Water use efficiency and economic approach

National study, Italy

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CONTENTS

Introduction

The aims of the present report are twofold. From one side, the report presents and describes the collected data concerning the calculation of the water efficiency index at national level in the domestic, industrial, and agricultural sector. On the other side, approaches, objectives and main progresses of national strategies oriented to improved water use efficiency are described. A special attention will be devoted to the use of economic instruments such as water prices, tariff and subsidies.

1. Country profile

Italy' peninsula, with a surface area of 301,340 km2, occupies a central location in the Mediterranean basin and stretches over 1,200 km between North and South with an exceptionally long coastline of almost 7,500 km. It is bound by the Tyrrhenian and Ligurian Seas to the west, the Adriatic Sea to the east, as well as the Ionian and Mediterranean Seas to the south, France to the northwest, Switzerland and Austria to the north, Slovenia to the northeast. About 27% of Italian territory is along the coast line and 73% is considered the inland. The territory also includes the mainland and the islands of Sardinia and Sicily, as well as some other smaller islands. The country is predominantly mountainous with plains accounting for less than 24% of the land area, the mountain and the hill areas occupy the 35% and the 41% of the territory, respectively. In 2007 almost 34 % of Italian territory was covered by forest, 32% was occupied by arable land and permanent crops, 14% by natural pastures and the remaining part of the territory was occupied by urban area and inland water (FAOSTAT, 2007).

Italy has a temperate climate with a variety of regional characteristics. The Alps region has harsh winters and moderately warm summers with abundant rainfall. The Po Plain, which is the less exposed to the sea climate mitigation, has harsh winters with long periods of subfreezing temperatures, and warm humid summers, with rainfall more common in winter. The Apennine region has extremely mild winters and hot summers. Southern Italy (including major islands) has a dry climate, generally hot, with long period without precipitation and sometime real drought events. Average temperature ranges in Rome are from 4° to 11° C in January to 20° to 30° C in July. The precipitations in Italy are relatively abundant (on average about 1,000 mm/year), but as often, they are not evenly distributed between seasons and regions, and high evapo-transpiration in coastal areas causes significant losses. Due to the range of rainfall, hydrological and climatic regimes (from Mediterranean to continental and Alpine), Italy presents a wide diversity of ecosystems, landscapes and agricultural practices.

As of 31 December 2009 the total resident population of Italy was 60.387.000: while until the end of the 1970s the increase was mainly the result of natural growth, in the last decades it has been increasingly and almost exclusively due to the migration component. Foreign residents in Italy accounted for approximately 4,279,000 units as of 1 January 2010: the foreign resident population, therefore, makes up 7.1% of the total population (6.5% in 2008). Italy has an increasingly elderly population: on 1 January 2010, individuals aged 65 years and over represented 20.2% of the population, while minors represented only 16.9%.

Italian economy accounts for the 13% of thee EU27 economy in 2008 with a Gross Domestic Product per inhabitant at market price equal to € 26.300 (ISTAT, 2009).

Two-thirds of Italy's Gross Domestic Product (approximately 69%) is represented b the services sector, whose strong point is tourism. Approximately 29% of the national income is owing to industry (including the construction sector) and the remaining approximate 2% derives from agriculture. The strongest industrial sectors are chemicals, machinery, car manufacture, food, textiles, clothing, footwear and ceramics.

Italy has few natural resources, and much of the land is unsuitable for farming, so that the country remains a net food importer. There are no substantial deposits of iron, coal, or oil, although natural gas deposits constitute Italy's most important mineral resources, and proven reserves (mainly in the Po Valley and offshore Adriatic) have increased in recent years. Most raw materials needed for manufacturing and more than 80% of the country's energy sources are imported. Italy has a large foreign trade, facilitated by its sizable commercial shipping fleet. The leading exports are engineering products, textiles and clothing, machinery, motor vehicles, transportation equipment, chemicals, food and beverages, tobacco, minerals,

and nonferrous metals. The main imports are raw materials, chemicals, transportation equipment, metals, textiles and clothing, foodstuffs, and petroleum. The chief trade partners are Germany, France, Spain, and Great Britain.

2. Institutions and legislation in the water sector

With the Law n°183/89 and the institution of the River Basin Authorities, the distribution of competencies concerning water management between the central government and the local administration was completely reorganised. River Basin Authorities, self-governing public bodies, responsible for soil protection, reclamation of water resources, usage and management of water heritage and environmental protection within the ecosystem of the concerned river basin, were set up, in order to carry out management and planning duties in the river basins having national relevance (Massarutto and Paccagnan, 2007). With the transposition of WFD in Italian legislation, approved with the Legislative Decree 152/2006, three years after the deadline established in the Directive, eight River basin districts were identified and eight River Basin Authority were established. They have to prepare the water management plan that, after a description of the state of the water environment in the district, has to identify a set of measures necessary to attain the good status for all surface and ground waters. It has to include also an economic analysis of both the water uses and the measures in order to identify the most cost-effectiveness ones. Recent legislation (Law n. 13/2009) has created the conditions for the start of training activities for Hydrographic District Management Plans which, on the basis of the directive cited, each Member State is required to publish by 22 December 2009. Responsibility for the co-ordination of that activity was assigned to national water authorities, called upon to work in co-operation with regions. The measures identified in the plans will constitute a reference framework in future years for protection and remediation initiatives designed to provide all citizens with adequate supplies of cleaner water. Specific legislation was put in place (Decree-Law n. 30/2009 for the protection of groundwater, Decree-Law. n. 56/2009 on monitoring criteria, Ministerial Decree of 17 July 2009 on the exchange of information on the implementation of the directive) to ensure proper coordination in drawing up the plans. With respect to the completion of the implementation of the legislative reform of water management (Galli Law), the main efforts in the southern regions of Italy need to be addressed to the completion of the concessions in the various regions.

As far as the ratification and adjustment of the planning instruments provided by the Framework Directive on Water (2000/60/CE), the administration's activity is focused on ensuring the adoption and approval of the Protection Plans and Management Plans containing the measures to be adopted at the hydrographic district level, as well as the preparation of suitable monitoring programs that are essential for the accurate classification of the surface and subterranean bodies of water on the basis of biological, physical/chemical and hydro morphological parameters.

For potable water, Law n° 36/1994 introduced in the Italian legislation the principle of the territorial unit for the management of water resources and for an effective water pricing. An Integrated Water Service (IWS) is created in areas defined by the regions as Optimal Territorial Ambits (ATO). Pursuant to this Law, the Italian territory was divided into 92 ATOs. Municipalities and Provinces within each ATO have the functions to organise the IWS and to establish the Authorities of the Optimal Territorial Ambits (AATO). The implementation of this law has been very slow and after 16 years, is quite completed (COVIRI, 2009).

In the agricultural sector, the law entrusts the "Reclamation and Irrigation Boards" (RIB) to manage the irrigation system and purposes. RIBs are public law associations of farmers that control the management and distribution of water resources over a certain area. Water use regulation is based on a complex system of rights, often developed since ancient times. Water pricing works usually through surface based charges that hardly cover RIB costs. There are a few examples of pricing per unit of water consumption (see after).

I. Production of the water efficiency index

1. Water demand per sector, current status and future trends

The total abstraction of freshwater in Italy is around 42 km³/year and represents, on average, 730 m³ per capita/year. In 2008, 15 % of the total abstracted is for energy production, 49 % for agriculture, 19% for domestic uses and 17% for industry, although strong regional variations are apparent. Sectoral trends in water abstraction are also apparent over recent years. Abstraction for industry has been slightly declining since the early 1990s while water demand for energy production and domestic uses increased (MAF, 1990; MATT, 2002 and 2009). These various trends and the driving forces behind them are examined in more detail in the following chapters of this report.

Household water demand: Water withdrawals for domestic use amount to about 8km³/year. They are quite stable since the early 1990s and are taken for 80% from ground water sources and for 20% from surface water. In 2008, for 100 liters of supplied water, 165 liters were abstracted (they were 167 in 2005 and 168 in 1999). These losses can be explained by technical reasons, by not authorized uses (mainly agricultural) and by transport and distribution network losses. In the last 10 years there were substantial increases in the infrastructures for the purification of the domestic wastewater: in 2008, the existing plants had a potential capacity to serve the 75.2% of the population - +22.5% if compared with 1999 - while actually covered the 59.0 of the population - +26.6% if compared with 1999 (ISTAT, 2009).

Trend: In order to estimate household water demand in 2025, three different population growth scenarios (low, medium and high) and three different levels of water consumption per capita (equal, -7.5% and -15% to the current one, respectively) have been considered. The range of estimations varies from the 6,943 million of m³ for the low growth population scenario with a water saving of 15%, to a 8,609 million of m³ for the high population growth scenario with no water saving.

Energy: For the energy sector, water demand is estimated around 6.5 km³/year. Only thermoelectric plants using water for the cooling phase have been considered while hydroelectric plants' uses have not been included.

Trend: The assessment of the future water demand for the energy sector depends on both the energy demand trend and the path and the rate of the introduction of technological innovations in the thermoelectric industry. For 2025 an increase of 20% has been estimated and the energy water consumption will be about 7,102 million of m³.

Industry: Italian industry consumes about 7 km³ of water per year. Failing direct recent estimations, the data has been calculated on the basis of the water consumption coefficient for person working in the different manufacturing sectors. The data does not include the withdrawal for water course and from ground water directly made by the firms. The coefficient are estimated and updated by national experts on irregular basis. Comparing the coefficient available for year 1972, 1986, 2001 and 2008 a reduction is evident for almost al sectors and, especially for the more water demanding such as manufacture of paper and paper products, rubber and plastic products, coke and refined petroleum products, chemicals and chemical products.

Trend: In the next decades, the reduction of the coefficients will continue and together with the declining trend of the heavy industry it will lead to a reduction of the industrial water demand. For the 2025, also for the effects of specific measures implemented at national and regional level (see after), the water demand estimated for the industrial sector amounts to 6,388 million m³.

Agriculture: Agricultural sector remains, in Italy, the main water consumer even though a detailed estimation of its water demand is not easy. Several studies and estimates to understand and monitor uses of water in agriculture have been carried out in the last decades. According to the Water national conference (Conferenza Nazionale delle Acque, 1972), crop water requirement for agricultural activity accounts for around 26 km³. Twenty years later the Agriculture and Forestry Ministry estimated water requirement for a similar amount (25,6 km³) (MAF, 1990). More recent studies showed that water abstraction used for

agriculture employment accounting for about 21 km^3 (Irsa-Cnr, 1999; Venezian Scarascia et al, 2007; ANBI, 2009). On Italian territory, water demand for crop cultivation accounts for the major share of water consumption in the agriculture sector. Agriculture water use varies depending on climatic conditions, water availability ad cropping pattern. In fact, due to the peculiarities of Italian climate some crops require additional water to grow. The main reason is that rain is concentrated in spring and in fall seasons, whereas the growing season (for spring-summer crops) is dry. Only in some cases raising ground water level and soil water content can satisfy water requirement of growing crops. The 40% of agricultural production comes from irrigated agriculture and accounts for the 84% of agricultural output (ANBI, 2004). Besides water used for irrigation purpose, other agricultural activities can require considerable amount of water. At farm level, livestock can consume water both for physiological need and for dejection management, depending on typology of stables. Nevertheless it has to be pointed out that water uses in agriculture largely depends on intensive farming system oriented to meat production. In fact maize and rotational forage cover a large part of the irrigated surface. Also fishing in fresh water and artificial basins is a growing business, requiring an increasing volume of water.

Against a reduction of the total cultivated area, (it was 15 million of hectares in 1990 and 12.75 million of hectares in 2007) irrigated surface is quite stable since 20 years: in 2007, 2.7 million of hectares were irrigated that is the 20.4% of total cultivated area. The water is distributed using sprinkler irrigation (36% of irrigated surface), followed to surface irrigation (30%), drip irrigation (21%), flooding (9%) and others method (4%). Drip irrigation is more diffused in South territory where it is more important to save water.

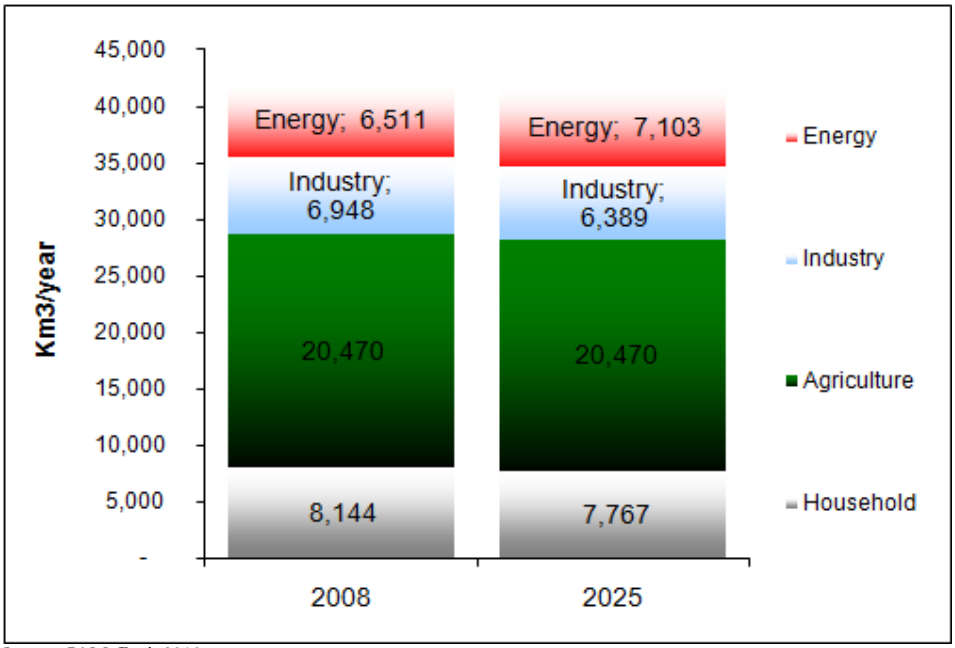
Trend: In the future several factors can affect the use of water in agriculture. First, the implementation of the WFD will reform, in many agricultural area, the water tariff system with the introduction of a volumetric tariff to cover the full cost of the resource[1].

Second, the completion of the decoupling process of agricultural subsidies will reinforce the market orientation of agricultural sector with an increase of high quality and more profitable production, such as fruit and horticultural products, that are very high water demanding. Further, crops cultivation for biomass production can became relevant. Finally, it is likely to expect a slight increase in the technical efficiency of irrigation methods (Severini, 2008). Although, it is very difficult to estimate the final impact of these multiple factors on the agricultural water demand at national level we assume the amelioration in the efficiency of the irrigation method and a stable level of irrigated surface.

Over the last decades Italy has not provided regularly estimates of water resources, due to the lack of studies on this matter. The lack of updating data was probably due to legislation delays, uncertainty in competence distribution, the great number of involved institutions and the complex territorial and climatic characteristics of Italian territory, which request specific research investments. Water abstraction and water use by economic sectors are issues poorly covered by existing statistics. Statistical information needs to be implemented and several methodological problems need to be faced in order to overcome data gaps. The main problem is unavailability of water abstraction measurements, even if water meters installation is mandatory since the Italian law n. 36 was passed in year 1994.

[1] In the River Basin Management Plans prepared by the eight national Italian basins there are several attempts to estimate the full cost of water resources in the different sector/uses. As for agricultural sector, the estimation of direct supply costs is mainly based on the Reclamation and Irrigation Boards's accounts while resource and environmental costs are often missing.

Figure 1 - Water demand by sector in 2008 and 2025



Source: IAM_Bari, 2010

2. Production of water efficiency index

Concerning the WUE index, the collection of the basic data needed to calculate it is carried out by different institutions, agencies and research centers. According to Italy's Supervisory Committee on the Use of Water Resources, which comes under the Ministry of the Environment, there is a lack of suitable data for obtaining an up-to-date synthesis of the volume and distribution of available water resources in Italy and the existing data are not always comparable (INEA, 2002).

As regard to **domestic water use**, in 2009 the Italian National Institute of Statistics (ISTAT, 2009) carried out and published a complete survey on drinking water withdrawal, supply and distribution, and treated sewage water. Further the COVIRI2 - the Comitato per la Vigilanza sull'Uso delle Risorse Idriche -, collets data on year regular basis about the state of implementation of Integrated Water Service, structure of water rates and investments as well as volume of water losses. All data are published in the Annual Report to the Parliament (COVIRI, 2009).

As for **water use in agriculture**, the availability of data is highly fragmented due to many reasons. First, the delay in adoption of legislative acts, such as the mandatory application of measurements in water abstraction responsible for having data unavailable at farm level and partially available at irrigation consortia level. Secondly there is the uncertainty in competence distribution, such as planning of new water abstraction permission. Furthermore also problems related to multiple use of the resource should be faced, whether abstraction is destined to agricultural uses jointly with other ones. Some important experiences, focusing on water abstraction and requirement for irrigation purpose, were carried out at national or sub national level by different institutions in order to overcome data gaps. Direct data collection still remains the main approach to get basic data from farm or from irrigation consortia. In some studies, major efforts are still oriented to assess consortia network structure. Information collected at farm level, anyway, is not always the good one to obtain global values of water. A closer co-operation would be required between institutions to eventually integrate different approaches and data sources; in this case the recent experience carried out by irrigation and land reclamation consortia is only the first step. Knowledge on pattern of the irrigation

[2] COVIRI was set up under the Galli Law with the purpose to oversee the implementation of the reform; to monitor the management of the service in order to guarantee the observance of the principles of efficiency, efficacy and cost-effectiveness; to as well as the regular determination and adjustment of rates and the safeguarding of users' interests.

phenomenon coming from survey conducted by National statistical institute can help in the adoption of different approaches. For instance, from the geographical point of view, supply and access to water pattern distribution in space suggest a modulated approach for different regions, since consortia delivering and resorted surface water is more widespread in northern regions, whereas self supply and resorted ground water dominate in the central and southern regions (from ISTAT, 2006).

As for the **industrial and energy water use**, in the lack of recent direct surveys on national scale, indirect methods are used through the use of water need coefficient for worker and the employment in the different manufacturing sectors. Water need coefficients have been estimated in several studies carried out in Italy from 70's and updated on irregular basis.

It is worth to mention the recent initiative of the National Institute of Statistics with the collaboration of APAT to prepare a data bank of indicators in historic series, on national level, for the purpose of analysing the phenomena considered important for sustainable development. These are multi-domain indicators, regarding economic, social and environmental phenomena, selected by an international working group, co-ordinated by Eurostat, in which all European and the most developed countries participate. At present, about 114 indicators subdivided into ten topics have been identified. At the same time, another working group, organised jointly by UNECE/OCSE/EUROSTAT, is devising a conceptual framework for the analysis of the sustainable development indicators, in terms of available capital and sustainable consumption. Italy has also contributed to the elaboration of the 34 indicators requested by UNEP's "Action Plan for the Mediterranean" (MAP) within the follow-up of the "Mediterranean Strategy for Sustainable Development" but indicators regarding water use efficiency (total and by sectors) are not estimated on regular basis (APAT, 2007).

II. Improving water efficiency in the different using sectors

Generally speaking, Italy is not a water scarce country. However, besides the traditional uses – domestic, agricultural, and industrial-, environmental and recreational uses are becoming more and more relevant and set new challenges to the management of the resource. Therefore, less demand is a priority goal, and saving, re-using and recycling interventions must be implemented (MATT, 2009).

In 2002, the **National Strategy for Sustainable Development** established for water resources a set of objectives and priorities to be pursued (MATT, 2002). In 2007, the **Progress report of NSSD** illustrated the actions realized and the results achieved in the different fields (Repubblica Italiana, 2007). Also in **The National Reform Programme**[3] , water resource management is one of the main areas for action identified for the three years 2008-2010. With reference to **Rural Development policies**, Italy has invested efforts in 2009 in the reprogramming of the policies, in light of the new challenges for farming in Europe: climate change, renewable energy, water resources, biodiversity, innovation and broadband technology. The financial resources related to the European Fund for Rural Development employed by Italian regions amount to approximately €370 million for the first five challenges outlined above (to be assigned as of 2010) and roughly €96 million (assigned in 2009) for the dissemination of the broadband. Such sums are added to those already planned and partly allocated to the challenges set out above, in the respective amounts of roughly €8 billion and €300 million. A greater emphasis has been placed on the sustainable management of water resources, based on water resource savings and on greater rationalisation and efficiency in their use, which involves generally promoting initiatives to pursue the objectives contained in Directive 2000/60/EC (e.g. investments in water savings systems and in industrial wastewater treatment). Additional financial resources totalled approximately €174 million, of which approximately €104 million from the EU.

Several policies and measures are formulated in the above mentioned programs and plans, the main are the following:

For the domestic sector:

- *Reducing leakages in conveyance, storage and distribution systems*. This objective includes: the census of existing supplying sites and related abstraction measurement; the provision of more efficient control and monitoring systems; a rationalisation and optimization of water systems management, notably total-use tanks, through computing model tools; ordinary maintenance of the existing networks; the partially wide reconstruction of water distribution systems, particularly in the civil sector.
- *Implementation of Full Cost Recovery*. The process started in 1994 and at present is still under way (see after).
- *Financial incentives* to promote the installation of low consumption equipments
- *Informative and promotional campaigns* to influence the water demand behaviours of individuals and public users such as civil services, schools, etc.

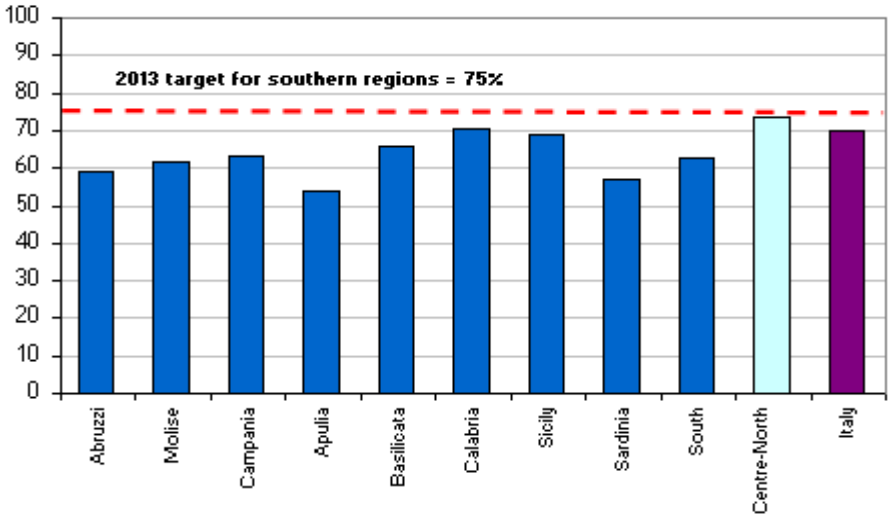
In relation to the integrated water service, the achievement of the objectives is measured on the basis of quantitative targets for two statistical indicators defined for the eight Southern regions. The first indicator is the percentage of water distributed calculated as the percentage of water delivered out of total water entering municipal water distribution systems.

Percentage of water distributed: percentage of water delivered out of total water entering municipal water distribution systems.

Target: increase percentage to 75%.

[3] The annual report on the implementation of the Lisbon Strategy in Italy has been prepared, by the Permanent Technical Committee of the Ministerial Committee for European Affairs (CIACE). The work of the Technical committee has been coordinated by the CIACE Secretariat, at the Department for European Affairs of the Presidenza del Consiglio dei Ministri. This report was approved by the Council of Ministers on 28 October 2009.

Figure 2 - Percentage of water delivered out of total water entering municipal water distribution systems, year 2005



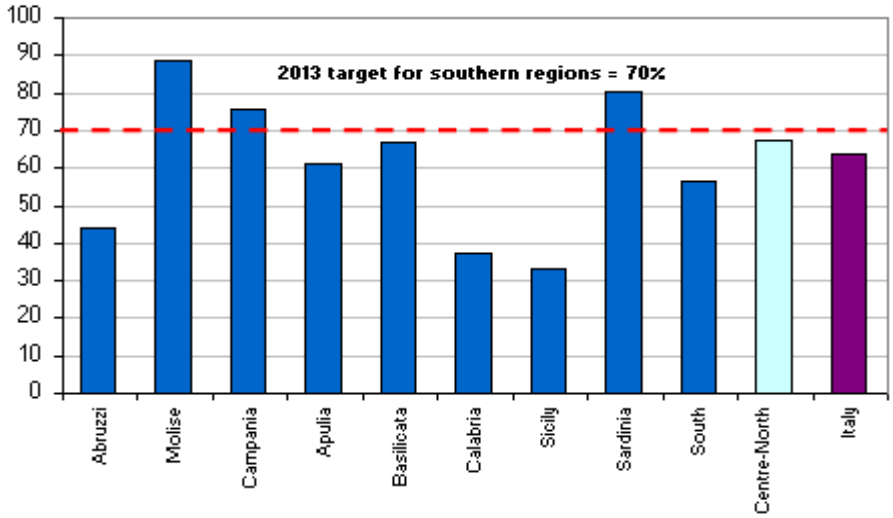
Source: Istat, Sistema di indagine sulle acque (SIA)

The second is the population served by waste water treatment plants: inhabitant equivalents served by waste water treatment plants with secondary or tertiary treatment, as a percentage of total urban inhabitant equivalents per region.

Population served by waste water treatment plants: inhabitant equivalents served by waste water treatment plants with secondary or tertiary treatment, as a percentage of total urban inhabitant equivalents per region.

Target: Increase percentage to 70%

Figure 3 - Inhabitant equivalents served by waste water treatment plants with secondary or tertiary treatment, as a percentage of total urban inhabitant equivalents per region, year 2005



Source: Istat, Sistema di indagine sulle acque (SIA)

For the industrial sector:

- *The promotion of interior recycling manufacturing processes* through incentives to recycle water in all the stages of manufacturing processes; the reuse of valley conveyed waters and the return of sewage waters featuring same qualitative characteristics as the exploited waters.
- *Spreading of Best Available Technique* for a more rational water resource exploitation;

There are no official targets established for these objectives at national level: we assumed a doubling of the current rate of recycled water to achieve the 30% by 2025.

For the agricultural sector:

- *Reduction of final consumptions*. It encompasses many different measures such as: the re-naturalisation of soil interventions, taking into account the territorial characteristics; changing to lower water demanding crops; the improvement of the irrigation techniques; the application of detection, monitoring, forecasting and management systems computing model in order to ensure an optimised use of resources; new data on the real use of water resources; the modernisation of irrigation networks; the imposition, at an agricultural policy level, of restrictions and disincentives, or, vice-versa, the provision of economical, financial and organisational incentives, such as access to markets, information, etc. Also sewage water reuse measures are promoted (MATT, 2009).
- *Infrastructure and irrigation projects*. With respect to infrastructure policy, in 2005 the Italian State approved the National Irrigation Plan. The National Irrigation Plan provides for total investments of around €1,122.4 million, including €770.0 million for the initiatives headed up by central/northern regions and €352.4 million for those headed by the southern regions. Most of the present projects refer to structural and technological adjustment of the irrigation networks; other works refer to the completion of schemes and some new initiatives, designed to improve resource management through interconnections. In any event, the improvements and the planning and execution of new works do not entail any increase of the irrigated surfaces at a national level. Infrastructure and irrigation initiatives implemented in 2009 covered resources of €84,228,000 as shown in the summary table reported below.

Table 1 - Infrastructure and irrigation projects (values in € 000's), 2009

Law	Type of project	Purpose	Amount
L135(1997)	Adjustment and restructuring works already completed	Irrigation improvement works	37,136
L140(1992)			
L350(2003)	Completion of works started up	Completion of irrigation works	27,947
L388(2000)			
L178(2002)	Planning and development of new initiatives	Planning and development of irrigation systems	19,145
	Total		84,228

Source: Ministry of Infrastructures and Transportation

In addition, by virtue of a decree drawn up in concert with the Ministry of the Economy and Finance on 18 February 2008, concessions were awarded for additional projects for the adjustment, restructuring and completion of the works already developed, with commitment of expenditure of €4.578,000 for which no payments have been made in 2009.

There are no official targets established for these objectives at national level; we assumed an increase in both transport and plot irrigation efficiency to 75%.

Cross-sectoral measures and actions: One of the main actions carried out in the field of water management concerns the activities initiated by the Ministry of the Environment to ensure progressive compliance with EU obligations by making significant progress in the implementation of Directive 2000/60/EC.

Finally, the Ministry for Environment and Protection of the Territory and the Sea is committed to getting beyond the water scarcity emergency in Italy, specifically in the southern regions of the country. The actions undertaken have been based on the contents of the National Programme of Initiatives in the Water Sector and the Water Protection Plans.

Other cross-sectoral measures are: legislative harmonization, fulfilment of demand and reliability of services through the monitoring of contracts and service cards; pro-active attitudes.

According to the assumptions used for the estimations, by 2025 the saving potential is assessed at around 15.5% of the current water demand, equal to around 6.5 km^3: irrigated agriculture accounts for 49% of the total potential recoverable losses while industrial and domestic sector contribute with 31 and 20%, respectively. Estimations are made taking into considerations only feasible hypotheses from economic, technical and institutional point of view. If we consider an average supply cost for unit of water of € 0.30 per m^3, we value an achievable saving of € 1.95 billion.

III. Economic approach to water management

The economic approach to water management issues is becoming increasingly important for many reasons. First, as water is becoming scarcer, its economic value is rising and the economic instruments can be used for sharing its use or consumption by competing sectors or groups since they tend to send appropriate signals to producers and consumers about the increasing scarcity of water. Second, financial viability for water-related projects and decisions becomes crucial since legal and political restrictions are increasingly imposed on deficit-generating activities and organisations. Third, alternative economic and financial instruments can be used for achieving efficiency, equity and sustainability in water management even thought trade-offs between them must be carefully considered (UNEP/WFP/Blue Plan, 2007; Cap-Net/ GWP/ EUWI-FWG, 2008.).

The use of economic tool is especially effective in the Water Demand Management. Economic tools, such as prices, taxes, subsidies and market-base instruments, can influence water demand and usage in order to meet economic efficiency, social development, social equity and environmental protection. WDM makes also use of legal incentives, awareness raising and education tools. Specific provisions in sectoral policies, particularly those concerning agriculture can also promote a more efficient use of water resources (Scardigno and Viaggi, 2007).

Different instruments are interdependent and mutually reinforcing. They aim at increasing both the efficiency and productivity of water use in various sectors (intra-sectoral allocation efficiency), thus achieving higher service levels and greater economic output per unit of water consumed and the efficiency of water allocation (inter-sectoral allocation efficiency), by (re)allocating water to applications that use water more productively and yield better output per unit water input.

1. Economic approach to water management: the Italian experience

Also in Italy, economic and finance instruments are becoming more and more important for taking better decisions that improve water management: in the NSSD the re-definition of the economic incentives and disincentives is considered the key objective for any sustainable policy.

Economic instruments to manage environmental issues and natural resources have been in use for a long time: excise tax on fuels, tax on energy products and electricity, automobile taxes were introduced since the 70's not for environmental motivations but for revenue reason. Later on, during the 90's numerous economic instruments have been introduced aimed at reflecting externalities and environmental costs and better orienting consumers and producers towards more sustainable models. Among the major instruments there are taxes on energy products, incentives for old vehicle scrapping, taxes on polluting emissions, tariffs on waste, and tariffs for the integrated water service. Even thought water policies in Italy are still dominated "by a rigid and formal command and control approach to environmental regulation and the basic policy instrument is represented by use license and authorizations" (Farrace, 2007), new approaches are gradually coming out.

1.1. Water pricing, tariffs and charges

In the domestic sector, since 1994 the Galli Law established an abstraction charges (canone di derivazione) as the instrument for ensuring the economic viability of the integrated water service. In 1996, the COVIRI proposed a method, known as the Standard Method, to set and revise tariffs. The Standard Method establishes a benchmark tariff that serves as basis for setting and adjusting actual tariffs in each basin in order to achieve adequate service levels, finance investment programmes, maintain sound finance, contain costs, enhance efficiency and protect consumers' interests. The formula for the computation of the benchmark tariff for the current year (year n) is the following:

$$Tt = (C + A + R)t-1 \times (1 + I + K)$$

Where:

Tt = tariff of current year (t);

C = operating expenditure including distribution, sewage and purification;

A = depreciation;

R = remuneration of invested capital;

I = projected inflation for current year;

K = price-cap.

The Standard Method establishes a progressive rate structure with increasing brackets for increased volume consumed: a first consumption bracket with a "subsidized" tariff, a second bracket with a "normal" tariff, third and fourth brackets with levels superior to the average tariff, which compensate in part the subsidy of the first bracket. The structure of rate is different for different type of users (domestic, agricultural, animal breeding commercial, etc) served by integrated water service. The average annual cost for customer (including a fixed annual quota; increasing rate for different consumption level; sewerage and purification rates, VAT at 10%) is given in the following table.

Table 2 - Average annual costs for different levels of consumption (€/m³)

	2007	2008
100 m³/ year	1.20	1.23
150 m³/ year	1.27	1.30
200 m³/ year	1.40	1.43
250 m³/ year	1.52	1.57

Source: our elaboration on COVIRI data

About half of total consumption is billed at facilitate rate, while volumes in the third and fourth brackets amount to 18%. Present social rate bracket privileges the first consumption units regardless of the user conditions thus subsidising both the poor and the well-off consumers. Therefore more selective equalising measures ought to be adopted (OECD, 2010). The average tariffs applied to different users show that agriculture, animal breeding and craftwork sector obtain more advantageous tariff conditions compared to household, industry and commerce: this disparity in water tariff represents a hidden subsidy to some sectors without any environmental motivation and the method is strongly criticized for its weak incentive mechanisms (MATT, 2009). Further, between 2002 and 2006, water tariffs raised on average by 35.2%, in real terms: the sharp increase of tariffs, likely to continue in the next years, must be carefully considered especially for the impact on the low income segment of population. According to the COVIRI, the current level of tariffs only cover the ordinary repairs of the network and no enough money is collected to provide financial support to extraordinary repairs and new infrastructure investments aimed to reduce the amount of distribution losses. (COVIRI, 2009) Notwithstanding reducing losses is an objective prescribed by several laws none of them can impose sanctions on governing authorities.

In the industrial sector, for the industrial users serviced by the public network a tariff is established on the basis of the quality and quantity of waste water discharged in the water bodies according to the Polluter Pays Principle. In order to enhance the reuse of water and the recycle of the wastewater, the water tariff for industrial uses can be reduced according to the quantity of water being reused.

As for the agricultural sector, structures and levels of water tariff are not homogeneous. In many irrigated area water is charged on the basis of irrigated or irrigable area independently on the volume of water used. In some other area, above all in the Southern Italy were the water deficit is more severe, water pricing mechanisms account for water consumption through unitary fix of increasing block rates. Water tariff per hectare of irrigable land varies from 160 to 500 € per year, while the average water tariff for cubic metre can vary from 0.06 to 0.12 €. In any case, irrigation water charges are far to cover the full cost of the resource as established by the WFD. The percentage of the FCR recovered by the current tariffication system can be estimated around the 50-70% of the operation costs (Liberati, 2008; Autorità di bacino del fiume Po, 2009).

Sometimes water pricing is associated with other water management instruments such as quota. Both allocation and tarrification of water resources take into account equity considerations.

Many Reclamation and Irrigation Boards are carrying out specific analysis and studies to assess economic, financial, technical and social sustainability of the implementation of the FCR principle. Results of the studied carried out in several irrigation districts confirm that the response of water demand to an increasing water price can be more or less rigid depending on many factors such as: the type of farm, the cultivated crops and the existence of alternative crops, the availability of alternative water sources and the irrigation techniques used, the initial level of the water tariff and the relevance of the water cost out of the total production costs. But there is no doubt that water pricing will influence irrigation farm technology boosting the transformation from sprinkler to drip irrigation, or even the adoption of complementary irrigation instead of the complete irrigation. Further, the adoption of a volumetric water pricing will affect both the cropping pattern and the water allocation among the several crops giving as a final result a raise in the water productivity without any effect on the quantity of water consumed. Finally many studies observed an inverse correlation between water pricing and farmers' income. Of course, the installation of water metering devices must be realized in many RIBs before the adoption of a system of volumetric charging.

Both for industrial and agricultural users that withdraw directly groundwater an abstraction license charge is established by the ATOs and varies according to the volume of water abstracted or it is associated with the abstraction permit or concession and based on the maximum quantity of water to be abstracted by the water user as laid down in the permit or concession. The abstraction rates for groundwater charged to each user group can differ. In particular, the use of groundwater for agricultural purposes benefits from lower rates or tax exemptions.[4] Rates can also differ between abstraction and consumption fees, putting a higher rate on consumptive use. Lower rates can be found with regard to areas without over-abstraction, specific industry sectors and even scarcity situations.

In agricultural sector, appropriate water pricing policies can be effective to reduce water demand but it is important to consider the presence of the two sources of water supply and the cross-elasticity of water demand: the price increase of the water supplied from public boards can indeed lead to increased abstraction from private wells with expectable worse environmental conditions over extensive areas together with a possible worsening in the public water agency balance[5] (Scardigno and Bazzani, 2008).

1.2. Taxes

"The fundamental point is to begin to gradually move taxation from citizens' income to environmentally harmful behaviours, without altering the tax burden. Only in this way individuals and businesses will be able to make their choices orientating them gradually towards more virtuous environmental behaviours"[6].

In 2005, environmental taxes have contributed to an overall tax revenue of over 40,000 million €, equal to a little more than 7% of the total revenue of the Public Administrations from taxes and social contributions and almost 3% of the Gross Domestic Product. Compared to 1990, the revenue from environmental taxes has increased almost 80%, whilst the amount of environmental taxes has decreased in relation to both total taxes and social contributions (-22%) and the GDP (-11%). The most significant component is the energy tax, 83% on average in the period taken into consideration. The rest is covered by motor vehicle taxes, equal to 16%; instead, pollution taxes, which have been in force only since 1993, represent only a minimum quota on average of 1%.

[4] This system encourages farmers to overexploit groundwater resources in many scarce areas in Italy. For this reason, an integrated water policy for both groundwater and surface water is under study in several basins.

[5] Cf. "An Integrated Territorial Simulation Model To Evaluate Cap Reform On Mediterranean Agriculture. Methodological Proposal And First Applications In Apulia Region (Southern Italy)," 109th Seminar, November 20-21, 2008, Viterbo, Italy 44799, European Association of Agricultural Economists.

[6] From the hearing at the Senate of Republic, 17 June 2008 of the Minister of environment

Waste water tax and taxes on polluted discharge in the water bodies are established. They are fixed and collected by municipalities and local authorities on the basis of volume and quantity of water and/or on pollutant's quantity. They are partially used to finance the collection and treatment of waste water or to restore the quality of the damaged water bodies.

1.3. Subsidies

In the agriculture sector, subsidies for the modernisation of irrigation equipment and maintenance of irrigation distribution network are established both in Rural Development and in Plans Protection and Management Plans. The Health Check of the CAP regarded water resources as one of the main challenges for the agriculture of the European Union and water savings and water use efficiency were considered as the main strategies to be adopted. The measures aimed at upgrading water use efficiency in the irrigated agriculture and recovering water losses of the distribution network both at farm and at district level. Further, subsidies for investments of the treatment of waste water at farm level were also planned.

Inset 1 - Incentives to water saving devices in the domestic sector

Numerous initiatives in many parts of Italy have been carried out to distribute domestic tap adaptators to reduce water consumptions. Through the collaboration of municipalities, no profit organizations, water agencies and national chains of distribution, families and public utilities have been provided - on free basis or at subsidized prices- with complete kit of devices to low water consumptions. Information and awareness campaign supported the distribution of the kit. The advantages of the initiatives are double: environmental since relevant quantity of water and energy can be saved, and economic, with a reduction of the water bill for consumers. It has been assessed a potential water saved from 30 to 50% of the current domestic water consumption and a cutback of 20/30% of the water bill.

1.4. The voluntary agreements

Voluntary agreement cannot be considered as economic tools but have been included in this review since they are often used together with economic incentives and subsidies.

In agricultural sector, voluntary agreements received a strong impulse from the CAP, and especially from Rural Policy, with the agro-environmental measures. In Italy agro-environmental measures were mainly targeted at soil protection and biodiversity safeguard while water resources were quite unconsidered. Similarly, cross-compliance does not include any obligation referred to water management resource. However, some agri-environmental measures - although not specifically targeted to water resources management - might have beneficial effect on water policy targets. This is the case of the voluntary programs aimed at the diffusion of organic and integrated agriculture; the growing commercial success of "environment-friendly" agricultural products and the adoption of "Codes of Good Practice" that can include specific norms regarding the rational use of irrigation water by a further spread of more efficient irrigation techniques and by the improvement of the irrigation management (Farrace, 2007).

Also in the industry sector an increasing diffusion of a "voluntary approach" is experimented aimed at achieving closed-cycles through direct recycling. The agreements are often realized among private enterprises and public local institutions that contribute to cover the costs of the initial investment through direct contributions or low-interest loans.

Inset 2 - Re-cycle and re-use of treated wastewater in the textile industry: the PROWATER project

Italy has promoted the stipulation of many supplementary or sector agreements (in particular, in the leather and textile sectors) for containing environmental impacts and for the recycling of purified water coming from the various industrial sectors by resorting to the "Best Available Technologies".

With the PROWATER project, Tecnotessile received from the European Commission one of the five awards as "Best of the Best" Project at the "Best LIFE Environment Projects 2007-2008" within the Green Week 2008 Conference. Tecnotessile is a research and technological innovation firm specialized in the textile industry; it is localized in the Prato district (Tuscany). Wet textile industry uses large amount of water for its wet production processes. In fact it was evaluated that from 200 to 500 liters of fresh-water are necessary to produce 1 kg of finished product. Besides textile wastewaters are often characterized by a significant pollution load cause of the chemicals like surfactants, softeners, dyes, auxiliaries and salts used to wash and finish yarns, fabrics and garments. So it is necessary to proceed with a proper wastewater treatment before discharging textile effluents in public sewerage or surface basins. Even when discharging wastewaters in centralized treatment plants, it could be interesting effluents pre-treatment in order to pay for lower purification fees. For these reasons, textile sector aspires to the partial or total re-cycle of treated wastewater in order to reduce the freshwater needs of textile mills and pollutant load of effluents discharged in surface basins, so developing the EU directives 61/96 (Integrated Pollution Prevention and Control, IPPC) and 2000/60.

In this context the PROWATER project studied an innovative treatment process for effluents from the textile wet industry, which aims at treated wastewater reuse in the production processes. The aim is the evaluation, from the technical and economic point of view, the possibility to recycle effluents from the wet textile industry through the use of an innovative purification process. In particular, wastewaters coming from four different textile processes (finishing, laundry, dyeing and finishing/dyeing) will be treated by means of a process that foresees three steps: physic-chemical pre-treatment, cross-flow ultra-filtration on flat membranes and advanced chemical oxidation by means of ozone. Technical evaluations of the quality of the treated wastewaters and of the finished products will be performed together with economic evaluations concerning operating costs of the prototypes and scaling up of the process. It was estimated a reduction of 40% of the water consumed in the textile wet industry.

Inset 3 - Sustainable Hospitality

Some facilities obtained the certification for their Environmental Management System applied to hotel reception and catering. Collaboration between Management and staff as well as rising guest awareness contribute to quality of service, monitoring and reducing activities' impact on the environment and implementing programmes for improved environmental performance and customer service. Water Saving is one of the main objectives and water consumption is controlled and regulated; leaks are promptly repaired and the staff was trained to avoid water waste in washing operations. Some bathrooms have water saving systems installed such as double WC flush and special taps.

Conclusion

On the basis of the previous pages it is possible to draw some concluding remarks:

- A national strategy to increase water use efficiency does not exist and, consequently, quantified and official policy targets for WUE increase are very difficult to be retrieved.
- Relevant increases in water use efficiency are still possible in all sectors. Recover of transport and distribution losses and higher rate of reuse of wastewater represent the most effective options.
- In order to achieve the above mentioned objective economic incentives are needed since currently reducing water losses is more expensive that the water wasted[7].
- Economic instruments for water management still remain underutilized; technical measures are often regarded as primary instruments of Water Demand Management in the water policies agenda.
- Of the range of available economic instruments, taxes, license fees and abstraction charges are the tools most widely used with environmental purposes. Fees are collected for both, abstraction and pollution of water.
- While the reform of national water pricing policies is still an ongoing process, its main objective seems to be the recovery the financial or industrial cost of supplying water to the users rather than to cover the full cost of the water since environmental and resource costs are hardly evaluated.
- Even though equity considerations are taken into account, social problems represented by a sharp increase in the water tariffs deserve to be considered.

[7] For example, in the domestic sector, consumers are not currently motivated to install water saving devices since the cost of the devices is higher than the savings in the water bill. Appropriate incentives can change the profitability of the water saving devices and enhance their use.

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