and the production costs of the main regional farm production chains and also to favour the diversification of crops and process innovation. These are system actions, concerning both the big distribution networks managed by consortia and single farms (Pillar 1), that are confirmed and integrated with the needs emerged in Pillar 2, that is, improvement of water quality by the agricultural sector through active phytodepuration activities and the reduction of the polluting potential.

2007-2013 resources amount to about 900 million Euros divided between the pillars. Actions relating to water resources may be financed in the whole region.

3. The setting-up of the partnership

The notion of partnership has become so familiar that, apparently, it does not need any explanation. However, its not always appropriate use in many different contexts (negotiated or concerted planning, contractualised policies, “community method”, etc.) leads us to wonder if and when a partnership is the best strategy to solve a problem and which “pattern” of partnership is the most suitable and efficient. Considering that these pages aim at illustrating the approach to territorial water resource protection and enhancement strategies and the role the partnership is playing

The partnership

The typical scenario of a partnership is a situation in which the solution of a problem is shared by different subjects, who are all on the same level or, in any case, not hierarchically subordinate one to the other. In the public sector, what has influenced the most the development of these scenarios is the progressive decline of the traditional vertical model, according to which the decision and implementation of a project came directly, exclusively and in a straightforward way from one single person, one single public authority with the necessary resources and competences to act. The increasing autonomy of local authorities and the increasing “fiscal crisis of the State” have led to new practices, more or less standardised, where local policies are defined with the contribution of many different stakeholders and resource owners, all formally or truly on the same level, and through negotiation processes aiming at undertaking pactitional obligations.

Currently, all these practices, considered “good practices”, are standardised in a number of procedures known as “negotiated planning”. However, partnership is not just negotiated planning, on the contrary, negotiated planning is just one possibility.

The most common, maybe the most usual, situation in which partnerships are set up is the opportunity for reaching set objectives, even minimum objectives. This is the case when negotiation is essential to involve all the people who cannot be excluded from the realisation of the project, since they hold exclusive powers/competences, with the aim of obtaining consistent and converging action or else the project is bound to fail or be weaker. This type of agreement is certainly positive, but also “forced”. In this situation, the public bodies involved are given, they can be identified according to their competences, provided for by the law, and necessarily play a role in solving the problem.

The reasons for this type of partnership are self-evident and do not need to be explained. It is a question of improving the efficiency of a process, also administrative, which is usually complex and characterised by concurring institutional roles, where often the “solution” is already defined and proposed by the promoting authority. When operational aspects are central, we can talk more of co-ordination than of real partnership, a dialogue in retrospect that cannot completely hide a prevailing, legitimate instrumental vocation.

However, also in this case, there may be the need or the opportunity for enlarging the partnership to include not just “given” subjects, for at least two reasons.

The first reason concerns resources. The second reason regards the “quality” of the result and differs from the mere instrumental interpretation of the process. It is possible to increase the number of parties involved by including subjects that, even though indifferent to the purely institutional implementation of the project, can contribute to improve quality and project performance.

This idea of the process is the one approaching the most the spirit of the partnership and the most interesting reasons at the basis of its setting up. The “spirit” we are talking about is the belief that the best solution to a complex territorial policy problem, either environmental or socio-economic, cannot but ensue from a plurality of points of view, each representing specific knowledge and feelings and not just or mainly partial interests to be composed. Hence, the aim of the partnership is not just reaching agreement (or reducing disagreement), but also improving the quality of solution strategies: the people who start collaborating and expressing assessments based on the merits of measures have already abandoned claiming attitudes, which is important in a partnership.

Pursuing this objective implies involving the partnership, that is, different subjects, from the beginning of the process, during the analysis of the problem and the drawing up of the solution and strategies. This degree of sharing becomes an important integration factor that can also lead to reducing potential conflicts of interest.

When the focus is the “quality” of the solution, the identification of partners is not always given beforehand. Therefore, a good local practice shall not just gather around a table any bodies proposing themselves as participants, but shall favour the involvement of “new” interlocutors whenever hidden, important problems or interests not adequately represented are identified (that could lead to potential future conflicts).

The right balance must be found between a slightly technocratic approach proposing to partners the sharing of given objectives, strategies and solutions only at the implementation stage and a fully participated approach, ready to bear higher negotiation costs to reach the best solutions, from the point of view of quality.

This is a very important issue. The direct and indirect costs of negotiation processes, including those linked with the inevitable slowing down of decisions, are often a deterrent against partnerships. However, we believe that in a well managed process, where the setting up of a partnership is not reduced to a bureaucratic ritual, all costs borne during participated procedures are fully repaid during the implementation stage (smooth and integrated actions, timetable reliability, reduction of risks) and also in terms of design quality and suitability of the solution.

Partnership is something that is created before the signing of an operating agreement, it is the key factor leading to the agreement (though it can continue during its implementation), that is, during that complex process of preventive analyses and assessments that should lead to the decision of signing or not a well defined type of operating agreement.

and will play in the future within their framework, we shall just make some remarks about the method, to highlight the potential of the experience under way.

A partnership, in the form for instance of “deal”, takes the shape of a permanent laboratory which life depends on the liveness of the debate, the interest in tackled problems and the trust in the productivity of the “participated” method. In this sense, it is not necessary for a partnership, for instance like that of the Water Deal, to become a negotiated planning institute or to be ratified by it. On the contrary, a “water deal” can lead to a series of targeted arrangements, programmatic and above all executive projection of the strategies constantly developing and evolving within the deal.

The Water Deal signed by Lombardy Region has in fact been developed in parallel with a thorough preliminary analysis leading to the drawing up of an analytical and management tool (the Programme for Water Use and Water Protection) with the purpose of regulating and harmonising the different uses of the water resource (civil, industrial, irrigation, energy production). The Deal was developed starting from the observation that competences in the field of water management and control are distributed between many different institutional or para-institutional bodies, sometimes independent one from the other. Hence, the Deal takes the shape of a common path, with regional direction, followed by the main bodies dealing with water to identify common objectives, best practices and priority actions to be implemented according to set times and modes: the resulting action plan is the subject-matter of the deal.

River contracts, instead, have a different vocation. Their origin is likely to naturally lead to their transformation into immediately operational negotiated planning agreements (reducing water pollution and hydraulic risk and reclaiming river course environmental systems by realising infrastructure and regulating production activities and human settlements). As described below, the river contracts signed in Lombardy region offer themselves directly as priority instruments to plan, finance and implement actions within river basins and are progressively institutionalised in Territorial Development Framework Agreements (Reg. Act No. 2/2003) with the support of all (territorial) local bodies directly interested in safeguarding and restoring river environments.



Adda river – Brivio

3.1 River contracts

“River contracts” are negotiated planning tools inter-related with strategic planning processes for the reclamation of river basins. The adjective “strategic” suggests a co-planning path and methodology shared by all stakeholders. The aim of these processes is making long-lasting basin development plans drawn up in a participated way so as to be widely shared.

“Basin reclamation” is meant in the widest sense and includes also landscape–environmental aspects, according to the provisions of the national act transposing the European Landscape Convention.

The River Contract is therefore an agreement enabling the adoption of a system of rules in which the criteria of public use, economic profitability, social value, environmental sustainability are considered priorities when looking for effective river basin reclamation solutions.

The elements coming into play in this agreement are:

- a community (local bodies, ATOs, region, associations, businesses, citizens, etc.)
- a territory (soil, water, built-up areas, air, etc.)
- a system of policies and projects at different levels/scales.

These elements, that have always been inter-related, must be directed towards shared reclamation objectives through adequate participatory processes enabling the shift from environmental protection policies to wider “landscape–environmental resource management” policies, by acting in many different sectors:

- protection and safeguarding of natural environments,
- water protection,
- soil protection,
- protection against hydraulic risk,
- safeguarding of natural beauties.

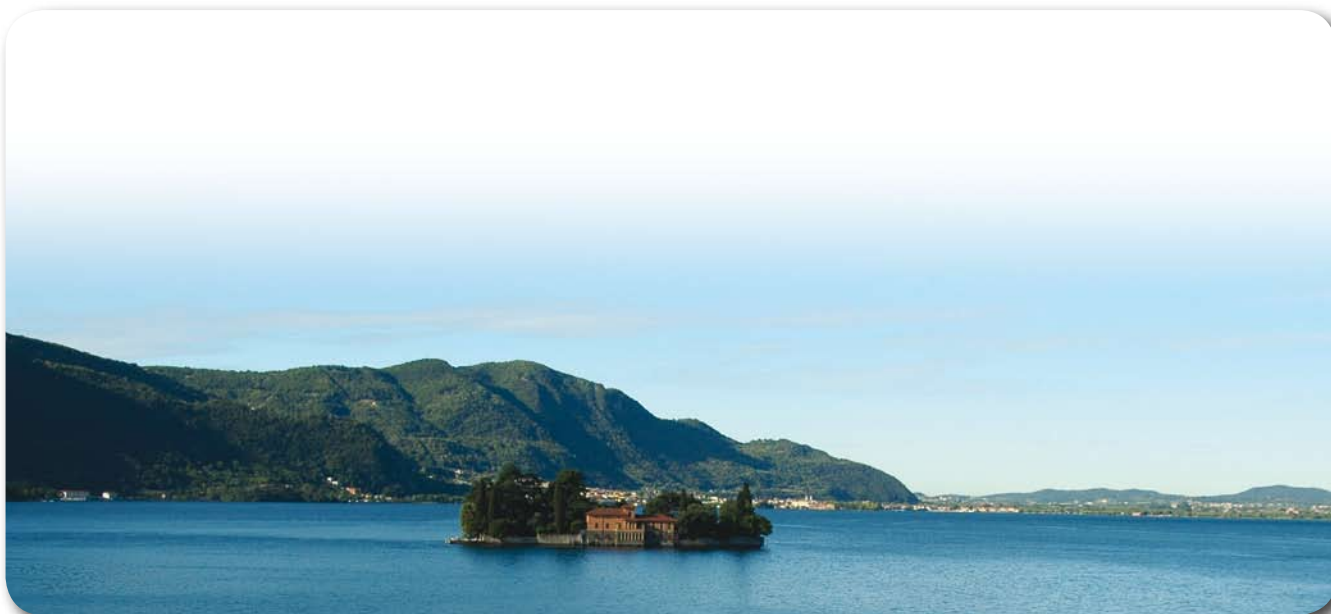
To reach these objectives, the River Contract is developed by defining:

- 1) a shared strategic plan, that is, a widely shared strategic medium-long term vision of the local development that we intend to pursue (meant as social-economic model, landscape in a broad sense, quality of life, ...) including:
 - a visual representation (cartographies)
 - an integrated system of policies to be developed in synergy.
- 2) an instrument to assess policies, their effectiveness and consistency with objectives
- 3) basin planning reporting the shared and integrated actions and rules to be implemented by interested parties within set deadlines.

The innovative feature of these processes is the choice to go in the direction of horizontal subsidiarity: the differentiation of territorial systems requires a system of flexible governance, able to solve conflicts and interests at the local level,



Po river



Lake Iseo

through negotiation processes respecting the vocations of the territory, and to create a “single” system through dialogue between planning tools for social-economic actions and territorial planning.

Along with already signed river contracts, namely, the “Olona, Bozzente and Lura River Contract” and the “Seveso River Contract” and the contract for Lambro river, for which a Memorandum of Understanding “Towards the Lambro River Contract” has been signed, various experiences dealing with river sub-basins are under way within the region, all of which, though in different ways, tend to lead to the signing of negotiated planning agreements.

With these voluntary agreements, signatories share the principle that only through a synergetic and strong action by all stakeholders, both public and private, can the trend leading to river basin territorial/environmental deterioration be reversed and sustainable development objectives suitably be pursued. For this purpose they undertake, each within their competences, to act within a framework of strong enhancement of the principle of subsidiarity, by using all partnership tools useful to fully reach shared objectives.

3.2 The Water Deal

In an attempt to overcome the chronic emergency situation due to water shortage featuring the last few years and shift to conscious and integrated management of its water resources, the Region is working to draw up an Action Plan, with the contribution of all stakeholders, enabling it to manage water in the future.

The Plan shall include actions developed by different stakeholders, with different resources, but aiming at reaching common objectives. Which is why this initiative is like a Water Deal featured by solidarity and sharing of objectives.

The overriding principle of this deal is that protecting water resources and the related environment is everybody’s main objective, because water is an inalienable public property which use can never be separated from general interest aims.

The second main principle is a fair distribution of periodically available water resources, by leading the different users to accept quantitative and/or qualitative reductions of supplies, with an equal distribution also of inconveniences, and by identifying damage compensation measures.

The effects of water availability reduction due to current climatic changes are dealt with according to these two principles and along five main strategic lines:

- raising of new awareness of the value of water and sharing of information and value,
- shared regulation of existing reservoirs,
- efficiency of water abstraction and distribution systems,
- measures to reduce demand in case of peaks in demand or minimum availability,
- new water storage opportunities and strengthening of distribution.



4 At citizens' service



1. Citizens' expectations

From the 80s, the improvement of economic and social conditions has been accompanied by an increasing demand for areas where people could spend their leisure time and relax, and for natural and urban quality environments.

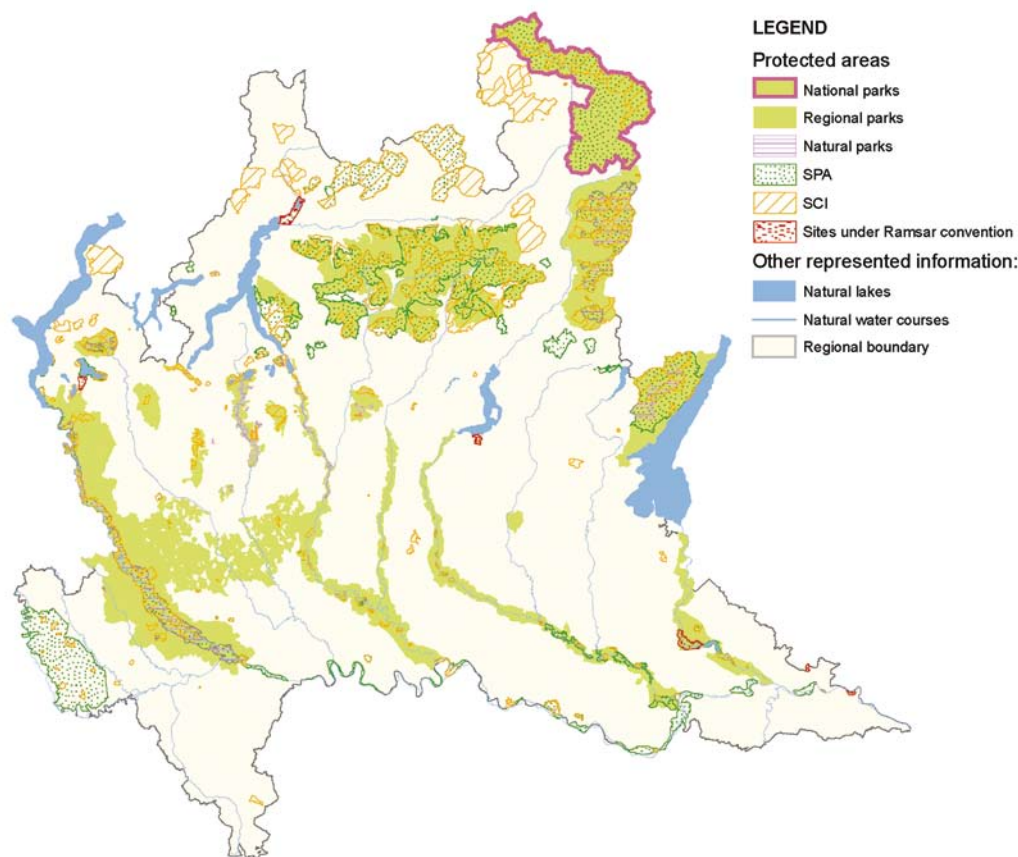
Lombardy Region was the first to set up a system of different types of protected areas with the aim of creating an environmental protection network covering the whole regional territory (*Figure 4.1*).

However, the creation of a network of protected areas has not always been accompanied by a real environmental improvement effort. The strong pressures linked with human settlements and the different decision levels have overloaded the territory and created critical situations only partially mitigated by the efforts of environmental protection authorities.

In the case of water in particular, issues linked with the organisation of really efficient services have very much delayed the creation of infrastructure important to reach and maintain acceptable quality levels of receiving water bodies. To build plants of suitable size, providing adequate treatment, within the proper environmental framework, comprehensive knowledge of the issue is required. This knowledge can be obtained only at the level of the Optimal Territorial Areas, by going beyond the municipal dimension, where plants are often too small, located at the outskirts of built-up areas, never in a suitable position as to the water network and with treatments that are too weak to guarantee the quality of the water discharged downstream, into the water network.



Sermide – Drainage pumping plant



Natural protected areas in Lombardy

2. Actions and controls

The approval of Leg. Decree No. 152/99 and of the Water Framework Directive 2000/60/EC, subsequently transposed by Leg. Decree No. 152/06, has deeply changed the reference legal framework for water resource protection and sustainable use policies. The management of water resources is now referred to the river basin territorial unit.

To solve the problems related to water bodies, an integrated vision and assessment of issues is needed, at the level of the river basin, which becomes the core of policies and of water protection and use actions. Hence, regional planning, along with a series of measures applicable to the whole regional territory and necessary to implement Community regulations in the field of water protection, provides for a number of measures to be implemented to reach the objectives of environmental quality and to define the specific

Protected areas in Lombardy region

Lombardy Region was the first in Italy to set up a councillorship for ecology in 1970. Its legislative activity in the field of parks and reserves started in 1973, with Regional Act No. 58 creating the first parks: Ticino (1974), Nord Milano (1975), Groane (1976), Colli di Bergamo (1977).

Regional Act No. 86 dated 1983 created a "System of Lombard Protected Areas" including 24 regional parks, divided by type: river, mountain, urban, rural and forest parks; 66 parks which interest exceeds municipal boundaries, 64 nature reserves, 29 natural monuments. This "network" covers over 450,000 hectares within Lombardy region and constitutes priceless heritage of natural, historic and cultural resources that must be not only protected, but also promoted and communicated, since they belong to all citizens (Figure 4.1).

Within this system, numerous habitats and species of community interest have been identified, mainly in parks or nature reserves. The system of Lombard protected areas is therefore a network which functional cores are regional parks and nature reserves, whereas linking areas have been created also by setting up Local Parks which interest exceeds municipal boundaries (in Italian PLIS).

PLIS are characteristic of Lombardy region and have a great strategic importance within the framework of the territorial protection and reclamation policy, since they connect and integrate the urban green system and protected areas.

Among all regional park systems, that of Lombardy region has the greatest potential, both owing to its vocation to mix parks with cities and countryside, by experimenting new forms of sustainable development and owing to its net-like structure, where parks are the main mesh, and also due to the numerous management models, open to different experiences involving local bodies and communities, thus contributing to strengthening and integrating cultural identity.

The management of protected areas is usually the responsibility of consortia of municipalities located within the protected territory, mountain communities or provinces, to enhance local administrations and make management decisions closer to the needs of resident populations.



Pavese canal

3. Objectives and timing

For each type of water body, environmental objectives to be met within set deadlines are set and reported in basin plans: all water bodies must be in good environmental conditions by 2015. For this purpose, the principle of water service cost recovery was adopted, including the economic analysis on water uses and in line with the “polluter pays” principle. According to European Directives, by 2010 water price policies shall: urge users to use water resources by implementing saving and re-use measures, thus contributing to reaching environmental objectives, and adjust water service cost recovery according to an economic analysis and taking into account the different water use sectors, divided at least into industry, households and farming.

Basin and district plans and the sets of measures implemented to reach environmental objectives increasingly tend to integrate sector environmental policies both at national and European levels to guarantee long-term sustainable management of water resources and comprehensive protection of relevant ecosystems, including all types of water bodies.

Moreover, water body quality objectives must co-ordinate in an organic and integrated vision the different needs reported in the guidelines drawn up at different levels: Region’s strategic choices, European and national general objectives and the objectives jointly set at river district level.

Currently, set objectives and implemented monitoring, as described above, abide by the criteria of Leg. Decree No.

uses for bodies of surface water and groundwater. These measures must take into account: the current quality level of water bodies, their specific environmental features, future development forecasts and enable the drawing up of plans and operating proposals to reach quality targets.

According to the above, the measures recently adopted by the Region provide for: the designation of sensitive areas and the relevant catchment basins; the designation of vulnerable zones; the calculation of the minimum vital flow of surface watercourses; the identification of the water intended for human consumption to be safeguarded; control on pollution caused by hazardous substances; water saving and re-use; restoration and protection of the water ecosystem; increased water availability in time. As for basin specific measures: additional actions to reach the environmental quality targets set for significant water bodies and the quality targets set for water for specific uses.

Monitoring of water body qualitative trend is the main tool to check the effectiveness of adopted measures and their implementation. For this reason, also in compliance with the European directives in the field of water, a comprehensive monitoring system of watercourse quality is constantly maintained, taking into account not just the chemical and physical features of the water matrix, but also the biological and hydro-morphologic characteristics of the watercourse.

Besides monitoring the general quality of water bodies, it is also necessary to check that the limits set by authorisations and water abstraction rights are abided by, since they are the contribution of single citizens (owners of drains or diversions) to good or poor water body quality.

152/99, waiting for a shared national and European monitoring and classification mode, according to framework directive 60/2000/EC and Leg. Decree No. 152/06.

Thanks to current monitoring, it has been possible to classify the ecological or environmental status of identified water bodies and to assess the anthropogenic pressures (loads and uses) and the main problems affecting them. By comparing these data with set objectives, it is possible to assess the strength of the measures to be implemented and to change objectives, if the situation so requires.

Notwithstanding some local improvements, the conditions of numerous stretches of watercourses within the basin, where anthropogenic pressures are particularly high, are still critical, even though infrastructure has been completed and the best technology available in the sector of water treatment is being used. This is the case of Lambro and Olona rivers. Only by moving the discharges by the most important plants, which are quite numerous in the basin, will it be possible to really improve the quality of watercourses as a whole.

As for lakes, in particular large lakes, the difficult identification of the parameters to be used to describe their ecological or environmental status and, above all, the specific reaction time of each single basin to actions make it very difficult to assess how far the objective is and the time needed to achieve it by each separately considered basin.

In some Lombard rivers and lakes, pollution is almost totally caused by urban discharges and the lack or unsuitability of current plants. Hence, water quality improvement is strictly connected with investments in treatment and, in turn, with the general low level of investments in this sector (see also Chapter 3).

Clearly, investments should come from the proceeds of the integrated water service, which are essentially the turnover of the service linked with the collection of the rate provided for in the Area Plan. The implementation of adopted measures is hampered by the current rate method, because Local Authorities fear that the shift from a system where rates were not linked to costs to the new system could exceed the socially acceptable limit or lead to abandoning works needing heavy investments. However, the rate paid by citizens must cover not only the costs of water supply, which is the simplest aspect of water service management in Lombardy region (see also Chapter 2), but also and above all the treatment of the water that returns to watercourses.



Mincio river

1. Access to the service

Lombardy Region has included water service management among its strategic objectives. In 2003, Reg. Act No. 26/2003 was approved, organically and harmoniously regulating all local services of general economic interest. Before that, a Directorate for Utilities had been set up, thus overcoming the fragmented competences featuring the organisational structures inherited from the past, persuaded that territorial development must be planned together with the people making up its fabric: local authorities, businesses and the world of finance.

The path trodden by the Region starts from the awareness that users' interests must be acknowledged and protected as reference value. From this point of view, water resource management is considered not as the objective of our government action, but as the means to guarantee the best quality and economical performance to citizens. The presence of a strong system of guarantees is essential to ensure that competition is targeted to users' interests.

2. Standard compliance control

To safeguard the central role of users, Lombardy Region has appointed a Service Authority to protect them, in their interest and to increase their satisfaction in using the service.

The Authority performs monitoring and control functions, also by using the data available at the Regional Observatory on Resources and Services, with particular reference to rate trends, services supply mode, quality of supplied services, offer competitiveness and compliance with Services Charters. Moreover, with its deeds, the Authority sets the general eligibility requirements and criteria to participate in calls for tenders and the modes and procedures regulating relations between ATOs, managers and service suppliers. While performing its control tasks, the Authority may ask information to sector operators and carry out analyses or surveys to check the degree of satisfaction of the service. The Authority also spreads data through the most suitable information means.

The Authority plays a directing and regulating role by issuing guidelines sketching the best scenario for the supply of services. On users' request, the Authority may report critical situations and advise on the



Ticino river oxbow

opportunity of applying sanctions. The Authority may also set best standards at which sector operators should aim and contributing to the setting of a service best standard.

Another function of the Authority is protecting users and settling disputes. The Authority examines the requests and complaints of single users or groups of users and suggests changes to the supply of services. The Authority may also settle any dispute between service providers and between service providers and local authorities.

3. Objectives and timing

The Region, in charge of regulating the sector and guaranteeing that the laws in force are abided by and the objectives provided for are attained, shall fulfil the task of providing all necessary instruments for stakeholders to organise themselves and take the necessary steps to face change. Meanwhile, strictly connected with that objective, there is the need to make infrastructural investments in the Lombard water system for service levels to meet the minimum standards accepted by the European Community. Also in this case, guidance is needed, along with adequate tools to favour investments to develop a service of economic-general interest.

Area Authorities shall comply with the regional organisational model by guaranteeing that the management of the infrastructure which ownership is yielded by local authorities to management companies is according to European and national laws regulating public contracts.

The application of the principle of the single management of networks and plants at the level of the ATO is momentarily postponed till December 31st, 2011 only for those ATOs which managing companies on December 31st, 2005 served at least 240,000 inhabitants. On December 31st, 2011, current management expires and, in the six following months, Area Authorities shall entrust with the management a single owner at the level of the ATO (see also Chapter 3).

The provision of services to users, that is to say, the use of infrastructure for the operational management, shall be entrusted by the ATO to another entity, to be chosen in a call for tenders. This entity, for a period that does not need to be too long, given that this company is not responsible for any investments to be amortised, shall be in charge of managing networks and plants, of ordinary maintenance and of invoicing the service to users and shall set aside a percentage of generated cash flows for the company responsible for investing in networks and plants.

The regional act excludes from adopting the compulsory regional organisational model: the ATO – Municipality of Milan, the only case in Lombardy region where Municipality and Area Authority coincide, and those ATOs which on July 10th, 2006 had already formally entrusted the management of the service, according to the so-called Galli Act (No. 36/1994), or had already approved the Area Plan and formally decided to entrust the management of the integrated water service through a call for tenders.

To step up the aggregation processes provided for, the Region, in case of infringement or delay on the part of the local authorities involved, may exercise specific substitute powers.

Hence, the reform shall lead to the setting up of as many companies provided with funds as the ATOs, thus reducing the number of companies involved and increasing the average size of the companies responsible for investments.

The services charter is a tool enabling citizens to know what to expect from utility suppliers in terms of performance standards, quality and timing and, at the same time, it is a concrete means to check that declared undertakings are met and, if necessary, to lodge complaints/damages claims, if some of the declared standards are not met.

In our country, the charters of services have a long history. The first document setting the general contents of these charters dates back to 1993 and was drawn up by the Civil Service Department. Then, other implementing regulations were approved, and in 1999, the “General Framework for the drawing up of services charters in the water sector” was issued (Decree of the President of the Council of Ministers dated April 29th, 1999). Even though service suppliers have customised the general framework, the following bottom-up guidelines remain valid for the setting and control of standards:

- the service supplier is responsible for checking reached service quality levels; they must measure to what extent set objectives have been attained and use performance monitoring data to draw up a progressive improvement plan;
- the specific objectives the service supplier must stick to are set in the service contract signed by the service supplier and the reference Area Authority;
- the specific objectives and standards reported in the service contract between Area Authorities are set and updated according to the general guidelines and standards defined “upstream” by Lombardy Region, also taking into account the different territorial features.

