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Rossi G., Cancelliere A., Alecci S., Alba I.

*in*

Iglesias A. (ed.), Moneo M. (ed.).  
Drought preparedness and mitigation in the Mediterranean: Analysis of the organizations and institutions

Zaragoza : CIHEAM  
Options Méditerranéennes : Série B. Etudes et Recherches; n. 51

2005  
pages 65-104

Article available on line / Article disponible en ligne à l'adresse :

<http://om.ciheam.org/article.php?IDPDF=6600010>

To cite this article / Pour citer cet article

Rossi G., Cancelliere A., Alecci S., Alba I. **Italy**. In : Iglesias A. (ed.), Moneo M. (ed.). *Drought preparedness and mitigation in the Mediterranean: Analysis of the organizations and institutions*. Zaragoza : CIHEAM, 2005. p. 65-104 (Options Méditerranéennes : Série B. Etudes et Recherches; n. 51)



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# Italy

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**SUMMARY** – Italy has experienced many drought events both in the northern regions, characterized by humid climate and sufficient water resources, and in semiarid southern regions where the greater variability of the hydro-meteorological variables and the reduced amount of water resources with respect to increasing demands lay the basis to more frequent conditions of water deficit. Despite the severity of past droughts, and in particular of the 88-90 one, very few lessons seem to have been learned at political and institutional level, since the mitigation approach remains reactive, with a preference to manage emergency situations rather than preventing them through an integrated approach to drought mitigation, which is considered necessary to successfully face this threat. Only a reactive response to drought has been experienced in Italy. In particular, two main tools have been applied: emergency actions of the Department of Civil Protection and subsidies to farmers for covering agricultural damages due to drought, under the provisions of national acts on national disasters. Although these factors have produced a legislation which contains several ethical principles and innovative criteria aiming to improve the water supply conditions for different uses, to mitigate the impacts of hydrologic extremes (floods and droughts), as well as to protect the quality of water bodies, the status of water management in Italy remains, in general terms, unsatisfactory.

**Key words:** Water resource management, hydrology, drought management, legislation.

**RESUME** – "Italie". L'Italie a subi plusieurs événements de sécheresse dans les régions du nord, caractérisées par un climat humide et des ressources en eau suffisantes, et dans les régions semi-arides du sud, où il existe un déficit hydrique plus fréquent en raison de la plus grande variabilité des facteurs hydro-météorologiques et de la quantité réduite de ressources en eau par rapport à la demande croissante. Malgré la sévérité des sécheresses passées, et en particulier celle de 88-90, apparemment très peu d'enseignements ont été tirés par les instances politiques et institutionnelles, car l'approche d'atténuation continue d'être réactive, tendant à la gestion des situations en urgence plutôt qu'à la prévention en utilisant une approche intégrée d'atténuation de la sécheresse, considérée nécessaire pour faire face de façon plus optimale à cette menace. L'Italie n'a vu qu'une réponse réactive à la sécheresse. En particulier, deux principaux instruments ont été appliqués : actions d'urgence du Département de Protection Civile et subventions aux agriculteurs pour les indemniser des dommages à l'agriculture causés par la sécheresse, selon les dispositions de la législation nationale concernant les désastres naturels. Bien que ces facteurs aient donné lieu à une législation qui contient plusieurs principes éthiques et des critères innovants visant à améliorer les conditions d'approvisionnement en eau pour divers usages, à atténuer les impacts des événements hydrologiques extrêmes (inondations et sécheresse) ainsi qu'à protéger la qualité des ressources hydriques, la situation de la gestion de l'eau en Italie reste, d'une façon générale, peu satisfaisante.

**Mots-clés :** Gestion des ressources en eau, hydrologie, gestion de la sécheresse, législation.

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## Introduction

This chapter describes the Italian organizational and institutional framework relevant to drought at national level as well as at regional level (with specific reference to Sicily, one of the most drought-prone regions). The analysis includes the following components:

- (i) Data and information collection system, with particular reference to hydro-meteorological data and socio-economic information linked to water supply for municipal and agricultural uses.
- (ii) Legislation at national and regional levels on policy and government of water resources, and planning and operation of water supply systems and strictly linked systems for soil conservation and pollution control (wastewater treatment).

(iii) Institutions involved in water and drought planning and management.

(iv) Institutional framework and technical guidelines on drought preparedness and management.

Besides, the report presents the results of the interviews made to the selected relevant institutions on the basis of the common questionnaire developed within the project with a few items added in order to adapt it to the Italian situation. An assessment of the general performance of the legal and institutional structure for drought management is also presented.

## Data and information systems

In many fields of climate and water resources data acquisition as well as of socio-economic information, Italy can be considered pioneer in starting national networks for collecting data representative at various temporal and spatial scales (e.g. National Hydrographic Service established on 1917 within Ministry of Public Works, Central Office of Agricultural Ecology within Ministry for Agriculture). Also recent legislative acts have given attention to the problem of technological innovations (e.g. Law 183/1989 on water and soil conservation which established a hydrologic information system) or to a new service for acquisition of information on municipal water supply (e.g. Law 36/1994 on consumption and prices data in the integrated water service).

The main organizations which have duties of data collection and processing in the hydro-meteorological fields are as follows:

(i) Central Office of Agricultural Ecology (within the Agricultural Policies Ministry) – one of the oldest institutions with about one hundred meteorological stations.

(ii) Meteorological Service of the Italian Air Force, including networks of gauges oriented mainly to air navigations and meteorological forecasting.

(iii) Hydrographic Service, established on 1917 and reformed on 1989 as Hydrographic and Mareographic Service, including 14 compartments defined on basin basis, today transferred into Regional Agencies for Environmental Protection (ARPA), while the central office has been enclosed in the Agency for Land and Environment Protection (APAT). Collected data include maximum and minimum daily temperatures, daily precipitation total and annual maxima for short durations (from 1 hour to 5 days) published in part 1 of yearly reports of *Annali Idrologici* and average daily hydrometric levels, discharges measured in hydrographic gauges on main rivers, periodic levels of groundwater and sediment transport on rivers published in part 2 of *Annali Idrologici*.

(iv) Several meteorological and agro-meteorological services in most of Italian regions oriented to collect and disseminate meteorological data, particularly those of interest for agricultural activities.

(v) Water quality data regarding both surface and groundwater resources are collected by ARPAs, under the coordination of the APAT connected to the Ministry of Environment. However a few ARPAs are up to now fully operative due to the delays of the regional administration in implementing them.

(vi) Geographic and cartographic information presents very high standards, due to the long activity of the Military Geographic Institute (IGM) at national level and to the several regional initiatives for developing technical maps at small scale (1:2000; 1:5000). Digital cartography at different scales is now available for almost the whole national territory.

(vii) Demographic information is periodically updated by the Italian Statistics Institute (ISTAT) through national census generally with 10-years intervals which include also acquisition of data on economic activities as agricultural and industry.

(viii) Periodic surveys on irrigated districts are carried out by the National Institute of Agricultural Economy (INEA) and by the Association of Land Reclamation Consortia (ANBI), particularly during recent drought events. Also annual values of energy produced by hydroelectric power plants are published by the Electric Power Agency (ENEL). Data on municipal water consumption is available for FEDERGASACQUA, an association of water utilities.

Accessibility of data is somewhat limited by the fact that data are often not published on the

internet, which causes delays in its availability. Some efforts in this direction are being carried out by few regional meteorological and agro-meteorological services, which however are still in the experimental stage.

## Legal framework

### National level

Italy is divided into 20 administrative regions, about 100 provinces and about 8000 municipalities. The Italian Constitution of 1947 provided decentralization to regions. These were distinguished in "Special Statute Regions" and "Ordinary Statute Regions". The former were established during the early years of the Republic (Sicily in 1946; Sardinia, Valle d'Aosta and Trentino Alto Adige in 1948; Friuli Venezia Giulia in 1963). The Ordinary Statute Regions have only been implemented later (laws and decrees regarding decentralization of 1970, 1972, 1975 and 1977) and almost completed with Law Decree 112/1998. More recently the Constitutional Law 3/2001 has turned over the previous constitutional framework, which assigned only a few competences to the regional legislative power, and the new text lists the competences at national level, leaving the remaining ones to the regions.

The regions have legislative powers and all major acts of Parliament on water field have to be translated into regional legislation for those regions with special autonomy (Sicily, Valle d'Aosta, Sardinia). Coordination between the national and regional levels of the administration is guaranteed by the Joint Committee Central Government-Regions (Conferenza Permanente Stato-Regioni).

A schematic representation of water legislation in Italy is presented in Table 1, which reports the main laws and decrees issued on water resources use, flood defence, and pollution control. The main European directives are also shown, as they have influenced significantly Italian legislation in the last decades.

Table 1. Development of Italian legislation on water management and European Union directives (from Rossi and Ancarani, 2002)<sup>†</sup>

Water resource use	Flood defence	Pollution control	EEC directives
R.D. 1775/1933 Water licenses and hydropower R.D. 215/1933 Integrated land reclamation	L. 184/1952 River regulation plan		
L. 129/1963 Drinking water supply master plan D.P.R. 8/1972 Transfer to regions of responsibilities in water fields			
L. 382/1975 Transfer to regions of responsibilities in water fields		L. 319/1976 Water pollution control	Dir. 75/440 Surface water quality for drinking use Dir. 76/160 Water quality for bathing use Dir. 76/464 Measures for water pollution control
D.P.R. 616/1977 Transfer to regions of responsibilities in water fields Del.C.I. 4/2/1977 Criteria for rational water use and aqueducts operation		Del.C.I. 4/2/1977 Guidelines for sewage, wastewater treatment and discharge	

Table 1 (cont.). Development of Italian legislation on water management and European Union directives (from Rossi and Ancarani, 2002)<sup>†</sup>

Water resource use	Flood defence	Pollution control	EEC directives
			Dir. 78/659 Water quality for fishes
		L. 650/1979 Revision of L. 319/1976 procedures	Dir. 79/869 Sampling methods of surface water for drinking use
			Dir. 80/68 Measures for protecting groundwater from pollution
			Dir. 80/778 Water quality control for municipal use
		L. 153/1981 Charges for sewage and wastewater treatment	
		D.P.R. 470/1982	
		D.P.R. 515/1982	
		D.P.R. 236/1982	
		Acknowledgement EEC directives on water quality (76/160, 75/440, 80/778)	
			Dir. 85/337 Environmental impact assessment (EIA) for waterworks
		L. 349/1986 Institution of Environment Ministry and EIA	Dir. 86/280 Enlargement of Dir 76/464
		D.P.R. 236/1988 Quality of water for municipal use	
		D.P.C.M. 337/1988 EIA procedures for major works	
	L. 183/1989 Soil and Water Conservation Act (modified by L. 253/1990 and by L. 179/2002)		
L. 142/1990 Local authorities autonomy regulation			
D.P.C.M. 233/1990 Criteria for implementing L. 183/1989			
D.P.R. 85/1991 National Technical Services reform			Dir. 91/271 Municipal waste water treatment
			Dir. 91/676 Water protection from nitrate pollution

Table 1 (cont.). Development of Italian legislation on water management and European Union directives (from Rossi and Ancarani, 2002)<sup>†</sup>

Water resource use	Flood defence	Pollution control	EEC directives
D.P.R. 7/1/1992 Information acquisition criteria for river basin plan L. 498/1992 Urgent actions on public finance	L. 225/1992 Institution of Civil Protection Service	D.L. 130/1992 D.L. 132/1992 D.L. 133/1992 Acknowledgement of EEC directives on water quality (76/464, 78/659, 80/68, etc.)	Dir. 92/43 Habitat or species protection
D.L. 96/1993 Management of water works D.L. 275/1993 Modification of water license rules L. 36/1994 Municipal water supply reform		L. 37/1994 Environmental protection of state property close to public water bodies L. 61/1994 Institution of Environmental Protection Agency L. 172/1995 Revision of L. 319/1976 procedures	
D.P.C.M. 4/3/1996 Directives on water resources	D.P.R. 18/7/1995 Approval of address act for the definition of the basin plan	D.P.R. 12/4/1996 EIA procedure enlargement	Dir. 96/61 Modifications of Dir 941/271
M. Finance 90/1997 Regulation on public water licences charges D.L.L.P.P. 99/1997 Criteria for losses evaluation in aqueducts and sewers	D.L.L.P.P. 14/2/1997 Directives for the identification of areas subject to hydrogeologic risk  L. 267/1998 Actions for coping with hydrogeological risk D.P.C.M. 29/9/1998 Criteria for areas under hydrogeological risk		Dir. 98/15 Measures for pollution prevention and reduction Dir. 98/83 Quality of water for human consumption
L. 290/1999 Deadline extension for wells declaration D.P.R. 238/1999 Declaration of all water as public D.P.C.M. 29/4/1999 Chart for water supply service D.L. 267/2000 Organisation of Local Authorities		D.L. 152/1999 Directives on pollution control  D.L. 258/2000 Integration to D.L. 152/1999 D.L. 31/2001 Acknowledgement UE directive 98/83/EC	Dir. 2000/60 Water Framework Directive

<sup>†</sup>R.D.: Royal Decree; L.: Law; D.P.R.: Decree of the President of the Italian Republic; Del.C.I.: Resolution of the Interministerial Committee; D.P.C.M.: Decree of the Prime Minister; D.L.: Governmental Decree; D.L.L.P.P.: Decree of the Minister of Public Infrastructures.

The legal framework for water resources use has been based for many decades on the R.D.

1775/1933, which asserted that all surface and groundwater resources are public, except for some cases, and provided a regulation of private withdrawals through the license. The general legislative framework aimed at increasing the utilization of resources for economic purposes, regarding both water supply and hydroelectric use, and therefore no planning of water resources by State was foreseen.

A first tool of water planning limited to the municipal use is represented by the Law 129/1963 which established the planning of drinking water supply through the Aqueduct Master Plan assigning a priority to municipal use. A similar principle of planning was introduced for river regulation by the Law 184/1952 issued after the Po River flooding on 1951.

During the seventies the attention was mainly focused on water quality and environmental problems. In particular, after the transfer of many responsibilities in the water field to the regions, the Law 319/1976 (usually referred to as Merli Act) regulated the sector of the pollution control through the introduction of standard quality levels for discharge and entrusted the regions with the preparation of water restoration plans, including sewers and wastewater treatment plants. Several later decrees defined technical guidelines for water pollution control and/or acknowledged several European directives on water quality.

In the 90's important innovations have been introduced by legislation in the institutional framework of water management and environmental protection in Italy. Main innovations derive from a few general principles, such as the public property of water resources, the sustainable use of water resources, the efficiency of public services, and the stakeholders involvement. The most innovative aspects of such recent legislative acts, namely Law 183/89, Law 36/94, and Legislative Decree 152/99, will be discussed with more details in the following paragraphs, excerpted from Rossi and Ancarani (2002) with necessary updating.

## Innovations in water resources planning

The Law 183/1989 on water and soil conservation was issued at the end of the 80's. It represented the end of a long process started after the Florence's flooding through the technical-scientific work of the De Marchi Commission (1970) for flood defence and soil conservation problems and used the reports of the Conferenza Nazionale delle Acque (1972) for the problems of water resource use, pollution control and institutional reform. Law 183/1989 aimed to adopt an integrated approach to water and land conservation problems. Both planning and management of water and land conservation must be conceived within a unitary vision for the whole territory of each hydrographic basin. It introduced the concept of river basin plan, which was conceived as the main tool to collect relevant information and to identify the actions necessary for: (i) hydraulic defence and soil conservation; (ii) utilization of water resources; and (iii) pollution control of water bodies.

The law established the river basin authorities entrusted with the coordination of all the planning, construction and control activities in water field within the river basin.

The law has identified 11 river basins of national importance in the largest Italian rivers, for which 6 basin authorities have been established (Po, Adige, Alto Adriatico, Arno, Tevere, Medio Tirreno). In each national basin, the river basin authority is in charge to coordinate all the planning, construction and control activities in water field within the river basin, and it includes a political committee with representatives from ministries and interested regions, a technical committee appointed by the Ministry of Public Works and a secretary.

The law also has identified 18 interregional river basins, listed in Table 2, and 1 prototype regional basin, and furthermore it has entrusted the regional governments with the identification of the regional river basins within their territory and with the establishment of the authorities and the committees of interregional and regional river basins.

The law establishes the National Committee for Technical Services and Interventions for Soil Protection (as modified by Art. 29 of the Law No. 179/2002), chaired by the Prime Minister or, on his behalf, by the Minister of Environment, and composed by several representatives of other ministries, namely the Minister of Infrastructures, Environment and Agricultural Policies, the Minister of Regional

Affairs, the Minister of Public Function and the Minister of Cultural Goods and Activities. Besides the law has established the National Committee for Soil Conservation, having technical consulting functions and to set planning trends.

Table 2. Italian interregional river basins as identified by Law 183/89

With mouth in	River basin (region)
Adriatic Sea	Lemene (Veneto, Friuli-Venezia Giulia) Fissaro-Tartaro-Canal Bianco (Lombardia, Veneto) Reno (Toscana, Emilia-Romagna) Marecchia (Toscana, Emilia-Romagna, Marche) Conca (Marche, Emilia-Romagna) Tronto (Marche, Lazio, Abruzzo) Sangro (Abruzzo, Molise) Trigno (Abruzzo, Molise) Saccione (Molise, Puglia) Fortore (Campania, Molise, Puglia) Ofanto (Campania, Basilicata, Puglia)
Ioanian Sea	Bradano (Puglia, Basilicata) Sinni (Basilicata, Calabria)
Tyrrhenian Sea	Magra (Liguria, Toscana) Fiora (Toscana, Lazio) Sele (Campania, Basilicata) Noce (Basilicata, Calabria) Lao (Basilicata, Calabria)

Furthermore, it has reformed the national technical services, transferred under the Prime Minister jurisdiction, assigning also the task of organizing and managing the information system on hydro-meteorological data. Later on, three technical services have been transferred to various ministries (e.g. Hydrographic Service to Environment Ministry, Dams Service to Infrastructure Ministry, formerly Ministry of Public Works).

## Innovations in municipal water services

The Law 36/94 (usually referred to as Galli Act) has removed the exceptions to the general principle that all surface and groundwater resources must be considered public, and has introduced important innovations asserting that water resource use must accomplish criteria of efficiency and effectiveness, also taking into account criteria of solidarity and environmental protection. Furthermore, the organization of municipal water services has been deeply reformed by considering:

(i) The integration of the management of the elements of the urban water cycle (water supply, sewage and wastewater treatment) under a single responsible agency in order to simplify the organizational structure and to improve the safeguard of water sources from pollution.

(ii) The definition by regional governments of the "Optimal Territorial Units" (OTUs) which should include several municipalities in order to overcome the current fragmentation of water utilities and to increase their size in terms of both served population and supplied volume.

(iii) The separation between the tasks of the public utilities operating the water services and the tasks of the local authorities giving directives and controlling the quality of the provided services.

(iv) The adoption of full cost recovery pricing criteria to ensure that the tariffs charged to users reflect all costs of the services, including operation, replacement and investments costs.

(v) The necessity to guarantee efficiency, effectiveness and economy in water service management.

(vi) The creation of the Committee for Water Resources Use at the Infrastructure Ministry with the function of controlling the management of OTUs, reporting information to Parliament every year, and guaranteeing services' quality.

Besides, the law confirms that the land reclamation consortia are responsible for construction and management of water networks for irrigation purpose, for the reuse of treated wastewater and for rural aqueducts. It indicates that under drought conditions the priority of water uses should be as follows: municipal, agricultural, industrial. Law 36/94 has been followed by Decree 47/1996, that issued some guidelines for the identification of the areas under risk of water crisis, unfortunately yet not accomplished.

## Innovations in water quality control

The most recent legislative act on water pollution control and water quality improvement has been the Legislative Decree 152/1999 (modified by Legislative Decree 258/2000). It has been conceived in order to adopt into Italian legislation the European Directives 91/271 on urban wastewater treatment and 91/676 on protection of water from agricultural pollution. It also rearranged all previous Italian legislative framework on pollution control, replacing the fundamental Law 319/1986 (Merli Act). In fact, the Decree 152/1999 has introduced the objectives of a minimum standards of water quality and of a specific level connected to each particular use (production of drinking water, bathing, etc.), by modifying the previous discipline of the standards on wastewater effluents. In particular, it has fixed different requirements for different zones distinguishing the vulnerable zones (subject to nitrates and phytosanitary products pollution) and the areas sensible to eutrophication process.

It has substituted the regional plan for water restoration provided by Law 319/1976 with the plan for water protection, considered as a part of the river basin plan established by Law 183/1989.

Also, it has provided the technical rules with respect to: (i) monitoring and classification of waters; (ii) classification of water bodies; (iii) guidelines for surveying river basin characteristics and human impacts, including guidelines for water sampling and analysis; (iv) contents of water protection plan; (v) standard on effluents; and (vi) criteria for sensible areas definition.

Finally, it has defined the stages for achieving environmental quality objectives, including the analysis of present conditions and classification of environmental status, the identification of restoration objectives and the implementation of the necessary actions in water bodies.

## Sicilian legal framework

Sicily Region includes 9 provinces and 409 municipalities. Sicily is a region with special autonomy since 1946 (R.D. 455/1946) and has extensive power for legislating on water field. The main legislative acts issued in Sicily on water field are as follows:

- Regional Law (R.L.) 40/1946, on irrigation in Sicily.
- Governmental Decree (D.L.) 2/1947, establishing the Ente Siciliano di Elettricità.
- D.L. 3/1949, on the construction of drinking troughs.
- D.L. 27/1950, on hydro-geological researches.
- R.L. 44/1956, on the construction of hill lakes.
- R.L. 30/1961, on the construction of reservoirs.
- R.L. 4/1965, funding the water resources researches (particularly with reference to sea water treatment plants).
- Law 21/1965, transforming ERAS (Agency for Agrarian Reform in Sicily) in ESA (Agriculture Development Agency), entrusting it with significant tasks in irrigation field.
- President of Region Decree 615/1968 on channels for irrigation.
- President of Region Decree 91/1969, establishing a regional committee for drawing up a water plan related with the regional plan for economical development.
- President of Region Decree 1503/1970, for transferring public water property from National Government to Sicilian region.
- R.L. 23/1974, on incentives for irrigation networks.
- R.L. 39/1977, on environment protection and fight against pollution.

- President of Region Decree 683/1977 on aqueducts of regional interest.
- R.L. 80/1978, on modification and integration to R.L. 39/1977.
- R.L. 212/1979, on "Ente Acquedotti Siciliani EAS" (Sicilian aqueducts agency) organization.
- R.L. 184/1982, issuing directives for sea water treatment plants management.
- R.L. 27/1986, regulating measures to alleviate effects of natural disasters.
- R.L. 27/1986, on municipal sewer discharges not connected to public sewers.
- R.L. 5/1994, acknowledging national Legislative Decree 275/1993 on water licenses.
- R.L. 45/1995, reforming the land reclamation consortia.
- R.L. 10/1999 (Art. 23) reforming the EAS, and (Art. 69) acknowledging Law 36/1994 (Galli Act) on water resources management.
- President of Region Decrees 16/05/2000 and 29/01/2002, identifying the OTUs.
- President of Region Decree 7/08/2001 regulating the constitution of OTUs.
- President of Region Decree 2/04/2002 regulating the transformation of the EAS into a joint-stock company.

With reference to the main acts issued at national level, Sicily has not acknowledged yet the Law 183/1989 on water and soil conservation. Therefore, it has not established the river basin authorities for regional basins and has not draft river basin plan. On the other hand, it has acknowledged Law 36/1994 (Galli Act), by defining nine regional OTUs and regulating all other topics necessary for implementing water service reform. However, the OTUs are not fully operational yet, and in particular water management firms for the integrated water service have not been chosen.

## **Institutions and organizations in water resources management**

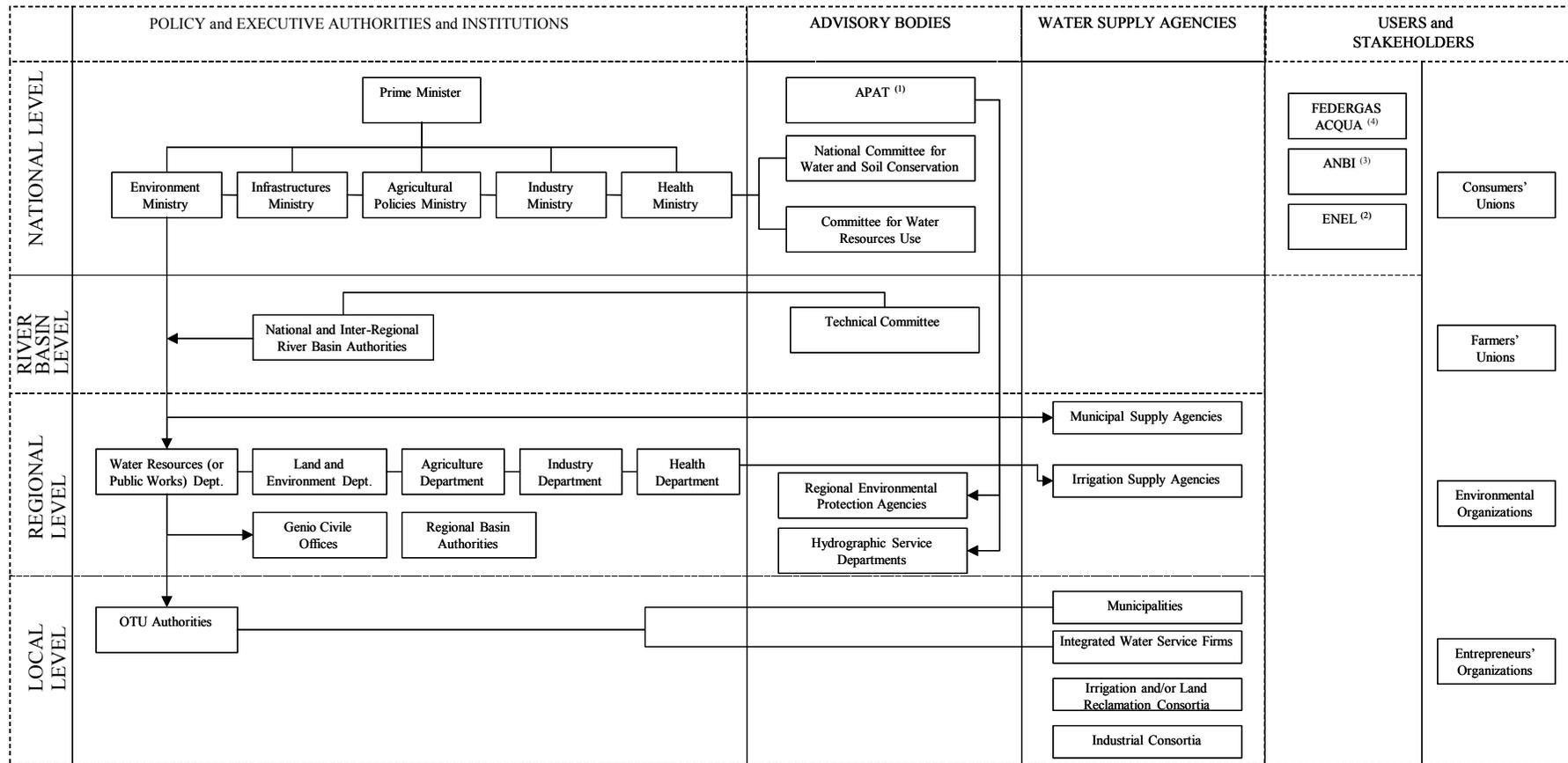
The institutional framework on water resources policy and administration, reformed by Law 183/89 and updated by successive acts, in particular by Laws 36/94 and 61/94, is shown in Fig. 1. The scheme is simplified since it does not consider the links between authorities involved in water government and authorities responsible for economic and social planning. However, the scheme appears really complex due to the fact that the responsibilities are spread among several bodies at the same levels and among different levels. Moreover, besides the Environmental and the Infrastructure Ministries, several other ministries have duties on water-related topics (Ministries of Agricultural Politics, Health, Industry, etc.) thus increasing the complexity of the institutional framework as many decisions have to be taken by agreement between a number of institutional bodies at different levels.

In particular, the competences assigned by recent laws at national, river basin, and regional levels are as follows:

(i) *At national level*, The Prime Minister is responsible for defining guidelines on water resources survey, methodologies for water planning, as well as for defining the criteria for water transfer, updating of Aqueduct Master Plan, identification of areas under water scarcity risk, operation of integrated water service, level of supply service (Decree 4/3/96). The Minister of Environment is responsible for the preparation of the report on the state of the environment, for issuing directives on rational use of water and on reuse of treated wastewater. The Ministry of Public Works (today transformed in Minister of Infrastructure) is responsible for determining the reference tariffs for water services (issued on 1997), for appointing the Committee for Water Resources Use (and connected Water Services Observatory), and for coordinating the water transfer between different regions. Both the Committee and the Observatory today are under the authority of the Ministry of Environment. Other ministries (Agriculture, Industry, Health) have also some minor competencies on water.

(ii) *At river basin level*, the river basin authority is in charge of evaluating and updating the water balance, of indicating measures for water economy planning and of managing public financial investments for hydraulic infrastructures.

(iii) *At regional level*, the region cooperates with interregional river basin authorities, establishes the regional river basin authorities, identifies OTUs, determines the organization of the relationships among the local authorities, to adopt a standard agreement between OTU authority and water firm; furthermore, it updates the Aqueduct Master Plan, adopts the water saving programmes, and establishes the criteria for personnel transfer to water firms; it provides to develop the water protection plan (Decree 152/1999).



(1) Agency for land and environment protection. (2) Hydroelectric power agency. (3) Association of land reclamation consortia. (4) Association of water distribution utilities.

Fig. 1. Water resources institutional framework in Italy.

(iv) *At local level*, the OTU authorities are responsible for planning, control and vigilance on water services provision through the following regulation tools:

- The "OTU Plan" which defines the investments and the related financial sources.
- The agreement between authorities and firms who would manage the water services, including the objectives to be attained and the penalties in case the services would not work well.
- The competition for acquiring the water service through a competitive tendering.
- The tariff, established according to the methodology defined by the Committee for Water Resources Use, with reference to firm's proposal and taking into account social sustainability.
- The service chart, stating customer rights and firms' obligations (according to Prime Minister Decrees 4/3/96 and 29/4/99).

## Sicilian institutional framework

The Sicilian Region has extensive political autonomy in water field, as established by the 1946 Statute. In particular, Sicily has the exclusive power to legislate on public water, fishing, agriculture and forestry, and land reclamation. The Presidential Decrees 1503/1970 and 616/1977 have further enlarged the regional competencies on water fields. Thus, Sicilian Region has also exclusive competencies for planning water resources use. In Sicily, responsibilities on water resources planning and management are shared among a number of subjects inside the Public Administration. Three are the main departments involved: Public Works, Agriculture and Forestry, Land and Environment. Municipalities and provinces have also competencies on water resources management. In particular, the competences assigned to the regional bodies are as follows:

(i) Department for Land and Environment – coordination of activity on water field and drawing up of water master plan and hydro-geological risk defence plan.

(ii) Department for Public Works – water works for regulation of water regime and hydroelectric power plants. Also, surveillance on EAS.

(iii) Department for Agriculture and Forestry – surveillance on land reclamation consortia and hydraulics-forest works.

Minor competencies are attributed to other departments, namely fishing also in the internal water bodies to Department for Cooperation, Handicraft and Fishing, water hygiene to Department for Health, water supply for industrial areas to Department for Industry. The Department for Public Works and the provincial "Genio Civile" Offices are competent for water licenses.

There are regional public agencies devoted to particular aspects related to water management. In particular, ESA (Agricultural Development Agency) manages surface reservoirs for irrigation purpose, funds rural infrastructures (roads, electric power lines, etc.), carries out researches on agricultural topics and on groundwater resources availability without a significant planning activity; EAS (Sicilian Aqueducts Agency) provides water supply for about 100 municipalities (mainly in the central-southern part of the island); some reservoirs and great conveyance pipelines currently operated by EAS, will be operated by the joint-stock company "Siciliacque", partly at public participation and not operative yet; land reclamation consortia (a total number of 11) manage water delivery for irrigation to associated farmers, maintain rural infrastructures, especially with regards to irrigation channels and water sources, and design new hydraulic infrastructures.

## Plans and actions in drought management

### Past experiences in drought management

Italy has experienced many drought events both in the northern regions, characterized by humid climate and sufficient water resources, as well as semiarid southern regions where the greater variability of the hydro-meteorological variables and the reduced amount of water resources with respect to increasing demands lay the basis to more frequent conditions of water deficit.

A very severe drought occurred on 1921 affecting most of the Italian regions, with relevant agricultural impacts. Another drought event on 1938 covered mainly northern regions during the January-April period with a strong reduction of river flow due to reduced snow precipitation.

Recent drought events have stimulated the scientific concern to promote *ad hoc* investigations for the purpose of learning as much as possible about the country's situation regarding drought vulnerability. For example a survey on the 1988-90 drought has been promoted by the Civil Protection (Rossi and Margaritora, 1994). This drought can be considered the most severe of the century, since it presented three-year sequence with very low precipitation. This situation was evenly distributed over the entire national territory and was particularly severe in the wet seasons of the period. In Table 3 the average precipitation and annual deficit during the 1988-90 period are shown. In particular, annual precipitation decreased 21% in 1988, 24% in 1989 and 16% in 1990. But more relevant was the decrease with respect to the September-March period with reduction of 44% and 43% respectively for the years 1988-89 and 1989-90.

Table 3. Rainfall shortfall during the 1988-90 drought event in Italy (from de Vito and Rusconi, 1994)

Hydrographic compartments	Catchment area (km <sup>2</sup> × 10 <sup>3</sup> )	Avg. rainfall (mm)	Annual values deficit (%)			Seasonal values (Sept.-March)			
						Avg. rainfall (mm)	1988-89 deficit (%)	1989-90 deficit (%)	1988-90 deficit (%)
Northern Italy	106.8	1116	13	18	12	567	38	42	40
Central Italy	79.5	977	27	16	18	716	53	39	46
Southern Italy	65.2	1106	20	30	20	733	40	50	45
Insular Italy	49.8	723	25	30	12	612	44	39	41
ITALY	301.3	1012	21	24	16	645	44	43	43

By using stream flows data available from the National Hydrographic and Mareographic Service in Table 4 average and annual deficit of a selected set of rivers over the country have been reported. Low precipitation had a strong effect on the behaviour of the rivers, on the Alpine lakes and on the aquifer. In particular, natural water availability displayed a substantial deficit in main rivers (mean deficit ranging from 12% to 74%), Lake Como and Lake Maggiore reached almost their minimum recorded level in both 1989 and 1990, and many aquifers displayed an unusual lowering of the water table. Also an increase in average temperature was measured, which contributed to reduce the snow precipitation and its persistence on the ground in the Alps and part of the Apennines.

Table 4. Runoff shortfall in some significant Italian rivers (from de Vito and Rusconi, 1994)

Rivers	Catchment area (km <sup>2</sup> )	Average runoff (mm)	Deficit (%)			Mean 1988-1990 deficit (%)	Total 1988-1990 deficit (mm)
			1988	1989	1990		
Brenta	1,567	1143.1	12	2	42	19	199
Adige	11,954	536.3	4	2	29	12	708
Sieve	831	576.8	38	64	41	48	813
Ombrone	2,657	316.9	37	67	66	57	540
Fiora	818	269.8	25	53	51	43	375
Pescara	3,125	573.2	33	34	39	35	597
Tevere	16,545	443.7	23	39	47	36	480
Biferno	1,290	281.1	60	32	52	48	388
Cervaro	657	134.4	43	89	89	74	297
Ofanto	2,716	160.2	2	67	59	43	232
Oreto	76	375.6	33	67	11	37	407
Tirso	587	214.9	48	70	75	64	406

The 1988-1990 drought has produced severe impacts on water management and on economic activities. In particular, in the South and the larger islands hit by unexpected shortage, the ultimate solution to supply drinking water was to rely on water transported by tank truck. Irrigated agriculture was also badly struck by the drought; for example in 1989 in several districts of Sicily and Sardinia only a few plots out of the thousands of hectares usually irrigated could be supplied. Irrigated surface decreased of about 50% (Table 5) with losses of about  $110 \times 10^6$  Euro/year. Also hydroelectric production exhibited a significant reduction and the low stream flows caused heavy impacts on aquatic ecosystems.

Table 5. Irrigated surface in irrigation district in some regions of southern Italy during 1988-89 drought (from Leone, 1994)

Region	Irrigation district	Surface			Comments
		Irrigable	Irrigated in 1998	Irrigated in 1989	
Abruzzo	Destra Pescara	3,300	3,300	3,300	Reduced supply by 50%
	Sinistra Pescara	10,000	7,750	5,000	Reduced supply
Campania	Sannio Alfano	10,893	8,870	6,300	
	Destra Sele	16,375	16,375	16,375	Reduced supply (50%)
	Sinistra Sele	9,018	8,700	7,000	Use of drainage water
Puglia	Tavoliere	96,870	47,409	37,800	Reduced supply for the south part (10,000 ha); the north part did not received any water
	Tara	16,770	7,734	3,400	
	Arneo	1,900		660	
Basilicata	Bradano a Metaponto	51,419	27,500	14,650	
	Alta val d'Agri	7,890	3,900	4,030	
Calabria	Riuniti Catanzaro	24,400	12,700	8,900	Highly irregular supply
	Lao Abatemarco	4,178	1,870	1,750	
	Sibari e Crati	24,600		12,500	

This drought in Italy found the communities involved almost unprepared to forecast possible events and reduce their impact to an acceptable level. Emergency actions therefore appeared as the most appropriate measures to be taken and the cost of drought consequences had to be borne also by communities not directly involved in the precarious situation concerning the particular water resource taken into consideration. Funds provided by State as emergency measures in the period 1989-1990 attained  $1133 \times 10^9$  Italian lire for both short-term and long-term measures (Cittadino and Mandrini, 1994). The drought events have confirmed the risk that the actual resources become unable to meet the usual demand, with backlash effects lasting several years after the water shortage has been experienced (Rossi and Margaritora, 1994).

Since the 90's several drought events occurred in different regions of peninsula, producing severe impacts on agriculture and municipal water supply. The most affected regions have been Sardinia and Sicily where mandatory rationing were adopted in municipal supply and emergency commissioners have been appointed in order to foster actions funded by Civil Protection. The last drought in spring and summer 2003 affected mainly the Po River basin, with low flows which have created strong concern on the possibility of providing necessary stream flow for cooling electric power plants.

Despite the severity of past droughts, and in particular of the 1988-90 one, very few lessons have been apparently learned at political and institutional level, since the mitigation approach remains reactive, with a preference to manage emergency situations rather than preventing them through an integrated approach to drought mitigation, which is considered necessary to successfully face this threat (Rossi, 2003).

## Measures for coping with drought

A classification of actions that can be pursued in order to face a drought focuses on the type of response to drought, distinguishing between a reactive and a proactive approach. The former consists of measures adopted once a drought occurs and its impacts are perceived (usually applied as emergency actions to face drought events). The latter consists of measures conceived and prepared according to a planning strategy (Yevjevich *et al.*, 1983). Within the last approach two main categories of measures, both planned in advance, can be identified, namely long-term actions, oriented to reduce the vulnerability of water supply systems to droughts, and short-term measures, trying to face in incoming drought event within the existing framework of infrastructures and management policies (Cancelliere *et al.*, 1998).

Generally three kinds of measures can be taken, namely increasing water availability, reducing demand and minimization of impacts of water shortage. Among the measures to increase water availability, the use of low-quality water and waste water reuse can be considered key actions to be pursued in southern regions for reducing vulnerability of water supply systems to drought. In particular, the saline water in the coastal areas through desalination plants seems to be a promising solution, but still has high exploitation costs. Efforts have been made in recent years to ascertain the feasibility of using brackish water in the coastal areas. In Apulia, for example, saline water has been blended with freshwater and raw wastewater to dilute the salt and increase the usable volume. Small islands, especially during the tourist season, have so far benefited from desalination (Batini *et al.*, 1996).

## Legislative basis for drought preparedness and mitigation

The measures to be adopted for drought mitigation in Italy have their legislative basis in different instruments (Table 6):

- (i) Law 183/1989 regulating soil conservation and water supply.
- (ii) Law 225/1992 regulating the Civil Protection Service.
- (iii) Guidelines for identifying areas affected by water crisis risk included in the Decree 47/1996 issued following the Galli Act (Law 36/1994).
- (iv) Legislative Decree 152/1999 modified by L.D. 258/2000 and Interministerial Committee for Economic Planning (CIPE) Deliberation 21/12/1999 regulating the identification of areas vulnerable to drought and desertification.

Table 6. Legislative indications for coping with drought impacts in Italy

Legislative act	Technical tool	Type of measure	Territorial unit
Law 183/1989	River basin plan	Long-term measures to improve drought preparedness	Hydrographic basin
Law 225/1992	Drought contingency plan	Short-term measures to reduce drought impacts	Region or province
Law 36/1994 and D.P.C.M. 47/1996	Identification of areas with water crisis risk	Long-term and short-term measures (municipal water supply)	Optimal territorial unit for integrated water service
Legislative Decree 152/1999 and CIPE Deliberat. 21/12/1999	Identification of areas vulnerable to drought and desertification	Long-term measures to combat drought and desertification	Hydrographic district

Unfortunately none of the indications given is currently operational, with the exception of the measures funded by Civil Protection in the form of emergency actions, generally implemented by local commissioners that operate according to a specific program drafted after the drought starts.

According to Law 225/1992 the responsibility for public response to natural disaster is shared at national, regional, and local level (see Fig. 2).

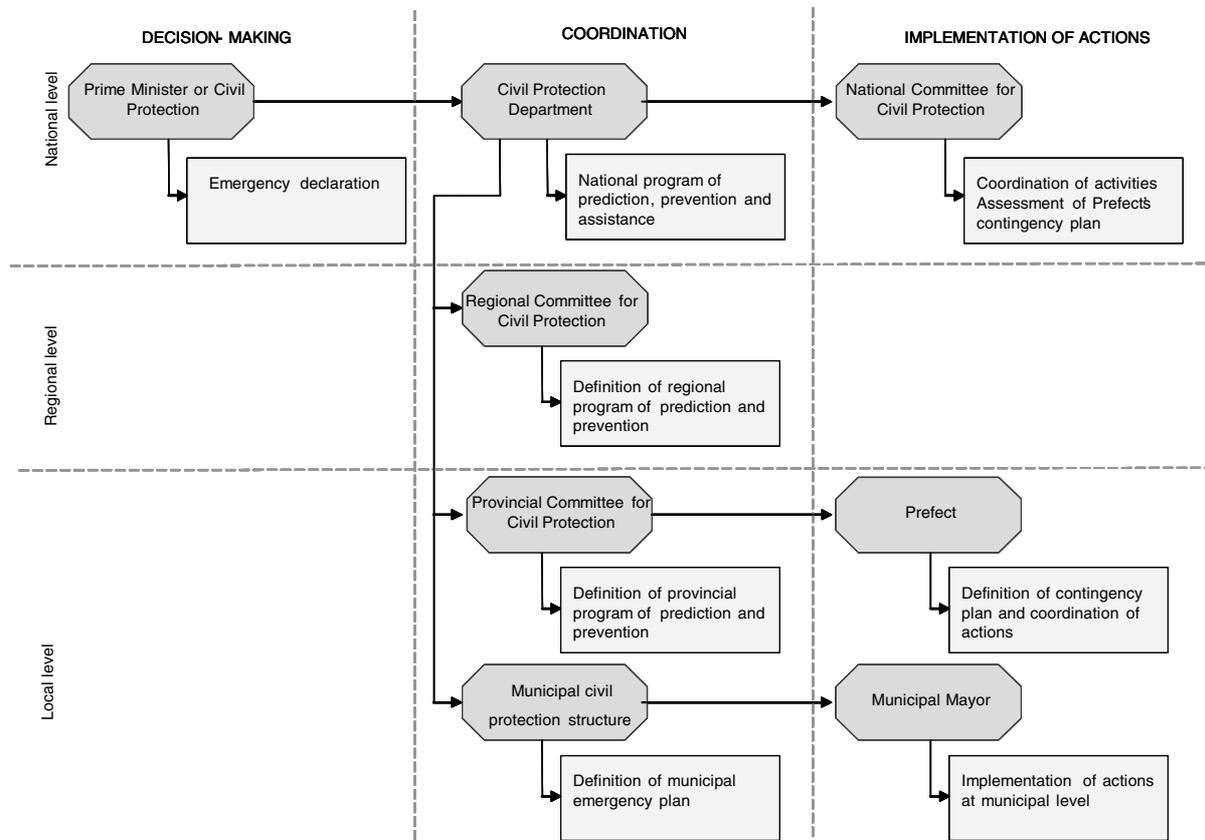


Fig. 2. Competences and actions of public institutions to face natural disasters in Italy (Law 225/1992).

In particular, the definition of national program of prediction and prevention, and of contingency and assistance plan is assigned to National Civil Protection Department. The duty of both planning tools is assigned to Regional Committee for Civil Protection, while the program of prediction and prevention at provincial level is assigned to a Provincial Committee. The Prefect is in charge of the definition of contingency plan and should coordinate the emergency actions (Rossi, 2000).

According to the guidelines for identifying water crisis areas, following the Law 36/1994 issued with D.P.C.M. 47/1996, the Authority of OTU seems to have competences for the assessment of water deficiency risk due to drought and to plan the necessary actions to prevent water emergency (see Fig. 3).

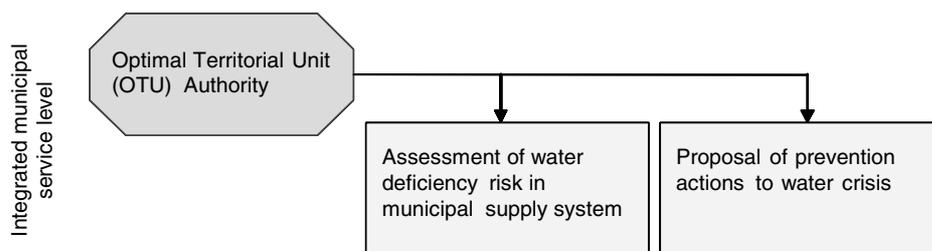


Fig. 3. Competences and actions of public institutions for the identification of areas of water crisis in municipal supply in Italy (according to guidelines of Law 36/1994 and D.P.C.M. 47/1996).

The guidelines are strictly oriented to identify the situation of vulnerability to drought of municipal water supply systems. However, they could represent a good basis for identifying the risk of water deficiencies in the different sectors since the analyses require a general balance between all available water resources and all water demands, even if municipal use has a priority claim on water resources reallocation during a drought period. Moreover, the guidelines can be considered as a good starting point for determining the measures necessary for reducing the water supply systems vulnerability to drought and to identify the emergency measures for mitigating drought impacts.

According to the Legislative Decree 152/1999 and the CIPE Deliberation 21/12/1999 the identification of areas vulnerable to drought and desertification as well as the program of action have to be made by basin authority and/or region within the general lines of the plan to combat drought and desertification coordinated by National Committee established after international convention against drought and desertification (see Fig. 4). However, no guidelines on technical standards or operative steps for identifying drought-vulnerable areas have been issued.

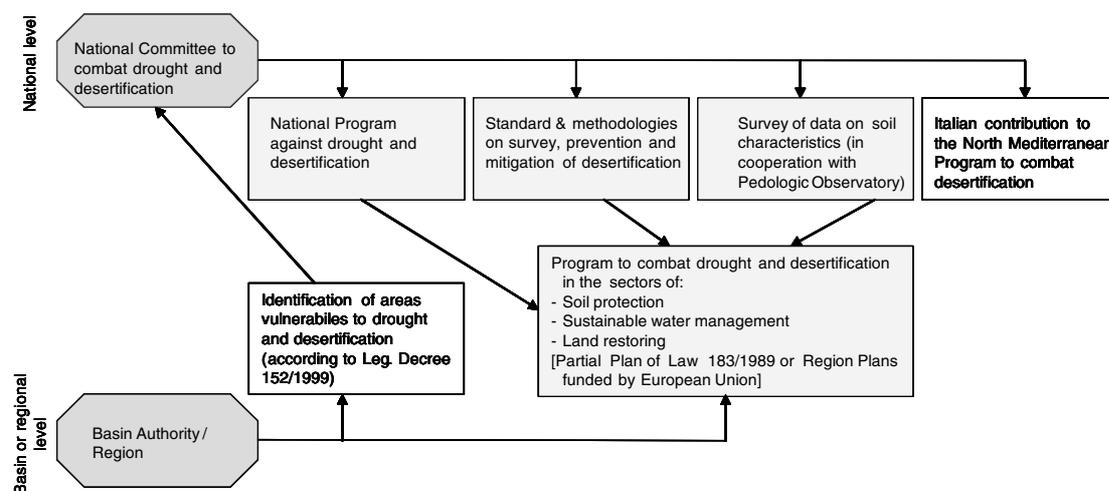


Fig. 4. Competences of public institutions for the identification of areas vulnerable to drought and desertification in Italy (according to Legislative Decree 152/1999 and CIPE Deliberation 21/12/1999).

In spite of the relevant financial resources devoted by the Civil Protection Service to emergency measures during the most recent drought events, no specific directive has been prepared for prediction, prevention, and assistance planning document for drought disasters at national, regional or provincial levels. Also, the planning documents oriented to a proactive approach for coping with drought, considered by the Guidelines 47/1996 (for the identification of areas with water deficiency risk for municipal supply) and by the Legislative Decree 151/1999 and CIPE Deliberation (for the identification of areas vulnerable to desertification) have not been yet implemented due to the delays in establishing operative directives.

On the other hand, only a reactive response to drought has been experienced in Italy. In particular, two main tools have been applied: (i) emergency actions of the Department of Civil Protection; and (ii) subsidies to farmers for covering agricultural damages due to drought, under the provisions of national acts on national disasters.

In Table 7 several information on the status of the drought management in Italy are summarized. In particular, the process which allows emergency measures to be implemented includes:

(i) Declaration by National Government of water emergency due to drought on request of local authorities through the Regional Government.

(ii) Appointment of a Commissioner for Water Emergency by the Prime Minister.

(iii) Establishment of the Office of the Commissioner for Water Emergency at regional level.

(iv) Approval of a list of water emergency measures issued by the Prime Minister including the funding of new water works, the authorization of water exchanges between users and a simplification of administrative procedures in order to foster the design and the realization of the planned works.

Table 7. Drought management information sheet in Italy (DICA, 2001)

Action	Comments
Drought Monitoring Service (DMS), used drought indices, hydrometeorological networks linked to DMS	No specific DMS exists in Italy. Information on hydrometeorological conditions are available at Hydrographic Service and Meteorological Service. A prototypal drought bulletin using SPI index was developed at Department of National Technical Service, within EU INTERREG program
Types of information transfer to decision makers	Any systematic information is given either to Government or water services. During the most severe drought, anomalies in hydrometeorological situation and storage in reservoir are communicated on request
Governmental authority for drought declaration	National Government on request of regional departments or provinces
Agency responsible for emergency actions during a drought	Department of Civil Protection and Regional Water Emergency Commissioner Office
Main emergency measures adopted for municipal supply sector	Mandatory rationing; transfer to municipal use of water resources devoted to other uses; aquifer overexploitation; acceleration of water infrastructures construction
Main emergency measures adopted for agricultural supply sector	Mandatory rationing; aquifer overexploitation; restrictions on the irrigation of some crops, reuse of wastewater
Types of public aid and/or tax relief	Subsidies to farmers for revenue losses, loans with reduced rate of interest
Long-term measures adopted to reduce drought vulnerability	Project of new water infrastructures (dams, inter-basin water transfers, desalination plants in small islands and high water scarcity areas)
Medium and short-term measures adopted to reduce drought effects	Use of non-conventional resources (desalination, reuse), maintenance and rehabilitation of water networks
Public awareness	A few programmes on water saving through advertisement in media exist. Occasional courses and seminar on drought management for water supply system operators (especially for irrigation) during severe droughts

Furthermore, by order of Civil Protection Department, local authorities can be authorized to implement specific actions such as rationing of supply or transfer of private sources to public use.

Subsidies to farmers for covering drought damages in agriculture require also a joint action by National and Regional Governments. Usually, Regional Department of Agriculture and Forestry calls for drought declaration by the National Ministry of Agriculture and Forestry Policy on the basis of the damages to different crops in some provinces (or municipalities). After the Decree of the National Ministry, the Regional Department publishes the rules to be followed for subsidies (contribution for revenue losses, loans with reduced interest rate). Funding is provided through a specific national fund for natural calamities.

The reported information will be detailed in what follows with respect to the particular conditions of Sicily.

## Drought emergency actions in Sicily

Several drought events occurred in Sicily during the past decades. The most severe drought affecting the whole Sicilian territory during the 1987-90 period presented different characteristics depending upon the area and the time interval considered.

The 1987-90 drought had very widespread effects on both water supply systems of several municipalities and agriculture of all Sicily. The impact on municipal water supply sector received the major concern from public opinion. In particular, the communities of the southern and western parts of Sicily, most of which suffer perennial shortages in drinking supply, experienced very severe mandatory restrictions in water use. Populations of Palermo, Agrigento, Caltanissetta and several other minor municipalities, already used to some form of restriction during the previous periods, suffered the most severe limitation in summers of 1989 and 1990: in fact water delivery was limited to a few hours every 2, 3 or, in some cases, 7 days.

The public action was mainly oriented to increase the municipal water supply availability. Other than a generally improved exploitation of the already existing water sources (e.g. further deepening of the existing wells or installation of more powerful pumps), several emergency measures were taken, including:

(i) Water transfers from other municipal supply systems with a greater water availability through new connections among existing aqueducts.

(ii) Use of water resources usually devoted to agricultural purposes (from both groundwater and surface reservoirs).

(iii) Exploitation of sources previously neglected due to their low quality or high costs.

(iv) In some cases use of desalinated water and transportation of water by trucks.

Most of the new works had the support of the Civil Protection Ministry. The major part of the ordinances aimed to simplify the administrative procedure in order to accelerate the completion of multi-purpose water systems already initiated before the drought event. Only about 24% of the investments concerned projects specifically designed as drought emergency measures and directly supported by funds supplied from the government for this aim (Table 8). Main interventions were devoted either to rehabilitate or to complete conveyance aqueducts (49%) and to desalination plants construction (20%).

The task of alleviating the drought impacts was consequently committed mainly to farmers. A 20% of yield reduction has been suffered by farmers in the irrigation seasons 1988-90 (Table 9). Damages have been significantly reduced due to the availability of private wells. A number of farm reservoirs have been built in that period and in the successive decades to cope with drought by adding a storing capacity to the system managed directly by the farmers. The emergency measures taken by the public administration essentially were in the form of loans, grants and tax reductions to farmers. These were accomplished through decrees, based on a previous national act (Law 590/1981 "Measures for coping with natural disasters", modified by Law 198/1985 "Actions to be undertaken for damages determined by natural disasters and weather calamities"). Following the droughts events occurred after 1990, several orders have been issued within the procedures established by the Law 225/1992 on Civil Protection as it is indicated in Table 10.

## Interviews

### Modifications to the general questionnaire

The original questionnaire for the interview on drought preparedness and management plans has been slightly modified in order to adapt it to the Italian and Sicilian situation. Generally speaking, the territorial scale, originally conceived at a basin level, has been extended to the whole region, due to the peculiar Sicilian situation where basins are generally small and larger water supply systems are generally connected to more than one basin.

Table 8. Civil Protection Acts during 1987-90 period of water emergency in Sicily, Italy (from Barbagallo *et al.*, 1994)

Type of intervention	Area of intervention	Amount (millions Euro)	% of amount
Surface reservoirs	Scanzano (Pa)	5.84	
	Poma (Pa)	16.85	
	Blufi (PA)	92.96	18.4
Links between surface reservoirs	Garcia-Poma (Pa)	11.88	
	Piana Albanesi-Risalaimi (Pa)	7.02	3.0
Desalination plants	Trapani	88.31	
	Gela (5° modulo)	36.15	19.8
Purification plants	Voltano (Ag)	1.55	
	Leone, Voltano and Castello (Ag)	3.31	0.8
Conveyance aqueducts	Municipalities of Palermo province	19.37	
	Municipalities of Trapani province	25.53	
	Municipalities of Caltanissetta province	96.58	
	Municipalities of Agrigento province	39.56	
	Municipalities of Catania province	73.50	
	Municipalities of Enna, Caltanissetta, Catania	54.02	49.1
Distribution networks	Municipalities of Palermo province	7.57	
	Municipalities of Trapani province	2.47	
	Municipalities of Agrigento province	38.73	
	Municipalities of Caltanissetta province	5.76	
	Municipalities of Catania province	1.55	8.9
Total		628.54	100

For the interviews in Italy, the questionnaire was modified to complete or include additional information in the following aspects:

(i) History and profile of the organization or institution. Two questions have been added regarding the relationships and possible conflicts with other organizations and institutions. Such questions have the objective to verify whether conflicts on competences exist between organizations, as they are usually perceived as true from observers.

(ii) Perception of drought and uncertainty. Hydroelectric power generation has been added to the sectors mostly affected by droughts. In Italy, many water supply systems include also hydroelectric use, which therefore is potentially in conflict with other uses. This section has been extended to other sectors, beside irrigated agriculture. In addition, a question has been added regarding procedures and/or indicators adopted to identify drought beginning and end.

(iii) Legal arrangements. A question regarding the modification to the legal arrangement regarding drought allocation during droughts has been added.

(iv) Stakeholders. Hydroelectric power sector has been added to the list. Other questions have been extended to other sectors, beside irrigated agriculture. A question has been added regarding the restrictions to be applied to groundwater withdrawals. The question is motivated by the situation in Sicily, where many small private wells exist, without an effective control on the withdrawals.

(v) Drought mitigation measures. Two questions have been added regarding prevention plans on drought effects, and one question on measures oriented to compensate drought damages.

(vi) Proposals. This chapter has been added to collect modification proposals to the legal arrangements, to the framework of institutions involved in drought management, to the internal structure of organizations/institutions, as well as to collect judgments about the adequacy of the financial and/or human resources devoted to drought management in each institution.

Table 9. Supplied volume and irrigated surface in Sicilian (Italy) irrigation districts during 1988-91 period (from Barbagallo *et al.*, 1994)

Irrigation district	Main crops	Mean irrigated surface (S) and seasonal water depth (W)		Surface (ha) and seasonal water depth (%W)									
				1988		1989		1990		1991		Mean 1988-1990 V (%W)	
				Period	S (ha)	W (m <sup>3</sup> /ha)	S (ha)	V (%W)	S (ha)	V (%W)	S (ha)		V (%W)
Acate	Vineyard, citrus	85-87	542	2394 <sup>†††††</sup>	789	103	857	72	1014	72	1073	94	82
Alto Simeto	Citrus, vegetable	85-87	100	5116 <sup>†††††</sup>	100	107	100	116	100	116	100	118	113
Belice Carb. <sup>†</sup>	Vineyard, artichoke	83-87	4697	2147 <sup>†††††</sup>	4464	76	1061	88	952	112	3221	71	92
Birgi	Vineyard	83-87	3325	1498 <sup>†††††</sup>	2589	35	0	0	0	0	2668	35	12
Delia Nivolelli	Vineyard	85-87	3194	1715 <sup>†††††</sup>	2879	35	2503	28	1555	28	2997	91	30
Gorgo Verd. <sup>††</sup>	Citrus	83-87	1214	4311 <sup>†††††</sup>	1203	133	2604	63	2740	20	2788	72	138
Iato	Citrus, vineyard, tomato	82-87	2894	3378 <sup>†††††</sup>	3403	125	3266	53	3577	16	3120	87	65
Piana di Gela	Artichoke, vineyard	83-87	3359		2355		1345		1716		1601		
East Sicily													
Caltagirone	Citrus	82-87	3033	3743 <sup>†††††</sup>	2578	81	2350	40	1400	47	2770	46	56
Catania <sup>†††</sup>	Citrus	78-87	16785	4350 <sup>†††††</sup>	20250	91	17000	31	16500	8	17173	45	43
Gagliano	Citrus	83-87	1240	2506 <sup>†††††</sup>	1240	107	1240	96	1240	21	1240	66	75
Lentini <sup>††††</sup>	Citrus	83-87	108	2044 <sup>†††††</sup>	171	31	122	31	0	0	135	95	21

<sup>†</sup>Referred to sub-district Arancio.

<sup>††</sup>Referred to sub-district Castello.

<sup>†††</sup>During 1989-90 year the scarce resources were distributed only for perennial crops irrigation.

<sup>††††</sup>Referred to sub-district Ogiastro.

<sup>†††††</sup>Net seasonal water depth (volume supplied to farmers).

<sup>††††††</sup>Gross seasonal water depth (volume diverted from water source).

Table 10. Main national and regional financial measures for covering agricultural damages due to recent droughts in Sicily, Italy

Decrees <sup>†</sup>	Drought period, areas and crops affected	Measures
Decree 23/09/1989 Regional Department for Agriculture and Forestry (GURS 46, 26/09/89)	1/10/1988 – 30/05/1989 <i>Agrigento Province</i> : cereal crops, fodder-pastures, annual crops, vegetable crops. <i>Caltanissetta Province</i> : cereal crops, fodder-pastures, artichokes, greenhouse crops, vegetable crops. <i>Catania Province</i> : cereal crops, fodder-pastures, fallow pastures, annual crops, pulses. <i>Enna Province</i> : cereal crops, fodder-pastures, fallow pastures, vegetable crops. <i>Palermo Province</i> : cereal crops, fodder-pastures, annual crops, pulses. <i>Trapani Province</i> : cereal crops, fodder-pastures, fallow pastures, pulses	Contribution to farms with more than 35% of total gross crop yield reduction of 2.5 million Italian lire (ITL) for operating capital recovery (8 million ITL for specialized protected crops). Loans with reduced rate of interest agrarian credit (L. 286/89)
Decree 07/11/1989 Regional Department for Agriculture and Forestry (GURS 55, 15/11/89)	01/06/1989 – 30/09/1989 <i>Agrigento Province</i> : vineyards for table and wine, citrus crops, almond. <i>Caltanissetta Province</i> : vineyards for table and wine, citrus crops, almond, olives trees. <i>Catania Province</i> : citrus crops. <i>Enna Province</i> : vineyards for table and wine, almond, citrus crops, hazel, pistachio. <i>Messina Province</i> : fallow-pastures, fodder-pastures, hazel, citrus crops, vegetable crops, floriculture. <i>Palermo Province</i> : vineyard, tomatoes, water melons. <i>Trapani Province</i> : vineyards, orchards, vegetable crops, floriculture.  01/10/1988 – 30/09/1989 <i>Enna Province</i> : pulses. <i>Ragusa Province</i> : cereal crops, fodder-pastures, vegetables crops, greenhouse crops, citrus crops, vineyards, olives trees, almonds, orchards crops, carob crops.  01/06/1989 – 31/08/1989 <i>Siracusa Province</i> : vineyards, citrus crops, almonds, carob crops	As those of the Decree 23/09/1989
Decree 10/08/1990 Regional Department for Agriculture and Forestry (GURS 40, 25/8/90)	Agricultural year 1988/1989 <i>9 municipalities (Catania Province)</i> : vegetable crops. <i>Palermo Province</i> : vegetable crops, citrus crops, olives trees, orchards crops, floriculture. <i>10 municipalities (Siracusa Province)</i> : vegetable crops. <i>Trapani Province</i> : citrus, olives.	Contribution and loans Delaying deadline for payment of rate of agrarian credit and contribution to the interest payment
Decree 13/12/1999 Ministry for Agriculture and Forestry Politics (GURI 306, 31/12/99)	01/10/1998 – 30/09/1999 – <i>Agrigento Province</i> . 01/01/1999 – 30/08/1999 – 22 municip. ( <i>Caltanissetta Province</i> ). 01/01/1999 – 30/09/1999 – 19 <i>Municipalities (Catania Province)</i> : cereals, pulses and vegetable crops. 01/03/1999 – 30/06/1999 – 20 <i>municipalities (Enna Province)</i> 12 <i>municipalities (Ragusa Province)</i> . 01/04/1999 – 15/10/1999 – 76 <i>municipalities (Palermo Province)</i> . 01/09/1998 – 30/06/1999 – <i>Siracusa Province</i>	Expected measures from L. 185/92 <sup>††</sup> : contribution up to 3 million ITL (or 10 million for specialised protected crops). Loans with reduced rate of interest and 5-year depreciation 5-year operation loans
Decree 15/04/2002 Ministry for Agriculture and Forestry Politics (GURI 120, 24/05/02)	01/09/2001 – 15/11/2001 <i>Agrigento Province</i> : all crops. 01/10/2001 – 16/12/2001 <i>Enna Province</i> : prickly pear	Measures provided by L. 185/92
Decree 17/02/2003 Ministry for Agriculture and Forestry Politics (GURI 61, 14/03/03)	01/07/2002 – 31/10/2002 – <i>Caltanissetta Province</i> : all crops. 26/06/2002 – 15/10/2002 – <i>Catania Province</i> : citrus crops. 01/05/2002 – 30/09/2002 – <i>Enna Province</i> : olives trees. 01/09/2002 – 30/10/2002 – <i>Palermo Province</i>	Measures provided by L. 185/92
Decree 28/08/2003 Ministry for Agriculture and Forestry Politics (GURI 62, 15/03/02)	01/09/2001 – 15/11/2001 – <i>Municipalities S. Biagio Platani and S. Angelo Maxaro (Agrigento Province)</i>	Measures provided by L. 185/92

<sup>†</sup>GURS: Official Journal of Sicily Region; GURI: Official Journal of the Italian Republic.

<sup>††</sup>Law 185/92 establishes a national fund for natural calamities.

## Main results of interviews

The institutions and organizations have been selected among those devoted to the observation of hydro-meteorological data for drought monitoring, to the management of water crisis due to drought, to the management of water supply systems, as well as among the stakeholders involved during droughts (users' organizations and environmental associations) and research centres. The total number of interviews was 12, divided among different categories as follows in Table 11.

Table 11. Different categories of institutions and organizations of interviewed persons in Italy

Responsibility of the institution	Institution
Observation and collection of hydro-meteorological data for drought monitoring	1) Ufficio Idrografico Regionale (Regional Hydrographic Office) 2) Servizio Informativo Agrometeorologico Siciliano (Regional Agro-meteorological Service)
Management of water crisis due to drought	3) Dipartimento per la Protezione Civile (Civil Protection Department) 4) Ufficio del Commissario Delegato per l'Emergenza Idrica in Sicilia (Office of the Commissioner for Water Emergency in Sicily)
Management of water supply system	5) Consorzio di Bonifica 9 Catania (Land Reclamation Consortium 9 Catania) 6) Azienda Municipale Acquedotto di Palermo (Palermo Municipal Water Agency) 7) Consorzio per l'Area di Sviluppo Industriale di Siracusa (Siracuse Industrial Area Consortium)
Water users organizations	8) Confagricoltura 9) Confederazione Italiana Agricoltori – CIA (Italian Confederation of Farmers) 10) Coldiretti
Environmental organizations	11) Legambiente
Water-related research centers	12) Centro Studi di Economia Applicata all'Ingegneria – CSEI
Total	12 interviews

### Ufficio Idrografico Regionale (Regional Hydrographic Office)

It is a structure of the Presidency of Sicily Region that manages the network of stations for acquisition of hydro-meteorological data (temperature, precipitation, stream flow and groundwater levels). The same office publishes yearly the collected data, after control and validation procedures. It started its activities in 1917 as an Office of National Hydrographic Service and systematic records of observations are available from 1921. Today, it manages about 100 temperature stations, 300 precipitation stations, 50 stream flow stations and about 10 groundwater level stations. Currently, the development of a drought watch bulletin accessible through the internet is in the experimental stage. The interviewed person is a senior official.

#### *Drought*

It is perceived as a random, non cyclical meteorological event affecting the region and not under the man control. Its identification and assessment is carried out analysing the collected hydro-meteorological data through statistical techniques based on the historical time series.

#### *Current legal framework, affected sectors and pressure mechanisms*

The current legal framework is perceived as lacking in regulating water rights and obligations of the water license holders, priorities among competitive sectors and in establishing an efficient and effective coordination among interested institutions. Therefore, occasionally private interests prevail

over actual needs, and groups of interest acquire a privilege position by making use of pressure mechanisms such as organized demonstrations or diffusion of news not properly documented.

### *Sectors having priority and drought mitigation measures*

In case of drought, highest priority is given to municipal use, then irrigation sector and industry, whereas lowest priorities are given to hydropower generation, recreational and environmental uses. The most useful measures for drought mitigation are inter-basins water transfers, monitoring of water consumptions, increase of irrigation efficiency and wastewater reuse. Deregulation of water market and reallocation of waters do not have as much importance.

### *Economic instruments and scenarios of agricultural policies*

Water cannot be traded as other natural resources, since it is essential for life. However, users should contribute to investment costs (up to 50%).

### *Climate changes*

They are carefully considered. Irregularity of the events and extreme phenomena are believed to be increasing in magnitude and frequency, leading to decreasing water resources availability and increasing water demands.

### *Proposals*

Modifications to legislative and institutional frameworks are believed to be necessary in order to better identify control mechanisms and long term planning tasks, and to build network based organizational structures which can help overcome fragmentation in competencies sharing.

## Servizio Informativo Agrometeorologico Siciliano (Regional Agro-meteorological Service)

It is a structure of the Regional Department of Agriculture and Forest in Sicily that manages a network of stations for acquisition of meteorological data oriented to agricultural activities. The network was activated in 1989 and today consists of about 100 temperature, precipitation and humidity stations, about 30 evaporation stations and some solar-radiations and wind stations. The observations are available on the internet and are published on a non-periodic basis. The interviewed person is a technical official.

### *Drought*

It is perceived as agricultural drought, with respect to the soil water stress conditions that cannot be avoided with irrigation, due to the prolonged precipitations deficits. Drought is seen as an irregular phenomenon not under the man control, which mainly affects dry farming and then irrigation practices and environment. Nevertheless, it is identified and assessed by monitoring precipitations and climatic comparisons. Drought beginning is defined when a precipitation threshold correlated to a given frequency is exceeded.

### *Current legal framework, affected sectors and pressure mechanisms*

The current legal framework is considered not satisfactory in defining the procedure of formal declaration of drought situation, since the latter is issued only much later than the drought start, when severe damages have already occurred, while it should be related to objective data. Among the affected sectors, industrial and energy production users are the ones which have higher ability to make or influence decisions in case of drought. This is mainly due to the fact that these sectors have a more direct and visible impact on the work market and services, since they can put pressure on public opinion threatening redundancies, organizing demonstrative actions such as freeways blocks, etc. On the contrary, the decisional process is not influenced enough by sectors representing environmental requirements.

### *Sectors having priority and drought mitigation measures*

In case of drought, municipal use is considered to have highest priority, since it affects the quality of life more than other sectors, followed by tourism and environmental uses. Lower priorities are given to irrigation sector, industry and then to recreational uses, since water deficits in these sectors cause minor discomforts. Among the mitigation measures, losses reduction in networks for municipal supply are considered very important, followed by the substitution of high water-demanding crops, monitoring of consumptions and wastewater reuse. A lower importance is given to deregulation of the water market, since it would not guarantee equity in water distribution.

### *Economic instruments and scenarios of agricultural policies*

Water cannot be traded like any other goods because this would lead to a non-optimal allocation of this resource from environmental and social points of view; costs should not necessarily be fully covered by the tariff. However, users should contribute to investments, even up to the 100%, depending on the type of measures.

Water consumptions for irrigation will remarkably decrease in a few years due to many factors, such as a higher attention to irrigation efficiency, new guidelines on agricultural policies set up at European level enforcing environmental protection and changes in agricultural development directives, making irrigation of some crops not profitable.

### *Climate changes*

Much attention is paid to this issue, and climatic changes are believed to increase drought periods.

### *Proposals*

Modifications to the institutional framework are believed to be necessary, in order to create an institution which can make long term planning on water management for irrigation supply, taking into account the actual water requirements of crops. Besides, organizational structures should be goal oriented.

## Dipartimento per la Protezione Civile (Civil Protection Department)

It is a national structure that coordinates and supports a network of local structures for civil protection since 1976. Although initially it was started with the objective to help people struck by earthquakes, floods and volcano eruptions, as well as to provide financial help, in the last years it has also managed severe water crisis due to drought. The interviewed person is a manager of the National Department.

### *Drought*

Water deficits can be caused by meteorological drought (precipitation shortages) or by other causes. For instance the breaking of a great conveyance pipeline can determine an emergency situation involving as many people as an earthquake. Irrigation and dry farming are the most affected sectors, followed by hydropower generation, whereas municipal use is sufficiently safe, due to favourable protection mechanisms.

### *Current legal framework, affected sectors and pressure mechanisms*

Rights of the water license holders are clearly defined, whereas compensations to users affected by drought are not. The latter aspect is not a lack, since aid measures would distort market mechanisms in the industrial and agricultural sector, and would have an appropriate influence on the municipal sector.

### *Sectors having priority and drought mitigation measures*

During drought, municipal use has the highest priority, followed by the energy sector, irrigation and

environment. In drought situations, authorities observe this order, and lately awareness of the involved sectors has been increasing.

The institution does not have a contingency plan for managing drought, since its main duty is aiding during disasters, and its role in prevention is limited to give directives to local authorities. Drought intervention plans, just like drought mitigation plans, must be set up by water agencies on a local scale or better on an optimal territorial unit scale. The Department is urging local authorities to set up the plans.

In the future, the Department should not be invoked to cope with water crisis due to the lack of appropriate infrastructures, since the latter should be faced by water management agencies. The Department should only be devoted to overcome emergency situations having the status of disasters.

### Ufficio del Commissario Delegato per l'Emergenza Idrica in Sicilia (Office of the Commissioner for Water Emergency in Sicily)

It is a temporary regional structure appointed by the National Government to adopt the necessary measures to mitigate emergency situations due to drought in Sicily. Its mandate is to develop structural measures, to promote initiatives to cope with emergency situations, to carry out all the necessary maintenance activities on existing dams, to acquire new water sources and to favour the rational use of water resources. The interviewed person is a representative.

#### *Drought*

It is perceived as a meteorological event (absence of rainfall for a long period), having a cyclical nature with tendency to increasing frequency. Drought is considered to be officially starting and ending according to the formal declarations by the Department of Civil Protection. However, the drought beginning is usually perceived in advance on the basis of the requests of the affected users.

#### *Current legal framework, affected sectors and pressure mechanisms*

In case of formal declaration of drought emergency, the Office is in charge to allocate water to the different uses. Decisions are made exclusively by the Office, after listening to the affected stakeholders. Farmers' boards are the most active users in terms of ability to propose solutions.

#### *Sectors having priority and drought mitigation measures*

During drought, environment should have the highest priority, since otherwise huge damages could occur, followed by municipal and irrigation uses, and lastly energy and recreational uses.

The most urgent mitigation measures are the reduction of losses in the municipal distribution networks, accurate water metering and remote control. Not much importance is given to full cost recovery and deregulation of water market, and the Office is not favourable to the restriction of irrigated areas because this is seen as an improper constraint on the private business.

Currently, efforts are being made to set a plan for the prevention of drought effects. During drought water is allocated among users of the same water supply system on a monthly basis, with priority to the municipal use.

#### *Economic instruments and scenarios of agricultural policies*

Water consumptions for irrigation will remarkably decrease in a few years due to many factors, such as the modernization of irrigation systems and new guidelines of agricultural policies enforcing a more sustainable use of resources. Although the tariff should only cover the service costs, water cannot be considered any longer as a "free good" that nobody should pay for. The latter idea constitutes the main resistance towards the establishment of a water market.

### *Climate changes*

The lack of long historical climatic data does not enable accurate mid and long term predictions. However, irreversible and uncontrollable climatic changes are taking place.

### *Proposals*

A unique Authority of Waters should be created, being also in charge of searching for funds. The structure of the new institution should be different from traditional public sector agencies. It should be organized as a firm, having a light and flexible central unit, and working through agreements with structures disseminated over the territory.

## Consorzio di Bonifica 9 Catania (Land Reclamation Consortium 9 Catania)

It is the most important agency devoted to the management of irrigation and drainage water systems in Sicily. It supplies the largest and most important irrigation area in Sicily, located in Catania plain and in part of the Simeto River basin. In the last decades, the irrigation area has experienced severe water shortages due to droughts. The interviewed person is a senior official.

### *Drought*

It is perceived as a crisis due to water scarcity, determined by the inadequate storage capacity combined with meteorological drought (absent or insufficient rainfalls). Drought beginning is identified through the information on rainfalls and storage volumes in the system reservoirs, making use of the official data collected by meteorological offices and water systems management agencies.

### *Current legal framework, affected sectors and pressure mechanisms*

The legal framework is lacking in defining rights of water license holders and in establishing compensations in case of reduction of water allowances under drought conditions. Users affected by drought do not adequately participate in deciding water allocations, except for agricultural and industrial boards that can be influential by using mass media and TV news.

### *Sectors having priority and drought mitigation measures*

Irrigation and dry farming are the most affected sectors by drought. However, priority must be given to municipal use first, then to irrigation, energy, industrial and recreational uses.

The most effective drought mitigation measures are the increase of irrigation efficiency, the wastewater reuse and the inter-basins water transfers. Lower importance is given to freezing the increase of irrigated crops and their conversion to dry farming.

The institution applies a plan for prevention of drought effects consisting in supplying private farmers' ponds during winter. During drought, priority is given to perennial crops.

### *Economic instruments and scenarios of agricultural policies*

Water is essential for life, hygiene and production, and as such it cannot be traded. Costs should not necessarily be fully covered by rates. However, users should contribute to investments depending on the costs type.

### *Climate changes*

They are thought to be getting worse as a function of the negative rainfall trends.

### *Proposals*

A law on soil conservation and a unique authority for management and regulation of water are believed necessary.

## Azienda Municipale Acquedotto di Palermo (Palermo Municipal Water Agency)

The agency manages the largest Sicilian municipal aqueduct and distribution networks, serving the city of Palermo and part of Palermo province. In the last decades it has experienced severe water shortages due to droughts and therefore it has learned several lessons on water management under drought conditions. The interviewed person is a technical official.

### *Drought*

It is perceived just as a crisis due to water scarcity (deficit of water availability towards demands). It is a cyclical phenomenon controlled to some extent by man, such as floods. The most affected sector is the municipal one, followed by environment and irrigation. Drought beginning is perceived when the available resources (reservoirs storage volumes) decrease. Historical data are used by means of statistical techniques to derive critical seasonal levels. A similar procedure is applied for flows pumped from wells (critical flows).

### *Sectors having priority and drought mitigation measures*

During drought, priority must be given to municipal use first, then to irrigation, environment and recreational uses.

The most effective drought mitigation measures are the improvement of efficiency of urban and irrigation distribution networks and the wastewater reuse. Minor importance is given to deregulation of water market and freezing of increase of irrigation areas.

### *Economic instruments and scenarios of agricultural policies*

Water is a primary good essential to man's needs, and therefore it cannot be traded. However, users should contribute to all investments aiming at mitigating drought effects, in a bigger way for those oriented to economic activities (70%) and more moderately (20-30%) for those oriented to the municipal use.

### *Climate changes*

They are thought to be the result of wrong environmental policies. They will encourage a higher environmental sensitiveness and will lead to reduced consumptions.

### *Proposals*

The regulation of drought management, increase of observing and monitoring institutions, a unique regional control authority are the most appropriate measures.

## Consorzio per l'Area di Sviluppo Industriale di Siracusa (Siracuse Industrial Area Consortium)

It manages the largest industrial area in Sicily region, covering the municipalities of Augusta, Priolo, Melilli and Siracusa. The area includes 6 refineries, 2 electric power plants, some large chemical plants and several small plants operating in the petrol and chemical sector. The area was developed starting in the early 60's and the consortium manages the largest and most important industrial water supply system in Sicily, that distributes both groundwater and surface water. In the future, it is planned to supply only surface water and treated wastewater. The interviewed person is a senior official.

### *Drought*

It is perceived as a condition of anomalous rainfall shortages.

### *Sectors having priority and drought mitigation measures*

During drought, priority must be given to municipal use first, then to irrigation, environment and recreational uses.

The most useful drought mitigation measures are the improvement of efficiency of urban and irrigation distribution networks and the wastewater reuse. Minor importance is given to deregulation of the water market and freezing of increase of irrigation areas.

## Confagricoltura

It is one of the most important farmers' organization, both at national and regional (Sicily) level. It represents locally several irrigation users, especially in the Catania plain. The interviewed person is a representative of a provincial section.

### *Drought*

It is identified with the crisis due to water shortage: irrigation deficits due to lacks of institutions in charge. Irrigation and dry farming are the most heavily affected sectors. Availability of water supply represents the major factor of uncertainty for farmers. The drought beginning is foreseen on the basis of the meteorological conditions even since March or April, using the soil water content as indicator.

### *Current legal framework, affected sectors and pressure mechanisms*

There is a lack of communications among institutions in charge. However, when a drought occurs, involved users (land reclamation consortia, prefectures and farmers boards) actively influence the water allocations; in particular, farmers' organizations appear to be decisive.

### *Sectors having priority and drought mitigation measures*

Despite the fact that irrigation and cattle breeding are seen as the most important social and economic sectors (they create jobs, help avoid emigration from countryside and promote economic development), municipal use is considered to have higher priority during drought, follow by irrigation and energy sectors.

The most useful drought mitigation measures are the inter-basins water transfers (if possible), improvement of efficiency of urban distribution networks and wastewater reuse. The less important measures are the conversion of some irrigation areas to dry farming (which is believed the measures gaining lowest social acceptance) and the full recovery of costs.

## Confederazione Italiana Agricoltori – CIA (Italian Confederation of Farmers)

It is a trade union of farmers established on 1977. Most of the members are farmers, however small independent farmers, young people, women and pensioners are also represented. The interviewed person is a representative of a provincial section.

### *Drought*

It is perceived mainly as a crisis situation due to water scarcity and determined by the negligence of mankind and weak prevention policies of governments all over the world ("rainfall is enough but we cannot store all the water"). Municipal sector is the most affected during drought, followed by irrigation and dry farming.

The institution recognizes the start and end of drought by the reports of farmers, and it makes use of hydro-meteorological data collected by public institutions (Regional Agro-meteorological Service, Universities, etc.).

### *Current legal framework, affected sectors and pressure mechanisms*

The current legal framework leaves too much room for discretion to water license holders. During drought, water allowances are decided by the land reclamation consortia, the regulator body (only on a technical level) and by the Commissioner for Water Emergency. Users affected by drought do not adequately participate, and in particular it is necessary to encourage participation of representatives of users and customers.

### *Sectors having priority and drought mitigation measures*

During drought, municipal use must have the highest priority, followed by irrigation and energy uses, whereas minor priority must be given to industrial, environmental and recreational uses. Irrigation agriculture is high-ranking in terms of social and economic importance, since it guarantees incomes, jobs and contributes to economic development of less favoured areas.

The most necessary drought mitigation measures are the wastewater reuse (since it is cost effective and ever lasting) and the improvement of efficiency of distribution networks. Minor importance is given to deregulation of water market (which would favour speculations and most influent lobbies provoking a dramatic cost increase), freezing the increase of irrigated crops and their conversion to dry farming.

### *Economic instruments and scenarios of agricultural policies*

Users should contribute in part to all investments aiming at mitigating drought effects, except for waste water reuse, whose cost should be totally covered by public sector. Water cannot be traded because it is a public good essential for human life. Furthermore, trading water as any other goods would lead eventually to a socially unacceptable situation and an unfair distribution of benefits (only limited to water management firms and high income users), making private interests and speculations easier.

### *Climate changes*

They are perceived as threatening and fuzzy changes of nature.

### *Proposals*

The most important actions are laws for soil conservation, a prevention policy against fires, higher priority to environmental and reforestation policies, a unique authority for management of great disasters and simplifications of interactions among institutions.

## **Coldiretti**

It is a trade union established in 1945 by small independent farmers, with the purpose of promoting interests of both organization members and agricultural sector. Members are agricultural firms, farmers and retired persons. The interviewed person is an official of a provincial section.

### *Drought*

It is perceived as meteorological drought (water scarcity due to precipitation shortages) in conjunction with a non rational storage and management of water resources. It is seen as a chronic phenomenon that can be controlled to some extent by man (like floods).

The most affected sector by drought is irrigation (due to the fact that water plays an essential role) followed by the municipal and industrial uses. The recreational uses are the least affected (due to the low importance of such a use in the region).

The institution recognizes the beginning and the end of drought by continuously monitoring the territory, in order to assess the entity of the phenomenon and its impacts on firms and affected areas.

### *Current legal framework, affected sectors and pressure mechanisms*

The legal framework does not adequately define rights of water license holders and compensations in case of reduction of water allowances under drought conditions. There are pressure mechanisms that play a decisive role in speeding up the decision making and avoiding bureaucratic slowness; some interest groups have a privilege position over others.

### *Sectors having priority and drought mitigation measures*

In case of drought, highest priority should be given to municipal use, agricultural sector and environment, whereas industrial, tourist and recreational uses should have the lowest priority. The most useful measures for drought mitigation are increase of storage capacity for irrigation use and increase of irrigation efficiency. Deregulation of water market (low social consensus), full costs recovery and freezing the increase of irrigated area have lower importance.

### *Economic instruments and scenarios of agricultural policies*

Water is not a good to be traded. It is a vital resource and as such it is a right. Water market is not acceptable, because it would hinder access to a right, promote speculations and cause an unfair distribution of benefits and biases towards some operators. Water demands for irrigation will not decrease in the future, but water use will be rationalized choosing low water-demanding crops and optimizing irrigation systems.

### *Climate changes*

Available data are not considered sufficient, however changes are perceived as a "slow tropicalization" of the climate. Phenomena such as temperature increase, alluvial rainfalls and the extension of warm season are becoming "normal".

### *Proposals*

The legislative framework should be modified, as well as the framework and the structure of involved institutions, on the light of the fact that decrease of rainfalls cannot be seen any longer as an extreme natural calamity, but rather as an event that constantly affects our lives.

## **Legambiente**

It is one of the most active environmentalists' organizations, with a dynamic role both at national and regional level. In Sicily, it has carried out several battles in the past, in and out of courthouses, on topics related to water resources management and environmental protection. The interviewed person is a representative of a provincial section.

### *Drought*

It is perceived as "deficiency of water availability with respect to common standards, generally due to climate". The most affected sector is environment (because it is very delicate and not protected by law), followed by the municipal use (protected only nominally), tourism, irrigation, energy and recreational use (which is not well developed in the region).

### *Current legal framework, involved sectors and pressure mechanisms*

The current legal framework leaves too much discretion to the public administration. During drought, water allowances are mainly decided by the "Genio Civile" offices, the Prefecture and the consortia. Users affected by drought do not adequately participate to the decisional process; in particular, agencies managing protected natural areas and water agencies should be more influent.

### *Sectors having priority and drought mitigation measures*

During drought, highest priority should be given to environmental sector, since it is essential for the

preservation of the water resources, followed by the municipal use. The lowest priority should be given to recreational use, since it is less relevant to society.

The most urgent drought mitigation measures are the full cost recovery (which can promote a more rational use of water), reallocation of resources from irrigation to domestic use, freezing the increase of irrigated areas and conversion to dry farming. Minor importance is given to deregulation of water market, inter-basins water transfers and increase of regulation capacity.

### *Economic instruments and scenarios of agricultural policies*

Water cannot be traded, either for social and environmental reasons. The rate must fully cover the costs, and users must participate to investments costs for mitigating drought impacts, generally to the 100%, except for measures oriented to the irrigation sector (from 50% to 80%) and water reuse (90%).

### *Climate changes*

Despite they are considered significant, available data are not considered sufficient. Climate changes will urge for a more efficient operation of the resources.

### *Proposals*

All uses should be managed by a unique water agency. Full costs recovery should be applied to every kind of use. Control mechanisms of ecosystems should be improved, and environmentalists' organizations and customers should be more influent. Besides, institutions involved in drought management should be privatized, at least until the full costs recovery.

## Centro Studi di Economia Applicata all'Ingegneria – CSEI

Founded in the 70's by a group of research and public institutions (e.g. the Cassa per il Mezzogiorno, local agencies and universities), it is one of the most active and renowned research centres on water resources management and environmental protection in Italy. It organizes also several educational events, in the form of specialization and training courses. The interviewed person is a senior manager.

### *Drought*

It is perceived mostly as meteorological drought (irregular rainfall shortages). It cannot be controlled by man because of economic limitations, whereas floods cannot be controlled also due to environmental and social constraints. Irrigation sector is the most affected one (strongly conditioned by water availability), followed by environment and tourism. The energy sector ranks the lowest position, since it is marginal and can be replaced by other sources.

### *Current legal framework, affected sectors and pressure mechanisms*

Rights of water license holders are clearly stated, unlike compensations in case of reduction of water allowances under drought conditions. During drought, water allowances are decided by water management agencies and, when drought is formally declared, also by the Office of the Commissioner for Water Emergency. Environmentalists associations can drive the decisional process, in conjunction with technical committees of protected areas and the Hydrographic Office. For each water system, a management committee should be established representing interests of both public interest and different users boards. Many pressure mechanisms are exerted to influence water allocations: besides (sometimes biased) informative campaigns, economic lobbies or politicians play an important role too. Sometimes inappropriate actions taken by judges are also decisive.

### *Sectors having priority and drought mitigation measures*

During drought, highest priority should be given to municipal sector (essential to life quality),

followed by irrigation use, tourism and services. Lowest priority should be given to recreational use and hydropower generation.

The most useful drought mitigation measures are the improvement of efficiency of urban and irrigation distribution networks (to reduce losses), followed by the increase of regulation capacity for irrigation, municipal or conjunctive uses. Lowest importance is given to deregulation of water market (which would be devastating from a social and economic point of view), preceded by full costs recovery and conversion of irrigation areas to dry farming.

### *Economic instruments and scenarios of agricultural policies*

Water cannot be traded, since it is an essential public good which should be available for everyone. However, the tariff should fully cover the costs. This will also enforce a significant decrease of consumptions. Besides, users must participate to investment costs (from 30% to 70%) for drought mitigation measures.

### *Climate changes*

Despite the lack of long time series of data and high uncertainty considerably affecting forecasting models results, climate changes are perceived as most likely affect global scale temperatures and spatial and temporal distributions of rainfalls. In the light of this, increasing frequency of droughts will lead to an increase of regulation capacity (due to higher concentration of precipitations), and also to increase of irrigation areas, since some currently dry farming could require irrigation in the future.

### *Proposals*

Drought should be more clearly defined, as well as competencies during drought periods. "Water use plans" should be drafted, taking properly into account needs prevailing during drought management. Furthermore, it is necessary to distinguish between planning, management and emergency institutions.

## **Synthesis of the interviews**

### **Drought perception**

Drought is perceived by interviewed persons in rather different ways. Indeed, this is the topic that has registered the widest spectrum of opinions. Some define drought just as a period of rainfall deficit with respect to normal precipitation, therefore basically referring to the concept of "meteorological drought". Others define it as a soil water stress-condition ("agricultural drought"), caused by rainfall shortages. Some perceive it as a reduction of stream flow or groundwater levels ("hydrological drought"). Some others perceive it as a water crisis situation determined by water deficits. In the latter case, a variety of slightly different opinions exists about the causes of water crisis: inadequacy of irrigation or municipal water supply systems, inadequacy of supply systems in conjunction with rainfall deficits, water deficits determined by accidents of remarkable proportion (for instance the breaking of a big pipeline by a landslide or earthquake). Finally, some others perceive drought as a combined effect of rainfall deficits and inadequacy of infrastructures or water management.

Usually drought is seen as an irregular phenomenon, whose magnitude and frequency are believed to be increasing. Optimistic visions about the possibility to control drought to some extent slightly prevail (7 out of 12 answers). This opinion is generally shared by people having decisional responsibilities, whereas other persons interviewed think that drought cannot be controlled by man. Except for a few cases, most of the persons have the same idea about the possibility of controlling droughts and floods.

Just a few people refer to more or less defined criteria for identifying the beginning of a drought and evaluating its severity. Criteria are based on historical data, to be analysed by means of statistical methods or experience.

Many believe that agricultural sectors are the most affected by drought, and in particular irrigation

use (ranking the first position for 5/12 and within the second position for 7/12), followed by municipal use (first position for 2/12 and within the second position for 7/12). Usually, recreational use, tourism, service sector and hydropower generation are seen as less affected. However, it is worthwhile to mention that many persons interviewed think about the municipal sector as one of the least affected, since it is more protected.

## Current legal framework, affected sectors and pressure mechanisms

According to the 50% of the people interviewed, the legal framework is lacking of clarity in defining rights of water license holders, according to the 25% it is sufficiently clear, whereas the remaining 25% does not give his opinion. In particular, the weakness of water license mechanisms is reported. All agree about the inadequacy of the compensations in case of reduction of water allowances under drought conditions. As a matter of fact, compensations are not considered by the Italian legal system under ordinary conditions, but in the last decades they have been granted through emergency acts in specific cases. A senior official of the public administration has declared to be against compensations, since they would distort market mechanisms in the industrial and agricultural sector, and would have an inappropriate influence on the municipal sector.

Highly different opinions are reported about the participation of users on the definition of water allocations during drought. Some think that participation is lacking or inadequate. Among those thinking that participation is allowed to some extent, many believe that farmer are the most influential users, whereas people from the farmers' organizations complain that there is not an adequate participation.

Most of the interviewed people think that mass media (TV mainly) are often used to influence decisions, and that they are usually effective. Some believe they are even too influential, giving sometimes biased or at least undocumented information with the purpose of supporting one sector rather than another. Only one interviewed person identifies other pressure mechanisms (interventions of influent politicians), and unwanted effects arising from actions of some judges, improper at times.

## Sectors having priority and drought mitigation measures

The question regarding the sectors assumed as having priority under drought conditions, has reached the highest level of agreement, at least as far as the extreme positions of the ranking are concerned. Almost in all cases (10/12), municipal use is considered as having the highest priority, followed by irrigation. It is to be mentioned that Italian legislation explicitly sets that order of priorities. Two persons interviewed have given highest priority to the environmental use, arguing that environment is essential for the existence of the resource itself, and therefore, not taking it properly into account would lead to severe negative consequences for all other uses.

A high degree of consensus has been registered even for sectors having lower priority. Many persons interviewed give lower priority to recreational use (due to the fact that it is not essential and usually not important for the region) or energy sector (again, not much important and easily replaceable). However there are a few exceptions, where tourism is considered to be getting economically significant in the future, and energy sector is seen as having a high capability of conditioning all other sectors.

Answers regarding drought mitigation measures are instead more scattered. Many persons interviewed have put in the first or second position the improvement of efficiency of urban or irrigation networks (in order to avoid unacceptable losses), or the increase of irrigation efficiency, which is low and causes considerable wastes. Often raking in the first positions are also inter-basins water transfers, increase of regulation capacity and (less frequently) waste water reuse.

For two out of three of the interviewed persons, the deregulation of water market ranks the last position, often in conjunction with the other economic measure, namely the full recovery of costs. Also, among the last positions rank the other two measures having noticeable effects on economy: freezing the increase of irrigated areas and conversion to dry farming. The latter measures are perceived as having a negative impact on the economy.

## Economic instruments and scenarios of agricultural policies

Almost in all cases water is seen as a primary good that cannot be traded. This vision is supported by the idea that water is essential to human life and supplies basic human needs, and therefore its availability is a right and it is a public good that should be guaranteed to everyone. Accordingly, most of the persons interviewed are against deregulation of water market, even if with minor emphasis or weaker motivations, since it is seen as causing an unfair distribution of benefits and biases towards some operators, besides favouring speculations.

Full costs recovery through the tariff is a controversial issue, with favourable opinions slightly prevailing over unfavourable ones, and much indecision. Almost everyone think that users must participate to investments costs for mitigating drought impacts, but only two interviewed persons think this has to occur regardless of the type of investments. Besides, contributions are very scattered, ranging from almost political percentages (10% or 20%) for some sectors, to the 100% for most of the investments.

Surprisingly enough, the unique person supporting the deregulation of water market, the full recovery of costs and the integral contributions of users to investments costs, believe that water cannot be traded.

Predictions about the trends of irrigation water consumptions (currently about 55% of the total water consumptions), clearly disagree. All of the farmers' representatives believe that current percentage will not decrease in the future and that new resources that will be made available by water savings (losses reduction, rationalization of irrigation techniques and adoption of less-demanding water crops) will guarantee a safest irrigation and enlargement of irrigated areas. On the contrary, all other persons interviewed guess that that percentage will decrease more or less to the 45% in 10 years, except for the research centre member, who in turn believes that climate changes in the future will increase irrigation requirements, due to the fact that current dry farming could need irrigation in the future.

## Climate change

In all cases except for one, climate changes are perceived as being already occurring, and some see them as severe and dangerous. Although differently described (negative precipitations trends, temperature increase, slow tropicalization, increase of extreme events), they are generally perceived as a tendency towards a more arid climate and therefore as leading to an increase of drought magnitude and frequency.

## Proposals

As far as the current legislative and institutional frameworks are concerned, except for two indecisions, all the persons interviewed think that some modifications are necessary. There is a large agreement on a "special water authority", although answers are slightly different for what regards its functions. For some it should only accomplish control functions, for others also planning and realization of works, for some others it should be a coordination or conflict resolution centre between existing actors. Many persons interviewed believe a discipline for drought management is necessary. Some propose a marked distinction of roles for institutions devoted to drought planning, ordinary drought management and emergency drought management. Some proposals have a wider purpose (soil protection, reforestation and support to agriculture).

For the majority of the persons interviewed, the institutions involved in drought management have insufficient (even very insufficient) financial tools, but for some they are adequate or even superfluous. Regarding the personnel units, one third of the persons think they are adequate, one third hesitates and the remaining part is equally split in two parts, one thinking it is inadequate and the other superfluous. Among those who believe the personnel units are sufficient or superfluous, many think that they are not well trained and sufficiently skilled.

## Assessment of institutions related to water resource policy and drought preparedness and management

### Current status of water reforms

The analysis of the evolution of recent water legislation (see "Legal framework" section) has shown that several factors have influenced the concepts and procedures considered as necessary to improve water management. In particular, the following main factors can be considered (DICA, 2001):

(i) The introduction of the principle of water planning oriented to satisfy public purposes (with priority to drinking supply) which has replaced the criterion of the allocation of the water resources among different uses regulated by the State through water license to individuals which take the initiative of the resources exploitation.

(ii) The growing awareness on the environmental impacts of water uses which pushed on the need for protecting and restoring ecosystems, and for moving from the traditional supply development practice to water saving and demand management strategies.

(iii) The perception by practitioners and legislators of the necessity of a comprehensive river basin planning, which has led to the adoption of the river basin as the territorial unit for which a plan has to be developed taking into account the allocation of water resources, the flood defence and the pollution control.

(iv) The introduction of national economical policy aiming to achieve a more efficient management of water services and to gradually obtain a full cost pricing.

(v) The demand of local communities to participate to decision making process for relevant projects.

Although these factors have produced a legislation which contains several ethic principles and innovative criteria aiming to improve the water supply conditions for different uses, to mitigate the impacts of hydrologic extremes (floods and droughts), as well as to protect water bodies quality, the status of the water management in Italy remains, in general terms, unsatisfactory.

A first reason of this situation can be identified in the significant delays in the implementation of these legislative innovations (CNR-IRSA, 1999). After fifteen years since the Law 183/1989 enactment, although all national and interregional river basin authorities and most of the regional authorities are operative, no river basin plan has been completed and approved not even for the largest rivers basins, where many provisional investigations were available (see Table 12). The greatest delays are in regional river basin in the southern part of the country (in Sicily the authority does not exist yet). This unfavourable situation has led the Parliament's Commission on Soil Conservation to formulate the proposal to extend the national river basin authorities also to the southern hydrographic districts.

Table 12. State of implementation of Law 183/1989 in Italy (at 2003). Three regions must still provide for the implementation†

River basins established by Law 183/1989	Basin authorities			River basin plans		
	Identified by Law 183/1989	Established by regional laws	Operative	Completed	Partial plans	
National level	11	6	–	6	0	4
Interregional level	18	–	14	13	0	9
Regional level	1	1	15†	14	0	9

However, great delays occurred also for enacting important national technical directives such as those regulating the treated wastewater reuse, the method for evaluating minimum in-stream flow, etc.

The information system, which is a duty of national technical services according to the Soil Conservation Laws, is not fully operative, too.

The worst aspect is that the principle of an integrated planning itself, introduced by law, has been neglected in practice. In fact, the Law 267/1998 has introduced the flooding areas identification as a separated planning action to reduce the flood risk, and more recently the Decree 152/1999 has indicated the water quality protection plan as a separated plan, formally to be considered as a part of the general river basin plan.

Also the Law 36/94 is far from being implemented, according to the information provided by the last annual report to the Parliament, prepared by the Committee for Water Resource Use and summarized in Table 13. In particular, even if all regions have approved the regional laws that identify the OTUs and most of them have already been established, several authorities are not operative yet, and the firm responsible for management of the integrated water service has been selected only in 27% of the cases.

Table 13. Status of implementation of Law 36/1994 (at 2003) in Italy

Region	OTUs identified		OTUs established		Management firms selected		
	Population		Population		OTUs	Population	Population
	No.	ISTAT '97 (1)	No.	ISTAT '97	No.	ISTAT '97	% of (1)
Piemonte	6	4,291,441	5	3,788,832	1	256,486	6
Valle d'Aosta	1	119,610	1	119,610	0	0	0
Lombardia	12	8,988,915	12	8,988,951	2	2,252,670	25
Trentino A.A.	NL <sup>†</sup>	–	–	–	–	0	–
Veneto	8	4,469,156	8	4,469,156	1	52,839	1
Friuli V. Giulia	4	1,184,654	0	0	0	0	0
Liguria	4	1,641,835	4	1,641,835	1	920,549	56
Emilia Romagna	9	3,947,102	8	3,595,246	1	267,879	7
Toscana	6	3,527,303	6	3,527,303	5	3,006,978	85
Umbria	3	831,714	3	831,714	3	831,714	100
Marche	5	1,450,879	5	1,450,879	3	783,058	54
Lazio	5	5,242,709	5	5,242,709	3	4,771,192	91
Abruzzo	6	1,276,040	6	1,276,040	2	711,845	56
Molise	1	329,894	0	0	0	0	0
Campania	4	5,796,899	4	5,796,899	1	1,454,925	25
Puglia	1	4,090,068	1	4,090,068	1	4,090,068	100
Basilicata	1	610,330	1	610,330	1	610,330	100
Calabria	5	2,070,992	5	2,070,992	0	0	0
Sicilia	9	5,108,067	9	5,108,067	0	0	0
Sardegna	1	1,661,429	1	1,661,429	0	0	0
Total Italy	91	56,639,073	84	54,270,06	25 (27%)	20,010,533	35
Total North	44	24,642,749	38	22,603,63	6 (14%)	3,750,423	15
Total Central	19	11,052,605	19	11,052,60	14 (74%)	9,392,942	85
Total South	28	20,943,719	27	20,613,82	5 (18%)	6,867,168	33

<sup>†</sup>NL: No law.

Initially, the law was welcomed with enthusiasm because of the adopted modern concept of integrated water cycle, of the positive expected reduction of fragmentation in water public utilities, and of the improvement of managerial and financial features of the integrated service. Later on, however, several criticisms have arisen regarding the basic law criteria themselves. Among these, the most important ones seem to be the following:

(i) Complexity of the organizational structure of the reform which would require a strict cooperation among the different levels of government.

(ii) Difficulties in applying the reorganization of the municipal water supply sector, due to the large number of multipurpose water supply schemes, in absence of river basin plans which would allocate water resources among municipal, agricultural, and industrial use.

(iii) Inadequacy of the definition of large OTUs to solve the problem of the scale economy in the case of safeguard of the incumbent public utilities.

(iv) Uncertainty on how to choose the firms who will manage the service, due to general debate on public services provision and to the strong opposition to any status-quo change by incumbent water firms.

(v) Ambiguity of the reference tariff and difficulties of achieving a full cost recovery pricing in many regions where the water infrastructures have to be completed.

People from two opposite extreme positions evaluate the Galli Act as inadequate. On one side, the difficulties of the reform implementation are attributed to the permanence of a bureaucratic approach strongly oriented to ex-ante regulation and therefore a greater autonomy of firms in organizing water services management is advocated (Massarutto, 1998). On the other side, the social value of water is reflected since water is seen as a primary resource to be available to all people at a reasonable price while the liberalization in water services is considered as a threat to this principle.

The status of water reforms in Sicily is rather disappointing. Historically, most of water supply planning was carried out by the Cassa per il Mezzogiorno (a special agency for the economical development of the southern regions in Italy) until the 80's, which caused some delay in the development of regional institutions with capability in water planning. Works in water fields are realized by regional departments (Assessorati) funded by European funds, but a satisfactory planning activity is lacking. Also the strategy for coping with drought is reactive and not pro-active, since plans for long-term measures oriented to reduce drought vulnerability of water supply systems are still lacking and also plans for drought management within the current operation of municipal water supply systems are in the initial stage [with some exceptions, e.g. Water Public Utility of the City of Palermo (AMAP Palermo)].

## Strengths and weaknesses of institutions

The comments on strength and weakness of the Italian institutional setting for coping with drought are based on the analysis of the legal framework (on water management in general and on drought management in particular), on the lessons drawn from past experiences in facing recent severe drought events and on the interviews to key stakeholders. The following sections outline the strengths and weaknesses of: (i) the hydro-meteorological and water use information and drought monitoring; (ii) the proactive measures to improve drought preparedness; and (iii) the reactive measures to mitigate drought impacts.

### *Hydro-meteorological and water use information and drought monitoring*

The important role that appropriate information on water, land and economic activities play for an effective water planning has been recognized in the guidelines for basin planning following the Law 183/1989. Also advanced projects of information systems have been designed within Ministry of Environment and the National Hydrographic Service. However the current situation of data collection, processing and timely accessibility of data is far than adequate. The fragmentation of the competences both horizontally (e.g. among different ministries and/or services) and vertically (between national and regional levels) is likely the most important factor to explain the difficulty to have reliable data timely for their use in decision making process.

Also the ambitious projects of information systems presented great delays in the implementation. The efforts of many regions to develop autonomous regional networks for meteorological, agro-meteorological and hydrological services, also as an answer to the crisis and delay of national initiatives, have contributed to create a very variegated and confused situation. As a consequence, drought watch systems are still lacking both at national and regional levels. Some efforts in this direction are undergoing at national level (Hydrographic Service) and at regional level (e.g. in Sicily,

Calabria, etc.) within EU INTERREG programs. However they are still at an experimental level (Rossi and Cancelliere, 2002) and not integrated within an appropriate proactive approach to drought management.

Also, data on water use are not generally complete, updated and reliable. In particular the last published census by ISTAT on domestic and industrial water consumption dates back to 1987. The information collected by Ministry of Interior from municipalities on water supply and wastewater treatment on a yearly basis does not present high reliability due to the lack of an effective data validation process. More reliable data are collected by Federgasacqua (association which includes most of the greatest water supply companies) and periodically published. General consideration on water consumption and prices are yearly made by the Comitato per la Vigilanza sull'Uso delle Risorse Idriche in the Report to the Parliament on the status of water (municipal) services which however focus on the implementation of Law 36/1994 and not on a detailed analysis of data.

The information on agricultural use of water is even more limited. The last agricultural census was issued on 1994 including fruit and vegetable production data but only limited data on water crop consumption and water efficiency in irrigation use. A few investigations have been recently completed by the National Institute for Agricultural Economy (INEA) in some regions of Southern Italy, presenting updated estimates on areas of irrigation districts and water resources used for supply systems operated by public organizations and partially for areas irrigated by privates. Information on water licenses is also lacking, especially for what regards groundwater exploitation. Indeed, even information about the location of wells is sometimes not available, let alone other relevant data such as pumped volume, depth, etc.

### *Proactive measures to improve drought preparedness*

As the presentation of the legislative basis of drought preparedness and mitigation (Table 6) has shown, Italian legislation has developed some tools oriented to a proactive approach to drought threat. Generally they include the consideration in the planning documents of the drought risk and consequent shortage risk limited to municipal supply (as in the Law 36/1994 and Decree 47/1996), or extended to supply for all uses (as in Legislative Decree 152/1999). These water resources plans should evaluate the areas affected by the risk of water crisis and define the long-term measures to reduce the vulnerability of water supply systems to drought and also to desertification according the latter decree.

On the basis of the Law on Civil Protection, a proactive approach should also be adopted, as programs of prediction and prevention of natural calamities are dictated at province and region levels and contingency plans are requested to coordinate the prefect's actions during the emergency at provincial levels.

However no planning instrument has been still implemented in practice and no technical guidelines have been issued to deal with the assessment of drought risk by means of appropriate scientific methodology.

The main weaknesses of the legislative provisions, even if correctly applied, can be ascribed to the lacking of:

(i) Emphasis on demand management measures, including the role of information campaign for saving water in municipal sector (through the use of appropriate methods for reduction of consumption and losses) and in agricultural sector (through the use of new irrigation techniques and less water demanding crops).

(ii) Initiatives for improving insurance policies for covering drought damages in crop yield and initiatives for allowing the water rights exchanges.

(iii) Necessary modifications in traditional water resources planning procedures to enlarge objectives and techniques for including, beside the satisfaction of water demands of different sectors, also the environmental and social perspectives of a sustainable development as adopted by EU Water Framework Directive (including stakeholders participation).

### *Reactive measures to mitigate drought impacts*

The reactive approach to drought has been generally the only response to drought events and to the consequent water shortages for municipal, irrigation and industrial uses. As it was discussed in Table 6, the public initiative has been two-fold: (i) to implement emergency actions through the declaration of drought, the appointment of a commissioner at regional level and the funding of water works to increase the available water resources, relaxing several legal constraints; and (ii) to subsidize the farmers for drought damage, giving the priority and/or increasing the financial aid to farmers.

Although the emergency measures have been in many cases useful for fostering water infrastructures construction (e.g. completion of ongoing dam constructions, reservoir connections, new wells, desalination plants in small islands, etc.) such type of actions are generally criticized, as they generally exhibit larger costs than those of planned actions, present procedures without transparency and thus potentially of interest for criminal organizations, and in a few cases with realization delayed after the drought termination (as for desalination plants after 1988-90 drought). Also the emergency actions often cover water works (as renovation of conveyance aqueducts) which should be realized under normal periodic maintenance programs.

In a few cases the criticism is extended to the fact that the offices for water emergency have responsibilities out of the emergency fields, including general planning activities (e.g. in Sicily for developing the water protection plans of hydrographic districts following the Legislative Decree 152/1999). Also the lack of serious efforts to inform the public opinion and to facilitate the participation of stakeholders to decision process is pointed out in the evaluation of a not fully adequate approach to drought management.

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