

BASILICATA SYSTEM FOR WATER RESOURCES PLANNING AND MANAGEMENT: EXPERIENCES AND TOOLS FOR WATER CRISIS AND FLOODING RISK PREVENTION

Interregional River Basin Authority of Basilicata – Technical Operational Secretariat¹
Via del Gallitello, 86 – 85100 Potenza (Italy)

with the contribution of:

Basilicata Region – Environment, Territory and Sustainability Policy Department²
Viale della regione Basilicata, 5 – 85100 Potenza (Italy)

Authority of Optimum Territorial Ambit of Basilicata³
Via Messina, 186 – 85100 Potenza (Italy)

1 INTRODUCTION

The territory of Basilicata Region, about 9.900 square kilometres, is located in the centre of Southern Italy and borders with Campania, Calabria e Apulia Regions (fig.1). The area is characterized by physical, social, economic and infrastructural conditions that make it a very specific and complex subject.

Talking from a morphological point of view, the territory of Basilicata is characterized on its western side by a mountainous chain, the Basilicata Apennine, whose highest elevation is reached with Mount Pollino (more than 2.000 meters above sea level), Mount Sirino (2.000 metres a.s.l.) and Mount Alpi (1.900 m. a.s.l.). The Apennine chain slopes down towards East in the wide hilly area of Matera, that windows down South on the Metaponto plain, the Murgia complex of Apulia Region to the East and the Ofanto Valley to the North.

This area is characterized by a wide and complex hydrographical network; some of the main water bodies, such as the Bradano river, the Basento river, the Cavone, Agri and Sinni rivers flow into the Ionic sea, after having streamed with a NW – SE direction through almost the entire region in a parallel way (fig.2).

Other important surface water bodies are: the Ofanto river, that flows into the Adriatic sea and borders the near Apulia Region; the Noce river, that flows into the Tirrenian sea, whose basin is partially included also in the Calabria Region; Melandro and Platano, tributaries of the Sele river, whose basin is included prevalently in the Campania Region. Only the Noce river flows inside the territory of Interregional River Basin Authority of Basilicata, whilst the Ofanto river is included inside the territory of the Interregional Basin Authority of Apulia and Melandro and Platano belongs to the Interregional Sele Basin Authority (fig.2).

The whole territory of Basilicata Region is thus comprised into four Interregional River Basin Authority: Interregional River Basin Authority of Basilicata (IRBA), that comprises most of the Basilicata territory; Interregional River Basin Authority of Apulia; Interregional Sele Basin Authority and Interregional River Basin Authority of Calabria (that holds a small fraction of Basilicata Region).

Basilicata Region is rich of surface water resources and, in a lesser way, of ground water resources, mainly located in the IRBA territory (fig.2); only the ground water resources belonging to the Vulture volcanic complex and to the Ofanto river belong to the Interregional River Basin Authority of Apulia.

¹ Interregional River Basin Authority of Basilicata Contact Points: Engineer Michele Vita (General Secretary) Tel. +390971475212, e-mail: mivita@regione.basilicata.it. Doctor Sonia Pagliaro (PhD Geologist) Tel +390971475254, e-mail: sonia.pagliaro@regione.basilicata.it; Marianna Bulfaro (Geologist) Tel. +390971 475226, e-mail: marianna.bulfaro@regione.basilicata.it; Doctor Clementina Cavuoti (PhD Engineer), Tel. +390971475254, e-mail: clementina.cavuoti@regione.basilicata.it

² Environment, Territory and Sustainability Policy Department Contact Points: Doctor Andrea Freschi (General Manager), Tel.+390971668849, e-mail: andrea.freschi@regione.basilicata.it; Lawyer Luigi Gianfranceschi (Manager), Tel. +390971668781, e-mail: luigi.gianfranceschi@regione.basilicata.it; Lorenzo D'anisi (Engineer) Tel. +390971669059, e-mail: Lorenzo.danisi@regione.basilicata.it

³ Authority of Optimum Territorial Ambit of Basilicata Contact Points: Professor Angelo Nardoza (President), Tel. +390971469102, e-mail: angelo.nardoza@atobasilicata.it; Donato Larocca (Engineer), Tel. +390971469527, e-mail: donato.larocca@atobasilicata.it; Gabriella Coviello (Geologist), Tel. +390971469102, e-mail: gabriella.coviello@atobasilicata.it.

Water resources of Basilicata are mainly used for drinking and irrigation purposes, and in a lesser way for other uses, not only within the region but also in other regions, like Apulia, where a significative quantity of resource is transferred, and in a smaller amount Calabria.

The hydraulic network of Basilicata Region is quite complex, because of the necessity to face in an adequate way the need for water demand coming from different uses, not only within Basilicata region but also from other boundary regions, and more over to ensure water availability during drought periods or in areas characterized by scarcity of the resource. As a consequence, the technical features of the hydraulic structures, that are part of this network, are advanced and quite articulated, in order to enable the efficient transfer of large amounts of water between boundary regions and different areas.

This is the main reason why important dams have been built in order to storage sufficient amount of water resources necessary to satisfy the needs of different uses in Basilicata and Apulia regions.

This system of hydraulic infrastructures, the very heart of the primary hydraulic system of Southern Italy, is made of a very complex network of hydraulic schemes (a system of great hydraulic works such as dams, weirs, pipelines, by means of which it is possible to link water sources and final users); among these the most important are Jonico-Sinni and Basento-Bradano schemes. Other schemes, such as Alta Val d'Agri, Noce and Mercure, can be considered as minor ones, because of their lesser complexity (fig.3).

The most important schemes are characterized by interregional transfers of water, regarding boundary regions other than Basilicata, especially Apulia region (fig.4). The most important scheme regarding Apulia and Basilicata regions is the Jonico-Sinni scheme, fed by three Basilicata rivers, the Sinni, Agri and Bradano rivers, that flow into the Ionic sea and whose water is exclusively belonging to Basilicata region.

But Basilicata region, though rich in water resources, is an area interested also by drought and desertification phenomena, primarily linked to the characteristics of the meteorological regime in the area, such that in the last few years extreme climatic events have occurred increasingly often. This situation has recently determined a difficult situation in water primary availability, also creating many problems to the main economical activities in the area (agriculture, tourism, tertiary sector and, in a lesser way, industrial activities).

The meteorological events occurred in the past few years, such that rainfall has been scarce especially during the winter and autumnal periods, has been constraining the efficient filling of water reservoirs, thus limiting water availability in those regions depending in an almost exclusive way on the resource accumulated in Basilicata artificial lakes.

The severe drought occurred in Apulia and Basilicata regions during the summer of 2000 and 2001 is quite highlighting in this respect, such that it induced the Italian Prime Minister to declare the emergency situation with regards to the water availability in both regions, for the 2001 2004 period.

But water deficit situations in the area can also be explained with the complexity of the structures and the particular mechanism that lay under the working of water resources transfer systems shared between Basilicata and Apulia Regions, with the distance existing between the territories where water resources are sourced and those in which these are utilized, because of the development of economical activities, among which also agriculture, in areas characterized by a limited amount of water resources availability.

It must be said that the several barrages built on the main Basilicata rivers on one hand have permitted to increase the capability of water storage for a wide area of Southern Italy, but on the other hand they have created a strong impact on the landscape and on the territory, such as: the regression of the shores in the Metaponto coastal plain, an area characterized by an highly tourist vocation; the loss of land because of the dams building and the works connected, and other similar problems linked to the creation of great infrastructures.

It is thus quite evident in this context that the choice of proper and sound techniques of water resources utilization and the efficient management of this complex system of hydraulic infrastructures, in order to ensure their adequate storage, supply and transfer represent for Basilicata region a primary goal, so to be able to supply water to a vast territory of Southern Italy, to prevent drought crisis, to protect and lifeguard surface and ground water resources, thus ensuring a sustainable social and economical development.

As a matter of fact in this area drought crisis are immediately linked to economical problems, because the scarcity of water resources greatly affects the main activities of the

area such as agriculture, tourism, commercial activities and industrial activities, though in a smaller way.

The other important result achieved by Basilicata region has been to think about a kind of compensation mechanism in order to reduce the effects created on the territory by the building of great hydraulic infrastructures (works for storage and transfer), that is to say works necessary to ensure water resource to populations of Apulia and Basilicata regions, besides the resources useful for the social and economical development of the territories.

Other significant problems besides the situations of water deficit are linked with the river basin dynamics, enhanced by the repeated occurring of meteorological events characterized by intensive rainfall, often concentrated in a short time span.

The risk of flooding events especially regards areas where important economical activities are located, e.g. agricultural activities and, less, industrial activities, besides inhabited areas.

In order to prevent and mitigate the flooding risk, the Interregional River Basin Authority of Basilicata and Basilicata Region work in a complete synergy: the first spots and perimeters the areas with such a risk, thus defining the operational rules and the programmes necessary to prevent and mitigate it, the latter enforces the intervention programmes and addresses the social economical development of the territories in a compatible way with the existing risk.

In the following will be exposed and described the systems developed in Basilicata in order to ensure a proper and sound utilization of water resources, and the mitigation and/or prevention of the risk of flooding.

2 THE "BASILICATA SYSTEM" FOR WATER RESOURCES PLANNING AND MANAGEMENT

In order to achieve a proper and sound management of water resources and to prevent situations of water deficit the Government of Basilicata Region, according to the duties and responsibility transferred from the central Government to the local authorities on this matter (L.D. 112/98 e L. 3/2001), the Interregional River Basin Authority of Basilicata and Authority of Optimum Territorial Ambit of Basilicata have conceived, developed and enforced a water resources governance system based on the basic principles of the main E.U. Directives and Italian Laws focused on this topic (Directive 2000/60/CE, Royal Decree 1775/33, L. 183/89, L. 36/94, L.D. 152/99), such as:

- solidarity and sustainable utilization of water resources, in order to achieve the lifeguard for future generations of the right to benefit from the fruition of a well preserved environment;
- the integration between the qualitative and the quantitative water resources protection;
- respect for the physical characteristics of the territory, the entire catchment basin and the management of the resources according to the basins (for surface and ground waters), regardless of the administrative boundaries;
- the management of water resources according to the main criteria of economics, efficacy and efficiency;
- avoiding the fragmentary architecture of the water resources management and the following enforcing of a unique Body for the Integrated Water Service;
- introducing the tariff principle as a consequence of the Integrated Water Service;
- conceiving the water resource as an economical commodity;
- introducing the principle according to which who is going to pollute will pay.

The Basilicata system conceived for water resources planning and management thus foresees:

a) the commitment and the participation of all the bodies involved in the water resources planning, programming and management activities:

- Basilicata Region (General Management and Water Cycle Office of Environment, Territory and Sustainability Policy Department);
- Interregional River Basin Authority of Basilicata (IRBA), which controls a great fraction of the territory of Basilicata Region and smaller fractions of Apulia and Calabria regions, carrying out its planning and programming activities on the basins of the main rivers of Basilicata region, besides on the surface and ground water resources afferent to them (fig.2);

- Authority of Optimum Territorial Ambit of Basilicata (Basilicata AATO - Control Body of the Management Body for the Integrated Water Service-IWS) whom area of influence is given by the whole regional territory;
- Acquedotto lucano (the Management Body of the IWS) and *Acqua S.p.A.* (public company for raw water transfer);
- Interregional River Basin Authority of Apulia, whom area of programming activity is exerted on the water resources located in Basilicata Region and belonging to the Ofanto river basin, and the Interregional Sele Basin Authority, which exerts its duties on the fraction of Basilicata region territory belonging to the Marmo and Platano rivers, affluent of Sele river.

b) a continuous comparison with the regional structures involved in the programming of the social economical development process of the territory, in order to match the economical growth of the territory and the availability of the resources, besides to help the implementation of policies aimed at the development of productive systems that take into account the recycling and reuse of water resources;

c) the commitment of Universities and Research Institutes working on the territory, in order to obtain a most reliable evaluation on quality and availability of the resources, so that it is possible to plan and manage the utilization of water resources, but also of the physical characteristics of the territory that can be used as a base in programming the realization of hydraulic infrastructures, in order to obtain an efficient water storage and transfer capability.

d) the comparison and the participation of the different users to the water resources planning and programming, in order to achieve a proper use of these.

On the basis of what has been described so far, it is possible to say that it has been created a real "*Basilicata System*" regarding the governance and the management of water resources. Such a system is agreed and shared by all of the subjects involved in the activities above said and aims at the realization of the best planning, programming and management of the natural systems, besides of the infrastructures that are deputed to the water distribution for the different uses (drinking purposes, irrigation, industrial, tourism and production), according to the legislative instruments of this sector.

This has allowed the creation of adequate instruments for planning, programming and enforcing of the interventions in the water resource sector, in order to regulate the correct use of them and taking into account the resources' and the territory characteristics, besides the proper needs for the social and economical development process of the region. The final aim is to obtain a proper solidarity and a sustainable use of the resource among different users, both within and outside the region, thus reducing or minimizing eventual conflicts existing in the area on water utilizations between boundary regions and the several categories of water users.

The correct management of risks connected to the utilization of natural and artificial systems has been achieved in Basilicata a region by means of a careful evaluation of the quality and the availability characteristics of the resource, by way of a continuous monitoring process of the physical and economic features of the infrastructures operating in the region and, last but not least, through the utilization of high technology in order to prevent losses of the resource, with the aim to obtain adequate water savings.

The "Basilicata System" for the water resources governance aims to ensure sustainable and jointly liable use of resources between the different users in regional and extra-regional area, the protection of water resources quality characteristics and availability through the adoption of suitable basin and regional scale planning and programming instruments for the governance of water resources shared between Basilicata and Apulia Regions, such as:

- The *Basilicata Water Protection Plan*, for the definition and monitoring of surface and ground water bodies quality characteristics and availability;
- the River Basin Plan for the Water Budget and Minimum Vital Outflow of Interregional River Basin Authority of Basilicata, finalized to: 1) the determination of the water budget to scale of hydrographical basin and hydro geological structures; 2) the definition of the river minimum vital outflow (fig.5).; 3) the location of structural and not structural actions for sustainable water resources uses;
- the Ambit Plan and the Paper of Quality Service from the Authority Of Optimum Territorial Ambit of Basilicata (AATO), finalized, the first one, to the planning and programming of the interventions for water infrastructures, to the drafting of the

Economic-financial Plan, to the managerial-organizational model and the tariff plan, and the second one to the protection of the rights of the citizens.

Because of the important transfers that regard most of the water resources of Basilicata region towards Apulia, it must be said that besides the instruments of planning and programming above mentioned, a particular importance for the governance process of the water resource lays in the Basilicata *Program Agreement on the Shared Water Resources* (L. 36/94) signed in 1999 by Basilicata Region, Apulia Region and the Ministry of Publics Works (currently Ministry of Infrastructures and Transports), for water transfer regulation, which rules and ensures the sustainable use between the inhabitants of the two regions.

Besides the instruments of planning and programming water resources, in Basilicata Region is also conceived and realized:

- An organic and unitary management of hydraulic infrastructures and programming of interventions aimed to ensure an efficient and economic water service.
- The project of a monitoring system aimed at the control of water resources, financed by the funds deriving from Law 431/2001 (Water Resources Objective Law).
- The elaboration and enforcing of Laws that rule the permission to derive water resource within the region; Basilicata Region has been adopting a specific law on this topic since 1996, the Regional Law n. 43, modified and updated with the L.R. n. 21/2005, which rules the permission to receive the authorization to derive water.
- The preparation and realization of intervention programmes in the water resources sector, in order to make more flexible the system of hydraulic infrastructures conceived for the storage and the use of these; this enables the system to transfer resources from one end to another, in case of water deficit of a part of it. Also these interventions have been realized with financial resources deriving from L.431/2001 (Water Resources Objective Law).
- The development of a tariff system that holds into account the necessity to ensure water utilization for all of the users, with sustainable costs and easy access to the resource especially for weak social levels, but that also holds consideration of the effects on landscape and environment deriving from the realization of the important existing infrastructures (dams, weirs, pipelines and so on), so to make possible the utilization of part of the money deriving from the application of the tariff for the realization of interventions aimed at the achieving of an environmental restoration. In this way the effects on environment produced by the building of the infrastructures can be quantified and the economic incomes deriving from the environmental costs can be equally parted among the different users of Basilicata and Apulia regions, committed in the realization of interventions aimed at the environmental compensation (interventions for the mitigation of the coastal shore erosion, for the realization of hydraulic forestry systems in catchment basins interested by important works).

The governance system of water resources developed in Basilicata has been based on solidarity with the boundary regions, and has a primary importance because it enables the utilization of these resources in a complex territorial system, characterized by different physical, social, and economical features, often put under pressure by recurrent periods of water deficits because of the occurring of repeated droughts.

It is thus, a system that because of its characteristics could be tested in various Countries of the Southern or Eastern Mediterranean, or in developing Countries often undergoing situations of water deficit, in relation to the meteorological conditions of the territory, where it is urgent to realize important works for the storage and the transfer of water and harsh situations of conflict, linked to the sharing of the resource are recurrent, not only among different social actors of the same Country but also amongst different and boundary Countries.

3 THE HYDRAULIC INFRASTRUCTURES SYSTEM IN BASILICATA

Basilicata region has been interested by the realization of important dams (fig.3), with the aim to ensure enough capability in terms of water resources storage for the utilization in agriculture and industry, in Basilicata and Apulia regions; these regions have been starting an important process of growth and development since the fifties. The realization of this massive system of hydraulic infrastructures in Basilicata has been starting in 1955, after the completion

of the works of San Giuliano dam and has ended after the completion of the works necessary for the construction of Trivigno weir in 1996.

Besides the realization of dams and weirs also great pipelines for different uses and water transferring from the area of storage to the final utilization area have been built, e.g. the Pertusillo and Sinni pipelines; moreover, some others works have been realized to ensure the interconnection between different areas of storage, such as the Agri, Sauro and Sarmento weirs or the Ginosa-San Giuliano pipeline (fig.3).

All of the river basins belonging to Basilicata, excepted Lao, Noce and Cavone are characterized along their main rivers by works aimed at water storage, so distributed to Basilicata, Apulia and in a subordinated way to Calabria (fig.3).

This complex hydraulic system is by a large fraction shared with Apulia Region and is the ultimate result of a series of intervention strategies, often aimed at this sector and developed in long periods of time, but in some cases not yet complete. This has been determining on one hand, a great deal of infrastructures on the territory and, on the other hand, a particular dynamic of realization for these interventions, not always faced to a strict coherence.

Inside this complex network three main systems can be easily determined, each one of these is made of all the hydraulic works that collaborate in satisfying water needs for the area (fig.4) to which they belong, though not always strictly interconnected one to the other. These are the Ofanto Scheme, Basento-Bradano Scheme and Ionian Scheme; each one of these is made by one or more aqueduct systems. Besides these greater schemes, other can be mentioned such as Alta Val d'Agri, Noce and Mercure, that can be considered as minor ones, because of their lower number of structures.

The *Ofanto Scheme* is feeded by surface water only and is made of seven dams: two are in Campania (Conza and Pesco S. Pietro), two are in Apulia (Marana Capacciotti and Monte Melillo) and three in Basilicata (Saetta, Abate Alonia and Toppo di Francia).

The scheme is mostly regulated by the Santa Venere Weir, which is located on the main course of Ofanto river from which, by pipelines and plitflow, the water is convoyed directly to Abate Alonia (Rendina), Marana Capacciotti and M. Melillo (Locone) reservoirs, especially during winter time. The main transporting system, about 86,0 km long, developes for about 55,0 km inside Basilicas a region and 31,0 km in Apulia region, providing drinking, irrigation and industrial services.

The *Basento - Bradano Scheme*, not yet completed, is based on the resources stored by Camastra, Acerenza, Genzano and Serra del Corvo dams, the Basento river flows, caught by Trivigno and Orto del Tufo weirs, and the river flow within the trait Camastra-Orto del Tufo. All of the hydraulic structures that are part of the scheme are located in Basilicata, except for Serra del Corvo dam, placed on the border between Apulia and Basilicata.

In this case water is erogated in Basilicata region only, it is used for drinking, agricultural and industrial purposes. The main node is represented by the Trivigno weir, conceived and realized with the aim to transfer by pipeline the water derived from Basento river to Acerenza, Genzano and Basentello dams, placed in the Bradano river basin, so to integrate the water requirements of the lands served by these reservoirs. Today the Trivigno weir is not still fully operating, it has been working partially and only for a short period during the drought period of 2002, so to integrate the water availability of San Giuliano reservoir in the lower course of Bradano river. Moreover, the project regarding the connection between Camastra and Trivigno is almost complete and ready, this should allow the transfer to Trivigno weir of the exceeded amounts of water stored in the Camastra reservoir, that can be evaluated in about 20 Millions of cubic metres per year.

The *Ionian-Sinni Scheme* has an interregional character and is made of four main aqueduct systems, linked one to the other; it is indeed the most complex and important scheme operating in Basilicata region, because it ensures water supply for multiple uses to a wide area comprising Basilicata and Apulia ionian area, Salento (Apulia) and the jonio area belonging to Calabria region. These four aqueduct systems that constitute this scheme are usually named as Sinni, Sinni-Noce, Agri and Lower Bradano.

The most important infrastructure existing in the Aqueduct system of Sinni is represented by the Monte Cotugno reservoir, located on the Sinni river (fig.3). This reservoir receives water flows from its own basin and from the Agri, Sauro and Sarmento weirs, though this last one is not yet finished. The water supply towards the areas of Metaponto and Southern Apulia is

carried out through a pipeline, named as "Canna del Sinni", that starts from M. Cotugno and ends in Nardò (Salento), with an overall development of about 189,0 Km.

The Monte Cotugno dam and the first 133,0 Km of the main pipeline (up to the Hydraulic point of Monteparano) have been built in several phases, starting from the first half of the seventies. These infrastructures are managed by EIPLI. The Monte Cotugno dam, finished and gone into activity starting from 1983, was conceived as a strategic infrastructure to avoid and mitigate eventual water deficit crisis, for multiple uses, in the coastal plains of Basilicata and Apulia.

The water resource stored in this reservoir is erogated in Basilicata, Apulia and Calabria, is used for drinking, irrigation and industrial purposes by way of the Sinni pipeline.

At the presente state, the Sinni pipeline is working up to the Monteparano hydraulic node (TA). For the completion of the scheme, a connection between the Sinni pipeline (Ginosa node) and San Giuliano dam has been realized. This infrastructure, named as Ginosa pipeline- S. Giuliano Dam, that has never been working because of the damages caused by the earthquake of 1980, was conceived with the aim to transfer water resources from the M. Cotugno reservoir to the S. Giuliano reservoir, often characterized by water deficits, but also in order to serve some irrigation districts (Irrigation and Land Reclamation Consortium of Bradano and Metaponto) located along the direction of the pipeline. The project aimed at the restoring and reactivation of this structure has been included in the Programme of intervention for water sector, referred to as the General State Agreement of 20.12.2002, signed by the Government of Basilicata Region according to the Law n. 443 of December 21st 2001 (Water Resources Objective Law).

The *Sinni-Noce Aqueduct system*, conceived for power purposes, only comprises Masseria Nicodemo (Cogliandrino) dam, located in the higher basin of Sinni river, and the pressure pipeline that connects it to the Castrocucco power plant, placed in the basin of Noce river. This dam was constructed in 1975 close to the confluence of the stream Cogliandrino, actually is managed by the National Electric Italian Company (ENEL S.p.A.) and is working since 1979. The average amount of water derived (1998 – 2000) to Castrocucco power plant, located on the main stream of the river Noce, managed by ENEL as well, is about 106,0 millions of cubic metres. During the emergency phase for drought of 2002, the permission to derive with hydro electrical purposes was temporarily suspended, in order to allow the transfer of water resources stored by Masseria Nicodemo reservoir to M. Cotugno reservoir. After the emergency was over, the water was turned again for hydro electric use to the Castrocucco power plant.

The *Agri Aqueduct system* is supplied by Marsico Nuovo, Pietra del Pertusillo and Gannano reservoirs, which catch the Agri river flows.

The main node of the scheme is the Pietra del Pertusillo dam. Water service is allowed by means of a derivation tunnel that forces water to the Missanello power plant, where it is forced into power turbines for energy generation and subsequently partially released in the below river basin and partially led to the Missanello water treatment plant, essential for the Apulia drinking purposes. The river flows discharged in the river bed are captured by the Agri weir during winter time, which then convoys them into the M. Cotugno reservoir; in the summer time (March to September), instead, these are kept and derived by the accumulation weir of Gannano, placed in the lower basin of the Agri river.

The *Basso Bradano Aqueduct system*, conceived only for irrigation use, is essentially made of the San Giuliano dam. This dam was built in 1955 on the Bradano river and is normally managed by the Irrigation and Land Reclamation Consortium of Bradano and Metaponto; it was conceived to satisfy part of the water demand coming from the coastal plain of Metaponto, both in the Basilicas a and Apulia areas, since the remaining fraction is served by the supply of M. Cotugno and Gannano reservoirs. The Apulia irrigated area belonging to the Irrigation and Land Reclamation Consortium of Stornara and Tara (Province of Taranto) is served by the Irrigation and Land Reclamation Consortium of Bradano and Metaponto, through the Bradano pipeline and the Girifalco node (Ginosa), where about 50 per cent of the water resource needed is supplied on behalf of a specific existing agreement.

4 MAIN BASILICATA ACTORS IN WATER RESOURCES PLANNING AND MANAGEMENT SECTOR

The Basilicata Region through the Environment, Territory and Sustainability Policy Department and its competent Offices (General Manager Office and Water Cycle Office) plays a

role in order to coordinate public and private bodies which are in charge of water resources planning and management within regional territory.

4.1 THE INTERREGIONAL RIVER BASIN AUTHORITY OF BASILICATA (IRBA)

The Interregional River Basin Authority of Basilicata (IRBA), established by Basilicata Region with Regional Law n. 2/2001 in compliance with National Law 183/89, includes portions of Region Basilicata territory and, in smaller measure, of the Apulia and Calabria Regions (Southern Italy, fig.1). IRBA territory, about 8.820 square kilometers, contains the catchment basins of the Bradano river (extended between Basilicata and Apulia), Sinni and Noce (extended between Basilicata and Calabria) and the catchment basins of the Basilicata rivers Basento, Cavone and Agri (fig.2).

In compliance with L.183/89 and to its institutive law, IRBA realizes study activities about environment and its general risk conditions; it addresses, coordinates and controls the planning, programming activities and the realization of works in the field of land defense, water resources and environmental protection in the IRBA territory, pursuing the catchment basins unitary government.

The IRBA territory comprises a large part of the surface and ground water resources of Basilicata Region and most of the hydraulic infrastructures (dams, weirs and pipelines, fig.3) for Basilicata and Apulia water supply. The IRBA water resources programming activity is therefore directed to water resources division between users in its territory and, above all, it constitutes a fundamental base for contractual strategies definition of shared water resources between Basilicata and Apulia Regions (fig.4).

The *River Basin Plan for Water Budget and Minimal Vital Outflow* (WB-MVO Plan) is the main IRBA tool for planning and programming actions/measures and regulations for land and water resources conservation, defense and valorization, on the base of the physical and environmental characteristics of its territory.

The IRBA WB-MVO Plan is the regulative framework to which all the authorizations and concessions about water resources uses have to be adapted and referred to.

IRBA has a wide experience in water resources management systems in areas facing the risk of drought, such as its territory. This experience has been acquired by arranging and/or participating to plans and programs for water resources management, that have seen the collaboration of all institutional subjects involved in water resources government in the IRBA territory and in particular in the Basilicata Region as well as of Universities and Research Institutes. In particular IRBA has played an important role in the water resources planning activities coordination, creating an operating synergy between all institutional subjects and assuring water resources uses in line with their quality characteristics and availability.

Moreover IRBA territory is subject to landslides and flooding due to its physical and climatic characteristics. Therefore IRBA activities in the water sectors are focussing on:

- shared water resources governance;
- characterisation of drought and flooding risk components;
- planning and programming of structural and non structural measures (works/actions) for a sustainable water resources and land use according to their characteristics and availability.

Such activities represent important elements of the risk management system in a large territory of Southern Italy in order to prevent or reduce drought and flooding risks.

IRBA participates to many international research projects concerning a sustainable water resources management, the fight against desertification and the safeguard of the territory (table 1).

Project title	Partners	Financing program	Specific objectives
Sustainable Water Resources Management in areas exposed to the risk of drought -SwaRM	IRBA (lead partner) Basilicata University Mediterranean Agronomic Institute of Bari; Acqua S.p.A.; Pedagogical Institute of Cyprus; Malta University; National Technical University of Athens; Technological Educational Institute of Epirus.	European Community Initiative INTERREG III B- ARCHIMED (at evaluating phase)	Implementation of a sustainable water resources management system in IRBA territory and areas facing the risk of drought in Greece, Cyprus and Malta
Integrated Research for the Application of new technologies and new processes for the fight of the desertification-	ENEA; IRBA; Sassari University; Advanced Computer System ACS S.p.A.;	Italian Operational Programme for Research "2000-2006" (funded)	Development of an integrated informative system and technologically innovative to monitoring the processes of desertification in areas of Southern Italy and to promote the safeguard of the territory (including also IRBA territory)

RIADE	Basilicata Region.		
Water Resources Management and Governance in Tanzania	Ministry of Water and Livestock Development of Tanzania; IRBA; Italian Ministry of Finance; Italian Ministry of Environment; Sogesid; Formez; Acquedotto Pugliese S.p.A.; the Italian ONG CEFA	ACP-EU Water Facility – Actions in ACP Countries 9th European Development Fund. (at evaluating phase)	1) Capacity building of Tanzanian institutional subjects involved in water resources management. 2) Implementation of a sustainable water resources management system in Tanzania. The IRBA activity focuses on capacity building of the Tanzanian Basin Water Boards (BWBs) staff for predisposition of water resources planning tools.
Gestion intégrée des ressources en eau, développement et confrontation des méthodologies communales et transnationales pour la lutte contre la sécheresse aux régions MEDOCC - MEDDMAN	National Technical University of Athens; IRBA; Technical University of Catalonia (Spain); Italian Research Council; Basilicata University; Tuscia University; Lazio Region (Italy); Centre National du Machinisme Agricole, du Génie Rural, des Eaux et des Forêts (France).	European Community Initiative P.I.C. Intereg IIIB – Méditerranée (MEDOCC). (at evaluating phase)	Development of an integrated and shared system for water resources management in Western Mediterranean areas facing risk of drought.
Innovative technologies in control, treatment and maintenance for solving water emergencies.- AQUATEC	Bari, Napoli, Catania, Calabria and Basilicata University; IRBA; Water Research Institute of Italian Research Council	Italian Operational Programme for Research "2000-2006" (funded)	Development of technological and operational innovative tools for water resources management in Sardinia, Sicily, Campania, Apulia and Basilicata Regions (Italy). Application of results and methods in Val d'Agri (Basilicata) also under the supervision of IRBA.

Table 1: IRBA Main International Research Projects

4.1.1 INTERREGIONAL BASIN AUTHORITY OF BASILICATA EXPERIENCES AND TOOLS FOR WATER RESOURCES PLANNING, PROGRAMMING AND MANAGEMENT

The most important tool for IRBA and Basilicata Region water resources use planning and programming is the *River Basin Plan for Water Budget and Minimal Vital Outflow* (WB-MVO Plan), elaborated in compliance with national legislation (L.183/89, L.D.152/99, L.36/94) and with EU Directive 2000/60. This plan is the key cognitive, normative and technical-operating instrument for planning and programming actions/measures and regulations for surface and ground water resources management. Particularly since it regulates the greater part of the Basilicata water resources used in regional territory but also shared and transferred towards the Apulia Region and, in smaller quantity, towards the Calabria Region (fig.3).

Moreover in the IRBA territory there are the main hydraulic infrastructures (Sinni-Pertusillo and Basento-Bradano), ensuring the most relevant part of water supply for multiple use of the two regions (fig.3).

The WB-MVO Plan is also the key tool of the Program Agreement on the shared water resources between the Basilicata and Apulia Regions for the predisposition of the shared water resources budget, in order to ensure water uses for a sustainable development of the two regions on the base of effective water availabilities and demands, safeguarding the maintenance of Minimal Vital Outflow (MVO) in the rivers and the hydrogeological equilibria.

IRBA has been appointed technical-administrative support structure by Basilicata Region in order to carry out a large number of activities in water resources management under the competence of Basilicata Region, such as:

- I) **Program Agreement on the Shared Water Resources.** IRBA has been appointed technical-administrative support structure of the Government Authority instituted by the Program Agreement. The IRBA carried out activities are: shared water budget assessment; definition of the infrastructural hydraulic works useful for the two regions; definition of methods for multiple uses water demand evaluation; definition of methods for evaluation of raw water costs production; definition of water crisis prevention measures (actions/works); definition of environmental compensation works.
- II) **The Water Emergency Management in Basilicata**
IRBA has been appointed support structure by Delegated Commissioner of the Italian Prime Minister (D.P.C.M. 21 December 2001) for the management of Basilicata water emergency in 2001-2004 due to a long period of drought. IRBA was responsible for technical and economical planning, programming and management of the activities and works necessary to face the water emergency.
- III) **Water Resources "Objective Law" (L.431/2001)**
IRBA was appointed as support structure of the Basilicata Regional Committee for planning and realising the public works provided in the L.443/2001 - Water Resources "Objective Law". These works were useful: 1) to make more efficient and

flexible the entire Basilicata system of hydraulic infrastructures to prevent situations of water deficit in Basilicata and Apulia; 2) to monitor water uses (about 800 million cubic meters of waters are annually produced in Basilicata and shared between Basilicata, Apulia and Calabria users).

IV) **Framework Program Agreement on Water Resources**

In 2002 IRBA participated to the drafting of the Framework Program Agreement for Protection and Integrated Management of Water Resources with the Basilicata Region competent Departments and Authority of Optimum Territorial Ambit (A.A.T.O.) of Basilicata signed, in compliance with L 662/96, by Basilicata Region, Ministry of the Economy and Finances and the Ministry of the Environment.

Moreover IRBA supplies technical support to the Basilicata Regional Environment Agency for the activities directed toward the implementation and rationalization of the meteorological, idrometric and hydrogeological parameters monitoring networks.

4.2 AUTHORITY OF OPTIMUM TERRITORIAL AMBIT OF BASILICATA EXPERIENCES AND TOOLS FOR WATER RESOURCES PLANNING, PROGRAMMING AND MANAGEMENT

In compliance with National Law 36/1994 ("Galli Law ") Basilicata Region proceeded to the territorial reorganization of the water services establishing a unique Optimum Territorial Ambit, in which Integrated Water Service (IWS) management could be lead according to principles of efficiency, efficacy and economics (Basilicata Law 63/1996 "Institution of the Integrated Water Service. Marking out of the Optimum Ambit and regulation of the forms and the ways of cooperation between the Local Authority").

It has been moreover instituted an agency with public legal personality and organizational autonomy defined Authority of Territorial Ambit of Basilicata (Basilicata AATO). The Basilicata AATO, instituted since 1999, includes all Basilicata Municipalities and the Provinces. Its organization and activities agree with national, regional and EU laws. The Basilicata AATO organizes IWS in order to ensure:

- equal cure and attention for all participating Local Authority;
- homogenous and suitable for customers levels and standards of water service;
- the respect of the efficiency, efficacy and economics criteria;
- the water resources protection, safeguard and optimum use;
- the unity of the tariff system, evaluated on the basis of water resources quality and of the supplied water service;
- the definition and the realization of an investment program for water service rationalization and improvement.

With Assembly Resolution n. 6/2004, the Basilicata AATO, in compliance with L.448/2001 (art. 35), entrusted the IWS management to "Acquedotto Lucano corporation" (public share joint-stock company), exceeding inefficiencies caused by a large managerial fragmentary architecture. This organization has allowed to realize the clean distinction between water resource governance, exercised by Local Authority, and the management of the same one, entrusted to structures with enterprise characteristics. The Basilicata AATO (art.11 L. 36/94) has carried out a reconnaissance of aqueducts, sewerage systems and waste water treatment plants and systems. The comparison between the existing infrastructures and the water service levels, defined for the Basilicata AATO, has allowed the identification and location of the hydraulic infrastructures critical states and the elaboration of the works and financial plans and of the managerial and organizational model, constituting the AATO Ambit Plan.

The IWS institution has allowed to exceed the managerial fragmentary architecture, defining a unitary policy, whose aims are: solidarity, reliability, efficacy, organizing efficiency, tariffs standardization. Moreover it is very important that Local Authority are involved in the planning activities, approving the IWS Paper of Quality.

Other peculiarity of the IWS governance policy is the study and the application of a suitable, unitary tariff, that it allows to cover the investment and management high costs, owing to: the Basilicata geomorphologic characteristics; the presence of large number of landslide and flooding risk areas; the presence of urbanized areas situated at altitude higher than water sources (springs and dams), with very high costs in order to lift water resources.

The Basilicata AATO and Basilicata Region are defining, moreover, economic facilities for drinking water producer Municipalities.

4.3 ACQUEDOTTO LUCANO

Acquedotto Lucano (AL), established by Basilicata AATO with Deliberation 19/2002, is an entirely public working capital Company (made of the Municipalities and the Government of Regione Basilicata), in charge of the Integrated Water Service in Basilicata; that is to say all of the activities that regard water uptake from the springs, transportation through the aqueducts and the hydraulic network, distribution to the houses, up to the depuration in the treatment plants and the commercial utilizations.

The Body in charge of the management for the IWS in Basilicata is operating inside an area that comprises 131 Municipalities, with a population of about 610.000 inhabitants, with 250.000 users and more than 4.000 Kilometres of network.

AL has been primarily conceived in order to achieve, according to Law 36/94, an efficient and economic management of the Water Service, bypassing costs and constrains deriving from a fragmentary architecture of it, mainly due to the existing multiple Bodies deputed to the management, amongst which also some Municipalities (so called "Economy management").

Since July 2003 AL has been taking direct charge of the depuration and sewage water treatment services in all of the 131 municipalities of Basilicata Region; besides the Water Service in 67 of these, previously held by Acquedotto Pugliese, has started instead on the 1st of May 2004.

More in a general way, the creation of the Company is to be thought of as essential within the reorganization of this sector, enforced during these last years by the Government of Regione Basilicata, in order to be able to exert a major control on the administration of Basilicata water resources. This is also the reason why Acqua S.p.A. was created.

4.4 ACQUA S.P.A.

The Government of Basilicata Region, with the Law 3rd June 2002 n.21 ("Rules on the exertion of regional duties with respect to water supply") has created an entirely Limited Public Company under the name of "Acqua S.p.A. – Limited Public Company for water supply".

This company, with an entirely public working capital (thus open to the participation of other Institutional and/or private bodies) will primarily deal with the collection of the water, its storage, transfer and adducing, but also with its treatment for the primary supply linked to the great water schemes, in order to satisfy civil uses, irrigation purposes and industrial utilizations in the territories served and, last but not least, also with the proper management and maintenance of the technical structures.

The activity of Acqua S.p.A. is thus aimed at the achieving of the following goals:

- United administration of water collection, both surface and ground resources, of its storage, transportation and adducing, also by enabling the transfer among complex and connected hydraulic schemes or different catchment basins, the treatment for primary supply to the civil, agricultural and industrial uses, besides its utilization for energy creation.
- Management, ordinary and extraordinary maintenance of the structures, the plants and the artefacts transferred to the Government of Basilicata Region, according to art. 6 of Law n.183 of 2 May 1976, besides those realized by means of regional, national and E.U. funds, conceived for primary supply to the different uses of the resource or located within the regional territory;
- Realization of studies, analysis and other activities aimed at supporting the organization and the correct working of the Water Service for the purposes recalled in art. 1 of the Regional Law n. 21 of 3 June 2002, also including the making of plans, programmes and territorial and/or system studies, the technical and economical evaluation and the tuning up of project financing initiatives and similar to obtain intervention programmes and/or single investments.
- Monitoring of the quantitative and qualitative status of the water resources, also in order to be able to obtain in continuous the water balance and the lifeguard of the citizens, during periods of crisis and water deficit emergency situations.
- Raising of the tariff for the primary water supply service to the final users, as agreed within the Programme Agreement on the Shared Water Resources and reminded from the articles 1 co. 2 and 4 of the Law of Basilicata Region n. 21 of the 3rd June 2002.

- Achievement of other duties, offices and activities demanded by the National and local Government, besides by the local Administrations, coherent with the activities recalled in the previous letters and with the aim recalled by art. 1 of the Law of Basilicata Region n. 21 of the 3rd June 2002.

According to the Law n. 488 of 28 December 2001 Acqua S.p.A will receive, on the basis of a specific agreement approved by the Governmental Bodies of the interested Regions, the administration of infrastructures, artefacts and regional plants actually managed by Italian Agency for the Development of Irrigation and Land Transformation of Apulia, Basilicata and Irpinia, named EIPLI in Italy), which is the body today in charge of the administration of the great reservoirs operating in Southern Italy.

5 BASILICATA TOOLS FOR WATER RESOURCES PROGRAMMING AND MANAGEMENT

The water resources normative framework at European and Italian level and, in Italy, at regional level, provides that the States and the Regions play an active role in water resources programming and management in their territories, controlling on contractual and cooperation bases, the water resources transfers between the water productive and water utilization areas, ensuring at the same time their sustainable use.

In Italy the administrative functions in water resources sector have been disciplined by the L.D.112/98 that characterises the Regions and the Local Authority as competent for public waters management. Following the Italian Constitution Title V reform (L. 3/2001) the water resources government is object of concurrent legislation (the Italy State prescribes the water resources management guide lines, the Regions discipline the water resources use and protection in their territorial ambit of competence, according to the national and communitarian dispositions).

In this system the Region is responsible for resource allocation between local Authority, the Interregional River Basin Authority of the Basilicata (IRBA) programs, in its territory, the division of the resource between the users categories, the Basilicata AATO and the managers of the water service program and manage the water infrastructures system. Particularly IRBA carries out a role of coordination of the planning choices, by making an operating synergy between the institutional actors in water sector, ensuring a water resources use in line with quality and availabilities characteristics. The IRBA programming activity constitutes an important base for contractual strategies definition for the shared water resources between Basilicata and Apulia Regions.

In the development of water resources planning and management tools Basilicata Region, AATO Basilicata and IRBA made use of the support of the Universities and the research Institute working on the territory, to make coherent the plan forecasts with the physical characteristics of the territory and with the water resources quality and availability characteristics.

In the following the main Basilicata Region water resources planning, programming and management tools are described.

5.1 THE BASILICATA WATER PROTECTION PLAN

The government and the corrected water resource use cannot disregard the careful water quality parameters evaluation. These can be express by the following fundamental aspects:

- water quality as by physical, chemical and organoleptic parameters control for various water resources;
- water quality as discharge in the receiving water bodies from sewage systems and from wastewater treatment plants;
- finally, water quality as predisposition of the best system for control, management and implementation of the national and regional legislation, in this sector, than is turned in water services quality and in environmental protection.

In compliance with Directive 2000/60/CE and L.D. 152/99, with respect to the water bodies quality characteristics determination, the Basilicata Region started the Water Protection Plan elaboration. Water bodies monitoring activities are propaedeutic to Water Protection Plan definition. The final document for the "Definition of the cognitive state of the surface, ground and marine-coastal water bodies ", have been, already, approved. The document contains the results of the surveying realized for regional water bodies quality characteristics definition.

Particularly a monitoring activity was carried out, by keeping water samples and with lab analysis, to assess:

- water resources suitability on the regional territory for drinking water supply, for zootechnic and agricultural use
- possible pollution phenomena around dangerous areas.

With Basilicata Regional Council Resolution n. 3169/2004 it has been therefore made the precondition for Water Protection Plan elaboration.

With Basilicata Regional Council Resolution n. 224/2003, it has been approved of the "Monitoring network project for ground waters exposed to agricultural sources pollution risk " that allows getting information on water characteristics from wells in vulnerable areas. Moreover the monitoring system has been improved, with Basilicata Regional Council Resolution n. 3164/2004, achieving a sampling density of a point in 5 Km².

From the activities carried out, it can be seen a tendency towards the increment of the waters vulnerability due to the nitrate presence of anthropic origin in areas with agricultural vocation. Probably, the final result will show that it is necessary to provide pollution risk prevention actions.

In compliance with L.D.152/99 Basilicata Region competent Offices have been, already, under way activities for surface waters qualitative control of the overall regional hydrological river net, in order to prevent or reduce pollution risks.

The cognitive picture on qualitative superficial waters condition shows critical situations due to chemical and biological pollution above all in correspondence of the Basento and Agri river mouths (Metaponto plain; fig.2). Also the Ofanto river, in correspondence of monitoring sections, shows chemical pollution due to elevated mercury and lead concentrations. Finally, in correspondence of other streams, next to Rendina reservoir (fig.3), there are high mercury concentrations.

With Basilicata Regional Council Resolution n. 1473/02, the completion of bacteriological and geochemical monitoring activities was been approved for Basento river; with Basilicata Regional Council Resolution n. 1476/02 it was been approved the completion of qualitative and geochemical monitoring for other Basilicata streams.

To the end of the monitoring activities water bodies critical states will be identified and characterized.

Basilicata Region is participating from 2000 to a national program for coastal water bodies monitoring. In particular, Basento and Sinni rivers were sampled near their mouths (Ionian coast). Also a stream flowing into Tyrrhenian sea was sampled.

From the analyses carried out is emerged one be of good and altogether sure such quality not to generate alarms.

The results of samples analysis show that the Tyrrhenian and Ionian coastal water bodies have a good quality state.

The results of water bodies monitoring will be used to plan and program measures for surface and ground water bodies protection from pollution.

The Basilicata Water Protection Plan and River Basin Plan for Water Budget and Minimum Vital Outflow specify measures necessary for the regulations of waste waters and water derivations.

The Basilicata General Director's Environment Office and the Italian Ministry of Infrastructures - Nets Direction are putting into action all procedures for the "Computer Science Portal" realization. This system will allow searching information about natural water springs and rivers and their capacities in order to define water concession and derivation procedures.

5.2 THE RIVER BASIN PLAN FOR WATER BUDGET AND MINIMUM VITAL OUTFLOW

The Interregional River Basin Authority of Basilicata (IRBA), in compliance to national legislation (L. 183/89, L.D.152/99, L. 36/94) and to EU Directive 2000/60/CE, has elaborated the River Basin Plan for Water Budget and Minimum Vital Outflow (WB-MVO Plan). This plan is the key cognitive, normative and technical-operating instrument for planning and programming actions/measures and regulation for surface and ground water resources management.

Such plan is very important in Region Basilicata territory, that is the centre of the primary water system of Southern Italy. The WB-MVO Plan is, in fact, the implementation of the Program Agreement between Basilicata and Apulia Regions on shared water resources. The Plan forecasts the predisposition of shared water budget, in order to guarantee the necessary water uses for a sustainable development of the two regions based on the effective water availability and demands (fig.4), safeguarding the maintenance of Minimal Vital Outflow (MVO) in the rivers (fig.5) and the hydrogeological equilibrium of ground water bodies.

The WB-MVO Plan defines:

- surface and ground water resources availability in each catchment basin and in the connected hydrogeological structures;
- the volumes taken and discharged in the river basins or sub basins;
- the water volumes coming from other river basins;
- the water resource uses (fig.4), the demand requirements and their spatial and temporal distribution;
- the characterisation of water infrastructures conditions (location of the main schemes for water supplying, adduction and distribution also with reference to resources transferred between river basins and between Basilicata and neighbouring Regions);
- the hydraulic budget and its equilibrium conditions;
- criteria and methods for MVO definition (fig.5) and discharge necessary for MVO maintenance in the rivers;
- the risk with respect to water resources availabilities and quality;
- measures for the maintenance of the equilibrium conditions of the water budget, for water infrastructures rationalization, for water saving and wastewaters reuse.

The Water Budget has been elaborated by matching the available water resources and the requirements for the various uses. The definition and safeguards of the water budget equilibrium are basic premises for water resources planning and programming finalised to guarantee an environmental sustainable and jointly liable use. Together with the WB-MVO Plan an informative system, that can be updated in continuous, has been developed. This allows to represent the availability and the water demands variability, also on daily scale.

IRBA during the WB-MVO Plan elaboration was putting in action coordination activity with all the actors in the water resources planning and management sector in the single local ambit beyond that with the University and with the Research Institutes involved in the physical system characterization in order to make coherent the plan forecasts with the physical characteristics of the territory and with the water resources quality and availability characteristics.

The WB-MVO Plan represents an effective water resources use planning instrument, that can be updated in continuous, in order to be able to manage the water bodies concessions of derivation and/or of ground water derivation, and to give a precise definition of the transferable volumes to the neighbouring regions, in a large territorial ambit of the Southern Italy, subject to water crisis.

5.3 THE BASILICATA AMBIT PLAN AND WATER TARIFF POLICY

The Authority of Optimum Territorial Ambit of Basilicata (Basilicata AATO), in which they are represented all Basilicata Municipalities, has been instituted since 1999; its organization and activities inspire to Eu policy and to national and regional provisions (D.P.C.M 27 January 1994; L. 273/ 1995; L. 36/1994).

To six years from the Integrated Water Service institution, in consideration of the experiences of the actions realized within Basilicata territory, AATO supports the development of an "integrated model" for monitoring the activities in the water sector in order to establish a united policy in the water resources planning and management between the institutional actors in water sector.

The Basilicata AATO water resources management is based on the following priority aspects: 1) water resources democratic management; 2) sustainable development of the territory; 3) water service improvement; 4) democratic tariff policy with particular attention to weak classes; 4) definition and fulfilment of an investment plan for the water services extension, rationalization and improvement.

The principles of water resources governance are: 1) solidarity; 2) elevated level of protection; 3) precaution principle; 4) preventive measures; 5) scientific and technical data

use; 6) variability of the environmental conditions; 7) costs/benefits ratio; 8) socio economic development; 9) international cooperation.

In relation to the water resources "risk management", the Basilicata AATO, one of the firsts in Italy to have been instituted and to have drawn up the Ambit Plan, means to emphasize the relation between the "risk" and the challenges faced throughout its early years of experience; they contribute every day to the definition of managerial choices directed towards the risks mitigation in territorial planning sector.

The institution of the Integrated Water Service (considered as the union of the public services of water intake, distribution, sewage and purification systems) concurs a sustainable water resource management, overcoming the fragmentary architecture of the local managements (often considered "in economy" managements).

The risks, to which the Basilicata AATO' activities are exposed, can therefore be summarized:

- Environmental Risk: among Ambit Plan targets it is comprised the connection of the sewage nets to the waste water treatment plants, therefore the waste waters must be consistent with the European and national provisions.
- Service Risk: to guarantee the water service continuously during the day, in order to allow to citizens living in healthy hygienic-sanitary conditions.
- Socio-economic risk: to adopt a water tariff proportionate to the works plan and consistent with territory socio-economic characteristic, aiming also to a facilitated tariff for weak classes.

In such context, the actions carried out for the attainment of the indicated purposes are:

- Attainment of quality standards in the water distribution. The start of the Acquedotto Lucano management, under Basilicata AATO control, has involved clearly an improvement of water distribution continuously during the day in the Basilicata Municipalities. In fact, from a recent study carried out through data supplied by Acquedotto Lucano, it has been taken place that the critical situations in water distribution are limited to the summer periods. The service reaches the quality standard defined by the Ambit Plan, in spite of the problems connected to the morphologic complexity of the territory.
- Tariff definition. The Basilicata AATO will proceed, as soon as possible, to water tariff definition, at first in relation to specific categories of water users until today not defined, like "Big Users" (hospitals and hotel-tourist structures) and "Big Provider" (Irrigation and Land Reclamation Consortia, Industrial Areas), but also in order to introduce economic facilities for indigent families and retired persons which live alone. The Basilicata AATO has started contacts with Municipalities in order to receive information regarding socially assisted families, old people which receive very low pensions, accomplishing support measures and guaranteeing some free water volumes for weak social levels. Support measures will be activated for Municipalities which have betrayed economic problems because of passage from autonomous water service to that integrated one.
- Approval of the Integrated Water Service Quality Paper, Regulations and the relative Annexes. The Quality Paper was approved by all Basilicata Mayors; it represents the basic document for water users protection, safeguarding their rights to use public water and to benefit from efficient IWS. The Quality Paper is the document by means of which the Basilicata Mayors can carry out a democratic management of IWS, assuming, therefore, an active role within Basilicata AATO. In this way Basilicata Municipalities can control IWS Management Body, which must give account of IWS budget.
- Support Environment Compensation Principle. This principle was established with Basilicata Regional Council Resolution n. 1321/02 in favour of Municipalities in whose territories there are located water resources to carry to main pipelines.

The water tariff includes also the costs of the measures needed for water resources safeguard, for carrying out jointly liable development of territories.

The Basilicata AATO has suggested that environment compensation funds coming from water tariff collection can be used by Municipalities also for other needs of their territories, extending the period of benefit validity.

In 2002 the IWS management was entrusted to Acquedotto Lucano (joint-stock company to which the greater part of Basilicata Municipalities is member). Acquedotto Lucano has

immediately provided to put into effect the AATO Ambit Plan, in order to remove IWS critical situations, where it will possible, in the near future.

Among the most important actions planned by Acquedotto Lucano for prevention of water crisis risk there is the realization of a program for the control of numerous water losses in various sites of Basilicata Region. The most considerable activity is the functioning rationalization of Potenza City water network and the predisposition of a modern remote control system that enable a real, direct and continue vision of the water flows during the service distribution. This system has concurred a water saving of about 220 l/s.

5.4 PROGRAM AGREEMENT ON SHARED WATER RESOURCES BETWEEN BASILICATA AND APULIA REGIONS

For IRBA and Basilicata Region territories it is particularly important for water resources management the *Program Agreement on Shared Water Resources- PA* (former art. 17 L. 36/94) signed in 1999 by Basilicata Region, Apulia Region and the Ministry of the Public Works (currently Ministry of Infrastructures and Transports).

The hydraulic schemes that are the object of the Program Agreement, in IRBA territory are: the Sinni-Pertusillo and the Basento-Bradano schemes, that constitute the bigger part of water supplying for multiple uses. IRBA, due to its experiences and to the activities carried out for water budget evaluation and planning, has been appointed technical-administrative support structure of the Government Authority instituted by Program Agreement.

The Program Agreement on Shared Water Resources has the objective to find a solution for some important problems that have always interested a wide territory of the Southern Italy, where there is a water deficit problem, like as:

- shared water budget between Basilicata and Apulia Regions arrangement;
- hydraulic interconnected infrastructures of common interest of the two regions definition;
- putting in to action tools of permanent coordination, for developing programming, planning and monitoring actions;
- definition of guidelines agreed between the Program Agreement signatories subjects for the evolution of the present configuration of the Subject Managers;
- homogenous criteria and guidelines definition about the agriculture, industrial and drinking water demands on which will be based a most objective possible regional necessities evaluation;
- determination of the raw water production costs by procedures and methods definition to establish the reference tariff for the primary supplying service for multiple use and for the realignment of water resource basins producers and consumers. The Program Agreement it is based on the principle, asserted to national and communitarian level, than the measures adopted to realise the environmental objectives of protection and sustainable water resource use, have to be coordinated between themselves and their effects have to be coordinated and managed to the inside of every catchment basin;
- starting recovery, recycle and water saving actions, in the different resource uses;
- protection and safeguard of the aquifers of the Ionian and Salento (Apulia) areas;
- determination of measures and interventions to allow the full reservoirs use and the relative hydraulic schemes accomplishment;
- feasibility verification of water resources new contributions and consequent transfers;
- definition of procedures shared by the Regions in order to face recurrent or exceptional periods of water crisis.

The Program Agreement was the first organic and, at still now, the only form of regional reciprocity, of jointly liable federalism, for a limited and precious resource use. It represents an institutional instrument of great innovative force in order to bring back the traditional formulations of "water politics" of the Southern Italy in a Co-decision regimen, by passing the anachronistic and unfair division between water production and consumption areas, establishing new shapes and methods for costs remuneration and for environmental compensations.

Thanks to the PA, conflicts and ancient incomprehension have been settled and, recently, with the raw water tariff definition, it has been finally established a sure criterion to divide with

the Apulia users the costs that, before the Agreement, the Basilicata Region supported for water collection, distribution and conservation for future generations benefit.

Using money deriving from water tariff collection it has been possible: to give run to environmental maintenance and conservation interventions; to support, without increases for the Region Basilicata budget, the costs necessary in order to yield waters to the neighbouring regions; it will be possible to carry out territorial re-balance measures in order to favour the territories and the communities that support the burden of water supplying and to which portions of territories have been taken away to ensure water storage.

One of the crucial points of the Agreement is represented by the determination of the raw water tariff, that is primary supply tariff (the system of hydraulic infrastructures for water resources production and transport).

The cost components of raw water tariff, established in May 2004 by the PA Coordination Committee, are:

- industrial costs for management and extraordinary maintenance, due to IWS management;
- costs related to public interest requirements, like as:
 - 1) environmental costs directed to the realization of: hydraulic -forest interventions for hidrogeological risk mitigation or prevention; waste water treatment plants; water bodies and meteo-climatic parameters monitoring networks; hydraulic intervention down to dams; interventions for costal shore protection in order to reduce or avoid regression due to sediment transport reduction;
 - 2) energetic costs due to water pumping stations;
 - 3) costs for environmental re-balance between water production and utilization areas.

As established from the PA, a work group composed by technicians from the Administrations signers of the Agreement, has been constituted to determine these costs.

In May 2004 the PA Coordination Committee has examined the document of the group work reaching an agreement between the Regions Basilicata and Apulia that approves:

- a temporary model with an experimental flat-rate tariff that allows to support a public works plan;
- measures and management modalities definition (within the 31/07/2004) for industrial costs in 2004.

Moreover, the Coordination Committee, is engaged so that, in the considered the three years deadline, the raw water tariff will be evaluated, also basing on monitoring results and on costs trend, covering also the industrial ones of the primary supplying management bodies.

The Program Agreement established that, starting already by July 2000, the production cost of the raw water (estimated until 2003, in a flat way, to 35 Meuro) are charged to the primary supplying management bodies.

The Program Agreement Coordination Committee has established, in May 2004, that:

- the economic obligations that Apulia Region, as Basilicata water resources user, must pay to Basilicata Region for period 2000-2002 (an amount of 35 Meuro) were directed towards the realisation of environmental safeguard and hydraulic-forestal maintenance intervents (already realized in 2003 or to be realised in 2004) in the catchment basins interested by the dams, pipelines and other hydraulic structures for water resource transfer in Apulia;
- the tariff proceeds of year 2003 (roughly 13 Meuro) were directed towards the Basilicata AATO, to concur the start of Basilicata Integrated Water System, and the transfer to Acquedotto Lucano of the activities carried out in Basilicata by Acquedotto Pugliese.

The programmatic document, approved by the PA Coordination Committee for biennium 2004-2005, establishes that the profits, deriving from the water volumes distributes to the regions, are assigned to the works and activities realisation necessary to guarantee the water resource protection, like as the extraordinary maintenance of the sensitive areas through the wood increase, the forest and environmental restoration, the river beds renaturalisation, the hydrographic river net maintenance.

Assuming the annual medium value of the volumes distributed to the Regions, for the program realisation, the following financial resources will be available: roughly 23,50 Meuro, for year 2004 and roughly 31,50 Meuro for year 2005.

In February 2005 the PA Coordination Committee, beyond approving the programs of water resources use for the year 2005, has established a work group (formed by functionaries of Basilicata and Apulia Regions and of Sogesid- Italian National Management Agency Hydraulic Systems) to determinate water tariff for 2006 and following years and for industrial costs determination.

5.5 THE WATER RESOURCES "OBJECTIVE LAW"

The functional and efficient water systems organisation for water resource transport, their corrected management, the water resources monitoring are essential requirements for water crisis risk reduction or prevention. IRBA supports the Basilicata Regional Council for planning and realising the public works provided in the L. 443/2001, Water Resources "Objective Law". The program includes interventions able to structurally modify the entire water resource supplying and distribution system of the Basilicata and neighbouring Regions, in order to make more efficient and flexible the entire system of hydraulic Basilicata schemes by realising interconnections between the hydraulic infrastructures, new pipelines and reservoirs (the overall cost of works is about 859 Meuro). The definition and realisation of these interventions constitute an effective instrument to solve possible water deficit situations, by allowing the water resource transfer towards those river basins in which water deficit is.

The program includes a very important project " Complete evaluation of the civil, industrial, agricultural users and water supplied measurement " (endorsed by CIPE on 20/12/2004), for realisation and upgrading of a monitoring system of the overall users in Basilicata territory to allow a better resources planning and management (the project cost is about 59 Meuro).

In such a way will be possible monitoring the management of roughly 800 million cubic meters of water, produced annually by Basilicata Region and distributed for multiple uses water demand satisfaction in the Basilicata, Apulia and Calabria territories.

This monitoring and remote control system, starting at the present, represents an effective and efficient continuous monitoring system of water resources and their uses, allowing a greater efficiency in the water systems management, for a corrected water resources planning and management. This system, moreover, can be considered as an early warning system of the water deficits risks, therefore it is also an prevention tool of the water emergencies in the Basilicata Region territory.

The project will involve all the main hydraulic infrastructures connected to the Basilicata hydraulic schemes by: monitoring of the civil, industrial and agricultural users of 13 dams and 7 weirs; measuring the capacity of 198 agricultural reservoirs, 100 water pumping stations and 70 water intakes in the Irrigation and Land Reclamation Consortium of Bradano-Metaponto, Val D' Agri and Vulture Alto Bradano territories; telemetry of water volumes for irrigation supplied to 59.079 agricultural users; telemetry of volumes and discharges of 202 reservoirs and 28 split flows, and of 25 water pumping stations from wells and springs; the telemetry of 30 water systems for the Potenza and Matera Industrial Areas; installing discharge measuring devices for 17 derivations along the main Sinni pipeline; measuring the discharges supplied to Apulia and Calabria Regions by Sinni, Pertusillo and Ofanto pipelines; telemetry of water consumptions of 3.816 users and 40 check points in Potenza.

5.6 FRAMEWORK PROGRAM AGREEMENT ON WATER RESOURCES

In 2002 Basilicata Region, IRBA and the Basilicata Authority of Optimal Territorial Ambit elaborated the " Framework Program Agreement for Water Protection and Integrated Water Resources Management" signed (in compliance with L 662/96) in Rome on 30 December 2002 by Basilicata Region, the Ministry of the Economy and Finances, and the Ministry of the Environment.

The Agreement objectives can be summed up:

- protection, pollution reduction and surface and ground water quality restoration in compliance with EU Directives 2000/60, 91/271/CEE, 91/676/CEE and 76/464/CEE;
- encouraging a global resources management policy for their sustainable use and for multiple use water demand satisfaction;
- the integrated water service achievement by a functional water resources management.

The Program Agreement defines, moreover, the realisation of the following interventions typologies:

- urgent interventions for drinking water supply, specifically reconstruction, rationalisation or construction of water nets works in 52 Municipalities;
- urgent interventions for surface and ground water bodies protection, comprising interventions of rationalization, upgrading or construction of sewage systems in urban and rural areas and wastewater treatment plant in 68 Municipalities;
- urgent interventions for valuable water bodies restoration and protection;
- interventions for hazardous chemicals discharge reduction and removal;
- interventions of monitoring and planning, regarding the overall regional territory.

The overall cost of interventions is about 296 Meuro.

6 BASILICATA TOOLS AND ACTIVITIES FOR FLOODING RISK MANAGEMENT

The Region Basilicata and IRBA territory are characterized by a strong predisposition to landslides and to flooding phenomena due to: its geologic, geomorphologic, hydrogeological and seismic characteristics; the hydrographic network peculiarity; hydrological regime of IRBA surface water bodies.

The defence of territory from landslides and flooding represents a priority for the protection of human life but also of the economic activities and the cultural and environmental goods.

To such aim IRBA, in compliance with national legislation (L.183/89, L.365/2000), has developed the *River Basin Hydrogeological Management Plan* (HM Plan), divided in *Flooding Management Plan* (FM Plan, fig.6) and *Landslides Management Plan* (LM Plan, fig.7).

Flooding Management Plan is the key tool for prevention and management of territorial problems due to flooding risk.

FM Plan, starting from the knowledge of territory physical characteristics and from the analysis of flooding hazard and risk, specifies structural and non structural measures (works/actions) useful to the regulation of the territory interested from floods.

The FM Plan priority aims are:

- identification of river beds and river strips (fig.6) flooded with return times until 30 years (Very high hydraulic risk Areas), with return times until 200 years (High hydraulic risk Areas) and with return times until 500 years (Moderated hydraulic risk Areas) for IRBA surface water bodies (Bradano, Basento, Cavone, Agri, Sinni, Noce).;
- definition of management strategies in flood risk areas useful: to reduce damages produced by anthropic activities and natural phenomena; to safeguard and/or to preserve natural hydraulic dynamics of water surface bodies; to protect water surface bodies from pollution;
- identification of structural and non structural actions/works reducing and preventing flooding hazard and risk.

The FM Plan was arranged by IRBA with the collaboration of Universities, Research Institutes and of all institutional subjects involved in land management, in order to elaborate an effective plan, annually updated, that ensures a socio-economic development of IRBA territory compatible with its physical characteristics and with flood risk conditions.

IRBA *Flooding Management Plan* is the regulative framework to which all authorizations and concessions about land uses have to be adapted and referred to.

For the prevention and reduction of the flooding risk in its territory, IRBA has developed an efficient activity of *Hydraulic Police* (HP) for surface water bodies monitoring (in compliance with National Law 365/2000), in order to identify the higher flood risk situations (fig.8) and the most urgent measures (works/actions) useful to risk mitigation.

The Hydraulic Police represents an activity of remarkable importance for flood risk management and prevention. IRBA has already realized two HP cycles (in 2003-2004), assessing: structures localized in river bed and in flooding river strips; geological instability of river banks and river levees; narrowing of river sections; impediments to natural river outflow; other critical states of surface water bodies. Moreover Hydraulic Police IRBA staff has localized river sections subject to erosion or to aggradation.

The assessed critical situations are divided in three hazard classes: class 1= high hazard; class 2= medium hazard; class 3 = moderate risk (tables 2 and 3).

Today the third HP Cycle is starting, in order to monitor critical states assessed in previous HP Cycles and to identify other critical states.

IRBA reports assessed critical states to all institutional subjects involved in surface water bodies and hydraulic infrastructures management, in order that they can realize timely maintenance and/or river recovery works.

RIVER	CLASS 1	CLASS 2	CLASS 3	TOTAL
BRADANO	80	7	13	100
BASENTO	212	55	49	316
CAVONE	26	7	4	37
AGRI	137	21	15	173
SINNI	68	4	9	81
NOCE	53	9	6	68
TOTAL	576	103	96	775

Table 2)

Table 2) Critical situations assessed the first Hp cycle, splitted among rivers and hazard classes

RIVER	CLASS 1 -	CLASS 2 -	CLASS 3 -	TOTAL
AGRI	8	21	17	46
BASENTO	2	5	12	19
BRADANO	4	2	5	11
CAVONE	3	4	3	10
NOCE	3	5	6	14
SINNI	9	7	11	27
TOTALE	29	44	54	127

Table 3)

Table 3) Critical situations assessed the second Hp cycle, splitted among rivers and hazard classes