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PARTICIPATORY WATER MANAGEMENT IN ITALY: CASE STUDY OF THE CONSORTIUM “BONIFICA DELLA CAPITANATA”

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SUMMARY – This work presents the case of study carried out on the Consortium of “Bonifica della Capitanata” (Southern Italy), which is one of the greatest and most important Irrigation Consortium in the Mediterranean region. The study of Capitanata is extremely interesting not only for technical reasons and adopted water saving practices but also because it represents a good example of participatory organization and management of a broad and important area. The Consortium has been analyzed from organizational, operational and technical point of view, with a particular attention to water saving strategies and pricing and financing instruments..

Key words: Participatory Irrigation Management, irrigated agriculture, Irrigation Consortia, water saving practices, water pricing, Bonifica della Capitanata.

INTRODUCTION

The tradition of participatory approach in irrigated agriculture is of long history and great relevance in many parts of Italy although it is of particular significance in the Apulia region where agricultural production together with tourism represent one of the major wheels of economy.

The Apulia region with a surface area of 19,361 km² occupies ultimate South-East of the Italian "Boot" (Fig. 1). The region is extended from NW to SE and it is largely opened to the Adriatic and Jonian Sea with a coastal zone of nearly 700 km. The climate is mainly of Mediterranean semi-arid type, characterised by hot and dry summer and moderately cold and rainy winter season.

The agricultural land represents more than 70% of the total surface area of the Apulia region and it is cultivated prevalently by cereals and vegetables, in the Central Northern area of “Tavoliere delle Puglie”, and by olive-trees and vineyards, in the Central part of the region and in Salento on the South. Most of agricultural production is based on irrigation although water availability is very limited and highly depends on the water inflow from the surrounding regions (primarily from Basilicata) and water extraction from groundwater aquifers.

Six land reclamation and irrigation consortia, covering about 90% of the whole region, are located in the region as illustrated in Figure 1. The Consortia cover an administrative area of 1,743,591 hectares or about 90% of the whole region. The surface area equipped with the consortia water distribution networks is extended over 236,012 hectares although only one-third of it is effectively irrigated by the Consortia due to high water requirements and chronic water shortage.

It is estimated that irrigated area is significantly greater and reach about 352,732 ha since most farmers used for irrigation water extracted from the wells located at their fields. In fact, it is estimated that only one-third of overall agricultural water demand of 789.65 million m³ per year is satisfied by with water delivered by the consortia while two-thirds (about 550,000 m³ per year) relied on the abstraction of groundwater (INEA, 1999). This huge and uncontrolled withdrawal of groundwater causes periodically an excessive drop of groundwater table and intrusion of the saltwater in the zone of aquifers. Such problems are actually mediated by the census of the wells located in private farms and the introduction of the measures for the control of withdrawal of groundwater resources.

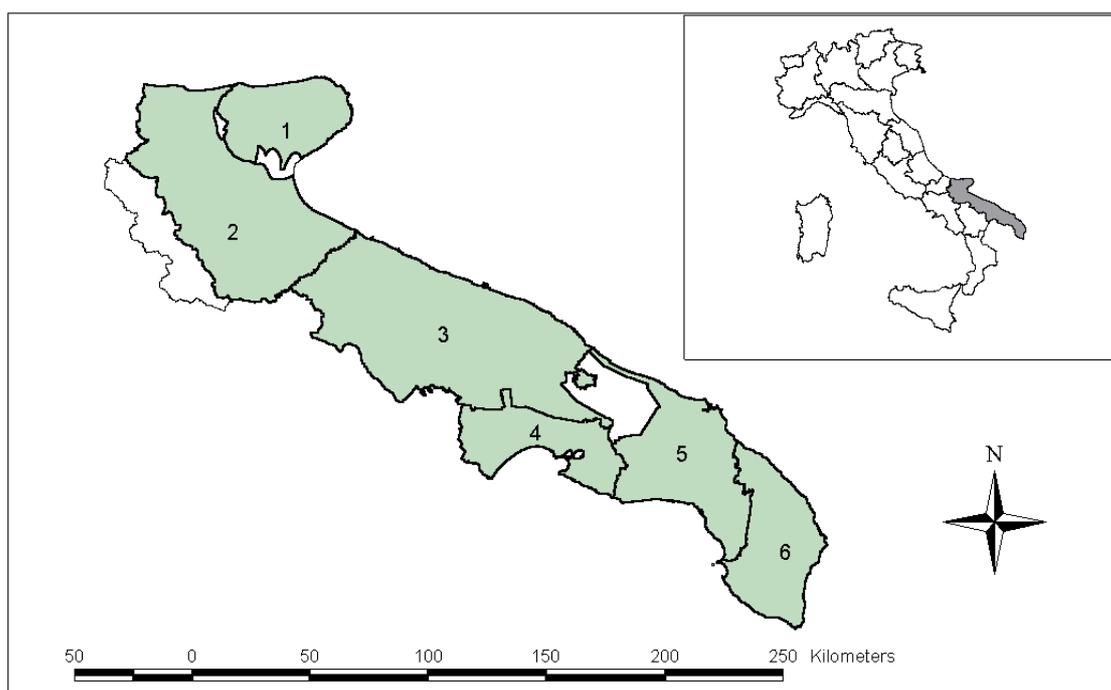


Fig. 1. Apulia region and administrative boundaries of irrigation consortia (1-Gargano; 2-Capitanata; 3-Terre d'Apulia; 4-Stornara e Tara; 5-Arneo; 6-Ugento e Li Foggi)

CONSORTIUM OF "BONIFICA DELLA CAPITANATA": MAIN TECHNICAL CHARACTERISTICS

The Consortium of "Bonifica della Capitanata" is located in the Northern part of Apulia region (Fig. 1). This is the most important Consortium in the Apulia region by means of both irrigated area and crop water requirements. Certainly, this is also one of the most important Consortium in the whole Mediterranean region.

The Consortium of "Bonifica della Capitanata" had been founded already in 1934 when nine basin Consortia were gathered into a unique Consortium that was called "Consorzio Generale per la Bonifica della Capitanata". The initial activities of the Consortium were aimed at recovering agricultural lands through hydraulic regulation works with amelioration of unhealthy areas to eradicate malaria and to create livable life conditions in the countryside. Only twenty years later (at the beginning of the '50s), the decisive role irrigation would have played in the subsequent cropping and economic transformation of the land became evident with all the consequences on the agricultural economic development of Capitanata and the community as a whole.

The results of all activities were indeed very impressive with a change in the landscape and a progressive increase of the population in the main flat built-up areas. The latter, rehabilitated and reclaimed from a healthy and sanitary point of view, provided the inhabitants of the small towns located in hilly and mountain areas, favoured so far for their healthiness, with better possibilities of economic growth and development. From 1931 to 1998 the population density within the reclamation scheme increased from 55 inhabitants to 155 inhabitants per Km². The flat built-up areas were those that grew most: neglecting the minor municipalities, these included Foggia that has seen its residents triple from 55,000 to 155,000, Lucera from 18,000 to 26,000, Manfredonia from 19,000 to 58,000, San Severo from 36,000 to 55,000 and Cerignola from 33,000 to 56,000.

Nowadays, the Consortium of "Bonifica della Capitanata" covers a surface area of 441,579 ha where is living about 550,000 inhabitants. The surface area covered by the Consortium water distribution network is about 140,378 ha and about 90% of it (126,000 ha) is effectively under functioning. The irrigated land is slightly smaller and it is estimated to about 121,266 ha (27.5% of total area). However, only 45% of it is irrigated through the Consortium water distribution network,

while the rest is located within the Consortium but is irrigated directly by the farmers using the private wells (INEA, 2001). The main reasons for this situation are:

- a) water shortage and non-adequate water supply through the Consortium water distribution network;
- b) huge irrigation water demand due to high-demand cropping pattern over the greatest part of Consortium;
- c) inadequate working performances of water distribution network during the periods of high water demand;
- d) non completeness of the Consortium water distribution network.

The annual water withdrawal by Consortium is estimated to about 150.5 million m³. Most of it (63.7% or 96 million m³) comes from the Fortore watershed and Occhito Dam, in the northern part of Consortium, while the rest (36.3% or 54.5 million m³) belongs to Ofanto watershed in the southern part of Consortium and, in particular, to the accumulation of Capacciotti. Consequently, two irrigation comprensoria are established within the Consortium (Fig. 2): Fortore, on the North, covering a surface area of 155,000 ha, and Sinistra Ofanto, on the South, expanding over the surface area of 55,000 ha.

Two irrigation comprensoria (Fortore and Sinistra Ofanto) deliver water to irrigation fields independently through a network of primary adductors (1,200 km) and a secondary water distribution network (8,000 km). The distribution of water to irrigation fields is estimated to about 86.7% of water withdrawal for irrigation (or 131 million m³) due to the hydraulic losses of water distribution system and non-authorized water use along the network. This means that the average water supply corresponds to 2,440 m³/ha which in many cases is not enough to satisfy crop water demands and requires a complementary use of groundwater resources.

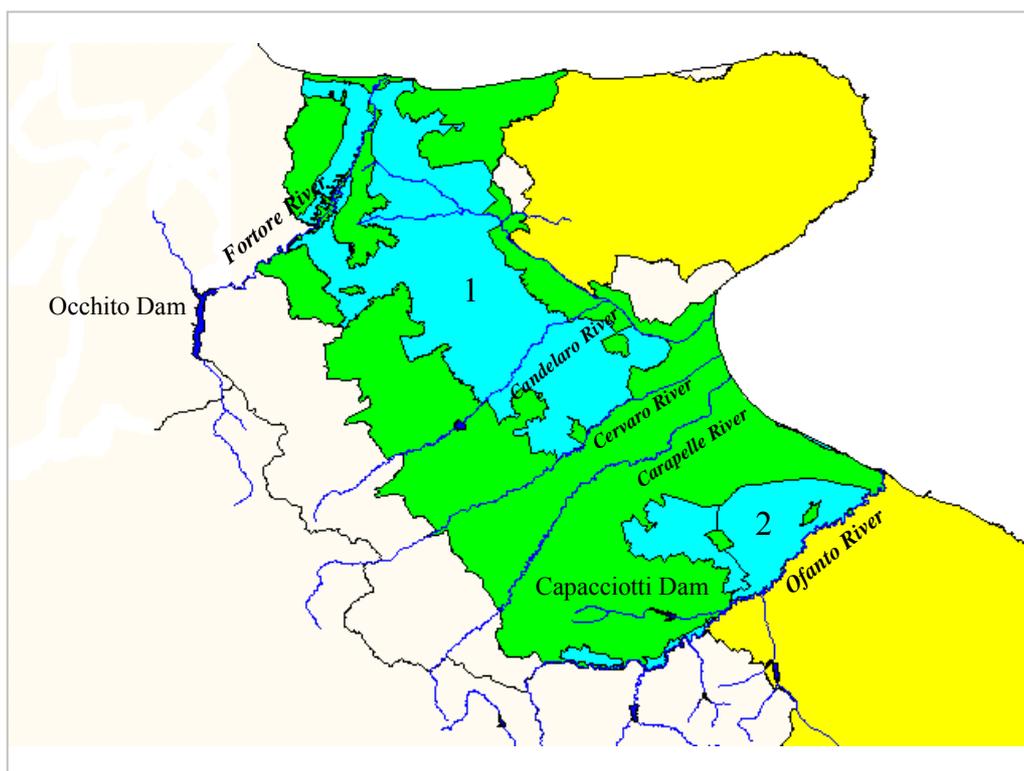


Fig. 2. Consortium "Bonifica della Capitanata": main water courses, accumulations and irrigation comprensoria (1 - Fortore; 2 - Sinistra Ofanto)

Total crop water requirements of the Consortium are much more greater than effective water supply and they are estimated to more than 330 million m³ (Table 2). In fact, in the Consortium are irrigated almost 70% of herbaceous field crops and more than 50% of vegetables cultivated in the

region. Furthermore, about one-third of all vineyards is irrigated, about 22.2% of fruit-crops and 13.2% of olive-trees presented in the area (INEA, 1999; INEA, 2001).

Table 2. Consortium "Bonifica della Capitanata": irrigated area per crops and crop water requirements - CWR (Source: INEA, 2001)

<i>Description</i>	<i>Irrigated area (ha)</i>	<i>Crop water requirements (CWR)</i>	
		<i>in m³</i>	<i>% of total CWR</i>
Herbaceous crops	38,372	109,580,433	33
Vegetables (summer-autumn vegetative cycle)	10,981	14,441,218	4
Vegetables (spring-summer vegetative cycle)	19,593	75,131,030	23
Vineyards	32,272	87,170,190	26
Fruit-crops	5,394	33,925,306	10
Olives	14,634	10,589,985	3
grassland	21	84,000	0.03
<i>Total</i>	<i>121,266</i>	<i>330,922,162</i>	<i>100</i>

ADMINISTRATIVE ORGANIZATION OF CONSORTIUM

The Consortium is administrated by the farmers who own the land within the Consortium. The farmers are called to operate the land, the resources and the environment in a form of self-management. The Consortium by-laws, approved by the Regional Council of Apulia Region in 1981, established the rules that regulate the administration and management of the Consortium.

The administrative organization of the Consortium is presented schematically in Figure 3 and it is guided by the following Consortium bodies:

- ❑ *"the General Assembly"*, including all landowners (about 79,600 farmers) who have their land within the territorial limits of the reclamation scheme or pay a charge under a land-related contract;
- ❑ *"the Council of Delegates"*, including 108 members, of which 90 are elected by the General Assembly and 18 are members by right, (representatives from the Region, Municipality, Province and Mountain Community);
- ❑ *"Administrative Deputation"*, including the President and 23 members elected among the components of the Council of Delegates, following the proportion existing between the elective members and the members by right;
- ❑ *"Presidency of the Consortium"*, including the *President*, elected among all elective members of the Administrative Deputation, and *two Vice-Presidents*, elected among the members of the Administrative Deputation;
- ❑ *"Board of Auditors"* elected by the Administrative Deputation;
- ❑ *"Standing Advisory Committees"* (presently 11), established by specific decision of the Council of Delegates.

All the tasks of different Consortium bodies have been defined and regulated by the by-laws of the Consortium. The administrative office lasts five years.

The "General Assembly" is subdivided into 5 rate-payment sections. The definition of the limits of rate-payment of each section is made by the Administration Deputation and approved by the Regional government. Each section is attributed a number of percentage seats equal to the ratio between the sum of rates imposed on the associates belonging to each section and the total of the consortium ratepayers, up to a maximum limit of half the delegates to be elected. Thus, it is not the surface owned by a firm that determines the membership to one of the five sections but the amounts of rates paid.

The “Advisory Committees” are charged to co-ordinate and further investigate the works on the matter of their concern and to refer, at the advisory stage, to the Deputation of Council (Fig. 3). Presently, eleven “Advisory Committees” are working on the issues related to:

- a) Personnel;
- b) Budget;
- c) Assets;
- d) Maintenance ;
- e) Fortore Irrigation Comprensoria ;
- f) Ofanto Irrigation Comprensoria ;
- g) Expropriation;
- h) Works in course of execution;
- i) C.E.D. (Data Processing Unit);
- j) Relations with other boards;
- k) New Classification Plan.

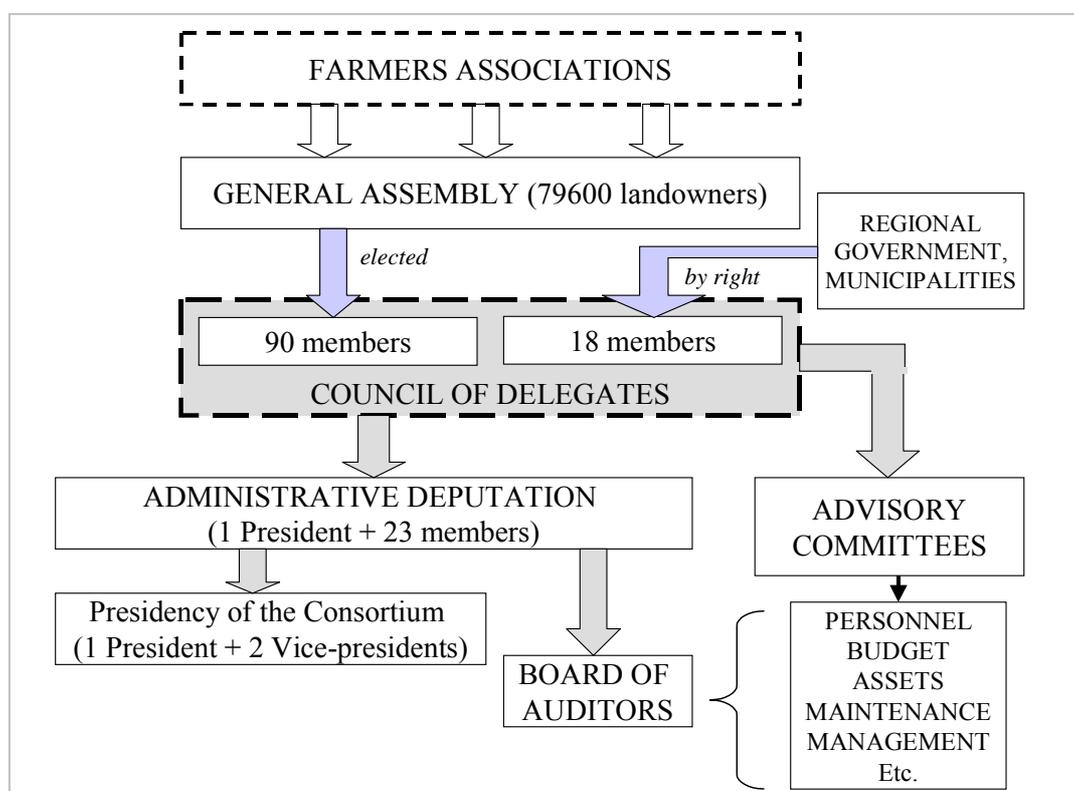


Fig. 3. Administrative organization of Consortium and flowchart of administrative staff

TECHNICAL ORGANIZATION OF CONSORTIUM

Technical organization of Consortium is regulated by a variable plan of organization (POV – Piano Operativo Variabile) that defines the staff composition of different Services and all consortium offices. Consequently, the technical staff is adequate to the operation needs of the Board and it is organized as illustrated in Fig. 4. The *Directorate General* supervises three *sectors* (Data Processing Centre, Secretary of Administrative Bodies and Library, Press and Public Relations) and three *Sub-Directorates* (Administrative, Agricultural and Engineering) each composed of several Departments – operational sectors in relation to the activities performed. It results that some sectors are only marginally or not at all concerned with the management of waters and irrigation.

The *Administrative Sub-Directorate* is mainly responsible for general affairs, legislation aspects

and accounting and includes eight Departments: General Affairs and Personnel, Legal Office, Contracts and Works, Administration and Assets, Accounting, Land Register and Taxes, Expropriations, Supply-office – Stores.

The *Agricultural Sub-Directorate* is responsible for agronomic aspects of irrigation (cropping pattern, crop water requirements and irrigation scheduling) and land and water management and is made up of four Departments: Studies and Programs, Irrigation of Fortore and Ofanto schemes, Extension Service, Watershed Management.

The *Engineering Sub-Directorate* guides all activities related to hydraulics and electro-mechanics works (dams, reservoirs, water delivery network) and is composed of ten Departments: Design, Electro-mechanics - Corrosion Control, Dams and Collective works, Conveyance works and South – Fortore Irrigation Systems, Conveyance Works and Ofanto Irrigation Systems, North Tavoliere Hydraulic Systems, Rural Waterworks and Hydraulic Systems falling within the South - Tavoliere scheme, Geology, Safety.

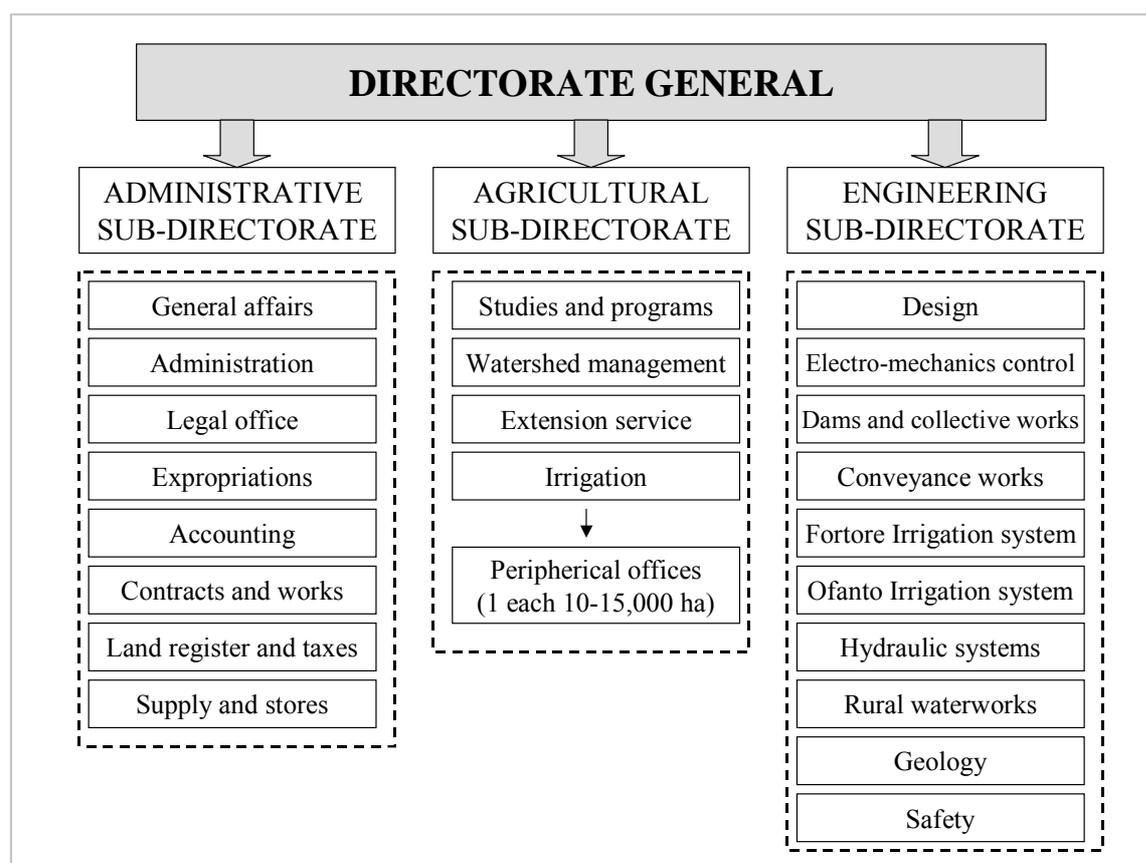


Fig. 4. Technical organization of Consortium and flowchart of technical staff

The Agricultural Sub-Directorate is directly responsible for the relations with the farmers and technical aspects of irrigation from the agronomic point of view. This Sub-Directorate

- ❑ prepares the irrigation scheduling and requests the discharge to be taken for the delivery to each irrigation sector:
- ❑ points out to the Directorate of the Engineering Service any inconvenience of the water delivery works and the lifting plants;
- ❑ draws up the documentation for the attribution of consumption rates to each user and informs the Land Register Section for the fee collection

Due to low frequency and specific characteristics of the machines and equipment necessary for the execution of the works, the Engineering Sub-Directorate mainly operates on the water delivery network through the contracts and only few interventions are made through direct administration. The

technicians of the directorate plan the works to be executed and scheduled, also for the operational periods, the interventions to be made based on the number of breakages occurred and the problems arisen in the previous years; they then prepare the technical drawings, the specifications and the corresponding tenders for contract for the assignment of works to specialized firms.

The control on the land and the good operation of the network and the equipment, the frequent interventions for repair both on pipes and on water meters or gates, require a wise operational organization, also because, considering the nature and frequency of interventions, each type of operation performed on the plants is made by direct administration, i.e. using the means and the personnel of the Board and the material specifically purchased at the beginning of the irrigation season.

The relations with the users, as for water demand, communication of any failures, request for information, complaints, suggestions, require the constant presence of technical staff in the peripheral offices. The specific irrigation offices depend directly on the irrigation sector of the Directorate of the Agricultural Service and they are located on the territory in such a way to be easily reached by users.

In the "Fortore" irrigation scheme, 9 irrigation centres have been set up with the corresponding peripheral offices; whereas in the "Sinistra Ofanto" scheme, 6 irrigation centres have been set up (Lamaddalena and Altieri, 2000). The command area of each center depends on the characteristics of the land and of the systems. Each irrigation office has a technician (surveyor or agricultural school graduate) who co-ordinates the group of technical assistants including:

- an employee;
- a foreman;
- a team of three workers for repairs;
- a team of two or three assistants for intervention and control operations.

WATER PRICING AND TARIFF RULES

By law, the Consortia are private boards of public law and they are non-profit organization. The associated members have to contribute only to the expenses borne for the management of the activities performed. Therefore, it is not a tax they pay to the Consortium but a contribution. Such contributions are proportioned to the direct benefit each user receives from the activity performed by the Consortium.

The Consortium performs also other activities in addition to irrigation for which it bears some costs. Therefore, the first contribution borne by the firm is that for reclamation and it is calculated with respect to the surface subdivided into six rate-payment classes in relation to the benefits each zone receives (Table 2).

Table 2. Rate-payment classes applied by the Consortium (Adapted from Lamaddalena and Altieri, 2000)

Homogeneous zones	Payment rate (Euro/ha)
Irrigated zone with reclamation works	32.28
Upper Sinistra Ofanto zone	29.08
Zone to be irrigated in the near future	26.66
Zone with designed irrigation systems not executed yet	24.23
Plain zones with reclamation works	16.16
Hilly zones	8.08

Moreover, if the estate falls within the irrigation scheme the firm has to pay also an irrigation water rate that consists of two parts (a fixed and a variable rate) as illustrated in Figure 10. The first part of irrigation water rate is proportioned directly to the surface served and the fee is related to the hectare, whereas the second depends on the volume of water taken from the hydrant (all the hydrants are equipped with water meters).

The fixed rate (15.50 Euro/ha) has to be paid even if the owner decides not to irrigate, since in any case the Consortium performs every year maintenance operations to keep the plants in a good operational state; moreover, although the user doesn't grow irrigated crops, he gets a benefit in terms of the re-evaluation of the estate submitted to irrigation. The benefit has necessarily to be associated with a fee. Also, by paying a fixed rate the farmer is stimulated to convert his farm to irrigation and to invest.

The variable rate depends on the volume of water used. The yearly water duty is 2,000 m³/ha. In order to prevent water wastes, due to bad use by farmers, rising tariffs are fixed for water surpluses as a true deterrent:

- up to 2,000 m³/ha: 0.088 Euro/m³
- from 2,000 to 2,500 m³/ha: 0.108 Euro/m³
- from 2,500 to 3,000 m³/ha: 0.155 Euro/m³
- more than 3,000 m³/ha: 0.207 Euro/m³

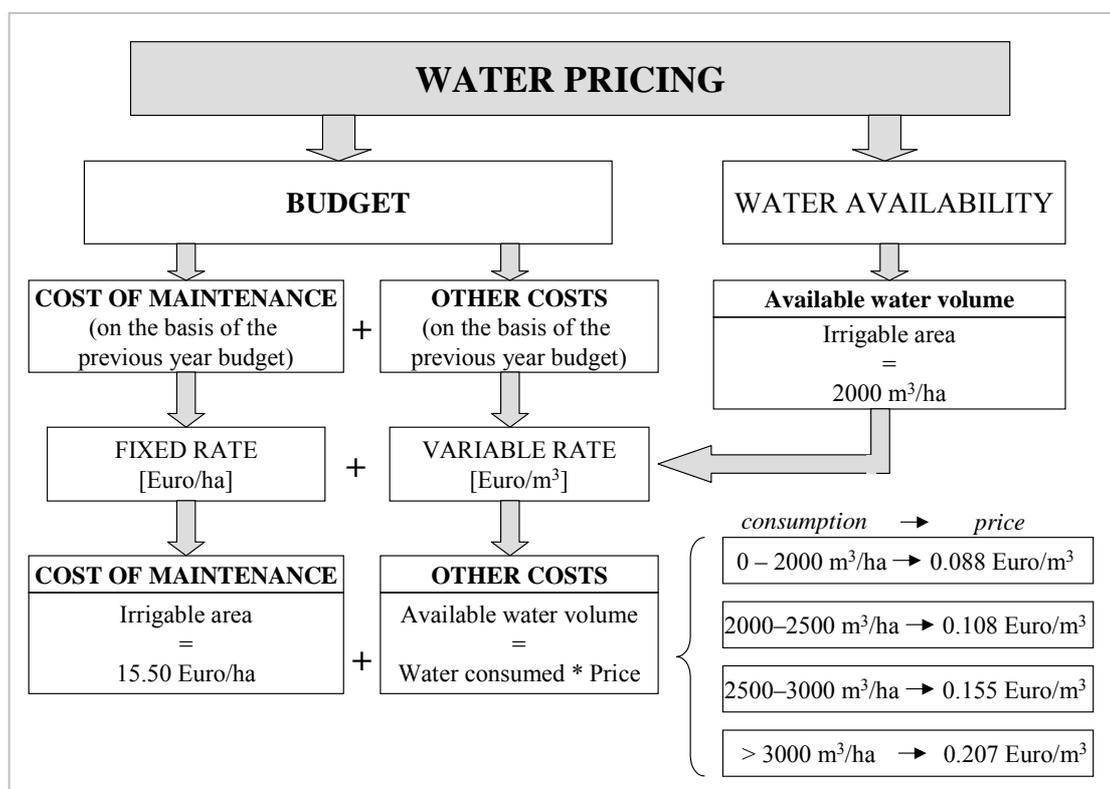


Fig. 5. Distribution of the costs and water pricing and tariffing rules applied by the Consortium (adapted after Lamaddalena and Altieri, 2000)

In the past, the Regional government participated in the management costs through special contributions allocated each year to the Consortium. But it is more than 10 years that, despite the presence of a regional law that states the allocation of contributions in favour of the reclamation consortia for the management expenses (maintenance and operation) for irrigation-related activities, due to the lack of funds, the Consortium has not received any sum of money. On one hand, the State has borne and still bears the costs for the execution of the works, whereas the private farmers only pay for the management of the system.

As for the definition of how much to pay, prior to the beginning of the irrigation season, the yearly budgets are made to establish the costs the Board will bear in the course of the irrigation season. Each operational sector that deals with irrigation draws up its own budget, subdividing the expenses between maintenance and operation; later on, all the budgets are aggregated into a unique general budget referring to irrigation. In order to take into account the costs of the personnel (and others) not

fully dedicated to the irrigation (administration, Land Register, Data Processing Unit, etc.) the grand total is increased by 25%.

Since the Board is non-profit, the receipts should theoretically coincide with the expenses. However, the receipts resulting from the fixed rate can be more or less exactly quantified in that the served surface and the farms among which the water has to be shared are well known, whereas the volume of water to be used is uncertain since it depends both on the availability of the resource stored in the reservoirs (at the time of drawing up the budgets the storage stage is still incomplete) and on the investments and the climatic pattern.

Certainly, there are factors that cannot be controlled and that can change the expected fees collected and the management costs. Therefore, at the end of the irrigation season, based on the management balance, the fixed and the operation fees are determined and registered in the tax-roll for collection. Any compensation in favour of the users is credited with them upon the collection of the fixed fee for the next year.

The collection of the fees paid by the users is made through the yearly tax-roll emission, made executive in conformity with the law. On this matter, for the variable rate, the irrigation sector transmits to the Land Register and Tax office – that in turn works in close co-operation with the Data Processing Unit – the data relative to the consumption of each user. The said sector up-dates the consortium land register, in relation to the type of taxation adopted and converts the volumes taken into fees to be paid, by applying the planned tariffs in relation to the unit discharges. The technical time required for the emission of the tax-rolls causes that the water used in the course of an irrigation season be paid at the beginning of the next irrigation season.

ROLE OF EXTENSION SERVICE AND ACTIVITIES ON WATER SAVING

Since the availability of water is scarce in respect to the crop water demands, the Consortium "Bonifica della Capitanata" was constrained to operate into several main directions in order to save water and to promote more efficient and sustainable use of water resources. These activities have been particularly vigorous since the beginning of eighties when the price of water started to increase and application of water saving practices has become particularly important in the compliance with the Regional Law 54/80.

These activities started initially as the preparation of technical files on crop water requirements and irrigation scheduling and publishing of weekly bulletins on agro-meteorological data which were distributed to the farmers in the meetings organized at the municipalities, the trade union offices and the extension service offices of the Consortium.

Successively, the activities include also the structural interventions on the water distribution network and introduction of a new generation of flow-meters, called "ACQUACARD" system, where the farmers, taking water from the same hydrant, use personal cards which measure and register water consumption of each user. This system has shown excellent results in a substantially better use of water in irrigation and it has been already applied over large areas (Lamaddalena, 1995; Lamaddalena and Sagardoy, 2000).

Recently, the Consortium has realized and activated on its web site (www.consorzio.fg.it) a set of free services to the farmers aiming at more efficient water use in irrigation sector. These services include:

- a. real-time and historical data on water availability in four accumulations (Occhito, San Giusto, San Pietro and Marana Capacciotti) proving water for irrigated fields and managed by Consortia;
- b. real-time and historical data about weather parameters over the whole area covered by 13 agro-meteorological stations managed by Consortia and equipped with electronic data acquisition system;
- c. real-time irrigation scheduling service for the whole area managed by Consortia considering climatic and soil characteristics and user-specified crops and irrigation systems technical characteristics; and

- d. agro-meteorological and phyto-sanitary bulletin with the services related to historical weather data and weather forecasting and eventual risks for the development of plant diseases.

The real-time irrigation scheduling service is of particular importance since it provides essential support to local farmers deciding when to irrigate and how much water to apply. The user of the system enters on the web site indicating approximately on a GIS-based map the area at which his farm is located which permits to the system to identify the closest agro-meteorological station and to use corresponding meteorological data for water balance calculations. Then, the farmers – local managers insert the information about the crop grown on the area of interest, soil characteristics, and irrigation system choosing between sprinklers, surface and drip irrigation method. In the case of drip irrigation method, the farmers should provide also the data about the distance between the rows, distance between the drippers and discharge of drippers. Finally, the farmers insert the date of the last irrigation and the system calculate soil water content on a daily basis indicating the date of next irrigation and corresponding amount of water to apply.

This service uses previously developed database on crop and soil characteristics in the region and weather forecasting information provided by the regional meteorological service and available also on the Consortia Internet site. It is important to highlight that this service together with other Internet-based tools offered by the Consortia have been accomplished step-by-step in several years and, actually, they are becoming very appreciated and are acquiring a significant number of users especially among new generation of farmers who are seeking for the modern tools in order to optimize agricultural production. Certainly, this is also due to widespread use of computers in the last years and Internet services, in general, also in many rural areas of Southern Italy.

Actually, the Consortium works on the realization of a new experimental program investigating the possibility of recovering and reusing in agriculture the waste water coming from the municipal sewage system. It is expected that this resource could contribute in the mitigation of water shortage problems in the region.

CONCLUSIONS

Nowadays, the topics of water saving and land and water resources management are getting even more importance since the resources, exposed to increasing pressure of various sectors, are becoming scarcer than in the past due to almost everywhere evident climatic change and collateral effects of hydrological imbalance, drought and flooding events, and accelerated desertification processes. Inevitable, this calls for new policies which acknowledge integrated land and water management strategies, based on the concept of sustainability and on a complex and multiple interaction and interdependency among various sectors and land and water subsystems (Hamdy and Lacirignola, 1999).

The implementation of such modern policies requires concerted actions and reforms based on a participatory approach embracing all levels of modern society and including not only agricultural and engineering sectors but also institutional, social, economic, legal and political initiatives. In this context should be seen the process of progressive modernization of irrigated agriculture and irrigation consortia in Italy which is closely connected with the overall strategies of sustainable development at national and EU scale.

The organization of Consortia in Italy aims to equilibrate the rights and duties of both governmental institutions and farmers, as it is shown in the case of Consortium “Bonifica della Capitanata”. In fact, on one side, the governmental institutions finance public works and maintain their property and on the other, they assign the management task to the Consortia and allow them to exert a control power through the members by right of the council of delegates and the governing board.

The Governing Board, elected among the associated members, is certainly very efficient, since administrators are users as well and, consequently, they are directly involved in the prompt resolution of any problem related to the management of the systems. The objective of the administrative choices is then to reach the high efficiency parameters in order to maximize, in economic and labour terms, the results of irrigation, through optimising water distribution both at the farm (through a wise management of collective systems) and crop level (through the orientations and suggestions of the

extension service).

The self-management of water resources and of the storage, conveyance and distribution works destined for the supply of irrigation water is undoubtedly an effective form of privatisation of a public "service". The involvement of the Consortium members, delegated by the Governing Board by elections, in decision-making generates responsibilities not only among the members of the Governing Board but also among users themselves. This enables to deal with problems and programs constructively, and to adopt management strategies that adjust to the requirements of water users farmers, without neglecting the needs of the whole population living in the area concerned.

Furthermore, it is worthy to mention the importance of politicians involvement, as members of the Governing board and representatives of Municipalities and regional authorities, in the participatory water management in Italy. They should be adequately informed about all the problems and necessities of a Consortium since they represent a bridge between the Consortium and regional authorities and have a relevant influence in obtaining of necessary funds for realization of new hydraulic structures and modernization of water distribution network. Moreover, they could be the promoters of many other initiatives as it is involvement of media and larger communities in the activities of Consortium, eventual modernization of legislation, etc.

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