Global Issues in Water Policy 28

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Water Law, Policy and Economics in Italy

Between National Autonomy and EU Law Constraints

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Introduction

The idea of this volume dates back to 2017, when two of us (Marco and Paolo) were working on a booklet on the implementation of the European Union (EU) Water Framework Directive and Floods Directive in Italy.[1] That publication, in Italian, was written from the point of view of lawyers, thus focusing on some legal aspects of Italy's struggle with a difficult, piecemeal reform of its water governance system. However, that booklet was one of the outputs of a project that had seen the volume's editors collaborating side by side with experts with different scientific backgrounds and expertise, as diverse as sociology, economics and engineering. Discussing with each of such colleagues, Marco and Paolo had learnt a great deal about water issues and, conversely, in each of them Marco and Paolo had found scholars sensitive to the legal facets of the respective subject matters – a textbook example of successful interdisciplinary cross-fertilisation.

The spark that set this editorial project in motion was a journal article whose authors had reviewed the English-language literature on the practical implementation of the Water Framework Directive in the EU. The results of the review were unambiguous: "[w]hat should be clear from this brief survey is that much is known about WFD implementation in northern and western Europe, but relatively little about WFD implementation in Mediterranean countries, including founding members and heavyweights such as France and Italy".[2] The article also ended up in the highlights of a periodic publication of the European Commission, which stressed the point forthrightly: there were "relatively few studies on one of the founder states, Italy".[3] Although the figures would have been different for sure if writings in

[1] Alberton, M., Turrini, P., & Pertile, M. (Eds.) (2018). *La Direttiva quadro sulle acque (2000/60/CE) e la Direttiva alluvioni (2007/60/CE) dell'Unione europea: attuazione e interazioni con particolare riferimento all'Italia*. Naples: Editoriale Scientifica.

[2] Boeuf, B., & Fritsch, O. (2016). Studying the implementation of the Water Framework Directive in Europe: a meta-analysis of 89 journal articles. *Ecology and Society 21*(2):19.

[3] See *Science for Environment Policy*, European Commission DG Environment News Alert Service, Issue 465 of 29 July 2016. Indeed, the survey had counted for France three times the articles on Italy (six against two).

languages other than English had been taken into account by the study, a message was clear: Italian scholars are less used than their fellows from other EU countries to publish their researches in English. And this, from the perspective of scientific dissemination, may certainly be an issue.

Thus, the coordinates had been set. What was needed was an English-language publication that could explain to the non-Italian-speaking academic and professional communities the way Italy deals with water issues. Of course, consideration of such a readership would entail consequences in terms of both content and style. No information of the Italian physical conformation, political setting, legal order or economic situation could be taken for granted, as the purpose was rightly that of providing the non-Italian reader, even the non-specialist one, with plain and thorough information on a wide array of topics. Indeed, the focus had to be greatly expanded from the original, limited view on the two abovementioned EU directives, so as to address several other issues that, presumably, do not receive adequate coverage in the scientific literature in English. After all, Italy offers the scholar of water issues enough materials for being a valuable case study: the uneven distribution of Italian water resources, the different geographical and climatic conditions of a long country that stretches across numerous parallels, the opposite extreme conditions affecting the Italian territory (frequent floods and, at the same time, an impending desertification), the significant role played by agriculture (a water-intensive activity), a lead position in the consumption of bottled water, the lower-than-average prices of water and a far-from-optimal efficiency of waterworks.

Such an ambitious editorial project demanded an interdisciplinary gaze and efforts by scholars not confined within the boundaries of legal studies. Therefore, Marco and Paolo joined forces with Antonio and Alessandro, who, coincidentally, were already musing about a similar endeavour. This was not surprising at all, as it only demonstrated the urgent need for such a work, and the fact that the times were ripe for it. The editors of a handbook on "Water Law, Policy and Economics in Italy" were ready, they just had to take contact with the team of authors. They did, and they are now most pleased to introduce to the reader the outcome of the intellectual labour of a wonderful group of distinguished scholars, all of them leaders in their own fields of expertise.

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The volume is composed of four main parts. Part I is entitled "Water Resources and Their Use and Management in Italy" and it aims at setting the scene, that is, illustrating the main natural and social features of Italy, by means of contributions that dwell upon some general questions from a variety of standpoints.

The book could not but open with a panoramic overview of the country's water endowments. Indeed, in Chap. 1 ("Water Resources of Italy"), Marcello Benedini and Giuseppe Rossi describe the distribution of water resources, highlighting the great variability across the country that is mainly due to geographical and climatic characteristics. The latter factor is of utmost importance in the future availability of water, as climate change could negatively impact on both the amount of accessible

water (because of more frequent droughts and different precipitation patterns) and the uses of water (especially economic ones: agriculture but also tourism). This would likely make more pressing the need to find alternative forms of water supply, such as the reclaiming of water, that are being already experimented in semi-arid areas of the country (particularly, in Southern Italy, including the Islands). Clearly, the spatial differences in the availability of water affect, but to some extent are also affected by, the uses of the resource and the development of water infrastructures: such uses are expounded, as are their consequences on the qualitative status of Italian waters. Before ending their chapter with several recommendations, the authors focus on some regions of the Country which they deem to be representative, be it for their large natural availability of water (for instance, the Po river basin) or for the opposite condition (for instance, Apulia).

In Chap. 2 ("Coping with Floods in Italy: Learning from the Past to Plan Future Adaptation"), Renzo Rosso deals with a problematic aspect of water resources in Italy, that is, the rebellious nature of waters, which obstinately refuse to be constricted within narrow boundaries. Recent Italian history, from the birth of modern Italy in mid-nineteenth century to the present day, shows the unpreparedness of the Country in tackling the issue of floods, which regularly hit the Italian urban and rural territory and, with equal regularity, take a heavy toll in terms of human lives and material properties. Lack of memory of the past is not a good premise, especially in a field, such as prediction of floods, where forecasts of the future must overcome challenging technical difficulties. After describing some major failures in coping with natural calamities that hit Italy in the second half of the twentieth century, Renzo Rosso indicates the way ahead and details the fittest measures and strategies to minimise the risk of disastrous events. As this, however, cannot be completely eradicated, societies must work to reduce exposure and enhance resilience, which can ultimately be attained only by raising people's awareness of the inevitability of floods and similar catastrophes.

Whereas Chap. 2 deals with a serious problem that is somehow "inherent" in water resources, albeit possibly worsened by men's ill-considered activities, Chap. 3 ("The Uses and Value of Water in Italy: Evidence from Selected Case Studies in Italy, with a Particular Focus on Irrigation, Industry and Hydropower"), addresses in greater detail an issue touched upon by the first chapter, that is, how Italian waters are utilised. Giulia Vaglietti, Alessandro de Carli, Federico Pontoni and Antonio Massarutto do this from the standpoint of economics, by analysing the most significant literature that focuses on Italy. In particular, the economic value of water is investigated in four main ambits. First, urban water services, a sector that has undergone multiple reforms over the years, whose success is analysed through the lenses of efficiency and sustainability. Second, agriculture, which has the lion's share as far as water withdrawals are concerned and is studied with respect to pollution, droughts and water prices. Third, energy and, in particular, hydropower, which is an important source of renewable energy in Italy: a sector that is considered in light of the growing importance of studies on the water-energy nexus. A fourth, less conventional field is also taken into account, that of recreational uses of water and the value integral to the existence of the resource. The literature review ultimately shows the

need for a more interconnected approach among sectors (which is currently lacking due, perhaps, to a fragmented governance), given the possibility of using and re-using water for different purposes. The authors underline that filling this gap by means of more numerous scientific researches focusing on Italy is vital for the future of a resilient water economy.

Another important – actually, the most fundamental – use of water is for drinking purposes. People's habits in this regard may vary greatly across different countries and, within the same country, across different categories of users and can therefore be analysed through sociological lenses. This is precisely what Filippo Oncini and Francesca Forno do in Chap. 4 with respect to Italy ("Testing the Waters: A Sociological Analysis of Domestic Water Use and Consumption"). Italians are well-known for being assiduous consumers of bottled water, to the extent that Italy ranks third in the world as to the purchase of packaged water. This occurs despite the generally good, or at least acceptable, quality of tap water in most areas of the country, and notwithstanding the fact that tap water is really cheap as compared to many other European countries. Filippo Oncini and Francesca Forno interrogate data from recent surveys in order to understand the reasons behind this situation, and find that wealthier consumers tend to buy bottled water in greater quantity than those with reduced financial capacity, in sharp contrast with other cases (such as purchase of local/organic food) where affluent people are more likely to be engaged in environmental-friendly, rather than unsustainable, social practices.

The first part of the volume concludes with a far-reaching overview of the regulatory landscape where water resources are situated. In Chap. 5 ("Water Resources Management in Italy: Institutions, Laws and Approaches"), Emanuele Boscolo draws the lines of the evolution of water governance in Italy, identifying some key reforms implemented in the second half of the twentieth century as collectively constituting a watershed for the way water resources are conceived and safeguarded. Starting from the axiom of the public nature of all water resources on and under the Italian soil, the author explains the most relevant corollary of that postulate, which describes the State as a custodian of all waters: these must be preserved by the former by means of a sound planning policy for the benefit of future generations and, if needed, against the potentially harmful claims of holders of concessions for the provision of water services. Moreover, such services, when concerning drinking water supply to the population, must be affordable to everyone, as satisfaction of human needs is, together with the protection of water ecosystems, the main goal of the "custodial State".

The chapter by Emanuele Boscolo, which focusses (also) on the defence of the hydrosphere, provides a perfect introduction to Part II of the book, whose title reads "Water Management and Environmental Concerns" and is evidently devoted to presenting some major problems affecting the health of water resources.

In order to fully grasp the gravity of the pathology, the natural physiologic conditions must be first described. In other words, the concept of water resources as a complex and fragile ecosystem providing for environmental services has to be expounded. This is done by Riccardo Santolini. Tommaso Pacetti and Elisa Morri in Chap. 6 ("Water-Dependent Ecosystems in Italy"), which introduces the idea of

water-related ecosystem services as tasks performed by water bodies in a multitude of ways that include both tangible functions (such as drinking water supply) and intangible ones (like the cultural values associated to water). This concept, in turn, requires that other notions (such as that of natural capital) be explained. These expressions make clear that this field of study stems from the integration of economy (services, capital) with ecology (nature, ecosystem) – a union based on the importance of understanding and quantifying ecosystem services. Such an assessment supports the identification of holistic management strategies that preserve the multifunctionality of ecosystems while enhancing the benefits produced by them. In stressing the positive development of the legal framework both at the Italian and European levels, the authors report on some Italian pilot experiences on the application of so-called payments for ecosystems services, thus drawing some suggestions to support the wider application of these tools in the whole Country.

A first and most obvious factor that negatively impacts on the status of water resources and imperils their use is pollution. Regrettably, Italy's record in protecting its waters from defilement is not astonishing – not in the positive sense, at least. Although the situation over the territory is uneven, certain areas suffer from heavy pollution, to the extent that even provision of safe drinking water is an issue. However, the normative framework has recently changed, demonstrating a new awareness of the severity of the problem. In Chap. 7 ("Water Quality Control Policies and the Criminalisation of Pollution"), Giovanni De Santis and Matteo Fermeglia tell the reader that such legal bonds aimed at curbing polluting practices have a double origin: on the one hand, EU directives (whose obligations, however, Italy tries to dodge by making frequent use of derogations) and, on the other, domestic laws, both of administrative and criminal character. The latter category, in particular, has brought about, through a 2015 law on environmental crimes, what the authors define a paradigm shift in the fight against water pollution. As this piece of legislation is only a few years old, time will tell whether it will suffice to effectively discourage polluting practices.

A second acute problem affecting water resources is scarcity. This can be the outcome of non-environmentally-sound human activities, but also of natural phenomena such as climate change, that multiplies droughts and accelerates desertification. This is the case of the Po river basin, which is thus considered even though Southern Italy is most commonly associated with water scarcity. Indeed, in Chap. 8 ("Managing Water Scarcity and Droughts: The Po Experience"), Antonio Massarutto and Dario Musolino inform the reader that this area is one of the most advanced in the Country, also due to its prosperous agricultural sector. Unfortunately, it is also a region increasingly hit by droughts – which could become even more frequent in the future – and the two authors devote their attention to the socio-economic impact of such events. Thus, they show that droughts engender not only losses but also gains, at least for farmers. From the point of view of institutions, the authors highlight a problem that seems to characterise Italy's approach to water-related disasters, as it is quite similar to the way the Country copes with floods: the adoption of a reactive rather than a proactive strategy. Things are slowly changing but further efforts are needed by planners.

The problems described above can, of course, present themselves in an international context, as water bodies do not necessarily follow State boundaries. Thus, interstate cooperation is needed to prevent harm to water resources and to take common measures for the recovery of deteriorated water bodies. As Mara Tignino and Benedetta Gambatesa explain in Chap. 9 ("The Management of International River Basins: The Case of Transboundary Water Cooperation Between Italy and its Neighbours"), international law has progressively developed several principles regulating the conduct of co-riparian States, be they positioned upstream or downstream. But more specific rules were laid down by the EU, which elected the river basin as the primary geographical (albeit not administrative) unit for the governance of watercourses: if two Member States share a river basin, then they must take steps to implement the Water Framework Directive in a co-ordinated way. Describing the case of Italy, Mara Tignino and Benedetta Gambatesa analyse the examples provided by a couple of lakes shared with Switzerland (which is not an EU Member State) and a river shared with Slovenia (an EU country): although none of them regard major water bodies, the joint efforts of the States involved represent interesting case studies in transboundary water management.

The overview given by authors of Part II of causes for environmental concern also encompasses a "hidden" phenomenon. Indeed, according to a now well-established theory, water-scarce countries or, more simply, water-stressed areas should not use their water resources to produce goods that the country or area can import from elsewhere. This relies on the concept of "virtual water", which Stefania Tamea, Marta Antonelli and Elena Vallino apply to Italian trade patterns in Chap. 10 ("The Italian Virtual Water Trade and Water Footprint of Agricultural Production: Trends and Perspectives"). The reader will discover that Italy is a net importer of blue water embedded in agricultural goods – one of the largest importers in the world, actually – and that this fact might be related to a constant reduction in cultivated land, which is not accompanied by a crisis of the agricultural sector. In fact, Italy has seen a constant increase in the value of its food exports, also thanks to a higher crop productivity that has come with an improved efficiency in water use. The authors analyse these trends by categorising goods in different classes and describing how the relative weights of such goods in Italy's exports has changed over time, and then focus on trade in wine and oil, two products that see the Country at the top of the exporters' ranking. According to data, the authors suggest, agricultural imports do not seem to be driven by Italy's impossibility of producing goods locally due to domestic water deficits.

Part III of the volume deals with "The Provision of Water and Sanitation Services". Whereas the previous section conceives water as a natural element to be protected, especially against humans' deplorable actions, this section sees water as a resource to be exploited by men and, thus, as a means capable of providing services.

At any rate, just to make clear that this human-centred approach has, at its heart, the well-being of the service user rather than that of the service provider, Part III begins with a contribution on the right to water. In Chap. 11 ("The Human Right to Water in Italy's Foreign Policy and Domestic Law"), Paolo Turrini and Marco

Pertile take stock of Italy's efforts in implementing the international duty to ensure the universal right to water. Such an obligation – whose actual existence is called into question by some – is binding upon the Country but, absent concrete measures to promote access to water for everyone, part of the population would see their right infringed. The human rights discourse in water matters has been particularly intense in civil society's initiatives in the last decade, incorporating battle cries like "water belongs to commons" and "water is a good to be managed by public bodies". Thus, it cannot be excluded that these stances have somewhat influenced the relatively fast evolution of the legislative framework in this field. Indeed, in the very last years some laws have been passed that required the regulatory authority to take into account the basic needs of users in setting the pricing scheme of water provision. Problems remain, but the significance of this improvement cannot be underestimated. Moreover, the reiterated reference in Italy to the fundamental right to water can explain some attempts at furthering it abroad.

The subsequent two chapters can also somehow be read in the sign of the right to water. Indeed, the public water movement managed to leave a mark on the Italian water governance system, although other pulling factors also contributed to determining the current, unfortunate situation. As recounted by Giulio Citroni and Andrea Lippi in Chap. 12 ("The Permanent (De-)Institutionalisation of Multi-Level Governance of Water Services in Italy"), the civil society's campaign against the privatisation of water services managed to set a constraint to governmental action, but the Government itself has proven to be split between the opposite poles of institutionalisation and de-institutionalisation. Over the last 25 years, politics has taken a wavering stance on the governance of water services, doing and undoing – or adjusting, or putting on hold – what had been done, sometimes for primarily political or budgetary reasons. Obviously, this process of continuous re-designing of the water system has had an impact on both the market of water services (as companies are not keen on investing in a sector characterised by legislative uncertainty) and the overall coherence and effectiveness of the legal and institutional architecture of water service provision. The governance palace is unguarded, the central Government currently being unable to call local actors to arms towards a sensible goal.

The same scenario is observed, albeit from a legal rather than a political science perspective, by Vera Parisio in Chap. 13 ("The Integrated Water Service in the Italian Legal System Between Solidarity and Competition: An Overview"). In the mid-1990s, the Italian Government inaugurated an important reform that merged the various segments that had composed till then the world of water-related services: water catchment and management of sewers, water supply for all kinds of uses and water purification were brought together to form the integrated water service. The running of such service has been, since then, the object of different laws, that have created new territorial units and new administrative bodies meant to organise the service under new rules: although such laws differ in their normative content, they all share a common approach, which is based on the idea of the provision of the service under market conditions. After all, as established by both legislation and judicial decisions, water services in Italy fall within the category of "services of general economic interest" devised by the EU. According to the idea of free

administration, the Union is neutral with respect to a Member State's choice as to the methods of delivery of these services, provided that some principles are complied with. Italy, too, allows for the adoption of one of several managing models, of both public and private nature, although preference for the latter type is evident. Fortunately – here the right to water comes up again – solidarity values are now embedded in the activity of ARERA, the body in charge of regulating the water service sector.

But has the new architecture of governance of water services delivered what it had promised in terms of quality of water provision and efficiency of providers? This is how the driving question of Chap. 14 ("The Evolution of the Italian Water and Wastewater Industry in the Period 1994–2018") could be phrased. There, Donato Berardi, Francesca Casarico and Samir Traini give an answer that partly overlaps with that offered by the authors of Chap. 12. After all, the institutional and legal context described by all these scholars is the same: a fragmented and non-linear framework that has hindered thus far the development of a mature water service industry. Things have started to change, however, with the creation of a central regulatory authority – the already mentioned ARERA – that in the last few years have successfully performed a task of standardisation in the sector. Although the process is still far from being complete, as not all local administrations have promptly responded to the stimulus (which is sustained by a carrot-and-stick philosophy), the Authority has managed to enhance the financial performance of the companies running the water service, to improve the quality of such service in several areas of the Country and, ultimately, to set up a more investment-friendly environment. Further progresses are expected to occur in the near future.

The protection of water resources as an environmental "subject" (Part II) and the conditions of their utilisation by men as an economic object (Part III) presuppose a rational and foresighted water governance. This is where Part IV comes up. Since water bodies are now governed according to the rules dictated by EU law, this section is entitled "The Implementation of the EU Water Framework Directive and the EU Floods Directive", which are the main pieces of legislation in the field.

Unlike regulations, EU directives are binding on Member States but only set out the principles governing a certain ambit, leaving to each Member a certain (variable) leeway in the definition of the means to reach the directives' goals. In Chap. 15 ("Water Governance in Italy: From Fragmentation to Coherence Through Coordination Attempts"), Mariachiara Alberton provides a historical overview of Italy's efforts in implementing the Water Framework Directive and its younger sister, the Floods Directive. When, in 2006, the former directive was incorporated in the Italian legal order, the Country had already begun (by means of a pioneering 1989 law) to reform the organisational structure for the governance of water bodies. Despite this promising start, aligning with the EU obligations has proved harder than expected. If a main culprit may be identified, it is probably the conflict between the central State and Regions on the correct way to interpret the partition of competences operated by the Italian Constitution, which just a few years before, in 2001, had been amended to grant the State exclusive powers in the domain of environmental protection. This clash caused delays in the implementation of the EU directives,

and although the reform process is now basically over (after many years and many laws), the heritage of these frictions is a governance system prone to inter-institutional conflict.

As said above, one of this book's strengths is – in the eyes of its editors – the multidisciplinary approach, whereby a given fact is seen through the lenses of diverse academic subjects or standpoints. This is why the path towards the implementation of the two abovementioned directives is described also from the point of view of practitioners involved in the administrative process. In other words, if Mariachiara Alberton's account is a larger picture taken by a lawyer, Chap. 16 ("A Practitioners' View on the Application of the Water Framework Directive and the Floods Directive in Italy"), written by Marta Martinengo, Antonio Ziantoni, Fabio Lazzeri, Giorgio Rosatti and Riccardo Rigon, zooms in and provides a sight "from within" of the actors, processes, outcomes and problems of the implementation stage. The result is unique in its bringing together engineers and public officials with a view to critically analysing the main turns of the whole process, and especially its shortcomings. As to the latter, one of the most challenging is probably the incomplete – and, in any case, difficult – integration of policy-making and science. Indeed, on the one hand, politics must finance science in order for the latter to be updated and, thus, effective; on the other hand, science can only be useful to politics if the latter puts in place an input transmission system capable of turning knowledge into action. This is the next test for Italian lawmakers.

Speaking of the role of science, it must be stressed that one of the most innovative duties stemming from the Water Framework Directive (its Article 9, to be precise) is the one that goes under the name of "full cost recovery principle". It requires that States, in the management of water services by means of public or private companies, cover through tariffs both the expenses for running the service and the value of water, which must include also the environmental and resource costs of using it. Calculating such costs is a knotty scientific problem, as is the balancing of different interests and goals. In Chap. 17 ("Economic Regulation, Water Pricing, and Environmental and Resource Costs: The Difficult Marriage Between Financial Sustainability, Investment Requirements and Economic Efficiency"), Antonio Massarutto addresses this challenge. He provides a thorough overview of both the management system and the financial structure of Italy's water governance scheme, broken down for different sectoral activities, which get water via different channels and follow different financial practices. Most such sectors, in any case, have now accepted the principle of the full recovery of all running costs, and this marks the success of a reform, enacted in the 1990s, that aimed at alleviating the burden of water provision on the public budget. When it comes to environmental and resource costs, however, no coherent idea of taxation has emerged yet. This is a pity, as recovering such costs could ease the mobilisation of much needed investment for the improvement of the water network, by means of a financial structure based on the co-participation of private and public capitals. At the same time, this financial project should use the full cost recovery principle as a leverage to promote sustainable behaviours on part of users, with economic benefits for those who save water and reduce pollution.

Further considerations on the issue are offered in Chap. 18 ("Environmental and Resource Costs Assessment and the Case for Reforming the Italian System of Water Abstraction Charges"), where Vito Frontuto, Silvana Dalmazzone, Paolo Mancin, Alessia Giannetta and Davide Attilio Calà portray their proposal to internalise the environmental and resource costs applied to public water abstraction charges. They do so by describing a pilot experience that is being tested by the water authorities of the Piedmont Region (in the northwest of Italy), that provides a perfect case for studying the practical difficulties in implementing Article 9 of the Water Framework Directive. As the ultimate purpose of assessing the environmental costs entailed by water use is the protection of water resources by making users pay in a way that is proportional to their "share" of the costs, so as to promote efficiency in the use of water and discourage wastages, measuring the abstraction of each user becomes a precondition. Equally fundamental is the devising of a method for calculating environmental costs. Should these be too high, however, their rescaling based on the affordability principle would be required, so as not to impact too much on the income of users – without renouncing to proportionality. Transparency and flexibility are two additional features of great importance to ensure the success and diffusion of this kind of pricing schemes, which might help better define the users' conception of the role of water in preserving the environment.

So far, we have seen the involvement of many experts in the implementation of the two EU directives. Lawyers, engineers, economists, governmental officers: all have a say in the process due to their specific expertise. However, both the Water Framework Directive and the Floods Directive provide for the participation of the public at large. This is exactly the topic of the last chapter of the volume. Indeed, in Chap. 19 ("Public Participation in the Implementation in Italy of the Water-Related Directives"), Elena Fasoli, Massimo Bastiani and Francesco Puma have a look at the EU law framework – which, in turn, has been influenced by a trend at the international level towards an ever-greater involvement of people in environmental affairs – and examine the state of the art as to Italy's compliance with the EU obligations to let the public take part in decision-making processes. As always, the Country's performance is mixed. Although possibilities of participation are generally on the rise, the situation varies greatly across Italian regions, as to the actors involved, the methods of such involvement, and the information provided. Chronical delays in meeting the deadlines set by the EU are yet another factor that curbs the spaces – in this case, the time-windows – of participation. However, positive aspects are present, too. Some river basin districts do not fare bad, as it is the case of the Eastern Alps district on which the authors focus. And the experience of river contracts is pretty lively in Italy, providing another interesting means of cooperation between governmental bodies and civil society.

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The book's farewell consists in a couple of brief sections that aim at zooming out on Italy's water law, policy and economics. These two sections offer different views, respectively, from the outside and from within Italy. The former tries to answer the

questions: what can the Country learn from other States? And what can it teach to them, either through its good practices or its avoidable errors? The latter section, instead, briefly sums up some lessons emerged in the book, following a few *fils rouges*. Thus, such a "view from within" is not just a view from within the editors' Country: it is also, and no less importantly, a view from within the editors' book. Because editorial projects such as this can be a fertile ground for a fruitful dialogue among scholars of different subjects, and among scholars and practitioners. This observation must be intended as a "thank you" to all our authors and the wish that our readers may find in similar exchanges the same valuable inputs we did find.

A final, brief remark must be devoted to the aspect of translation. As this book focuses on Italy, very often the authors have faced the problem of how to best render a concept whose original name is in Italian. Sometimes, the best solution is the most linear one. Therefore, whenever they deemed it appropriate, the authors as well as the editors gave a literal translation of the concept, accompanied by an explanation integrated in the text. Thus, for instance, the idea of "*servizio idrico integrato*" was simply translated as "integrated water service", and if the context required the reader to understand the reference, then a sentence was added to clarify that, in Italy, such a service include the catchment, intake and supply of water for all kinds of uses, and sewerage and depuration of waste water. We hope that this suffices to build an additional bridge between the culture of the readers and that of the writers.

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Part I
Water Resources and Their Use and Management in Italy

Chapter 1
Water Resources of Italy

Marcello Benedini and Giuseppe Rossi

Abstract Due to its geographical position, Italy denotes great meteorological variability from one Region to the other, which affects the availability of natural water resources. The main rivers and the largest lakes are located in the northern and central parts of the Country. A discrepancy characterises also the availability of groundwater, which is conditioned by the variable geological pattern of the Italian territory. An evaluation of water resources is based on the available data collected during a long sequence of years by the responsible structures belonging to the central Government and the Regional administrations. More recent data, focusing on the hydrological balances in selected zones of the country, allows the potential and the usable resource to be evaluated. For the present time, the current withdrawal meets principally the urban and domestic demand, but other fundamental sectors, like agriculture, industry and electric energy generation, request large amounts of water, which often gives rise to undesirable conflicts among users. A widespread discharge of polluted wastewater is now responsible of the low quality level of some receiving surface and underground bodies, reducing the amount of usable resources. An intensive activity is in progress to achieve the ecological standards imposed by the European Union on wastewater by means of treatment plants and to guarantee the ecological flows in the watercourses. Unconventional resources, like desalinated sea and brackish water and treated urban and industrial wastewater, contribute to increasing the availability of usable water. Recycling treated wastewater can be a promising solution for reducing freshwater demand. Some assumptions on climate change have been considered, which could affect the availability of water resources in the various Regions of the Country.

Keywords Italian water bodies · Water resources · Water uses · Water resources management · Water pollution control

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1.1 The Country's Outlines

The national territory of Italy stretches across more than 10° of latitude, between the Alps and the small southern islands facing the African shore, with a total area of 301,336 km^2. With its maximum altitude of 4810.90 m above sea level at the Mount Blanc's peak, the Alpine chain is the natural border of the Country, which is almost completely inserted in the Mediterranean basin, with the exception of some small Alpine valleys, at the border with Austria, which belong to the Danube catchment. The geographic structure of Italy consists of a large continental area surrounded by the Alps, and of a long peninsula leaning into the sea, with some islands, the major ones being Sicily (25,707 km^2) and Sardinia (24,090 km^2). The peninsula contains the Apennines chain, with the maximum altitude of 2912 m above sea level at Gran Sasso Mount.

The total length of the coasts, including that of the islands, is 7456 km. The peninsula is surrounded by the Adriatic Sea to the east, the Tyrrhenian Sea to the west and the Ionian Sea to the south (Fig. 1.1).

The Italian territory is the effect of a sequence of million years of Earth's evolution. Massive limestone predominates in the Alpine zone and in the central parts of the Apennines, beside some limited extensions of alluvial areas, surrounding the most important rivers. Mounts cover 35.2% of the territory, while the remaining part includes hills for 23.2% and plains for 41.6%, located principally in the northern valleys. The coastline in the peninsula and islands is mostly made up by cliffs, shaped by the sea erosion. Extended sandy beaches and shallow seawater characterise the coastline around the large plains and surround the mouth of the rivers discharging into the sea.

The central parts of the peninsula and eastern Sicily denote volcanic origins. Some eruptive phenomena are still there at Etna and in Eolian isles, while Vesuvio has been silent for more than 80 years. Hot water springs are present in almost all the Country.

In some Regions, deep geological faults in subsoil give rise to ground instability and, consequently, large parts of the Country are subject to frequent seismic phenomena. Recently, unpredictable earthquakes have caused conspicuous damages and casualties. Moreover, other local instability phenomena, in form of massive landslides, often worsened by improper man-made intervention, characterise the territory and, during unexpected events of intensive precipitation, they invade large dwelling zones and infrastructures, with casualties and serious damages. The landslides alter the natural course of rivers and streams, causing uncontrollable floods.

The water availability and all the problems concerning water resources use and protection, as well as the flood defense, are strictly related to the actual political and administrative aspect of the national territory, which is structured in 20 Regions, as shown in Fig. 1.2 (Rossi and Benedini 2020).

Every Region has its own institutional bodies, working under the supervision and the coordination of the central Government, in line also with the laws enacted and the policies promoted by the European Union.

Fig. 1.1 Principal characteristics of the Italian territory. (Source: Rossi and Benedini 2020)

1.2 Surface Water Resources

In spite of careful estimates carried out during the last decades, a reliable assessment of surface water availability in the various regions is still lacking. Estimates carried out with reference to meteorological and hydrological variables are not representative of current conditions, which are affected by significant changes in

Fig. 1.2 Political and administrative partition of the Republic of Italy, with the centres of Regional administrations. (Source: Rossi and Benedini 2020)

climate and soil utilisation. On the other hand, recent application of water balance to the national territory did not consider the water amounts of the different territorial aggregations in the Country. Anyway, a comparison between estimates that differ in basic data relied on and methods of assessment can provide some useful evaluations (Benedini 2020; Rossi and Benedini 2020).

The water resources have been distinguished in natural, potential and usable.

Considering the average values for the 1921–1960 period, with the total precipitation being 296 km^3/y (990 mm/y), the *natural* surface resources was estimated to be 155 km^3/y (510 mm/y). A further approximate assessment estimates the *potential* surface resources as 110 km^3/y and the *usable* surface resources as 40–45 km^3/y. These figures can be accepted as an order of magnitude, also confirmed by recent investigations.

More recently, following the hydrological balance carried out by ISPRA (2015a, b) using the 1966–2015 data, the amount of surface runoff has been assessed as 65 km^3/y (217 mm/y), with an estimated infiltration of 68.7 km^3/y (227 mm/y).

The EUROSTAT data of 2019, with an actual precipitation of 241.1 km^3/y, prospects a *renewable internal water amount* of 86.3 km^3/y, with a *total actual outflow* (surface and groundwater) of 115.9 km^3/y (EUROSTAT 2019).

The natural consistency of surface water reflects the overall characteristics of climate. The northern and central regions have greater water availability than the South and large islands, and a better distribution in time and space. Such disparity characterises the nature and the hydrological aspects of all surface bodies.

The natural hydrographic network of Italy consists principally of numerous rivers discharging directly into the sea. Their length is normally restricted within a few hundreds of kilometres, while the catchment seldom exceeds 10,000 km^2. These rivers originate from the local highland and are characterised by a flow greatly variable during the year. This configuration is typical of large part of the peninsula, where the rivers originate from the Apennines, and of the large islands of Sicily and Sardinia.

A remarkable exception are a few large rivers, principally Po, Adige, Reno and Brenta in the Northeast, originating from the Alps and discharging into the northern Adriatic Sea. Exceptions are also the rivers Tiber, Arno and Volturno, in the peninsula, originating from the Apennines and discharging into the Tyrrhenian Sea.

The main characteristics of the most important rivers are in Table 1.1.

Several rivers are harnessed for human purposes, primarily for irrigation and electricity generation.

Table 1.1 Principal rivers of Italy

River	Region	Catchment area (km^2)	Length (km)	Average Flow (m^3/s)	Receiver
Po	North West	74,000	652	540	Adriatic Sea
Tiber	Centre	17,370	405	230	Tyrrhenian Sea
Adige	Trentino-Alto Adige, Venetian Plains	12,100	410	235	Adriatic Sea
Arno	Tuscany	8228	241	110	Tyrrhenian Sea
Reno	Emilia-Romagna	5965	212	95	Adriatic Sea
Brenta	Trentino-Alto Adige, Veneto	5840	174	80	Adriatic Sea
Volturno	Molise, Campania	5550	175	82	Tyrrhenian Sea
Liri-Garigliano	Abruzzo, Lazio, Campania	5020	168	120	Tyrrhenian Sea
Simeto	Sicily	4186	113	25	Ionian Sea
Piave	Venetian Plains	4127	220	125	Adriatic Sea
Isonzo	Fiuli-Venezia Giulia *(and Slovenia)*	3460	136	172	Adriatic Sea
Livenza	Veneto, Friuli- Venezia Giulia	2221	112	85	Adriatic Sea