GOVERNMENT AGENCIES AND INSTITUTIONS

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Contents

Summary

At the present time the problems related to water are very complex. This is due to the fact that the high numbers of aspects involved are strictly interrelated to each other and that it is necessary to rely on a great quantity of data. While the world population is increasing, the available water on the earth remains constant, and the deterioration of its quality reduces the per-capita availability. Science and technology have provided several tools, able to handle the large amount of data and find suitable solutions. To achieve the proposed goals it is necessary to establish an appropriate structure, able to realize and carry out the suggestions proposed by the scientific community. As water is almost universally defined a public entity, the responsible structure must be a *public agency*, financed by the taxpayers, and characterized by an active co-operation with the

people involved. Its responsibility should be preferably at the catchment scale, in terms of a water authority acting as a technical advisor to the governing structures, to which it has to install a well-defined tie.

Planning is the most important activity of a water authority, taking into account hydrology and all the other vital aspects in the area. The conflict arising between the river authority and the governing body can be settled only adopting suitable compromises. It is important to bear in mind that a plan is a dynamic tool, which can be always modified and revised following the process of updating the available information. One of the most fundamental points to consider is the availability of suitable financial support, which is normally achieved through special contributions of the ordinary government bodies. The internal structure of a water authority depends largely on the size of the catchment and the importance of the problems. An *institutional committee* is responsible for any decision the authority has to undertake in its duties, while a *general manager*, supported by a technical and scientific body, should be in charge of all the ordinary activities.

1. Peculiarities of Water Problems

1.1. A Challenge for the Modern Society

The problems relevant to water management, protection and control are acquiring greater and greater complexity, due to a multiplicity of aspects interacting with one another. More than in the past, a water problem cannot be handled individually, but has to take into consideration many other problems, to which it is closely tied, sometimes in not easily perceptible ways. The practice in past years was to pay attention only to a single aspect, considered autonomous and completely severed from others. As a clear example among the numerous cases, it is worth remembering several large schemes for energy production that were developed without paying heed to the environmental preservation: as the final effect, long river stretches were completely emptied, with no more water left for the aquatic life.

On the other side, actions concerning transportation and territorial planning were made without taking into consideration the basic problems of the involved water bodies. Consequently, several bridges and roads, built with no attention to the mechanism of flood propagation in the river, have become barriers to the natural motion of water, raising its level and causing land inundation. Many other examples in the world confirm that dealing with only one aspect of water has caused negative effects. To face simultaneously several water problems taking into account their mutual interaction has now become compulsory for mankind.

At the present time the world population has started to increase dramatically, while the available water on earth remains constant. Moreover, the increasing deterioration of water quality is further reducing the per-capita availability. Such a situation is expected to worsen in the future, stressing the need of a continuous improvement of the available tools and criteria for a rational approach to water problems.

There is a trend to categorize the world into two components, namely the industrialized

and the developing countries, and the difference between them seems to increase continuously in spite of all the efforts undertaken. Water plays a fundamental role in both these components.

Figure 1. The water problems requesting a responsible management and administrative structure.

1.2. An Inter-Disciplinary Commitment

The complexity of water problems can also be confirmed by the amount of data, of various natures, that have to be considered in order to bring a problem to a solution. Data must be manipulated, evaluated and eventually compared with the reality they represent. At the present time it is necessary to deal with a great quantity of data, in order to have a thorough understanding of the various aspects involved, since the larger the amount of data the better the chance to achieve a solution. Fig. 1 shows, in the form of a block chart, how the water problems can be structured.

Water problems are strictly connected to all the intrinsic aspects of human living and civilization. There are numerous problems, each one related to everyday life. However, the problems can be grouped into three main categories:

- The rational utilization of the existing surface and underground resources, to satisfy the demand of the various users;
- The protection of land from inundation, controlling the flood in rivers and streams and preventing the erosion of coastal areas and lake shores;
- The preservation of quality in rivers, streams, lakes, aquifers and coastal water.

- Several disciplines, which require to be kept up to date in their specific field, are involved in searching for a solution to water problems.

Hydrology is the most important discipline to evaluate the amount of water on the earth, but it requires close connection with *Meteorology*, to understand the mechanisms of precipitation and evaporation. *Geology* is necessary to know the origin and the behavior of groundwater. The presence of living organisms is interpreted by *Biology*, and the compounds that can affect water quality must be evaluated by *Chemistry*. Man's health is better analyzed by *Toxicology*, which is becoming very important. Manmade intervention in water bodies, for water use, flood prevention and environmental preservation, needs an appropriate *Engineering* support, which, in turn, has many linkages with *Economics*. The study of people's reaction to the impact of any water-related intervention can be performed by *Social Science*, while the possibilities of governing water and all the man-made structures need an appropriate commitment of *Legislation*.

Science and technology have been able to develop appropriate tools that can be very useful to solve the water problems. Moreover, *Computer Science* has pointed out very powerful devices based on the breakthrough of *Mathematics* and *Statistics*, able to handle thousands of data in a very short time.

Finally, the necessities of numerous and very accurate data, in the fields relevant to the various disciplines, require appropriate instruments based on many scientific fundamentals and mostly relying on *Electronics*.

Technology itself is characterized by a continuous progress that necessitates keeping the available tools up-to-date. Such a situation can be recognized in all the aspects of human living, but in the field of water is particularly determinant, even though some aspects are not always clear to the general public.

2. Necessity of a Responsible Authority

Water problems cannot be solved without *an appropriate structure*, able to bring together all the experts in the various disciplines mentioned above. If this is not the case, the chances of a reasonable solution are very poor. The role of such a structure acquires the greatest importance in the general context of water resources management. The structure must be equipped with the best expertise, able to understand and put into practice what the scientific community can suggest.

In line with this, one can underline the requirement for the structure responsible for water. It is essential that it is made by people able to understand the multiple aspects of the problems and to handle the proposed tools with high familiarity. These people must have appropriate professional qualification, great experience and sensitivity. These experts must be open to the innovation continuously proposed by the scientific world, and should be able to focus on the peculiar points that need further attention and research. The main feature of an active structure dealing with water problems should be therefore a staff having the best possible experience, always abreast with the scientific progress.

A unique structure responsible for all water problems is in many cases an innovative concept. There are very good examples of similar structures in many countries, but there are also situations in which a long tradition can hamper innovations considered too drastic. This happens in particular if there are different bodies, each one responsible for a single use. Electricity generation normally belongs to specific institutions, either public or private; irrigation schemes are in the hands of farmers; water quality preservation is the responsibility of public health authorities. All these bodies have great power in their respective fields and are not always willing to interact. Such a situation is peculiar of the industrialized countries, where a structure responsible for all the water problems is not able to absorb the existing institutions, but has to do a sort of supervision to put them together and harmonize. On the contrary, it might be easier in a developing country, where all these considerations can start practically from zero, and there is more freedom to devise the most appropriate structure.

3. The Role of Water in Human Life

Water is almost universally defined as a public entity. Either considered an exploitable resource or an environmental component to protect and control, water belongs to the whole community, which can benefit from its correct management or can be damaged because of an improper use. The community itself has the overall responsibility of preventing water from becoming a useless stuff or a source of threat. The community has also to provide the necessary financial means.

Rivers, lakes, aquifers and coastal areas -- the *natural bodies* -- are public property and their water can be used totally or partly, only after ascertaining that their integrity, in terms of both quantity and quality, is preserved not only for the present but also for the future generations.

Water can be abstracted from a natural body and then sold to a private user, becoming a private commodity. It can be transformed into other goods or referred to other entities, for which the user can claim full property. Nevertheless, the same user cannot neglect the requirements of other actual or potential users that also claim their rights to abstract and purchase water from the same natural body. Besides the competition between uses, the *environmental requirements* must be taken into account. This imposes severe constraint for the benefit of the involved community, and also in monetary terms.

If not consumed, the abstracted water is returned, at least in part, to the natural bodies, in a way that stresses the fact that private property lasts only temporarily, while the same water comes back into the public domain.

In a similar way, the problems related to environmental protection and flood control fall with no exception within the domain of public concern.

4. Connotation of the Water Authority

4.1. The Public Entity

Following the above considerations, the structure responsible for water problems must

be a *public agency*, financed by the taxpayers, to which it has eventually to report.

The ultimate goal of water management problems is always the overall benefit of all the people involved in the same water body. Its best use, protection and control make up the main framework in which the water problems must be identified, tackled and solved. Therefore, the agency in charge must be able to understand people's needs and act in their own interest. In other words, it must be a people's expression. The agency should be above any individual interests and act impartially.

4.2. Territorial Jurisdiction

An essential point refers to the territorial extension for which the structure should be responsible. There are several possibilities, according to the experience in the various countries. In any case a responsibility at the *catchment scale* is fundamental and should be recommended in the majority of the cases.

The *catchment area* is indeed the only reliable entity as far as hydrology is concerned. Surface water complies with rigorous rules imposed by nature, which can be justified only if the catchment is considered. Some doubt can arise for groundwater, especially if two or more different rivers control an aquifer. In this case also the related problems of groundwater protection and exploitation can be justified if the surface-groundwater interaction is considered in the catchment context.

According to hydrology, the catchment area is the land portion on which the water naturally arrived makes up a unique river. The European Water Framework identifies the catchment as *the territory from which all the surface water, through watercourses, rivers and sometimes lakes, reaches the sea converging into a unique outfall, either in form of estuary or delta*.

Such definitions are obviously based on the rainfall-runoff mechanism. Normally the outfall is a well-defined cross-section to evaluate and possibly measure the flow resulting from the entire catchment area. This flow is the effect of rain and other precipitation forms (snow, hail, dew) on the area, but can be also due to a groundwater outcrop or even a manmade conveyance from another catchment. For these reasons the term *hydrographic basin* should be more appropriate. As these phenomena are present everywhere, all the emerged land on earth is made up of a mosaic of numerous catchment areas contiguous with one another.

The catchment of a given river, as sketched in Fig. 2, is separated from the contiguous ones by means of its *divide* and contains the various tributaries, each one with its *sub-catchment* and relevant *sub-divides*.

Beside the hydrology, several other aspects favor the adoption of catchment for a rational approach to water problems. Particularly for the largest rivers, the catchment identifies also the area on which the other aspects, besides the hydrological ones, can be considered. There are in fact validated historical grounds to state that the life of the involved people is normally oriented in a way that is parallel to the natural motion of water and that the divides have been always an impervious separation of tradition,

language and activities.

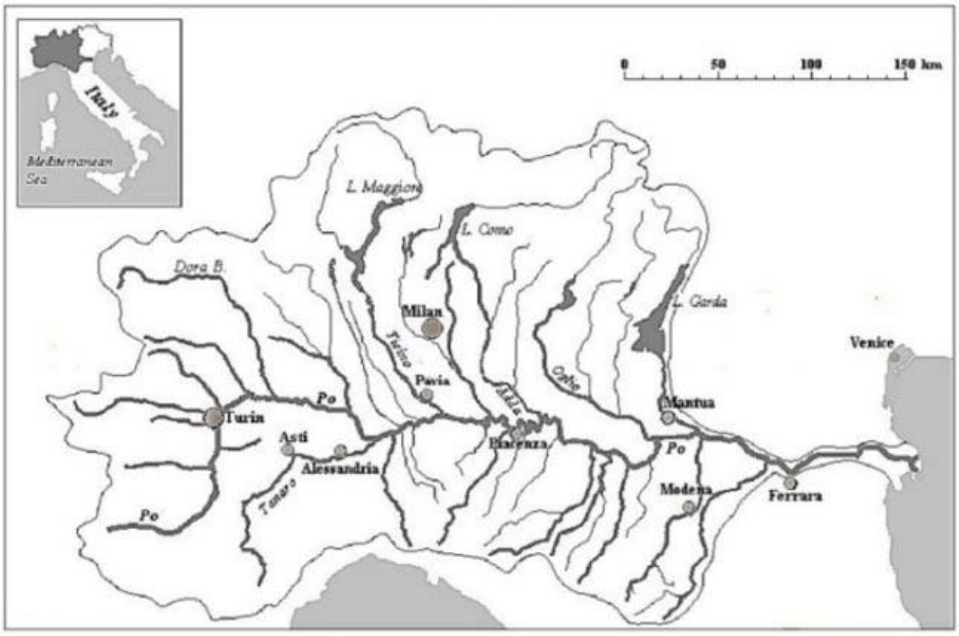

Figure 2. The catchment of River Po in Northern Italy.

The catchment area is therefore a territorial entity on which the water problems can be tackled in a rational way, according to the natural phenomena governing surface and groundwater. It is only in a catchment area that the water balance has a true significance and can be entirely appreciated.

5. Characteristic Aspects of a Catchment Area

The boundaries of sovereign countries coincide very often with the divide of a large river catchment. If the catchment is larger than the country's territory, or if it includes territories belonging to different countries, water problems affect the national policies and trespass the political boundaries. If this is the case, national governments have to comply with rules dictated by the hydrological pattern of the river flowing through their territory and shape their policies taking into account what happens upstream and downstream.

Typical is the case of the Danube, the catchment of which covers an area of 817,000 km² belonging to 18 different countries and involves more than 82 million people.

In a similar way but on a smaller scale, if two or more river basins belong entirely to the same country, their relevant catchment identifies very often different administrative regions, in which several vital aspects become exclusive and can be featured in a way that is parallel to the hydrological conditions.

In line with the above and as a more general consideration, one can say that even the economical life of a country is normally developed in a way consistent with its catchment areas.

To this aim is oriented the scientific community, which has based on the catchment area the research on water problems. In the practical field, many countries have already structured their national water policy in a way consistent with the catchment areas existing on their territory. The European Union, in its Water Framework Directive, states clearly that water problems should be considered in the catchment concern.

River	Location	Length	Catchm. area
		(km)	(km²)
Amazon	South America	6,280	7,050,000
Congo	Central Africa	4,200	3,690,000
Nile	North-Central Africa	6,671	2,867,000
Mississippi-Missouri	North America	5,970	3,328,000
Volga	Russia	3,688	1,350,000
Danube	Central-East Europe	2,860	817,000
Rhine	Central Europe	1,326	160,000
Rhone	Switzerland-France	812	98,420
Seine	France	776	115,120
Po	Italy	652	74,970
Garonne	France	647	56,000
Tiber	Italy	405	17,169

Table 1. Some of the most important rivers in the world

The major world catchment areas, with their principal characteristics, are listed in Table 1.

6. The River Authority

In this respect the most rational and efficient structure responsible for water problems stands out clearly as the authority *acting at the catchment area*.

Territories and communities belonging to the same catchment are normally bound by the consciousness that the above mentioned aspects comply with rules not always clearly identified but strong enough to direct and justify common actions that trespass the ordinary political and administrative concepts. This way of approaching the water problems is in line with the so-called *principle of solidarity*, which justifies the adoption of a catchment-oriented policy and the appointment of a *river authority* responsible for the entire catchment area.

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Biographical Sketches

Marcello Benedini
Until his retirement in 1999, Dr. Marcello Benedini was for several decades the head of the Water Resources Department of the Water Research Institute in Rome. He has many years' experience in both surface and ground water problems, with the application of advanced methods for management purposes. He has been responsible of multi-disciplinary research projects for large river basins, with the coordination of activities in hydrology, hydrogeology, water quality and treatment, including economic and social aspects. In such a position he acted also as an expert on water problems for the European Commission, for the Italian Ministries of Public Works, Agriculture and Environment, and for the Po River Authority. At the present time he acts as a consultant for technical and scientific institutions of the Italian Government. He has been in the directive board of national and international research associations and has currently lectured in postgraduate courses in various Italian universities, particularly those devoted to developing countries. He is the author of about 150 papers on water management problems, reported in scientific conferences and journals, at national and international level.

Roberto Passino
After a period at the School of Engineering of the University of Rome as Assistant Professor and another period as an industrial manager, Roberto Passino since 1969 to the present has been the Director of the Water Research Institute of the Italian National Research Council. In 1971 he was also appointed full Professor at the University of Rome. In such positions he had several international and national commitments in the field of research and water resources management. He has been the Italian Delegate

to the OECD Committee for the Environment, to the ECE Working Group on Environment and to the UN Committee for Europe on Water Problems. He has organized and directed large-scale research projects on environment protection, as a scientific support to the Italian Government. From 1990 to 2001 he has been the Secretary General of the Po River Authority, in such a position promoting the planning activity of the most important river basin in Italy. Roberto Passino is author of several selected scientific publications and textbooks in the field of water resources management, wastewater treatment and desalination, and has participated in the drawing of rules and regulations relevant to Italian water problems.