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Groundwater utilisation and protection: the experience and the comparison of Argentine and Italian regulations

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ABSTRACT: *This contribution describes the approach of two wide coastal areas, located in two countries, Argentina and Italy, to the regulation of groundwater utilisation and protection, considering the general purpose to satisfy the current demand of high quality water and to guarantee sustainable utilisation of groundwater resources.*

The contribution also considers some local government initiatives concerning the protection of water resources, in terms of availability and quality, and of ecosystems. Moreover, attention is given to the effect of the whole water cycle management, comparing Italian national legislation, defined in the framework of European Union, considering the specificities of Apulian region, with Argentine national legislation, considering the specificity of Buenos Aires province. Natural resources management is considered from two perspectives: legislation and the government structure managing it.

It can be argued that the two cases studied possess, up to a certain extent, completely opposing advantages and disadvantages and are therefore complementary.

KEYWORDS: *legislation, protection, management, groundwater resources*

1. INTRODUCTION

As water is a vital resource for life, health and human development, water management policies must aim at providing not only economic efficiency but mainly social equality. In this sense, the United Nations Declaration of Human Rights states that every human being should have access to clear water. Not only is this a basic human right, but it is also critical in the reduction of water-borne diseases. Those purposes are pursued using mainly groundwater resources, as in the cases of Apulia (Italy) and Buenos Aires Province (Argentina), where more than 80% of drinking water is discharged by springs and wells.

At the same time, population and their per capita use of fresh water are increasing worldwide, with more population concentrating in coastal areas; climate change and groundwater contamination will increase the stress on available drinking groundwater resources and valuable ecosystems.

Environmental regulations aim to protect nature, minimise harmful modifications of human origins and correct the negative impact caused by environmental degradation. Regulations for environmental protection aim to protect people from their own behaviour, and environmental protection focuses on conserving living conditions in their broadest sense, including human quality of life and the biota, which are closely interlinked, while trying to achieve the sustainable use and management of natural resources. The possibility of using water and other natural resources, and even the right to use them, has never been an issue. But the concept of use needs to be regulated in order to avoid regular misuse, or at least to reduce it, and especially in order to prevent use from becoming abuse. The legal environmental protection regime requires different actions for every natural resource. This is especially so for such an essential element as water, as different needs have to be addressed and a large number of specific situations have to be considered (del Castillo, 2006).

This contribution describes the approach of two wide coastal areas, located in two very different countries, Argentina and Italy, to the regulation of groundwater utilisation and protection, considering the general purpose to satisfy the current demand of high quality water, and to guarantee sustainable utilisation of groundwater resources in the case of coastal aquifers of Apulian region (Italy) and Buenos Aires Province (Argentina).

The comparison between these two national experiences shows some similar environmental and hydrogeological characteristics but also a very different approach to the management and the protection of groundwater resources, showing very interesting and dissimilar advantages and disadvantages of the said approaches.

2. HYDROGEOLOGICAL FEATURES OF SELECTED STUDY AREAS

The Apulia region is located in the south-eastern portion of Italy. The Apulian region is characterized by very low availability of surface water resources due to its widespread karstic nature. Considerable groundwater resources are located in large carbonate coastal aquifers. Groundwater for domestic, irrigation and industrial use has been withdrawn in large and increasing quantities over the years; it still allows for the development of local population.

Carbonate rock outcrops are widespread in three areas of the region; in these areas the natural protection of the aquifer by pollution is very low. The intrinsic vulnerability of main aquifers, which is spatially variable but significant everywhere, exposes groundwater almost directly to effects of potential pollution sources from anthropogenic activities at the land surface. The natural or intrinsic vulnerability is increased by using custom-bored wells, karstic pits, and dolines to discharge underground wastewaters and runoff from urbanized surfaces.

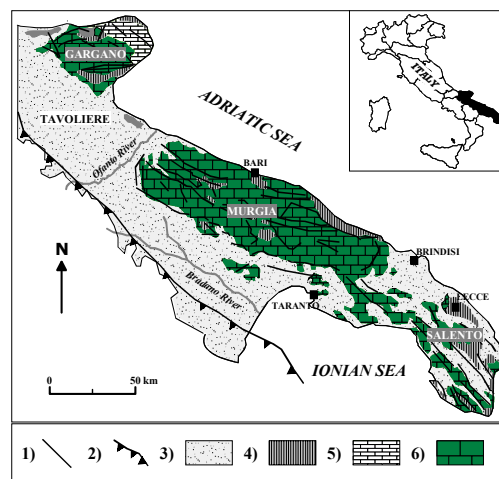


Fig. 1 Geological scheme of Apulian hydrogeological units and structures. 1) Fault; 2) Front of the Apennines; 3) recent clastic cover (Pliocene –Pleistocene); 4) Bioclastic carbonate rocks (Paleogene) and calcarenites (Miocene); 5) Carbonate platform rocks (Upper Jurassic-Cretaceous); 6) Scarp and basin chert-carbonate rocks (Upper Jurassic-Cretaceous).

Four of these units are traditionally considered the main Apulian hydrogeological ones (Fig. 1). Apart from Apulian Tableland (Tavoliere hereinafter), all these hydrogeological units share some common features (Polemio 2005), except for the Apulian Tableland (Tavoliere hereinafter). They consist of large and deep carbonate aquifers, the predominant rock material of which is either limestone or limestone-dolomite. Aquifers are affected by karstic and fracturing phenomena, also well below the sea level, whereas intruded seawater underlies fresh groundwater owing to a difference in density. In both the Gargano Promontory (Gargano) and the low Murge Plateau (Murgia) aquifers are under pressure except on a restricted coastline strip. In the Salentine Peninsula (Salento), subsurface water flow under phreatic conditions is prevailing. The Salentine hydrogeological unit is the only unit which is lapped by the sea on both sides. Tavoliere hydrogeological unit consists of a large porous aquifer within a conglomerate sandy-silty succession, less than sixty meters deep with a clayey impermeable bottom.

The whole Apulian groundwater has undergone a two-fold pollution, both originated by human action: salinization due to seawater intrusion has evolved progressively as it has affected increasingly larger portions of land; and biological and chemical-physical pollution has gained importance and is mainly concentrated around urbanized areas. Salt contamination of the Apulian

groundwater, due to seawater intrusion, is a well-known and thoroughly investigated phenomenon (Grassi & Tadolini, 1996). Nowadays, a strong connection between the increase in salt contamination and the lowering of piezometric levels, which can be ascribed to groundwater overdraft and/or a natural decrease in groundwater recharge, has been recognised (Polemio *et al.*, 2004). The aquifers have been considered a kind of ultimate "receptacle" for domestic and industrial waste waters. Groundwater of adequate quality is diminishing; chemical-physical and biological pollution is gaining importance; it is mainly due to the diffuse pollution of agricultural origin or is localised around urbanized areas (Tulipano & Fidelibus, 1993; Polemio, 2006). The quality degradation effects of a multitude of pollution sources are dramatically observed, to the outflow, constituted by many springs located along the coasts, above and below the sea level.

In Buenos Aires Province (Fig. 2a) there are 11 hydrogeological regions (Gonzalez, 2005); one of them, the coastal area of Mar del Plata could be equivalent to the Apulia Region in Italy. The coastal area of Mar del Plata is located on the northeastern side of the "Tandilia Range" a horst and graben system (Fig. 2b). The Tandilia range has a maximum altitude of about 40 m a.s.l. in the Mar del Plata urban area, and it reaches 250 masl in rural zones. In the study area, the range consists of lower Palaeozoic quartzites, grouped under the name of Balcarce Formation (Dalla Salda & Iñiguez, 1978). They are considered as hydrogeological bedrock. The quartzite bedrock is overlain by a sedimentary cover of Upper Tertiary and Quaternary silts and silty-to-sandy sediments. Miocene clayey-to-sandy sediments are found at a depth of 60 m in the grabens. The Quaternary deposits, surrounding the range system in the "Pampean plains" (Fig. 2b) are called "Pampean sediments" or "loess-like sediments" and, from a hydrogeological viewpoint, they constitute the most important sequence. They are a multi-layered phreatic aquifer with a thickness ranging from 70 to 100 m, and a hydraulic conductivity is 10 m/d. The transmissivity is about 600–800 m²/d in the urban area and between 1000 and 1400 m²/d in the rural area (Bocanegra *et al.*, 1993). The storage coefficient, estimated from pumping tests, is 0.001, and the porosity is 0.15. As in the Apulia Region, the Mar del Plata aquifer has undergone a two-fold pollution, both originated by human action: salinization due to seawater intrusion has evolved progressively as it has affected increasingly larger portions of land up to the '90s; and biological and chemical-physical pollution has gained importance and is mainly concentrated around urbanized areas (Massone *et al.*, 1998). Another common point with Apulia is the fact that Mar del Plata region is characterized by very low availability of surface water and groundwater for domestic, irrigation and industrial use has been withdrawn in large and increasing quantities over the years, still allowing for the development of local population.

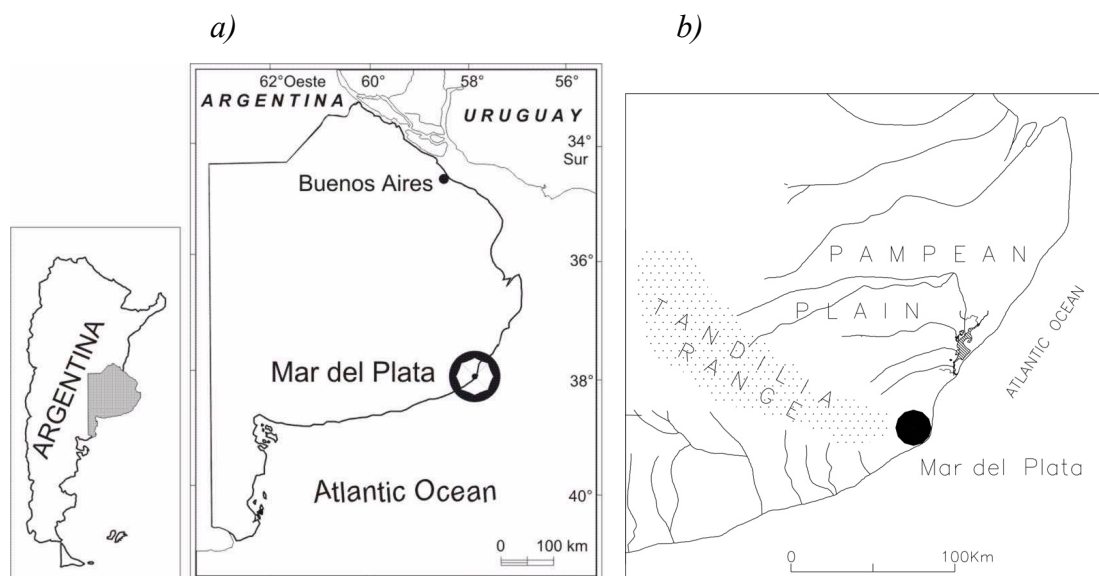


Fig. 2. Mar del Plata study area. a) location map; b) Hydrogeological units

From the eighties on, legislation intended to transfer competence from the national to the regional level, applying a prescription of republican constitution unattended from 1947 on the one hand and on the other hand, the effect of European directives.

The evolution of legal framework shows similarities and differences between both legislations. The oldest Italian and Argentinean laws on water utilisation (Italian Kingdom, 1934; Civil Code of Argentina, 1878), defined water as resource of “public interest” (Italy) or “goods of civic property” (Argentina), regulating in both cases the water utilisation. From this starting point, many laws concerning partial aspects have been defined in these countries, enriching the legislation and pursuing a better groundwater utilisation.

A clarification and new impetus to water protection was obtained in Italy by the implementation of the Merli law of 1976 (Italian Republic, 1976) and by Law 5965 of Buenos Aires Province (Provincia de Buenos Aires, 1960), both concerning the regulation of any kind of discharge inside water bodies, the organisation of public service of water distribution, sewer system and purification, and the surveying of quality of any kind of water body (Table 1). These laws also look for the protection of water resources, considering the whole water cycle, defining as main management tool the “Piano di Risanamento delle Acque” in Italy. In Buenos Aires Province, on the other hand, only qualitative directives, such as not to worsen the water quality are considered.

From the eighties on, both national legislations aimed at transferring competence from the national level to the regional one; in Italy, by applying a prescription of republican constitution unattended from 1947 and the effect of European directives, whereas Argentina followed a prescription specified in the new National Constitution of 1994 (República Argentina, 1994). In countries with a federal structure, such as Argentina, regulations that cover environmental protection and application procedures at a federal level have to be included in a national/provincial integrated management of the environment in general, and water resources in particular. Federal legislation is essential in order to elaborate a comprehensive environmental policy. Moreover, it is of vital importance that basic regulations be uniform and compatible so that national policy on the environment can be established and put into practice. Therefore, there are federal entities with jurisdiction to set the general standards for environmental protection as well as control systems to supervise their implementation. Together with the national authorities, local bodies exercise their own jurisdiction in order to apply the national environmental policy, using additional regulations and their own monitoring and control procedures that are adapted to the specific situation of each provincial state. As a consequence, according to the new National Constitution, the State issues and applies the minimum premises relating to environmental protection while provincial states issue and apply the additional local legislation within those premises. In this way, federal and provincial jurisdiction is applied to environmental protection. This does not imply a failure to accept municipal jurisdiction on environmental protection. As a matter of fact, municipal governments recognise at a constitutional level that, although they must adjust their regulatory guidelines to national and provincial regulations, they are autonomous as regards the approval and application of regulations on environmental protection, authorisation for the installation of stores and industries, use of water, dumping of waste in the water bodies, and so on (del Castillo, 2006). Article 28 of the Buenos Aires provincial Constitution (highest provincial law) states that natural resources belong to the provincial state and this entity must look after their preservation, recovery and conservation (Provincia de Buenos Aires, 1994).

It is very important to consider that national Italian regulations are developed following European directives; this kind of continental regulations does not exist in South America.

European water policy began in 1970 with the adoption of the “First Environmental Action Programme” for the period which ran from 1973 to 1976. The programmes, up to and including the most recent one, the sixth, are implemented mainly via the passage of European Directives, i.e. actual laws whose contents must be transposed by European countries into national law, either by passage of one or more laws or by modification of existing laws, all of which must be accomplished within a specified timetable. The sixth programme’s aims are to guarantee a supply of water for a number of uses, the protection of and preservation of water environment and curtailing natural catastrophes such as droughts and floods, all in line with the criteria of sustainable development.

It is the Water Framework Directive (EEC, 2000) which is principally responsible for safeguarding water resources. Said Directive covers all internal waters, coastal waters, transitional

waters and underground waters and aims at preventing and reducing pollution, ensuring sustainable water use and improving the conditions of aquatic ecosystems and the effects of floods and drought. The Directive stipulates that each individual member state will identify its watersheds and will group them in the most possible rational way and will set up so-called drainage basin districts. Each directive lays down provisions for an initial study stage made up of an analysis of the various features of the district itself, the impact of human activities on the waters and an economic analysis of water use. On the basis of this initial study, a management plan and an operational program will be drawn up, with the following aims: to protect, improve and restore the original qualitative and quantitative features of surface waters and groundwater, improve the ecological status of surface waters and prevent water pollution, particularly groundwater pollution, it being necessary to achieve a balance between extraction and renewal of groundwater and, lastly, preserve protected areas.

The Directive on the protection of groundwater against pollution and deterioration (EEC, 2006) was applied in December, 2006. The Directive on groundwater supplemented the 2000 Framework Directive (EEC, 2000). In particular, it contains further definitions in terms of threshold levels, significant and lasting trends towards increased concentrations and indirect discharges into groundwater; it establishes criteria for the assessment of the chemical status of groundwater, specifying threshold levels for pollutants and, lastly, it establishes specific criteria for the identification of significant and lasting trends towards an increase in concentration and defines the point of departure for reversal of trends.

The implementation of European directives must be in compliance with the specific organizational aspects of each member state. The main national government competences are the following: drawing up general criteria and methodologies aimed at carrying out surveys of water bodies; providing guidelines, promoting, consultancy and coordination involved in protection water from pollution; provision of general criteria for the achievement of rational and appropriate use of water resources even in relation to different uses; drawing up a general water recovery plan in relation to regional plans and drawing up technical standards.

All other competences are transferred in Italy from national level to Regions and their provinces and municipalities, according to criteria drawn up by each regional government. According to the current Constitution, it is still only national governments who have legislative jurisdiction over 'environmental protection', whereas Regions are assigned the task of 'protecting health' which is part and parcel of protecting water against pollution.

Law number 1989/183 (Italian Republic, 1989) represents a radical departure in that it provides for a reorganization of soil protection, improvement of water quality, organizing, using and managing the country's water resources for social and economic development purposes and protecting the environment. The law confers upon the entire public administration apparatus the task of planning, programming and implementation, involving – in accordance with their specific jurisdictions – the central government, the regional governments, the provincial governments, the municipalities and a number of public agencies and local authorities, some of which have as stakeholder's owners of farmland. All of these entities were established on the basis of national laws, such as the Upland Communities, Reclamation and Irrigation Agencies and Watershed Basin and Upland Drainage Basin Agencies. One important new factor is the introduction of the Drainage Basin Plan, which oversees the planning of measures for soil protection and resource protection, which are to be coordinated with national, regional and sub-regional programs of economic development and of area use and protection.

The equivalent in Provincia de Buenos Aires is Law 12257 called "Código de Aguas" (Water Code) from 1999 (Provincia de Buenos Aires, 1999). It establishes the system of protection, conservation and management of water in Buenos Aires Province. It regulates the planning and inventory of this resource as well as the rights and obligations of users. This Water Code sets up protection, conservation and management of water resources, as well as the third generation rights. In Mar del Plata, Obras Sanitarias (a public yet autonomous entity) is responsible for the supplying of water. Although it must adjust itself to the provincial law, this entity also generates local regulations concerning drillings and well closures.

As regards qualitative protection, decree 1999/152 (Italian Republic, 1999) transposed European Directives on the protection of water against nitrates (EEC, 1991b) and on the treatment of urban waste water (EEC, 1991a) into Italian law; the decree further regulates a number of activities such as water discharge on the ground and underground, conferring upon the Regions the task of fully

implementing said decree. It prohibits the use of water intended for human consumption for any other purpose and reduces the duration of water concessions which become temporary; the concessions may not last longer than 30 years (40 years if the water is used for irrigation). Lastly, the decree forces Regions to establish areas which are vulnerable to pollution by agricultural nitrates, vulnerable to plant health products and to desertification and to draw up specific action plan programs.

In the case of Buenos Aires Province, regarding this water quality regulations, there exist two, a national one: Ley 18284, “Código Alimentario Argentino or “Argentinian Food Code” (República Argentina, 1975 and its later modifications), the one traditionally used, and a second one, present in the provincial law of 1999 (Provincia de Buenos Aires, 1999). The application of one or the other of the said regulations does not have clear-cut limits.

In Italy, the 1999/152 decree establishes a specific instrument – the Water Protection Plan (WPP) – as the priority instrument which is essential in order to achieve and maintain the goals of water body environmental quality and the quality goals for water end use. The WPP is essentially a regional planning instrument, and is a de facto replacement of the old ‘Water Improvement Plan’ as laid down by Law 319/76. The WPP is a transitional section of the Watershed Plan as envisaged within the provisions of law 183/1989.

Within the context of the hierarchy of regional planning, the WPP is a regional law and has precedence over other regional laws; its provisions are immediately binding for administrations, local authorities and public agencies and for private entities. Decree 1999/152 sets the objectives, contents and instruments as laid down in the Water Protection Plan, and it in part anticipates the provisions of Directive 2000/60 (EEC, 2000), which has only recently been transposed into Italian law (Italian Republic, 2006). Environmental quality objectives are established in relation to the deviation from the undisturbed water quality standards, where there are no (or very few) changes in the values of the hydro-morphological, chemical-physical and biological parameters due to human pressure. From this point of view, what is affirmed here is a concept of environmental quality which is much broader than the aim of achieving a “regular check at discharge of mainly chemical-physical parameters” as was the prevailing philosophy enshrined in law 1976/319 (Italian Republic, 1976).

It is only by comparing the present status with that specific objective and only by carefully analysing the relationship between pressure/impact and its possible responses that it will be possible to establish protection measures which can achieve the goals laid down in that law.

Thus, it is absolutely essential and of the highest priorities to define and describe water bodies when drafting a water protection plan. One of the innovations introduced by the Water Protection Plan is that it includes the concept of qualitative protection in the concept of quantitative protection of water resources.

Creating a water balance is a very useful tool in terms of quantitative protection. The water balance is used as a planning criterion for resource use. It also forms the basis for an assessment of requests for authorizing concessions of derivations and for analysing compatibility amongst existing derivations, for an assessment of quality objectives and for the maintenance of a minimal level of vital water flow.

Apulia’s WPP is still pending.

The law referred to as the Galli law (Italian Republic, 1994) also represented a significant step towards defining an integral approach to the management of the water cycle, taking into account the entire drainage basin and adopting criteria of sustainable use of water resources. The law states that water must be economized and that resources must be renewable so that water resources are not depleted and so as to ensure a well the protection of the environment, including agriculture, water fauna and flora and geomorphological processes, and a viable hydrogeological equilibrium. Among other provisions, this law also categorically excludes any type of deviation of spring waters, both aboveground and below ground, since they are necessary in order to preserve ecosystems. Water for human consumption has priority of use over any other type of use for every single body of water both on the ground and underground. After water for human consumption, water for agricultural purposes is next in the scale of priorities.

The drainage basin is always central to legislation. The Drainage Basin Authority, which is another public agency established by law and whose jurisdiction covers drainage basins themselves and not regions or provinces, has as its stated task to draw up a balance between water needs and water

availability in the drainage basin on a regular basis, so that minimal river flows are guaranteed in order to preserve existing ecosystems.

The law has introduced another novelty: the rise of a drinking water industry. An Integrated Water Service (IWS) is established, with jurisdiction over the management of the entire cycle of water use within an Optimal Regional Area (ORA), which is defined by regional administrations on the basis of the criteria of economic and rational use of service and where reference is made to the concept of a drainage basin.

Regional law 1999/28 (Apulian Region, 1999) states that the ORA is comprised of the entire regional area. Regional law 2000/17 (Apulian Region, 2000) covers all aspects pertaining to the protection of nature and the environment and in particular the protection of water resources, ground resources and water.

Table 1 Regulation synthesis of Italian and Argentine selected study cases.

SUBJECT	ITALY, APULIA REGION No/yes, from	ARGENTINE, PROV.BUENOS AIRES No/yes, from
Water as public interest resource	Yes, 1934	No, "resource of civil property" 1878
Regulation of any kind of discharge inside water bodies	Yes, 1976	Yes, 1960
Concept of protection formally established	Yes, 1976	Yes, 1960
The organisation of public service of water distribution	Yes, 1976	Yes, 1996
Competence transfer from the national level to the regional level	Yes, '80s	Yes, '90s
Systemic approach on water management	Yes, 1989	Yes, 1999
Zonation of aquifer's vulnerability	Yes, 1999 (Nitrate)	No
Continental coordination	Yes, European Directives	No, just a "work team" on integrated aquifer management since 2005 at MERCOSUR (Argentine, Brazil, Uruguay, Paraguay)
Management tools	Plan of Water Quality Recovery (Italian Republic, 1976) Drainage Basin Plan "piano di bacino" (Italian Republic, 1989) Water Protection Plan (Italian Republic, 1999) Optimal Regional Area (Italian Republic, 1994; Apulian Region, 2000)	"Argentinian Food Code" (1975) Basin Committee (2003, national level; 1994, local level)

A part from competence of Drainage Basin Authority and ORA as far as protecting water resources are concerned, the regional administration is entrusted with the tasks of programming and planning, ensuring that provincial and municipal governments are involved, together with other bodies, in establishing criteria, ground rules and procedures in using public water and in defining and safeguarding the protected areas of the region's water resources, in order to ensure that surface water and groundwater use is sound from an ecological and functional point of view. Water resource use must be sustainable and in line with the forecasts contained in the drainage area plans.

The Regional administration shall monitor use of public water by promoting – in cooperation with the provincial administrations – data collection on resource availability, on the qualitative characteristics of both groundwater and surface water and on current uses.

As regards government structure, in Buenos Aires Province there exists a pyramidal design of responsibilities. The Executive Power (presided by a governor) has a Ministry of Infrastructure, Housing and State Services. Within the sub-secretary of State Services (which depends on the Ministry mentioned before) there exist four head offices. These deal with groundwater management. The most relevant of these is the "Water Authority", which controls the fulfilment and execution of the "Código de Aguas." Each municipality also has local prerogatives as regards the regulation and

control of the services of exploitation and supply of running water. All of this leads to a certain overlapping of actions that may render operational functioning difficult.

4. DISCUSSION

Both the Italy-Puglia case and the Buenos Aires-Argentina case are characterized by a highly complex articulation of competences and prerogatives in terms of water management, water cycle and related environmental aspects.

The Italian region of Apulia has an extremely complex system of oversight in terms of governing its water resources, its hydrological cycle and all environmental aspects pertaining to the same. European regulations have then been superimposed on this already complicated system. European directives are transposed into national laws which delegate a number of powers to the many regions which, in turn, may manage said powers with a not inconsiderable degree of autonomy via regional laws. National law states that provincial administrations within the regions must also share in water management authority, as must municipalities in the provinces. All of this means that there is a highly complex legal system, to which must be added the competences and initiatives of other institutions such as the Reclamation Consortia, the Uplands Communities and the Drainage Area Agencies. The remit of the Drainage Area Agencies is such that they exercise their authority, by law, over a watershed area which by its nature does not often correspond to the areas of administration of the regional, provincial and municipal governments.

In the case of Argentina, there exist no regulations on a continental scale. However, the provinces must accept the minimum premises laid down by the National State in each case. They are a sort of national standard which must be contemplated both by provinces and municipalities when setting their respective laws.

The main advantage of the 'Italian model' is that power is shared amongst many participants during the planning stages and during the management of water resources, given the large number of entities and agencies involved, representing national interests, local interests and the interests of the users community. The major difficulty lies in the fact that the jurisdiction of these numerous competent bodies is not always clearly discernible, particularly when dealing with specific practical cases which require a high degree of competence and operational abilities, which at times is lacking due to the fragmentation of human and economic resources. This at times leads to a lack of competence and skills in many technical services.

Considering the Apulia case, in particular, where the water resources that can be tapped by hydrographic network are scarce and where the water is mainly groundwater, the karstic landscape has a negative impact on the situation. Laws written for river drainage areas as distinct reference areas and where the management and planning stages are predicated upon the existence of the said drainage basins deal with groundwater almost as an afterthought. In the case of Apulia, the law needs to be deeply modified, switching the order of priorities and importance of types of areas and types of water. The positive aspect of the Argentinian model is that the chain of responsibilities for the creation, planning and use of the water resource is clear, since in the Buenos Aires province, from the year 1999 onwards, groundwater has been considered the main water source. The aspects that could be considered negative or, at least those which have room for improvement, are mainly three:

First of all, despite legislation has formally incorporated the protection concept since 1960, the focus on water management is mainly placed on its uses, to the detriment of the protection and quality of the resource. This can be verified in the new provincial water codes, such as the one enacted for Buenos Aires province in 1999, which, despite having the purpose of protecting the water resources of the province, does not contain a special chapter on water quality and its protection. Second, the lack of state control mechanisms to guarantee that the already established rules and norms are followed; finally, the lack of user participation in the process of water management.

It therefore can be argued that the two cases studied have, to a certain extent, completely opposing advantages and disadvantages and are therefore complementary. They both represent, in other words, reasons to strive to achieve balanced and efficient legal instruments in order to protect the groundwater resources of each country's coastal aquifers.

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