

Paying for water-related forest services: a survey on Italian payment mechanisms

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The paper reviews the state of implementation of one of the most relevant mechanisms of payments for environmental services (PES) in the forestry sector: the systems of payments for water-related forest services. Three water services with economic relevance are analyzed with reference to the Italian context: hydropower generation, tap-water supply and mineral water use by industry. Using the consolidated definition of PES as a basis for the analysis and considering the regulatory framework on water, we compared the three water-related services to describe the strengths and weaknesses in environmental services provision. From the analysis we deduced that pure PES schemes do not exist in the water sector in Italy, while PES-like schemes driven by public authorities have a relatively long and consolidated tradition, but need to be better oriented and more widely implemented in order to compensate the providers of the services.

Keywords: Payments For Environmental Services (PES), Water, Environmental Services, Italy

Introduction

Forests are worldwide considered generators of a multitude of environmental goods and services. Due to increasing problems of scarcity and quality, the water-related services are assuming a priority role among forest-based ES (FAO 2008, Birot et al. 2011).

The essential role of water for human life is being recognized by many water legislative frameworks in Western society (Scott & Coustalin 1995, Cullet 2011, Grafton & Hussey 2011), which are setting out rights and duties on its use, as a result of demographic expansion, use conflicts and perceived problems of scarcity (Dosi & Muraro 2003, Kuks 2004). Despite this, in the European Union (EU) and in many countries no specific normative tools directly address the link between forest and water production. For example, even if the EU Water Framework Directive (WFD - Directive 2000/60/EC) has pointed out the key role played by environmental resources management policies in the water cycle, especially for water quality, it does not refer explicitly to forests. Nonetheless, scientific evidence is growing of the cause-effect links between forest management and water quality: recent papers have highlighted the role of wooded areas on water quality maintenance (Neary et al. 2009, Eriksson et al. 2011, Robinson & Cosandey 2011), underlining the possible management options to enhance quality parameters in rivers as well as in shallow aquifers.

In some countries, both the most advanced and developing economies, the cause-effect scientific proofs combined with gaps in the

legislative framework allowed private or public entities to create payment schemes on a voluntary basis in order to ensure higher water quality standards, using economic tools to stimulate the catchment areas' landowners to change their management practices. An historical example is the payment mechanism promoted by the New York City Council to enhance water quality, compensating landowners in the catchment area when they improve their management practices (NYC-DEP 2010). Several public authorities in France have also encouraged the production of forest drinking water by drafting a similar compensation scheme (Ferry 2006). Again in France, a private company (Vittel) producing bottled mineral water has implemented a payment scheme to compensate land managers for their farming practices aimed at water quality protection (Perrot-Maître 2006).

These mechanisms are better known as Payment for Environmental Services (PES), defined as a "voluntary" transaction where a "well-defined" environmental service (ES) (or a land-use likely to secure that service) is being "bought" by a (minimum one) ES "buyer" from a (minimum one) ES "provider", if and only if the ES provider secures ES provision (conditionality - Wunder 2005). Nevertheless, in many cases one or two out of five parameters are not fulfilled, so Wunder (2007) suggested the use of the term PES-like schemes. Generally, PES are contract-based schemes acting as a financial tool. They target ES as goods traded among the parties, particularly where no public regulations have been implemented. In Wes-

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tern society, local or national governments have only recently promoted PES schemes, while they continue to develop and implement PES-like approaches based on legislative tools. However, in several cases the complex and rigid legal systems lack a clear property rights definition, this being the main obstacle for the promotion of economic tools such as PES.

PES schemes in Italy have not yet been implemented or investigated in detail, except for some scattered cases linked to non-timber forest products (Pettenella & Kloehn 2007) and some exploratory case-studies on water (Gatto et al. 2009). This paper analyzes three Italian water-related payment schemes based on: (i) hydropower generation; (ii) tap-water supply; and (iii) mineral water production. Each scheme is embedded in a national legislative framework that sets limitations and constraints on water use, as well as how its benefits should be redistributed to the catchment areas (thus reflecting the basic principles of PES-like schemes).

Starting with a brief description of the Italian regulatory framework on water, we compared the three water-related services to describe the strengths and weaknesses in environmental services provision, concluding with some political findings.

Methods

The regulatory framework related to water resources and environmental services has been defined making reference to the relatively ample literature and the official Acts approved by the State and regional authorities.

For the comparative analysis of the three services we used the six parameters defined by Wunder (2005, 2007) as key-criteria to make a distinction between PES and PES-like schemes, as well as the five key-criteria defined by the OECD (2010) to address the cost-effectiveness of PES schemes.

In detail, starting with a definition of the PES scope, we compared the different cases analysing the presence of monitoring and reporting frameworks, cost-benefit targeting, contracts-based payment mechanisms and systems of payment revision.

Water and environment: the Italian regulatory framework

PES schemes vary case by case, according to the type and scale of traded ES, payment source, measures and practices implemented to enhance the ES, output performance, and payment transfer between the parties (Engel et al. 2008). A crucial role in PES development is played by the implementation of a proper property rights regulatory system. As already known, common or public goods and services (like ES) are much less tangible than private goods and services normally exchanged on the market, even if resource scarcities connected with certain public services are quite clearly perceived. Moreover, the uncertain property rights and high fragmentation of demand and supply of ES contribute to limiting the market development. Due to these factors the transaction costs are expected to be very high, thus representing the major constraint to the implementation of PES-like schemes. In such conditions, local, regional or national governments play essential roles in promoting a more effective system based on defined, defensible and divisible economic property rights (Yandle 1999, Bougherara et al. 2009), as well as embodying supply-demand coordination.

In Italy PES-like schemes related to water have been developed in the national legislative framework on the basis of the principle of keeping the ownership of the resources in public hands. According to Act 36/1994, surface and underground water belongs to the State. Private water ownership may be established only if the rain is collected on private property.

Public ownership of water is connected to the strict link between water services and mountain forests: almost two thirds of the land surface consists of mountain areas, historically facing major social and economic problems such as unemployment, depopulation, loss of identity and cultural heritage. Some 66.3% of the national forest cover (8.7 million ha on the basis of the 2004-05 National Forest Inventory - <http://www.infc.it>) is located in areas at altitudes above 500 m and 44.6% has a slope over 40%. Consequently, the national government developed a set of regulations in order to ensure a financial support for maintaining a viable mountain environment and to control deforestation and forest degradation processes. The first important Act was approved in 1923 (the "Forest Act" - Decree 3267), in which strict restrictions were set out on forest land use and conversion; 95% of the

national forest cover still comes under these restrictions to prevent soil erosion and regulate the water cycle. In theory, the Act established the creation of a compensation fund, but in practice, the lack of public financial resources has limited its use. A decade later, a water and hydropower Act (Decree 1775/1933) established a compulsory fee for each water use. Under this Act, the hydropower companies had to pay a certain sum of money per kilowatt installed in the power plant (this sum is now about 7.0 €/kWh). This payment is transferred both to the municipalities included in the catchment basin and those downstream where the water is reintroduced in the riverbed. The payments compensate the municipality's opportunity costs of the potential water uses and the money have to be invested in local public services. In many mountain regions these funds represent a relevant income for local administrations, and have also been used to improve forestry operations and management.

The water legislative framework continued to evolve for half a century with minor regulations until the Water Quality Act (Law 183/1989) was approved. A few years later, Galli's Act (from the name of the main proposer - Law 36/1994), formally introduced the concept of catchment area compensation (art. 18), even though it was just addressed to public or collective lands (art. 24), thus implementing a principle already stated by Law 183/1989 concerning environment protection. However, its implementation has been limited and has occurred only at local level. Indeed, only a two regional public authorities (Piedmont and Veneto Regions) have fully implemented Galli's Act in their local legislative framework. This law basically resets the fragmented municipal-based water supply into a wider integrated system (based on the principle of whole river basin supply). Six years later, the EU Water Framework Directive (WFD - Directive 60/2000) enforced a regulatory system of the entire water cycle, especially in terms of water quality maintenance. This issue has been considered in Legislative Decree 152/2006; the Decree affirms the three driving principles of the WFD: (i) the "full-cost-recovery principle"; (ii) "polluter-pay-principle"; and (iii) "access-right-guarantee principle" (Kissling-Naf & Kuks 2004). The "full-recovery-cost" key-concept has been an important step to recognize the role and costs of ES on water supply quality, recently withdrawn in a national referendum.

Given the complexity of the Italian regulations, some public as well as private organizations have used gaps in the legislative framework to promote and build PES-like schemes, moving towards an innovative economic approach based on ES supply and demand for water quality.

The state of water-related PES implementation

Hydropower generation

Italy has traditionally taken advantage of the many streams and rivers in its mountain areas and, since the last century, dams and plants have been built to produce hydroelectric power. Today, hydropower represents 16.6 % of the total Italian electricity production, and is the top national renewable energy source (ISTAT 2010). The infrastructural impacts had already been well recognized in the 1930s, when the first compensation scheme was implemented by Decree 1775/1933 through the creation of a quite complex system of public agencies and governance rules.

Basically, the rationale is that the canalization of mountain streams greatly reduces the water availability for the local residents, hence reducing the land opportunity costs on the areas between the catchment point and the place in which water is re-introduced in the riverbed. In the compensation scheme introduced by Decree 1775/1933, the payment was based on the installed power capacity of the power plants, strictly linked with the quantity of exploited water. To define the amount of the annual payment the installed power of the power plant is multiplied by three economic parameters: the state fee concession (min 9.65 - max 35.03 €/kW), the extra-fee for the Mountain Basin Agency¹ (28.00 €/kWh) and a further extra-free to compensate those municipalities located between the catchment and the place where the water is returned to the riverbed, named Coastal Municipalities (7.00 €/kWh). Law 925/1980 let the extra-fee be reviewed every two years. Finally Law 122/2110 increased the extra-fee up to 28.00 €/kWh (instead of 21.08 €/kWh) and established another extra-fee to be delivered to Coastal Municipalities (7.00 €/kWh). The repartition of the second last extra-fee among actors is based on Ministerial criteria², while 20% of the Coastal Municipalities extra-fee is delivered to the Provinces. The three mentioned agencies are formally the beneficiaries of the ES, while private or public hydroelectric companies represent the suppliers. The fund allocation is driven by political decisions and priorities, but is generally reinvested in public infrastructure and innovation including in the forest sector, especially in slope stability and rural area investments. A feeble point of the PES-like scheme is surely the competence overlapping among the involved agencies that can create conflicts in some cases; moreover, the linkage between land stability provided by forests and its compensation seems to be rather weak. In fact, the prevention of soil erosion is one major externality of forestland that guarantees slope stability and reduces damages to the artificial chan-

nels and water infrastructure for hydropower production. The scheme today involves almost one-fourth of Italian municipalities (1684 municipalities all located in mountain or hilly areas with 518 hydropower plants) and is managed by Mountain Basin Authorities (consortia of municipalities).

Tap-water provision

Water for human consumption has formally been declared a priority by the State with regard to the alternative uses (art. 2, Law 36/1994 - Galli's Act). Hence, this assumption sets a sort of hierarchy on water uses, where environment maintenance has been addressed (Kuks 2004). The compensation (art. 18) is directed at public owners (art. 24 - municipalities and other public authorities), probably because of the high fragmentation of private land, which has been considered an obstacle in managing the scheme due to high transaction costs and huge numbers of landowners. However, ES payments based on an extra-charge on the tap-water bill ("user-pay-principle") have only been introduced in some local contexts, namely two Italian Regions: Piedmont and Veneto. Piedmont Region (Regional Act 13/1997, art. 14) built up a structural fund with 3-8% of extra-charge on water bills to compensate mountain areas in terms of projects or infrastructure aimed to improve local land management practices. In the same way, the Veneto Regional Decree no. 3483 of 10th December 2010 set up a financial tool for mountain areas (3% of the water bill) partially covering the costs of new hydraulic infrastructure or forest operations close to areas of slope instability, in order to protect the downstream population. There are few examples in addition to these two regional payment schemes. It is worth mentioning the case of *Romagna Acque S.p.A.*, a public company owning and managing all the drinkable water resources of Romagna sub-regional area. Started as a consortium of municipalities to reduce the cost of drinking water supply in 1966, it was able to cover the distribution of water to the whole Romagna area in 1989

and just a few years later, in 1994, *Romagna Acque S.p.A.* was founded, becoming owner of water resources in 2004. The most important water source of the company is a dam-basin in the central Apennines (Ridracoli, municipality of Bagno di Romagna), which covers 50% of the entire Romagna tap-water demand (108 M m³/year). Since its construction, the biggest problems have been dam sedimentation and the maintenance of high water quality. In 1993, the company invested in research to understand the link between forest management and soil erosion as well as water quality stabilization. The research (Bagnaresi et al. 1999) shows the clear impact of forest operations such as clear-cut or forest conversion from coppice to high stands on soil erosion, while minimal silviculture treatments or natural evolution of stands markedly reduce the erosion. These last two practices were also demonstrated to have a positive influence on nitrogen reduction and pH stability. Acknowledging these problems, part of the revenues deriving from the water tariff payments (1-3%) has been used to compensate landowners in the catchment areas, helping them to cover the costs related with management practices changes. The positive impact of the PES scheme was accounted in a general decrease in soil erosion of 25% (from an initial 40 000 m³/year to the ongoing 30 000 m³/year), and a consistent nitrogen reduction as well as pH stabilization. In terms of performance both *Romagna Acque S.p.A.* and the landowners have increased their utility: the company has reduced its costs for water purification and assured longer dam life, while the landowners have increased or maintained their annual forest revenue. Anyway, due to the complex bureaucratic process, a public company cannot deliver public funds or subsidies to a single landowner if there are unclear traded goods or services, hence *Romagna Acque S.p.A.* decided to directly acquire the land whenever this was possible, or to promote forest road maintenance for the other landowners in the catchment area. Part of the compensation has been invested in

programmes to inform the public on the use of tap water and the effects of the management practices adopted in the catchment area. The positive example of *Romagna Acque S.p.A.* represents a PES-like scheme built on legislative gaps (art. 18 and 24 Act 36/1994); it cannot be categorized as pure PES due to the overlapping between the ES supplier and consumer: in some way, they are both represented by *Romagna Acque S.p.A.*

Mineral water supply

Italy has been one of the first five world bottled mineral water consumers since 2002 and (with 191.7 liters *per capita* consumption in 2009) the second *per capita* mineral water consumer in the world, after Mexico (see statistics at the IBWA website - <http://www.bottledwater.org>). Considered as the safest water for human consumption, since the 1980s bottled water has been promoted by several industries due also to the introduction of new plastic polymers like polyethylene terephthalate (PET) instead of the traditional glass (Niccolucci et al. 2011). Nowadays, there are approximately 230 mineral springs in Italy, with a total production of 12.2 billion liters and an annual sector turnover of 2.3 billion euros (Beverfood 2011). Nevertheless, there are no substantial differences in terms of qualities between bottled water and most of the tap water currently offered by the aqueduct companies.

Bottled water production is a concession-based business where a given company applies for the extraction license of a particular spring. The fee³ considers the compensation to the local municipality for the land that is covered by the mineral water plant and a general production fee based on the water extracted in the power plant, but no compensation is addressed by law to the surrounding catchment areas. However, the environmental code addresses the preservation of any water resources (Decree 152/2006) and some positive examples do exist.

According to *Mineracqua* (personal communication) there are several contract-based

Tab. 1 - PES parameters to classify Italian PES-like schemes (source: Wunder 2005 - modified).

PES parameters	Hydropower generation	Tap-water provision	Mineral water supply
Start-up (voluntariness)	Compulsory compensation. Governmental and legislative driving force (Decree 1775/1933 and Law 959/1953)	Voluntary compensation, following the Galli's Act indications (art.18 and 24, Law 36/1994)	Voluntary compensation, following Decree 152/2006
ES definition	Forest hydrological protection (indirectly mentioned in Decree 1775/1933 and Law 959/1953)	Water cleaning service and erosion mitigation service	Set aside forest land to improve its natural evolution
Buyer/s	Hydropower companies	<i>Romagna Acqua S.p.A.</i>	Mineral water industry
Seller/s	River basin municipalities and forest owner associations	Municipalities in the catchment area	Municipalities in the spring catchment area
Conditionality	Forest operations to reduce erosion, landslides and forest instability	Forest management change towards close-to-nature silviculture	Land management change to reduce pollutants in the watershed
Basic principle	Polluter-pay-principle	Buyer-pay-principle	Buyer-pay-principle

Tab. 2 - Cost-effectiveness of PES schemes: a comparative analysis of the three types of water uses (source: OECD 2010 - modified).

PES parameters		Hydropower generation	Tap-water provision	Mineral water supply
Purpose and scope	Environmental objective	Reduce soil erosion and enhance forest stability in the river basin	Enhance water quality through close-to-nature forest practices	Enhance water quality through grazing intensity reduction
	Social objective	Compensate the water opportunity cost for local populations	Compensate the water opportunity cost for local populations	Compensate the water opportunity cost for local populations
	Principal ecosystem services	Soil erosion, water quantity	Water quality, soil erosion (only in the case of dam), biodiversity	Water quality, biodiversity (only in the case of <i>Acqua Panna - Nestlé</i> group)
	Scale	River basin	Spring catchment basin or dam basin	Spring catchment basin
	Reference law	Decree 1775/1933 and Law 959/1953	Law 36/1994 (Galli's Act) and Decree 152/06 (environmental code)	Decree 105/1992 and 339/19
Monitoring & reporting	ES Monitoring	Linked to the given municipality consortium statute; generally it is performed by the Mountain Basin Authority	Romagna Acque S.p.a. monitors the water quality parameters, hence indirectly the performance of forest ecosystem. Soil erosion is estimated according to the annual water quantity processed at level of tap-water facilities, annual precipitation and water losses	The monitoring depends on the contracts or agreements between the mineral water company and generally the municipality that manages the catchment area
	ES Reporting	Generally no ES reports are preformed	Romagna Acque S.p.a., under its corporate social responsibility policy, is publishing an annual environmental report	Generally no ES reports are produced; scattered information is sometimes provided in company advertising campaign
Benefit-Cost targets	Ecosystem benefits	Forest stability and reduction of landslides	Natural evolution of forest areas with an enhancement of biodiversity richness and stability. Minimal anthropogenic pressure.	Nitrogen reduction in the water environment. Only in the case of <i>Acqua Panna</i> biodiversity enhancement is measured in terms of species.
	Additionality	Number of forests or forest operations in the river basin (prescribed by law)	Forest management changes are considered additional (indicated but not prescribed by law)	Land and pasture management changes are consider additional (mitigation on the catchment is prescribed by law). In the case of <i>Acqua Panna</i> species presence such as wolves is considered additional
	Risks	Conflicts within the municipal consortium may lead to political instead of technical decisions	Risk of losing additionality in the long run. Once the forest reaches the climax status no environmental improvements may be carried out by the company	Where deep springs are exploited, the rock filters and cleans the water, so there is no need to invest in PES
	Opportunity cost	It is estimated by the government that consequently fixes concession extra-fee	<i>Romagna Acque S.p.A.</i> estimates it according to the constraints induced by the water withdrawal along the catchment basin valley	No available information
Payment mechanism and contract	Payment source	Hydropower concession fee	Percentage of water bill (1-3%)	Mineral water industry's direct payment
	PES contract and length	The coastal and catchment municipality consortium statute and the River Basin Authority decide the length and the priorities of the action. Theoretically the PES scheme will last until the law is repealed	The PES scheme will be enforced as long as Romagna Acque S.p.a. and the local municipalities (<i>i.e.</i> , the company shareholders) consider it useful. Anyway, any law change in terms of fund transfer may limit or delete the monetary transfer	No available information
	Payment mode and amount	Monetary transfer to the municipalities within the consortium. The actual extra-fee is fixed at 28 + 7 €/kWh installed in a given power plant, but no data are available in terms of direct reinvestment in forest of hydraulic operations	Monetary transfer to the municipalities in the catchment area. The actual water bill percentage is between 2 and 2.5% for an overall monetary transfer of half a million euro/year	No available information
Revision	Payment revision	The revision takes place every two years, but the forest operations rely directly on the consortium's decision and the River Basin Authority	The revision takes place every year according to the forest operations needed and the opportunity cost of the forest owners (mainly municipalities and <i>Romagna Acque S.p.A.</i>)	No available information

mechanisms between the mineral water plants and the local municipalities to reduce the grazing intensity in the catchment areas, as well as to convert meadows into set-aside lands, to leave lands to their natural evolution or to change intensively cultivated farmland to organic farming systems. Two singular cases in Italy involve two Nestlé-controlled water companies: *Levissima*, which is using large plastic sheets during summer time to reduce the glacier melting in its Alpine catchment area; and *Acqua Panna*, which is promoting natural evolution of forestland to enhance biodiversity around the spring. Unfortunately, specific data and reports are lacking, and information is still incomplete.

Notwithstanding the massive investments in advertising and communication by all the mineral water producers, only scattered and limited information is provided on the catchment areas management policies. We presume that, generally, mineral water industries do not directly invest in ES within the catchment areas because they use deep spring water, hence the role of forest is probably considered minimal in comparison to the filtering effect of rocks.

Tab. 1 summarizes the main findings of the analysis comparing the three services on the basis of the six parameters defined by Wunder (2005, 2007), while Tab. 2 presents a summary view of the issues connected to cost-effectiveness of PES schemes using the five key-criteria defined by the OECD (2010).

Discussion and conclusions

From the analysis of the three payment mechanisms described above, we can deduce that pure PES schemes do not exist in the water sector in Italy, while PES-like schemes driven by national government are well represented among the different water uses.

As a matter of fact Italy represents a emblematic case where the implementation of economic tools such as pure PES schemes is inhibited by the presence of a complex regulatory and institutional framework. According to some authors (Aubin & Varone 2004, Carbone & Savelli 2009), the accumulation of norms, customary rights and formal institutions have limited the effectiveness and coordination of policy and rules implementation in Italy. Besides, Italy is facing two significant constraints to any PES implementation in the forestry sector: (i) the highly fragmented landownership structure; and (ii) the limited number of forest owners' associations, which both determine higher transaction costs and limit the capabilities of ES potential investors or suppliers to take action. In such conditions the role of national or local governments is fundamental, due to the fact that the economic agents involved in any PES scheme trade mainly access

rights to the resources (Hill 1997, Yandle 1999). The perceived environmental scarcity has stimulated regulatory interventions, but only in terms of new command and control instruments (thresholds and constraints). Despite common law, civil law systems like the Italian one lack efficiency due to the delay in updating the regulatory framework with the inclusion of the new stakeholders' needs and expectations connected to rapidly developing issues like water resources management. Due to the Italian water legislative framework the PES schemes should operate within the legislative gaps, so quite a few ES trades may be put in practice and in most cases linked with the public authorities. From the political point of view, although policy-makers are pushing the privatization of common goods (such water, health care and education), civil society seems more reluctant about the privatization process in the water sector. In June 2011, in a national referendum on this topic, an overwhelming majority of Italians (95.8%) expressed a negative evaluation of any privatization process in the tap-water management sector.

A further problem that would need to be solved by the legislator is the definition of clear property rights over the land and related forest externalities. The civil or penal code considers the negative externalities rather than the positive ones (Mattei 1995). In the case, for example, of medium-large scale positive externalities such as water quality improvement or soil erosion control, the ES may be achieved at large catchment area, so only the conjoint actions of all the interested landowners may change the water quality parameter or soil stability, while the action of each single actor has a minimal impact. The policy-makers should review the property rights in order to let any ES stakeholders attain their direct or indirect benefits.

The water sector operators need to operate in synergy with land and forest managers at different scales according to the ES extension. Anyhow, technicians have often faced legal constraints, while an economic approach may increase the environmental preservation, stimulating the parties to deal in a more efficient way. The traditional command and control approach has already revealed several weak points, linked to the high cost of monitoring and the failure to follow the dynamic needs and wants of society. The need to build a critical mass of land (suppliers) or ES consumers (buyers) is the first step towards the success of a PES scheme, hence ensuring the provision of ES. The landowner associations may tangibly decrease the transaction costs on the supply side, but the most relevant effort should be spent on increasing ES awareness *de facto*, the real engine of the green economy. It is likely that PES or PES-like schemes may be

partly replaced by subsidy-based mechanisms, in order to operate more dynamically than the legislative process, especially in mountain rural areas.

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References

- Aubin D, Varone F (2004). The evolution of European water policy. In: "The evolution of national water regimes in Europe. Transitions in water rights and water policies" (Kissling-Näf I, Kuks S eds). Kluwer Academic Publishers, Dordrecht-Boston-London, pp. 49-86.
- Bagnaresi U, Minotta G, Vianello G, Barbieri A, Simoni A, Tedaldi G, Busetto R (1999). Relazione conclusiva del progetto di ricerca: effetti dei diversi tipi di trattamento dei boschi sul deflusso idrico afferente al bacino di Ridracoli (anni 1993-1999). Dip. Colture Arboree, University of Bologna, Italy.
- Beverfood (2011). Bevititalia, acque minerali, bibite e succhi, soft drinks directory 2010-2011. Beverfood, Mineracqua, Milan, Italy.
- Birost Y, Gracia C, Palahi, M. (2011). Water for forests and people in the Mediterranean region: a challenging balance. What Science can tell us. EFI, Joensuu [online] URL: http://www.efimed.efi.int/files/attachments/efimed/publications/efi_what_science_can_tell_us_1_2011_en.pdf
- Bougherara D, Grolleau G, Mzoughi N (2009). The "make or buy" decision in private environmental transactions. Eur. J. Law. Econ. 27: 79-99. [online] URL: [http://www.isnie.org/ISNIE06/Papers06/02.5%20\(no%20discussant\)/grolleau.pdf](http://www.isnie.org/ISNIE06/Papers06/02.5%20(no%20discussant)/grolleau.pdf)
- Carbone F, Savelli S (2009). Forestry programmes and the contribution of the forestry research community to the Italy experience. Forest Policy and Economics 11 (7): 508-515. - doi: [10.1016/j.forpol.2009.06.001](https://doi.org/10.1016/j.forpol.2009.06.001)
- Cullet P (2011). Water law in a globalised world: the need for a new conceptual framework. Journal of Environmental Law 23(2): 233-254 - doi: [10.1093/jel/eqr003](https://doi.org/10.1093/jel/eqr003)
- Dosi C, Muraro G (2003). I servizi idrici e il ruolo dell'intervento pubblico. In: "I servizi idrici tra mercato e regole" (Muraro G, Valbonesi P eds). Carocci Ed., Rome, Italy, pp. 19-39.
- Engel S, Pagiola S, Wunder S (2008). Design payment for environmental services in theory and practice: an overview of the issue. Ecological Economics 65: 663-674. - doi: [10.1016/j.ecolecon.2008.03.011](https://doi.org/10.1016/j.ecolecon.2008.03.011)
- Eriksson LO, Löfgren S, Öhman K (2011). Implications for forest management of the EU water framework directive's stream water quality requirements. A modelling approach. Forest Policy

- and Economics 13: 284-291. - doi: [10.1016/j-forpol.2011.02.002](https://doi.org/10.1016/j-forpol.2011.02.002)
- FAO (2008). Forest and water. A thematic study prepared in the framework of the global forest resource assessment 2005. Food and Agriculture Organization of the United Nations, Rome, Italy. [online] URL: <http://en.scientificcommons.org/51100358>
- Ferry O (2006). Quels contrats pour une forêt au service de l'eau? Quelques enseignements du projet Life forests for water. ENGREF, Ecole Nationale du Génie Rural, des Eaux et des Forêts, Nancy, France.
- Gatto P, Pettenella D, Secco L (2009). Payments for forest environmental services: organisational models and related experiences in Italy. *iForest - Biogeosciences and Forestry* 2 (1): 133-139. - doi: [10.3832/ifor0504-002](https://doi.org/10.3832/ifor0504-002)
- Grafton Q, Hussey K (2011). Water resource planning and management. Cambridge University Press, New York, USA.
- Hill PJ (1997). Market-based environmentalism and the free market: Substitutes or complements? *The Independent Review* 1(3): 387-396. [online] URL: http://www.independent.org/pdf/tir/tir_01_3_hill.pdf
- ISTAT (2010). Ambiente e territorio. Statistiche in breve. ISTAT, Statistiche Ambientali, Rome, Italy.
- Kissling-Näf I, Kuks S (2004). The evolution of national water regimes in Europe. Transitions in water rights and water policies. Kluwer Academic Publishers, Dordrecht-Boston-London, pp. 87-142.
- Kuks S (2004). Comparative review and analysis of regime changes in Europe. In: "The evolution of national water regimes in Europe. Transitions in water rights and water policies" (Kissling-Näf I, Kuks S eds). Kluwer Academic Publishers, Dordrecht-Boston-London, pp. 87-142.
- Mattei U (1995). La proprietà immobiliare, Giapichelli, Turin, Italy.
- Nearly DG, Ice GG, Jackson CR (2009). Linkages between forest soils and water quality and quantity. *Forest Ecology and Management* 258: 2269-2281. - doi: [10.1016/j.foreco.2009.05.027](https://doi.org/10.1016/j.foreco.2009.05.027)
- NYC-DEP (2010). Filtration avoidance. Department of Environmental Protection Annual Report, New York city, NY, USA.
- Niccolucci V, Botto S, Rugani B, Nicolardi V, Bastianoni S, Gaggi C (2011). The real water consumption behind drinking water: the case of Italy. *Journal of Environmental Management* 92: 2611-2618. - doi: [10.1016/j.jenvman.2011.05.033](https://doi.org/10.1016/j.jenvman.2011.05.033)
- OECD (2010). Paying for biodiversity: enhancing the cost-effectiveness of payment for ecosystem services. Paris, France, pp. 1-196.
- Perrot-Maitre D (2006). The Vittel payments for ecosystem services: a "perfect" PES case? International Institute for Environment and Development, London, UK.
- Pettenella D, Kloehn S (2007). Mediterranean mushrooms: how to market them. In: "Beyond Cork-a wealth of resources for people and nature" (Berrahmouni B, Escuté X, Regato P, Stein C eds). WWF Mediterranean and IPADE, Madrid, Spain, pp. 52-68. [online] URL: http://assets.panda.org/downloads/beyond_cork_publication.pdf
- Robinson M, Cosandey C (2011). Water resources depend on vegetation cover and land use. In: "Water for forests and people in Mediterranean Region - a challenging balance" (Biot Y, Gracia C, Palahi M eds). What science tell us 1: 59-64. [online] URL: http://www.efimed.efi.int/files/attachments/efimed/publications/efi_what_science_can_tell_us_1_2011_en.pdf
- Scott A, Coustalin G (1995). The evolution of water rights. *Natural Resources Journal* 35(4): 821-960.
- Wunder S (2005). Payments for environmental services: some nuts and bolts. Occasional paper No 42. CIFOR, Bogor. [online] URL: http://www.cifor.org/publications/pdf_files/OccPapers/OP-42.pdf
- Wunder S (2007). The efficiency of payments for environmental services in tropical conservation. *Conservation Biology* 21 (1): 48-58. - doi: [10.1111/j.1523-1739.2006.00559.x](https://doi.org/10.1111/j.1523-1739.2006.00559.x)
- Yandle B (1999). Grasping for the heavens: 3-D property rights and global commons. *Duke Environmental Law and Policy Forum* 10: 13-44.

Notes

1. The Mountain Basin Agency (*Bacini Imbriferi Montani* - BIM) is a consortium of municipalities that charge for the water use in order to re-invest for socio-economic purposes within the managed area, the extra-fee introduced by the Act 959/1953, art. 1 and art. 53 (only for those power plants larger than 220 kWh installed).
2. The extra-fee being 100% (7 €/kWh): 10% is distributed equally among all the municipalities within the Mountain Basin Agency; 20% is linked to the given municipality's population within the Agency; 30% is linked to the surface of a given municipality within the Agency; 40% is linked to the presence of water infrastructure and its impacts.
3. Regional governments implement the fee, so conditions are very different in the 21 Italian regions. The fee is based on the surface that the mineral water plant uses and the water extraction. Both fees vary a lot among regions, for instance the surface based fee is 5.11 €/ha in Molise (Regional Law 33/1977) and 587.27 €/ha in Veneto (Regional Law 40/1989), while the water production fee varies between 0.3 €/m³ in Campania, Basilicata and Abruzzo (respectively, Regional Laws 8/2008, 43/1996, 15/2002) and 3 €/m³ in Veneto (Regional Law 40/1989).