Chapter 9
Water Tariffs in Agriculture: Emilia Romagna Case Study

Michele Vollaro, Laura Sardonini, Meri Raggi, and Davide Viaggi

Abstract The chapter presents changes in the irrigation tariff system of the irrigation district Tarabina, in the Emilia Romagna Region, Italy. In order to improve the management of the irrigation water resources (distribution of water and related costs), in 2006 the users voluntarily replaced the area-based payment (a financial instrument) with a volumetric tariff (EPI) and introduced a set of formal rules. In the following years, a reduction in water use at district level has been observed. Such an outcome has aroused a particular interest in studying the contribution of the volumetric tariff, intended as an EPI, on the reduction of water use. The capability of such an EPI in reducing the amount of water used in agriculture would strengthen the policy intentions of the EU of implementing measures that induce a more efficient use of water resources. Based on a counterfactual analysis, it has been found that the introduction of the volumetric tariff induced a reduction, on average, of about 50 % of the water used for irrigation along with a reduction of about 70 % of the costs for the non-irrigators. Such findings suggest that EPIs, associated to other instruments, such as site-specific regulations, might improve their effectiveness and pursue multiple policy goals.

Keywords Irrigation water management • Marginal pricing • Volumetric tariff

9.1 Introduction

The chapter reports the water management experiences of an users-based irrigation organization in Emilia Romagna Region and aims at assessing, through a qualitative approach, the relative performances in terms of improvements in water allocation

M. Vollaro (✉) • L. Sardonini • D. Viaggi
Department of Agricultural Sciences, Alma Mater Studiorum University of Bologna, viale Fanin 50, 40127 Bologna, Italy
e-mail: michele.vollaro@unibo.it; laura.sardonini@unibo.it; davide.viaggi@unibo.it

M. Raggi
Department of Statistical Sciences, Alma Mater Studiorum University of Bologna, via delle Belle Arti 41, 40126 Bologna, Italy
e-mail: meri.raggi@unibo.it

© Springer International Publishing Switzerland 2015

M. Lago et al. (eds.), *Use of Economic Instruments in Water Policy*, Global Issues in Water Policy 14, DOI 10.1007/978-3-319-18287-2_9

and relative costs. The case represents an interesting example of improvements in the governance of irrigation water that took place in the irrigation district Tarabina, in which a voluntary change in the tariff system, from a unique area-based payment to a composite tariff accounting for the quantity of water used, set up by the users to resolve distributional issues in the quantity and costs of irrigation water, have implied a remarkable reduction of water use. Although the choice of implementing volumetric tariffs has not essentially been a response to changes in the availability of irrigation water resources, this particular experience *de facto* demonstrates the potential of improvements in water management (water pricing and metering) as effective adaptation strategies aimed at improving the management of water resources by the employment of an Economic-Policy Instrument (EPI).

9.2 Setting the Scene: Challenges, Opportunities and EPIs

Incentive pricing is the instrument envisaged by the Water Framework Directive (WFD) in art. 9 for inducing (i) the full-cost recovery of the water services, including the environmental and resource costs, and (ii) a more efficient use of the water resources, concurring to the environmental objectives, in the context of the application of the Polluter Pays (PPP) and User Pays (UPP) Principles. The adoption of pricing has been highly recommended also by the *Blueprint* (EC 2012), which is an orientation document about water policy at EU level that focuses also on quantitative aspects of water resources.

The case study is located in the South-East of the Emilia Romagna Region and is part of the district managed by the Land Reclamation and Irrigation Board "Romagna Occidentale" (LRIBRO). The focus of the study is the introduction of an incentive pricing instrument (volumetric tariff system) in a sub-area of LRIBRO.

Although the diffusion of pricing mechanisms across the EU is mostly related to environmental and/or quantitative issues, the adoption of a volumetric tariff in the irrigation district Tarabina is the governance response to an intentional correction of the repartition of water costs and allocation among district members. Indeed, many members, especially non-irrigators, considered the area-based tariff as an unfair pricing system, but also many irrigators were not able to stand anymore to repeated increases in the tariff level. The change to a volumetric tariff system represented, therefore, a solution for improving fairness among non-irrigators and an instrument for inducing self-regulation in the use of irrigation water among irrigators.

This specific incentive pricing has been chosen among a set of other possible instruments mainly because the irrigation district is served by a network of pressure pipes, but also for fulfilling the requirement provided by the art. 11 of WFD, which recognizes pricing as a "basic" measure, namely minimum requirements to be complied with. Moreover, the Tarabina Management Committee (TMC), in agreement with the LRIBRO authorities, adopted a set of formal rules in order to provide the best management ground for the implementation of the incentive pricing. This

innovative governance and institutional setting is in line with the indications of the WFD, which provides River Basin Authorities (RBAs) with the opportunity of creating *ad hoc* policy mixes by envisaging "supplementary" measures concurring to the environmental objectives of the Directive. However, an aspect to be considered is the specific context in which the EPI has been implemented. Indeed, the district Tarabina is a relatively small area which covers about 700 ha and includes approximately 50 farms (one of them is a cooperative and covers more than an half of the total surface). Moreover, the area hardly suffers from water scarcity because the irrigation water is delivered by the Canale Emiliano Romagnolo[1] (CER) for the means of a long-term contracts of water supply with LRIBRO. Such contextualization has represented a favorable ground for the adoption of an incentive pricing system based on water metering, especially in virtue of the relatively low costs of implementation, both at administrative level and for farm-level adaptation of irrigation facilities.

Despite the specific context considered, incentive pricing instruments are usually adopted for inducing users to profitably self-regulate the consumption of a good (behavioural change/collective action) (Cross 1970) in order to promote the realization of one or more social outcomes (e.g., reduction in pollution, adoption of water saving technologies…) (Rogers et al. 2002; Ward and Pulido-Velazquez 2009), especially improvements in allocation efficiency of available resources. Indeed, incentive pricing instruments have been envisaged by the WFD on the basis of the dynamic relations between quality and quantity of water resources (an increase in quantity induce increase in quality, *ceteris paribus*) for concurring to the objective of improving the environmental status of water bodies. However, the effectiveness of an EPI cannot be evaluated solely on the performance of the pursued outcome, because its implementation might produce second-order effects or affect other factors not properly or directly considered during the design stage, such as, e.g., the ability of the EPI of not debilitating economic development, the effort to avoid unfairness in the distribution of economic and financial burdens among members of the society and of the economic sectors (avoid social conflicts). This is especially true/valid for EPIs, like incentive pricing, which operate through the internalization of water uses' costs. Based on such considerations, this case study proposes to analyse the effects on water use of an incentive pricing instrument that has been designed for correcting the cost distribution of irrigation among users. Such quantitative aspects of the outcomes of the incentive pricing instrument have been assessed by the means of a counterfactual analysis, based on a performance's comparison with respect to the "twin" irrigation district Selice in which the tariff system has remained unchanged.

[1] CER is one of the most important water infrastructures in Italy. It delivers water from the Po River to supply agriculture (mainly) and industrial uses in the south eastern areas of the Emilia Romagna Region.

9.3 The Volumetric Tariff in Action

The agricultural area of the district is served by a network of pressured pipe system that was built by the national government in the early 1980s. Such type of infrastructure allowed for an autonomous administration of the district, called "cost center", such to keep the accounting system of the district Tarabina separated from the general administration of the LRIBRO. The definition of Tarabina as a "costs center" involved the introduction of a management committee (TMC) (farmers elect seven members out of a total of nine). Data on land use and the crop mix in the Tarabina area are not available from statistical sources (due to lack of information at the appropriate scale), but qualitative information was made available by the technical staff of LRIBRO, consulted through direct interviews. They stated that the main specialization in the Tarabina area is horticultural crops and that heterogeneous crop mixes are present at the farm level based on combinations of other crops, such as seed for industrial uses, cereals and fruit (peaches, kiwis, apricots, plums). Data on water uses and tariff paid by district members are available at aggregate (district) level up to 2011 and at farm level (for irrigators) since 2006. However, the staff of LRIBRO cannot release such data because of privacy restrictions on the use of such information. Data on M&O costs are available at aggregate level.

At the outset of the irrigation system, a flat-rate (*per ha*) tariff system was adopted (representing a minimum contribution, equal for all members, to the maintenance and operational (M&O) costs of the district). In 2005, the TMC proposed to change the pricing system, supporting those farmers who complained of excessive water tariff increases (from EUR 20/ha in 1983 to EUR 155/ha in 2005 for all farmers, both irrigators and non-irrigators). The solution was identified in shifting towards the adoption of a volumetric tariff, implemented through the installation of water meters, by charging water users according to the actual applied quantity of irrigation water and by the collateral adoption of a formal set of rules, needed for governing the new EPI. The majority of farmers decided to adopt the new volumetric tariff system. Its introduction was first tested in 2005 and definitely adopted in 2006.

The new pricing is called "trinomial", since the tariff is the sum of three components:

- A fixed component (EUR/ha): paid by both irrigators and non-irrigators, representing a payment quota for M&O costs;
- A volumetric component (EUR/m^3): representing the actual water use, quantified by water meters and paid by irrigators only to recover the costs of the resource and its delivery;
- A variable component (EUR/ha) introduced to recover all the remaining costs related to water use (not covered by the previous two quotas); this part is charged in the next business year and includes additional costs such as non-ordinary interventions, unmetered water use and M&O costs, and is paid by irrigators only.

Figure 9.1 represents the rationale of the ex-post analysis, performed in order to clarify which were the preconditions of EPI introduction, the EPI and which are the main effects to be analyzed:

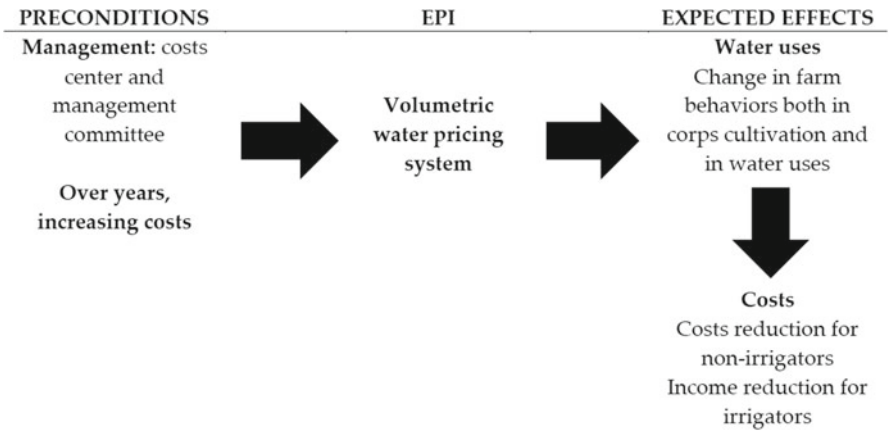

Fig. 9.1 Rationale under the implementation of the volumetric water pricing system in Tarabina (Source: Own elaboration)

9.3.1 The EPI Contribution

The contribution brought about the implementation of the volumetric tariff in Tarabina can be better assessed by implementing a counterfactual analysis based on the performance of the irrigation district Selice, instead of focusing on time-differences within the same district Tarabina. The "cost center" Selice is considered the twin of Tarabina since it is identical as regards the agricultural and infrastructural characteristics. Selice neighbors Tarabina from the South border and its plain agricultural land of about 1,300 ha is shared among 42 farms that receive water from the CER.

Since 1983, the contributive system in Selice is regulated by a monomial areal tariff and the district has its own formal set of rules for the management of irrigation infrastructures and water resources. Given the close vicinity to Tarabina, the weather conditions in Selice can be considered as yielding the same effects on water use borne by Tarabina. Indeed, by exploring the linear trends in water use as shown in Fig. 9.2, Tarabina records a marginal increase close to 24 m^3/ha per year until 2005, thereafter it shows a null tendency, while Selice shows a marginally increase of 21 m^3/ha per year over all the considered period.

9.3.1.1 Environmental Outcomes

In the context of the environmental outcome, the main result of the EPI implementation, judging by the responses of the agents involved, is the reduction of the global amount of water used by farmers in the irrigation district Tarabina. In the period prior to the introduction of the EPI, the distribution of water use was particularly variable, as noted in Fig. 9.3, with a general increasing trend and an average consumption of about 440,000 m^3.

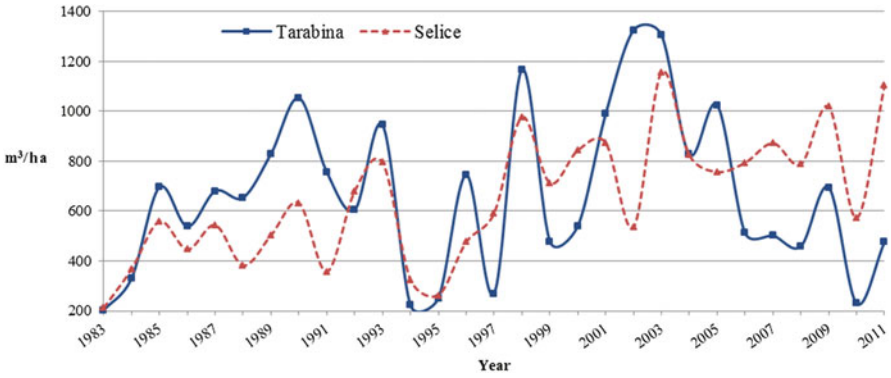

Fig. 9.2 Unitary (per ha) use of irrigation water in Tarabina and Selice (Source: Own elaboration on LRIBRO data)

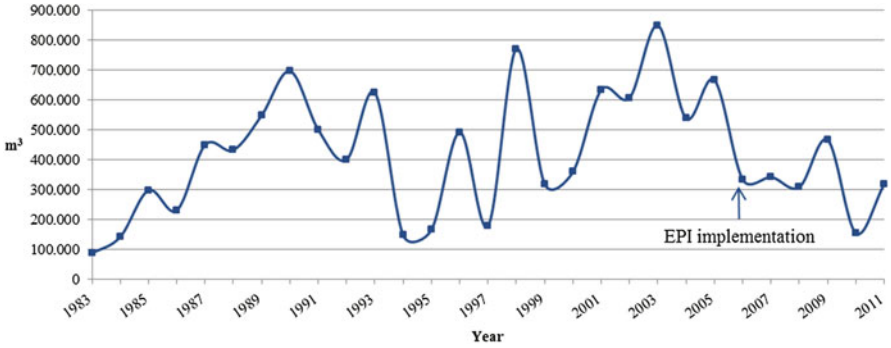

Fig. 9.3 Water use distribution in Tarabina between 1983 and 2011 (Source: Own elaboration on LRIBRO data)

After the introduction of the volumetric tariff in 2006, the distribution seems to follow a more stable trend with an average level of 320,000 m^3, about 30 % lower than the one registered in the previous period. The variability in water use is likely linked both to climatic factors (such as rainfall and temperature) and the water requirements of crops that differ from year to year. However, by looking at the variation in water use in the twin irrigation district Selice, for which the weather effects can be considered the same as in Tarabina, the average consumption of water changed from about 835,000 to 1,100,000 m^3, an increase of about 32 %. In terms of water quality or pollution problems, the EPI implementation did not bring about any change, as the water in this area is good enough for irrigation. Moreover, from a social perspective, the EPI is not likely to have clear effects in terms of environmental pressures, as previous studies show that they are poorly related to changes in water use (at least in the relevant use interval) (Raggi and Viaggi 2009).

Two main consequences, related to changes in individual behavior, have been observed with respect to pressures on water-related ecosystems after the introduction of the EPI. The first is the elimination of "chiari" (lake advocated for hunting activities) and the second concerns energy use. Nevertheless, another aspect regarding possible crop changes should deserve particular attention. However, according to LRIBRO technical staff, crop cultivation did not change on the majority of farms.

With respect to the first aspect, the use of water meters discouraged the non-agricultural uses of water, such as the "chiari" that are ponds used for recreational purposes, in particular hunting activities. Before the EPI implementation, the "chiari" were filled at least two or three times each summer with large quantities of water (up to 200,000 m^3). The new tariff system triggered an incentive to reduce the amount of water used to fill the "chiari", but, however, the abandonment of such behavior brought about, as a direct ecosystem consequences, a significant reduction in the number of birds. Indeed, the other aspect to be considered is that the purpose of "chiari" is not to provide environmental improvements.

The second aspect concerns the variation in energy use, measured as the total costs for energy services. The data available cover the period 1983–2011, but have serious limitations in assessing the effect of the introduction of volumetric pricing in 2006 (the data covers only 5 years of the EPI implementation and data related to 2002 and 2004 are missing). In Fig. 9.4, the trend related to energy costs is shown. Up until 1993, the trend is that of increasing costs; in the subsequent 10 years the behavior is rather variable and after 2006 it shows a stability.

By relating the energy costs to the total amount of irrigation water delivered (energy costs per unit of irrigation water), an increasing trend of EUR 0.0027/m^3 per year is observed, while Eurostat data on energy prices for industrial purposes increased by EUR 0.0017/Kwh per year.[2] An estimate of energy consumption at

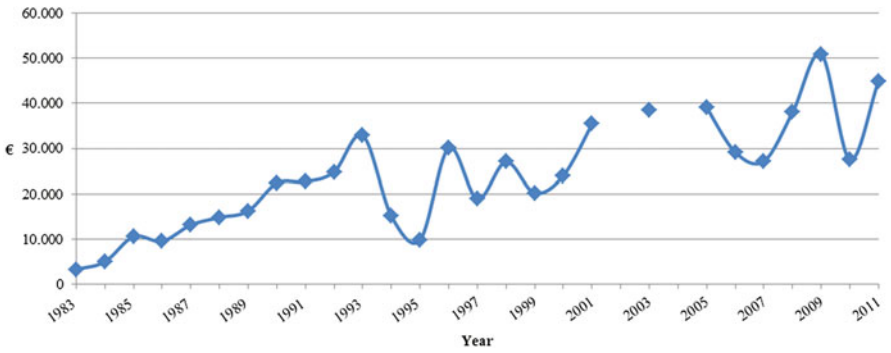

Fig. 9.4 Energy costs in Tarabina between 1983 and 2011 (Source: Own elaboration on LRIBRO data)

[2]The observed period goes from 1991 to 2011, according to the availability of Eurostat data on unitary energy prices (EUR per kilowatt-hour) for industrial purposes in Italy, including levies and taxes.

district level would be necessary to isolate the effects of both water consumption and inflation on the total energy costs. However, given that the computed trends present a difference in the order of millesimals, the yearly fluctuations of energy costs in the Tarabina district could be partially attributed to the variation in yearly water consumption. Therefore, it may be that one of the outcomes of the EPI is a stabilization in energy costs, which implies a benefit in environmental terms due to a more accurate use of energy and, maybe, a reduction in fossil fuel inferred by the increases in unitary energy costs since 2008 (EUR 0.0028/Kwh per year).

9.3.1.2 Economic Outcomes

The EPI in this context was not compared to alternative water pricing systems at the time of its selection, but its implementation was decided upon by implicitly comparing it to the existing area-based pricing system. The choice of the EPI was quite obvious because of the presence of a pressure pipe system, in principle allowing for an easy installation of water meters and related reporting procedures. The shift from an area-based to a volumetric water pricing system was hence identified as the 'best' solution by and for the users in the area. The change of water pricing system was also supported by the good characteristics of the hydraulic system and the small geographic area covered.

Compared to the previous area-based system, the EPI contributed to economic efficiency both in terms of water allocation among farmers and overall water use. The shift in the pricing system resulted in water re-allocation between users in terms of quantity used, in particular providing incentives to use less water for farmers with lower marginal value of water (that would have used more water in an area-based system, in which the marginal cost of water is zero).

In terms of cost-effectiveness, the volumetric pricing implemented in Tarabina can be assessed by a qualitative comparative analysis with respect to the performance of the previous tariff system, by focusing on the differences in costs distribution among users. Indeed, the main reason for the implementation of the EPI was due to the significant increase in M&O costs, which yielded an incentive to non-irrigators to push for abandoning the area-based pricing approach. Those who were non-irrigators in the past and who maintained the same behavior after the EPI implementation benefited from large cost reductions.

Indeed, during the period 1982–2005, the area-based tariff increased from EUR 20/ha up to EUR 155/ha (in 2005) for all farmers in the area. It followed that, for most of the district members, water tariffs were considered "wrong" because the cost allocation was not related to actual use. For this reason, the introduction of the EPI in Tarabina was easily justified. The actual implementation took place by way of the use of water meters by those farmers who planned to irrigate in the future and consequently in the shift to the volumetric water pricing system. The volumetric water pricing system was tested in the first year (2006) and improved in the following year (2007). As for the previous tariff system, the payment that each farmer bears in year t is calculated on the basis of the cost (for the flat tariff) and the actual

Table 9.1 Volumetric tariff system adopted in 2006

Trinomial tariff	Non-irrigators	Irrigators
Fixed component	EUR 29/ha	EUR 29/ha
Volumetric component	Not paid	EUR 0.15/m^3
Variable component	Not paid	Paid (EUR/ha)

Source: LRIBRO data

use (for the volumetric tariff) of water in the year *t-1*. Table 9.1 shows the amount of the three components of the volumetric water pricing system related to usage in 2007.

A fixed component (EUR/ha) is paid by both irrigators and non-irrigators and represents the payment component for M&O costs. The volumetric component (EUR/m^3) represents the real water used in year *t* and is controlled by water meters. The variable component (EUR/ha) is computed in year *t+1* and is paid by irrigators only. The latter component (variable each year) is introduced to recover all the remaining costs (not covered by the previous two components). This part could include additional costs beyond ordinary interventions, such as unmetered water and M&O costs.

After only few years from the implementation of the EPI, a very first assessment of the impact of the volumetric pricing can be made. At the global level (whole area), the general efficiency of the system increased because the reduced water use resulted in an abatement of the cost of water provision (as commented by the LRIBRO technical staff). In fact, the total amount of water used decreased and consequently the M&O costs also decreased. The LRIBRO evidence shows that non-irrigators benefited from a cost reduction of about 70 % in 2006 (from 155 to 29 EUR/ha), whereas irrigators experienced a reduction of around 50 % due mainly to a water use reduction induced by the volumetric pricing system. Based on this information it is likely that the shift to the EPI translated into a prevailing reduction of revenues for the farmers. However, at this stage it is not possible to estimate the overall effect on profits given the short time elapsed since the implementation of the EPI and the relative non-availability of data at farm level. Nonetheless, some information were made available from the technical staff of the LRIBRO. In particular, for non-irrigator farmers, it seems likely that the balance between reduced revenues and costs yields an increase in income. The result is more ambiguous for the other farmers.

9.3.1.3 Distributional Effects and Social Equity

The productive activities in the area have changed due to the introduction of the EPI. At the moment, however, precise data is not available. Hence, the present illustration relies on information reported by LRIBRO technical staff. From February 2011 to October 2011, two LRIBRO technical staff members were interviewed on three separate occasions. The objective of the interviews was to collect information,

Table 9.2 Example of decreasing water costs for a non-irrigator

Year	ha	EUR/ha	Total
2005	1.56	123	192
2007	1.56	29	45

Source: Interview to LRIBRO technical staff

data and opinions about the volumetric water pricing system, the main reasons for shifting to volumetric water tariffs and the main effects observed.

On the basis of the information collected, it is possible to identify three different groups of actors to analyze the change in income distribution due to the implementation of the EPI: (1) the first group includes non-irrigators who decreased their water costs; (2) the second includes those who ceased irrigation after the implementation of the EPI; and (3) the third group includes irrigators. Data is not available for groups 2 and 3 therefore considerations about income changes are not provided. With regard to the first group, farmer income increased because water costs decreased after the implementation of the EPI. In Table 9.2 an example is shown, related to an individual farm that reported a reduction in costs related to water tariffs of more than 70 %.

For those who ceased the irrigation activities after the introduction of the volumetric pricing it can be deduced that some labor savings occurred in the farm. In fact, irrigation activities require time for management and the main consequence of stopping irrigation is likely some savings in terms of labor.

The farmers who saved labor are most likely to re-allocate such time to other farming activities. At this stage, we do not have any direct information about the relevance of this issue, as these considerations came from the qualitative assessments of researchers and LRIBRO technical staff.

For irrigators, however, farm-level data are not available at the moment and a specific analysis of changes in internal organization, costs and profits are not possible to be performed.

9.3.2 The EPI Setting Up

The design and the implementation of the EPI did not encountered particular or specific obstacles, given the appropriate infrastructural predisposition of the irrigation system and the management organization as well. The will of the majority of farmers to abandon the current pricing system pushed the TMC to propose the alternative tariff.

9.3.2.1 Institutions

An important aspect that highly contributed to the realization of the EPI is the governance organization and the good relationship existing between the water authorities at different administrative levels. In order to establish a hierarchy among the water authorities that have been instituted during the years in Italy, different administrative levels can be individuated. In fact, in this case study, the relevant organizations are at upper levels: the first level includes the LRIBRO and the CER, while the second level includes the TMC. These organizations were set up at different times: organizations at second level started at the beginning of the 1900s (1933 and 1939), while the TMC is much more recent (1982).

At the national level, Land Reclamation and Irrigation Boards (LRIBs) were introduced in 1933 and regulated by the Royal Decree (R.D.) 215.[3] The LRIBs are public authorities subject to national laws and, since 1977, to regional laws as well. The functions of the RIBs – the reason of their institutionalization – are mainly related to the reclamation of wetlands and irrigation of agricultural areas. In 1989, the functions of LRIBs have been widened to cover many aspects related to land and subsoil protection, in coordination and subalternity to regional laws. In 1984, the Emilia Romagna Region anticipated such national orientation by emanating the regional law 42/1984 that widened the role of the regional LRIBs with respect to use, monitoring and protection of land and water resources. In 1994, a reform at national level about the management of water resources was realized and the related national laws were joined into a unique law, the Law 36/1994 (called Galli law), that provided the LRIBs with the power of building and managing irrigation networks, plants for the agricultural reuse of wastewater, rural aqueducts and other infrastructures functional to reclamation and irrigation systems. After the introduction of the Water Framework Directive (WFD 60/2000), the Italian legislative decree 152/2006 (named "environmental code") improved the functions of the LRIBs, including in particular the environmental protection intended as the protection and recovery of land and subsoil and the hydrogeological restoration of the territory, in concurrence with national, regional, provincial and municipal institutions (Ferrara 2009).

The relationship between LRIBRO, CER and TMC is considered to be quite good and this facilitated the EPI implementation. In fact, the long-term contracts between LRIBRO and CER guarantee the water supply in the area and this avoids water scarcity problems. The water management activities proposed by the LRIBRO can be supported and shared by farmers through the TMC. The sharing of water pricing amongst farmers represents one of the main points in the EPI implementation process in order to guarantee its acceptance. In addition, TMC can propose changes in the water management on the basis of farmers' needs.

With regard to culture and attitudes, the case study area is characterized by the presence of several cooperatives (lower level) that link farmers through shared preservation, processing and selling of their products. Another aspect that highlights the

[3] In 1933, the name of the boards was Land Reclamation Boards, without any mention to irrigation even though such function was provided by the R.D. 215.

level of entrepreneurship of the farmers in the area is the specificity of the crop cultivated, as industrial seeds require good relationships with market buyers and professional ability for cultivation. The strong presence of national farmers associations (lower level) helps avoiding, or mediates in the case of, conflicts among farmers.

All the cited organizations (upper and lower levels) have been involved in the design, implementation and operations of the EPI through a bottom-up approach, from complainer farmers to LRIBRO administration. The TMC, as representative of farmers' needs, submitted a proposal to the technical staff of the LRIBRO. LRIBRO was in favor of change and suggested shifting to a volumetric water pricing system through water metering installation. The move to a new water pricing system benefited from the definition of the area as a "cost center". The tariff was designed to recover all costs from farmers in the area. In addition, given the small area involved the identification of irrigators and non-irrigators was accomplished by way of a direct verification process (farm by farm).

9.3.2.2 Transaction Costs and Design

On the basis of our knowledge, there are no existing studies in this area that analyze transaction costs. However, it is possible to hypothesize that transaction costs are highly correlated with: (a) the purchase of water meters, (b) a system to control and identify non-irrigator farmers; and (c) data collection related to water use.

The cost of water meters was equal to EUR 193 + VAT and is covered by irrigators. In addition, the infrastructure was not modified, so this did not imply any transaction costs related to the irrigation network. Another point to consider is that transaction costs are correlated to the ability of institutions to deal with administrative and negotiation matters. In this case the good collaboration between the TMC and the LRIBRO likely kept transaction costs low. The only transaction costs that administratively represents an increase in total costs is attributable to the monitoring of the water use and the related reports. In fact, data collection concerning use is undertaken directly on the farm by the LRIBRO technical staff who downloads water meter information. In addition, the time spent in the calculation of water tariffs increased and so did the related costs.

9.3.2.3 Policy Implementability

The flexibility of the EPI is particularly connected with some characteristics of the specific case study. In the Tarabina area, the EPI implementation can be considered simple by virtue of its nature and the existing governance system. The simplicity of the implementation depended on the small size of the area, which enabled tailoring the EPI to the aforementioned local particularities: the existence of a pressure pipe system, a "cost center" definition, and the existence of a management committee (TMC). In addition to these characteristics, the fact that the EPI implementation was

voluntarily chosen by the farming community positively impacted on the EPI's implementability.

The authorities that managed the implementation of the EPI were highly able to strengthen the synergies between the volumetric pricing and some sectorial policies. In particular, it is possible to identify two main aspects:

- The volumetric pricing is coherent with the needs of the farmers who claim the need for cost reductions in general and, specifically, related to water use;
- The decoupling of payments introduced in 2005 by the Common Agriculture Policy reform (CAP) likely helped in the reduction of the quantity of water used (at the least the CAP reform was not in conflict with it).

The adoption of the incentive pricing system in Tarabina did not found any legislative or bureaucratic obstacle, because the aims underlying the introduction of such instrument are in line with auspices of the mentioned national and regional laws. Moreover, the indications about incentive pricing and cost recovery provided by the WFD were actually important in facilitating the transition from the design to the process of the EPI implementation.

9.4 Conclusions

The Tarabina case study investigates the adoption of a volumetric water pricing system in the agricultural sector. Even though the area examined is quite small, the EPI application can be considered significant within the Italian context.

Some specific conditions have had a crucial role in the implementation of the EPI. Firstly, a pressure pipe system had already been used in the Tarabina area; in addition, the identification of Tarabina as a "cost center" allows for measuring (and hence potentially recovering) all costs related to it, as they are already separately identified in the LRIBRO accounting system. Moreover, the presence of a Management Committee – who actually decided for the adoption of a new tariff – avoided transaction costs related to the administrative and bureaucratic process of changing the tariff system. Finally, contract between LRIBRO and CER has guaranteed, since the outset of the irrigation district, the supply of water even in periods of scarcity, hence allowing EPI to focus only on economic aspects (as compared to EPIs mainly driven by water savings concerns).

The main reason for the introduction of the EPI was the increase in water tariffs during the period 1983–2005 caused by increases in M&O costs. Such increases also caused high inequalities between users (irrigators and non-irrigators). Accordingly, farmers representatives elected to the TMC, with the assistance of the LRIBRO, sought a solution to reduce inequality and overall costs. The solution identified was the implementation of water metering and the shift to a volumetric water pricing system.

The EPI provided multiple impacts related to economic, environment and social aspects. The economic impacts are most evident, in particular those related to the

decrease in water delivery costs and the change in the distribution of contribution costs among farmers. In particular, a noteworthy cost reduction for non-irrigators occurred, due to a more efficient cost distribution based on quantity used. With regard to the environment, due to a decrease in water used, the amount of water remaining in the environment increased. Finally, regarding social aspects, the EPI increased the level of 'social agreement' within the group of non-irrigators.

References

Cross, G. J. (1970). Incentive pricing and utility regulation. *The Quarterly Journal of Economics, 84*(2), 236–253.

European Commission [EC]. (2012). A blueprint to safeguard Europe's water resources (COM673), Brussels.

Ferrara, G. (2009). L'ordinamento dei Consorzi di bonifica nell'evoluzione della disciplina nazionale e regionale. *Economia e Diritto Agroalimentare, 13*(2), 63–85.

Raggi, M., & Viaggi, D. (2009). Valutazione degli effetti delle politiche di tariffazione e di scenari mercato nel Consorzio di Bonifica della Romagna Occidentale in Acqua e Agricoltura in Italia Valutazione di scenari e strumenti di supporto alle decisioni a cura di V. Gallerani, G La Via and G- Zanni. Franco Angeli editore.

Rogers, P., Silva, R. D., & Bhatia, R. (2002). Water is an economic good: How to use prices to promote equity, efficiency, and sustainability. *Water Policy, 4*(1), 1–17.

Ward, F. A., & Pulido-Velazquez, M. (2009). Incentive pricing and cost recovery at the basin scale. *Journal of Environmental Management, 90*(1), 293–313.