

Economic instruments for the sustainable management of Mediterranean watersheds

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Abstract

Problems of unsustainable watershed use in the Mediterranean areas (overgrazing, forest degradation and clearing, soil erosion, fires, etc.) often result from the reduced profitability of traditional land use systems, lack of clearly defined property rights, insufficient enforcement of existing rules, and lack of adequate economic instruments. The paper tries to analyze these problems from two complementary economic perspectives: the first one, based on a Cost-Benefit Analysis approach, highlight the gap between public interest and local private profitability in ordinary watershed management activities through three case studies in Tunisia. Once we have demonstrated that market mechanisms are unable to allocate efficiently watershed resources, we assume a more normative perspective focusing on the implementation of voluntary instruments related to payments for environmental services. Due to the lack of experiences in the Mediterranean basin, we discuss the results of a comparison among six case-studies of payments for water provision services in some developing countries underlying the role of transaction costs and social capital in the successful implementation of these new economic instruments for the sustainable management of Mediterranean watershed resources.

Key words: cost-benefit analysis, payments for environmental services, Tunisia.

Resumen

Instrumentos económicos para la gestión sostenible de cuencas en el Mediterráneo

Los problemas del uso insostenible de cuencas en la zona mediterránea (sobrepastoreo, degradación del bosque, erosión, incendios, etc.) son a menudo el resultado de la reducida rentabilidad de los sistemas tradicionales de uso del terreno, la falta de derechos sobre la propiedad claramente definidos, la aplicación insuficiente de reglas existentes, y de la falta de instrumentos económicos adecuados. El artículo trata de analizar estos problemas desde dos perspectivas económicas complementarias: la primera, basada en un enfoque del análisis coste-beneficio, destaca el vacío entre el interés público y la rentabilidad privada local en actividades ordinarias de gestión de las cuencas en tres casos de estudio en Túnez. Una vez que hemos demostrado que esos mecanismos de mercado no pueden asignar eficientemente los recursos de la cuenca, asumimos una perspectiva más normativa que se centra en la implementación de instrumentos voluntarios relacionados con el pago por servicios ambientales. Debido a la falta de experiencias en la cuenca mediterránea, discutimos los resultados de una comparación entre seis casos de estudio de pago por servicios de provisión de agua en algunos países en desarrollo resaltando el papel de los costes de transacción y el capital social en la implementación exitosa de estos nuevos instrumentos económicos para la gestión sostenible de los recursos de las cuencas Mediterráneas.

Palabras clave: análisis coste-beneficio, pagos por servicios ambientales, Túnez.

Introduction

The management of watershed resources and the supply of water and other environmental services have been subject to quite similar negative processes from

Middle East and North Africa Mediterranean countries (Med-MENA) to South East Mediterranean countries (Med-SE): increased erosion and soil productivity, reduced supply of water services, loss of biodiversity (Lacirignola and Hamdy, 1995).

Nevertheless, the scale of the processes and their driving forces are quite different: in Med-MENA negative environmental effects are mainly due to an intensive

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use of natural resources: water scarcity, soil erosion, potential reduction of forage, loss of biodiversity and forest degradation. Due to the loss of natural forest cover in Med-MENA, less than 1% of land area is actually covered by natural forest (Perman *et al.*, 2003). Two sets of reasons could explain this state of degradation: firstly, the lack of clearly defined property rights, insufficient enforcement of existing rules on fuelwood harvesting and on use of grazing resources. The second reason is the short-sightedness and low interest by local population and farmers to the sustainable use and long-term effects of forest cover. In fact, farmers and local forest users have an objective to maximize their current commercial incomes from the present intensive use of natural resources (subsistence economy), and disregard the loss in future profitability of the forests, which will affect their income directly.

In Med-SE negative environmental effects are mainly due to farm land and forest land extensivisation and abandonment in inner marginal rural areas, and to land development in coastal areas, with locally an increased pressure on forests by tourism, recreation and urban development. This twofold process has caused an increase of forest fires in the last years, with negative externalities such as soil erosion, water scarcity, loss of biodiversity and cultural landscapes.

Watershed management activities are associated to both, short term and long term, private and public (social) costs and benefits (OECD, 1985). Moreover cost and benefits are perceived locally (*i.e.* on-site effects) or/and by the population living outside the area, downstream the watershed (*i.e.* off-site effects).

By comparison between the financial and economic analysis of watershed economic activities, instruments could be designed that would make private owners cope with society's desired action. Furthermore, the problems related to institutional arrangements to implement the «beneficiary pays» principle should be considered.

This paper attempts to analyze these problems and to discuss some relevant features of payments for watershed services to induce sustainable management of Mediterranean forests. More specifically, the paper is organized into two main parts: in the first we highlight, with a Cost-Benefit Analysis (CBA) approach, the gap between public interest and local private profitability in ordinary watershed management activities through three case studies in Tunisia. Once we have demonstrated that market mechanisms are unable to allocate efficiently watershed resources, we assume a more normative perspective focusing on the implementation of economic

instruments related to payments for water provision services.

Private and public profitability in Mediterranean watershed management: three case studies

Forest resources in Tunisia, as in all other Mediterranean countries, play a key-role in watershed protection and in providing environmental services to the local inhabitants and to the off-site population. In Tunisia forestland is characterized by a lack of clearly defined property rights: in theory the State is the owner of the land, but local households actually have free access to forest resources for livestock grazing, firewood harvesting of some Non Wood Forest Products (NWFP). Thus, forest management is guided by the need of maximizing the current commercial income for local users. The costs of soil and water conservation practices to local users are much higher compared to additional land users' income. As a consequence, forests are characterized by a steady process of degradation with negative impacts on a large set of off-site services.

A first case study was conducted to compare, using a Cost-Benefit Analysis, the results of sustainable natural regeneration and unsustainable management of a cork oak woodland for different economic actors (Daly-Hassen *et al.*, 2009). The second and third case studies are similar in the methodological approach consisting in a step-wise CBA of two watershed protection investments where costs and benefits are compared with reference to enlarged sets of potential beneficiaries.

In adopting a CBA approach to watershed conservation investments we refer to the basic distinction between financial and economic analysis of investments, as codified by several manuals (*e.g.* for the forest investments: Gregersen and Contreras, 1979, 1992; OECD, 1986; Ray, 1990; Watt, 1993), some of them specifically related to watershed management investments (Gregersen *et al.*, 1987; OECD, 1985). Unfortunately the definition of economic analysis remains far from clear both in the literature and even more in empirical applications. Little progress has been made on the standard conceptions of the early 1970s according to which the essence of CBA was «adjustment» of receipts and expenditure to find out the «welfare gain» of investments and changes affecting society (Little and Mirrlees, 1974, p. 19). Indeed the state of art is such

that a reasonable codification of «adjustment» has been achieved only in terms of treatment of taxes, transfers and market distortions, while the «welfare gain» due to «off-site» and «non-market» costs and benefits and to distributional effects remains a vague concept. As stressed by Johansson (1993, p. 21) «the problem in using social welfare when assessing projects is that the social welfare function cannot be measured».

Ain Snoussi cork oak forest management case study

A financial and an economic analysis were conducted taking into consideration two management scenarios for the Ain Snoussi cork oak woodland: under the first one, cork oaks naturally regenerate at infinite horizon (the «sustainable scenario»), whereas in the second one the cork oak forest is over-used until the aged trees gradually disappear and are replaced by shrub land (the «unsustainable» or «business as usual scenario»). Expenditures and revenues of the entire production cycle of cork oak forests under the two management scenarios were valued with reference to two groups of economic actors: the local households and the Government representing the community interests.

Results of the financial analysis show that cork oak depletion (the «Business as usual scenario») is the most profitable alternative for the local households (more detailed information on data collection and assumptions are reported in Campos *et al.*, 2007; Daly *et al.*, 2009). At a real discount rate of 2%, financial Net Present Values (NPV) in the «sustainable scenario» is more profitable for the Government (NPV = 4,756 € ha⁻¹; Fig. 1), but much less advantageous for the local households (NPV = 1,492 € ha⁻¹). Under the current market, renewing a cork oak stand results in a capital loss compared to the alternative of letting those stands deplete. This comparison stresses the conflict between sustainability and a private income of local forest users. Thus, there is a need of compensation for income losses suffered by families under sustainable management since they seem unable to accept income losses in order to avoid cork oak depletion, or to pay for the losses incurred. Compensation should cover at minimum the difference between the two situations, and that can be covered by the surplus gained by the Government. Even if cork oak sustainable management is not economically profitable for private owners, we argue that the situation could differ when conservation values, such as

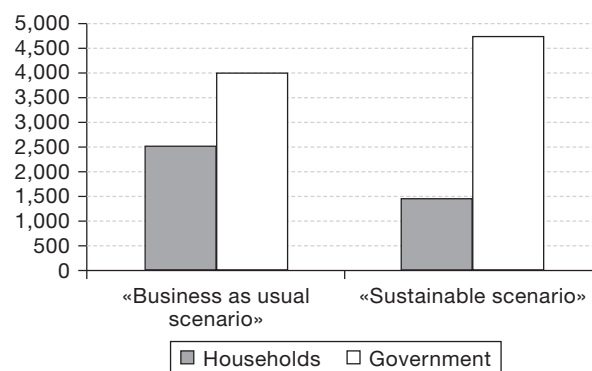


Figure 1. Comparison of financial Net Present Values in the «sustainable» and «business as usual» scenarios for the local households and for the Government (€ ha⁻¹; discount rate: 2%).

reducing soil erosion, decreasing dam siltation, carbon sequestration and biodiversity conservation are included.

The estimation of environment benefits provided by the cork forests and the damages costs resulting from the overuse caused by local populations were attempted in a second study (Daly-Hassen *et al.*, 2007). The objectives of this study were to estimate both the private and social economic values associated with the Tunisia's cork oak forests and their distribution among the different stakeholders.

Results showed that private benefits (benefits derived from private goods such as cork, fuelwood, grazed forage, etc.), offer an incomplete view of the social benefits. In fact, external benefits (20 € ha⁻¹) make up 20% of all the social benefits (98 € ha⁻¹). Private benefits amounted to 77.9 € ha⁻¹, split into 38.1 € ha⁻¹ for forest administration and 39.8 € ha⁻¹ for local population. However, the current use induces a costs of damages due degradation and overuse supported by all the stakeholders: the reduced forage potential (7.7 € ha⁻¹), which is solely suffered by the local users, the loss of current and future returns especially from cork (7.4 € ha⁻¹) born by the government, and the loss of carbon sequestration and increased erosion (5.6 € ha⁻¹) born by the whole society and global community (Fig. 2). The studied region's excessive human pressure and its high poverty levels explain the widespread overuse of common forest resources pool and resulting private and environmental costs.

A sustainable use could enhance the households' net benefits and reduce degradation costs from a private and social perspective. Hence, there is a need for mechanisms for forage allocation and incentives in order to attain a greater sustainable management and rationa-

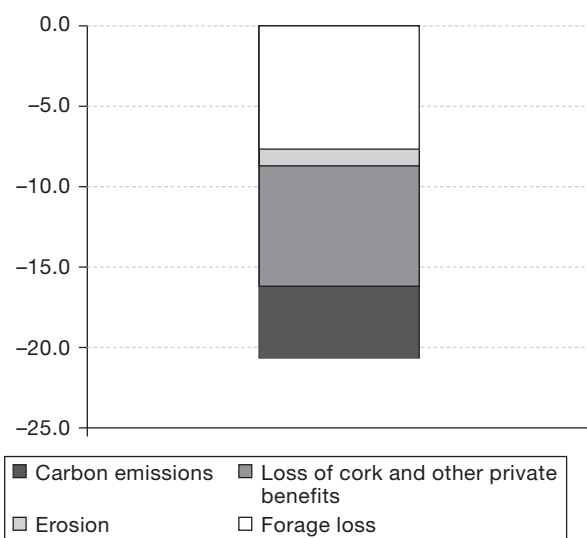


Figure 2. Degradation costs incurred by the current use (€ ha⁻¹).

lized local usage. The public owner and society will be better off due to avoided higher costs of degradation from current practice, and farmers will gain more profit from sustainable use (Fig. 3).

Bou Hertna and Marguellil watershed investment case studies

In the case studies carried out for analyzing the integrated watershed investment projects in Bou Hertna and Marguellil, a CBA exercise has been organized in four steps (detailed information on data and methods are presented in Cesaro *et al.*, 1998):

(i) Financial Analysis (FA) where monetary flows of expenditures and revenues alone, were taken into account. Prices were those observed in the market.

(ii) Conventional Economic Analysis (CEA) where market prices of costs and benefits items were adjusted by means of conversion factors to reflect the true value of resources, therefore eliminating market failures (monopolies, etc.) and transfer payments (taxes, etc.).

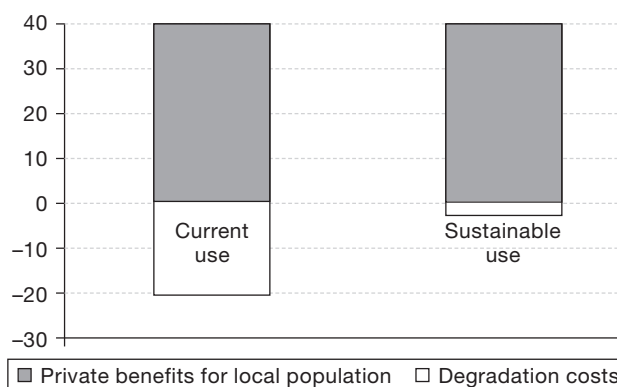


Figure 3. Comparison of private benefits and degradation costs between current and sustainable use (€ ha⁻¹).

(iii) Extended Economic Analysis II (EEA) where on-site and off-site effects, internal and external to the market (intangibles, public goods, etc.) enter the CBA. Economic valuation techniques used for this purpose were based on indirect market effects, such as the productivity change down the watershed; non-market values have been estimated using consumer surplus measures, *i.e.* with methods such as Travel Cost and Contingent Valuation.

(iv) Socio-Economic Analysis (SEA) where, first, the previous costs and benefits were assigned to the various social groups and, second, weighted according to «utilities». Undoubtedly, this is the most critical and controversial step both from the theoretical and practical point of view. Far from representing a specific step (or extension) of CBA, SEA is rather a way of attempting a «social» analysis of the projects' gains and losses that could be done at each step of the CBA.

Crossing impacts effects with their financial/economic consequences, Table 1 shows how physical and economic aspects interact giving rise to the various possible steps of the CBA procedure.

The framework proposed therefore attempts to organise the CBA procedure in such a way that analysts and decision-makers can be constantly informed and

Table 1. Investment effects, financial/economic consequences and CBA steps

Effects	Financial Analysis (FA)	Conventional Economic Analysis (CEA)	Extended Economic Analysis (EEA)	Socio-Economic Analysis (SEA)
On site (for the residents)	*	*	*	*
Off site (external to the watershed)	—	—	*	*
Market	*	*	*	*
Non market	—	—	*	*
Redistribution among stakeholders	—	—	—	*

Table 2. Bou Hertma watershed: components and relative quantities and investment values

Components	Area (ha)	Investment costs (€ ha ⁻¹)	Total costs (1,000 €)
Pine plantation for wood production	434	2,780	1,207
Plantations with mixed sp. for soil protection	190	1,642	323
Cork oak regeneration	837	290	244
Grazing land amelioration	1,017	2,447	2,488
Meadow management	110	1,559	172
Management of existing forests	685	424	290
Soil stabilization	280	660	185
Pine forests thinning	939	192	180
Forest roads construction	44*	18,000*	792
NWFPs	2,461		
Total		0	5,868

* Data related to 1 km.

aware of the type of impacts, effects and valuation techniques and the increasing complexity and controversy arising as they move from financial to economic *latu sensu* and social analysis modules. In this way the CBA objective function is gradually extended to include measure of social welfare gain towards an assessment of the Total Economic Value of watershed resources, products and services.

As shown by Table 2, the Bou Hertma investment included ten components, mainly concerned with forestry and rangeland improvements, each having an investment period of 2-3 years. The area on which the actions were carried out covers 4,532 ha, *i.e.* about 13.5% of the total surface of the watershed. The cost investment amounts to around US\$ 26.5 million.

The Marguelliil watershed covers about 154,000 ha, being closed in the lower part by a dam creating a

reservoir of about 78 millions m³. Sedimentation of the reservoirs is one of the most relevant problems. Erosive processes, similarly to many other parts of Tunisia and of the Mediterranean basin, are clearly evident, affecting 75% of the watershed agricultural land which must be therefore carefully protected, and this explains why most of the actions consist of soil and water conservation (Table 3). The intervention area covered 40,000 ha of highly erosive soil, and represented about 25% of the total watershed area.

Identification, quantification and monetary valuation of the various effects are outlined in Table 4, where this process is closely linked to the analyst/decision maker's objective function, and therefore to the CBA steps.

On each step of analysis the NPV and the Internal Rate of Return (IRR) have been calculated. Table 5 shows how passing from financial (FA) to economic (CEA,

Table 3. Marguelliil watershed: components and relative quantities and investment values

Components	Area (ha)	Investment costs (€ ha ⁻¹)	Total costs (1,000 €)
Terracing	7,500	448	3,356
Stone lives <i>Cordons</i>	4,000	600	2,400
Tree basins <i>Couvettes</i>	3,000	168	504
Fruit trees plantations	2,960	936	2,771
Forage trees plantations	6,000	948	4,824
Range improvement	10,000	235	8,040
Protective plantations	6,000	804	4,824
Small reservoirs	4*	180,000	720
Landslide fixation	172,000**	21.6	3,715
River management	70,000**	75.6	5,292
Total			36,446

* Data are related to one reservoir. ** Data are related to cubic meters.

Table 4. Valuation approaches implemented in the CBA of Bou Hertma and Marguellil watersheds

CBA steps	Effects	Valuation	Objective functions
FA	— Agricultural and forest products (wood and non-wood)	Market prices of inputs and outputs	Net financial revenue
CEA	— Agricultural and forest products (wood and non-wood)	Use of specific conversion factors to adjust market prices	Adjusted economic net revenue
EEA	— Erosion	Modified Universal Soil Loss Equation used in a Geographical Information System in order to forecast erosion, flooding and consequent agricultural production levels	Extended adjusted net revenue
	— Water availability (reduced siltation)		
	— Flooding occurrence	Lower costs of access to market and social services	Welfare gain
	— Improved rural access due to road building*		
	— Development of hunting*		
	— Damages from flooding**	Damages to agriculture, infrastructures and houses	Extended adjusted net revenue
	— Tourism & outdoor recreation*	Number of visits* (average unit value-Benefit transfer approach)	
— Climate stabilization*	Carbon fixation* (average unit value-Benefit transfer approach)	Welfare gain	
— Water table recharge**	Water supply for irrigation and hence greater agricultural production		
SEA	— Distribution	Three social groups: natives living in the action's area (weight: 1.5), farmers in the watershed (weight: 1.15) and the rest of the population (weight: 1.0)	Extended adjusted net welfare gain (including distribution)

* Effects calculated only for the Bou Hertma watershed. ** Effects calculated only for the Marguellil watershed.

EEA) and social CBA (SEA), the IRR indicators for the whole project increase from 9.2% to 21.4%. FA and CEA show results comparable to those of similar investments in other Mediterranean countries. EEA analysis improves the IRR to over 19%. Taking account

of welfare per income groups, SEA increases the IRR to 23%. The NPV also shows similar trends. One can therefore argue, rather soundly, that accounting for off-site, non market and social costs and benefits (*i.e.* EEA and SEA) certainly shows a remarkable additional welfare gain of the watershed projects and an overall high profitability.

Table 5. Main results of CBA application

	Watershed	NPV (1,000 \$S)	IRR
FA	Bou Hertma	1,186,039	12.7%
	Marguellil	-1,435,617	9.2%
	Total	-249,578	9.9%
CEA	Bou Hertma	4,623,708	19.9%
	Marguellil	5,784,849	13.9%
	Total	10,408,557	15.4%
EEA	Bou Hertma	6,231,660	23.3%
	Marguellil	10,534,898	17.6%
	Total	16,776,558	19.1%
SEA	Bou Hertma	9,325,018	28.0%
	Marguellil	22,474,503	21.6%
	Total	31,799,521	23.1%

How to fill the gap between private profitability and public utility: the role of payments for watershed services

Usually, public intervention to promote watershed conservation is based on the idea of integrated management projects with a combination of participatory approaches, direct public investments in infrastructures, subsidies for adopting conservation measures, enforcements of some limitations in land use, and income creation investments (Pswarayi-Riddihough, 2002). Experiences gained in integrated watershed conservation

projects developed in Morocco, Egypt and Tunisia show the effectiveness of subsidies for intensive livestock breeding, introducing new agro-forestry systems, converting croplands to pastoral lands, with compensations to local population for prohibiting access to new plantations and limiting the use of degraded pastoral land.

Besides these traditional instruments, a growing interest is characterizing the introduction of market-based payments by off-site beneficiaries for environmental services associated to watershed conservation projects, namely: carbon sequestration, biodiversity protection and water provision. In the Mediterranean region there are positive examples of carbon sequestration and biodiversity protection payment systems¹, while for water provision there is no evidence of well established and fully operational initiatives. This is quite an un-explicable development, being water provision a key service: both tap and irrigation water represent a strategic development factor for the region.

Looking at the experiences gained in other regions (Perrot-Maitre and Davis, 2001) different types of market-based payments for water provision services can be implemented based on voluntary contractual arrangements, *i.e.* on direct negotiations between water users and landowners, with direct payments for management practices that protect water quality or the trade of «credits» between companies and landowners for respecting the requirements on water use or pollution limits. In the following pages, after summarizing the main theoretical issues under discussion, we try to understand the underlying causes of successful systems of payments for water provision services looking at the experiences in six case-studies.

General issues related to the establishment of payments systems for watershed services

It is generally accepted that land use decisions can affect the provision of watershed environmental services, although there is sometimes disagreement about the extent and nature of the effects (Calder, 2000; Donovan, 2007). However, managing land and water interactions

is difficult because of the public good characteristic of watershed services: usually costs of watershed interventions are supported by private owners in upstream areas, while benefits for water capacity (*i.e.* irrigation and drinkable water) profit the farmers and the population in downstream areas. However, there is also a problem of measurability of land use effects at different scales: the impacts of land uses on the flow and stocks of water, sediments, nutrients, organic matter and pathogens are not always easily measurable, specially for large scale basins (FAO, 2000). Water users have little incentive to pay for improved watershed services provision if they cannot exclude non-payers from enjoying these benefits (Pagiola *et al.*, 2002). Indeed, changes on the part of one upstream land owner or user aimed at improving a habitat or reducing erosion in a watershed are unlikely to be sufficient to provide these environmental services, unless the owner or user controls a large proportion of the land and water resources for the services provision. This means that considering change at a landscape level is as important as it is at the scale of the individual owner or user. It also means that the effectiveness of any given changes may depend critically on coordinating the actions of a number of producers (FAO, 2007) and this has led to high transaction costs of establishing payment for watershed services (PWS) (Pagiola *et al.*, 2005). This situation is exacerbated by the fact that most PWS involve a large number of smallholder farmers.

The implications of excessive transaction costs are that markets are thin or fail if prohibitively high costs prevent exchange. This link between transaction costs and the emergence of institutions has long been recognized in the theory of institutional economics (Coase, 1937; North, 1990; Williamson, 1981). Two major categories of transaction costs can pose major obstacles to functional markets for environmental services: negotiation costs and enforcement costs. Negotiation costs include the time, social and financial costs of organizing buyers and sellers into operating units, as well as the costs of establishing contact, preparing the necessary documentation, and negotiation between buyers and sellers. Enforcement costs include the costs of monitoring and enforcement of contracts between buyers and sellers, and among groups of buyers and sellers,

¹ See some projects in Morocco and Tunisia financed by the Global Environmental Facility for wild fauna and flora protection; seven afforestation and reforestation projects under the Clean Development Mechanism are recently registered in the Med-MENA region and project ideas under the Global Forest Carbon Mechanism are also developed in some Med-MENA countries for emissions reductions through reduced deforestation and forest degradation investments.

the costs of internal and external auditing and, when needed, of certification (Swallow *et al.*, 2005).

In circumstance of excessive transaction costs informal and formal institutions are necessary for individual and collective pursuits and influence economic and environmental outcomes. Institutions matter because they contribute to solve problems of coordination of agents' plans; help to promote cooperative behaviour and overcome opportunism; make agents internalize externalities, reduce uncertainty and support the formation of social capital and of a historical experience of collective action which, in turn, positively affect the likelihood to credibly commit in cooperative strategies (Gagliardi, 2008).

Another area where institutions could play a great role is in property rights assignment and enforcement. Well-defined land and resource tenure are at the foundation of payment schemes (Pagiola *et al.*, 2002). Tenure issues need to be taken into account for property rights to effectively support a payment scheme for watershed services. Hence, property rights must provide for more than the regulation of land ownership and include the natural resources that the land provides. Ensuring that property rights are clearly designated, whether through formal or customary law, is essential if payment schemes are to result in the anticipated incentives for watershed management. Property rights are found to be most valuable, and create the strongest incentives for resource management, when they are secure. Effective registration and administration of tenure rights is an instrument for clarifying rights among stakeholders. Moreover, environmental service mechanisms that link private purchasers with private or collective suppliers of those services are usually supported by an explicit contract that increases the accountability of the suppliers to the performance of agreed-upon actions. Contracts usually require that the environmental service providers have clear and secure rights to perform the agreed-upon actions on that land, like the standards approved by the Climate, Community and Biodiversity Alliance (CCBA, 2004). Farmers operating on plots without secure tenure tend to practice extractive short-duration agriculture, while farmers operating on plots with secure private title tend to practice complex multi-strata agroforestry systems. Even if laws are passed to define property rights over environmental services, the rights will not be effective property rights unless they are accompanied by effective enforcement. Enforcement can come from a range of international, state, local or customary institutions (Swallow *et al.*, 2005).

Recently the role of social capital in the governance of collective resources such as natural resources has become a topic of widespread interest especially in development policy debates. It is increasingly agreed that customary institutions as a form of social capital matter in the management of collective resources as they provide structure and foster trust and norms of reciprocity for cooperation and coordinated actions. These institutions are the local equivalents of the rule of law as they are deeply tied to local notions of identity and social norms of cooperation. Social capital describes circumstances in which individuals can use membership in groups and networks to secure benefits. It is an attribute of an individual in a social context. One can acquire social capital through purposeful actions and can transform social capital into conventional economic gains. The ability to do so, however, depends on the nature of the social obligations, connections, and networks available (Sobel, 2002). The endowment of community social capital, which is often defined as trust, norms and networks facilitating cooperation and collective action (Putnam, 1993), is the prime aspect that plays a vital role in determining success or failure of management of collective actions (Dahal, 2008).

Payments for watershed services: lessons from six case studies

To analyze the role of property rights, social capital, transaction costs, and initiatives of the public sector institutions in PWS schemes, six case studies have been selected. The selection of the schemes was deliberately done to be two schemes from each Asia and South America. The schemes were chosen from the watershed market website (www.watershedmarkets.org) which comprises a description of more than fifty PWS schemes mainly in developing countries. Available published and un-published literature and direct interviews with the schemes project managers and FAO experts have been the main sources of information. In Box 1 a brief general description of each selected scheme is reported, while Table 6 presents a summary of the key factors to illustrate the six PWS schemes considered in the paper.

A key determinant in the successful establishment of PWS schemes considered in this study has been the presence of traditional institutions. For example, in Sumberjaya, two informal institutions, *gotong-royong* (labor sharing on common property) and *arisan* (capital sharing among community members) were instrumental

Box 1. The six case studies*Water Conservation Fund in Quito (Ecuador)*

The experience of this trust fund has been considered of high interest for its institutional set up to collect funds from the buyers of watershed services. Moreover the scheme is known for the involvement of a number of institutions including bi-lateral donors. Relatively good informative materials are also available for this scheme (Echavarría, 2002; Espinosa, 2005).

Heredia Public Service Enterprise scheme (Costa Rica)

Costa Rica being one of the pioneer countries in developing payments for environmental schemes and known for its success in this regard, it was worth considering one scheme related to watershed conservation. This PWS scheme is mainly concerned with water quality and the need for regulating its flow. Moreover, the scheme has been developed for serving the city of Heredia, a case quite similar to that potentially found in many Mediterranean coastal cities. Most of the relatively abundant literatures pertaining to this scheme is in Spanish (Echavarría, 2002; Redondo-Brenes and Welsh, 2006).

Sumberjaya scheme (Indonesia)

This is an interesting and unique experience among the PWS schemes so far. The farmers in this scheme are rewarded tenure rights for five years, with possibility of extension for 25 years in return for protecting the remaining forests in the area and as well as to exercise agroforestry practices in their coffee farms. In addition, relatively good

published information is available regarding its institutional dimension (Arifin, 2005).

Maasin Watershed Reserve Forest scheme, Iloilo province, Panay Island (Philippines)

This scheme involves a number of institutions including different public sector agencies, NGOs, and others. Moreover the scheme is specifically dealing with water flow regulation and literature pertaining the scheme is relatively abundant and of good quality (Francisco and Salas, 2004).

Working for Wetland programme (South Africa)

The scheme is supporting the rehabilitation of wetlands based on biophysical characteristics of catchments areas with less regard paid to the land ownership. Direct payments for rehabilitation work are made on the basis of the selection of the best contractor bid. No much information is available on this as well as five other South African PWS initiatives that are in the planning stages (King *et al.*, 2005).

Equitable Payment for Watershed Services scheme, Uluguru Mountains (Tanzania)

The scheme is one of the very few PWS implemented in Africa, but still in a pilot phase. The watershed has a crucial role in regulating the Ruvu river flow, the principal source of water for the city of Dar Es Salaam. Information from literature is relatively good, thanks also to the involvement of some international NGOs in the project (Lopa, 2009; CARE/WWF, 2007).

in facilitating the adoption of local PWS schemes. This was also the case in Maasin watershed scheme where, because of the existing social capital among the local people, their participation in the project was very high. These informal institutions help increase local participation and adoption of conservation measures as well as reduce the costs of transactions. Also the Tanzania case study confirms that social relationships and networks, able to share resources and risks and to enhance cooperative attitudes among local actors, facilitate the adoption of PWS schemes.

But bonding of social capital alone is not adequate for the sustainable functioning of PWS schemes. Rather a lot has to be done in bridging social capital since in most cases the interest of upland and lowland communities is conflicting. Recognizing this fact, it was outlined that bridging social capital is the next challenge of the Maasin watershed scheme. The Heredia Public Service Enterprise scheme is ahead of the other schemes in this regard as a result of which the socio-economic well being of both buyers and sellers is in

much better condition. The role of education and environmental campaign was found to be important in this regard. In almost all the schemes there has been some practice of awareness creation and thereby strengthening the social capital in the respective places. However to make this environmental education programmes more effective, it is necessary to attach this campaigns with direct benefits to the learner in order to provide motivation to change.

Enabling policy environment appeared to be crucial for both tenure security and mobilizing resources for PWS schemes. The case studies show that major support for PWS usually come from dynamic and innovative leaders at both local and national levels who can act as champions for innovative approaches. For example, political willingness and support from the local government was a success factor in the Maasin watershed in the Philippines where the provincial governor and municipal mayor were champions of PWS, motivating local stakeholders and mobilizing finance for conservation efforts. This support was not only crucial to con-

Table 6. Summary of the major characteristics of the PWS schemes considered

Title	Maturity of initiative	Suppliers	Beneficiaries	System of payment	Transaction costs	Land tenure	Role of public sector
The Water Conservation Fund (Ecuador)	Contributions to the fund began in 2000 and financing of watershed protection projects in January 2002	Public reserve inhabited by local communities (sellers). Investment in watershed protection, initially in the Cayambe-Coca (400,000 ha) and Antisana Ecological Reserves (120,000 ha). The area is inhabited by 27,000 people distributed in small communities	Pooled demand from various users: water users in Quito and surrounding areas, including farmers, hydropower companies, industries, tourist operators and households	In 2005, the fund amounted to US\$3 million. Annual expenditure is equivalent to the annual interest raised (12% in 2005 = US\$ 360,000). Upstream farmers receive support for watershed protection programmes, but no direct cash payments	10-20% of total expenditure. The time scale for the negotiation process and capitalisation of the Trust Fund has been very long	Land holders never compensated for the loss of land titles	Buyer and Intermediary services
Heredia Public Service Enterprise (Costa Rica)	Environmental fees charged since 2000 and payments to upstream landowners began in 2002	Private landowners (sellers) in the target areas (highest parts of the watershed and micro-basins of some rivers). Currently the programme covers 1,900 ha and involves 21 landowners	Private water utility company (through public concession) of the city of Heredia, on behalf of the end users	Direct negotiation and user fees. Since In April 2009 the annual payment was \$132/ha. Until 2005 the scheme has invested about US\$ 383,000	From very low to zero since the scheme is based on already existing institutional arrangements	Secured tenure as the contract is with private land owners	Regulator
Maasin Watershed Reserve Forest scheme (Philippines)	Rehabilitation work has been going on for decades	Farmers living within (or farming in) the watershed reserve, organized into the Maasin people federation. Currently 30% of the watershed is being used in farming	Metro Iloilo Water District is responsible for water supply to Iloilo city and three other towns plus 2,900 ha of irrigation. Currently 35% of the household water requirements of Iloilo City is met by the Maasin watershed	In-cash and in-kind: cash for reforestation labour costs and in-kind as stewards of the land for 25 years, renewable for another 25 years. US\$ 1.4 million has been generated from different sources	No information is found on the level of transaction costs, but they are expected to be high given that the scheme has serious social costs	Aim to improve the tenure condition in the area	Buyer and Intermediary services
Sumberjaya scheme (Indonesia)	The scheme has been ongoing since 1998 and the first contracts were signed in 2000	Upstream communities wanting to access state-owned forestland classified as (watershed) Protection Forest. From around 40,000 ha of eligible land, sixteen farmer groups have been granted rights in the community forest programme	National government on behalf of water users in general, and of hydropower plants in particular, like the government-owned Way Besai Plant	In kind: legal permission to use state-owned protection forest, for a trial period of 5 years with the possibility of extension of 25 years	US\$55 per household which amounts to more than half of the annual average income of the farmers in the area	Secured tenure is the reward for proper land use for a period of 5 years with the possibility of extension for 25 years	Buyer of PWS but involvement in the scheme is limited

Table 6 (cont.). Summary of the major characteristics of the PWS schemes considered

Title	Maturity of initiative	Suppliers	Beneficiaries	System of payment	Transaction costs	Land tenure	Role of public sector
Working for Wetland programme (South Africa)	Informally started in 2000 when the Working for Water program rehabilitated some wetlands. It became a separate program in 2001 and, in 2003, its management was taken over by the South African National Biodiversity Institute	The scheme is implementing 42 projects covering all the country, employing almost 1,700 people from the target population of poor and historically disadvantaged, and rehabilitating 157,000 square miles of degraded wetlands	Large amount of indirect beneficiaries (no precise data available)	The vast majority of scheme budget (67 million Rand) comes from the State Poverty Relief Fund. Some other funds come from international donors and conservation groups.	Payments are made on the basis of selection of the best contractors bid. Selection criteria are also connected to social criteria (women, youth and disabled employment)	Secured tenure as a pre-requisite for the contractor	Buyer (with other donors) of PWS, regulator and Intermediary services
Equitable Payment for Watershed Services scheme (Tanzania)	The scheme is in a pilot phase (2008-2011) implemented in the Kibungo sub-catchment, focusing on the Mfizigo River	The activities of the pilot phase involve 4 villages located south-east of the Uluguru Mountains with 4,860 people (substance farming) out of 51 villages with approx. 150,000 people of the potential suppliers	The watershed is regulating the Ruvu river, the main source of water for the city of Dar Es Salaam (4 million people) and of 80% of Tanzanian industries	The public water utility DAWASCO (Dar es Salaam Water Supply and Sewerage Corporate) and the private company Coca Cola KL to which DAWASCO supplies water have agreed to contribute 100,000 and 200,000 US\$ respectively to cover, over the pilot period, the costs of the improved practices by local farmers	Being in the pilot phase, transaction costs are still not clear	Land users without formal land property rights but compensated through the village authorities	Participation to the an Intermediary Group with other institutions and NGOs to regulate the scheme

solidate local efforts towards PWS, but also instrumental in designing acceptable watershed protection fees to be paid by watershed service beneficiaries in the area. In addition to the role of governments as buyers of environmental services, like in the South Africa case study, participation in PWS could be enhanced through enabling policy support, and financial and technical assistance. The role of national governments will be more relevant when it leads to create the necessary legal framework for PWS schemes, and if sufficient governmental institutions are present, property rights can be clearly assigned and enforced as in the case of Costa Rica and South Africa schemes. Equally important is cooperation between other relevant institutions towards the shared objectives of enhancing environmental service markets and conservation, as in the Tanzanian Equitable Payment for Watershed Services scheme. Since partnerships between private and civil

society institutions are relatively uncommon, a more coordinated and integrated approach helps efforts toward addressing poverty-related environmental degradation and comprehensive natural resource management.

However the public sectors were not the ultimate source of success for these schemes and it was not without limitations. Water utilities that belong to the public sector depend on political issues, which can easily change with different administrations threatening the long term sustainability of the initiatives. In the Water Conservation Fund in Quito for example on the past eight years, the city leadership had changed three times which required investing in lobbying the new mayor to continue honouring this contract. Problems pertaining the amount and duration of disbursement of funds were also observed in some of the schemes.

The role of intermediary organizations appeared to be vital to link service producers and buyers as well as

reducing the costs of transaction. The findings from most of the schemes shows that awareness of environmental services and even willingness to pay for environmental services rose through the concerted efforts of environmental Non-Governmental Organizations (NGOs). These organizations can mobilize and assist communities in crafting rules and regulations at the local level. The role of NGOs was apparent in many cases, especially in raising awareness among stakeholders. In the Maasin watershed in the Philippines, NGOs helped in community mobilization, organization build up, data collection, conflict resolution, and execution of environmental activities compatible with the PWS scheme in the watershed. The same situation was observed in the Water Conservation Fund and the Sumberjaya case study. This significant involvement of NGOs in most of the schemes considered is an important indicator of institutional shift away from the public sector which resulted in an increasing role for NGOs in providing public goods. In practice the international lenders have focused more on helping the private sector in order to avoid government corruption and misuse of development aid as well as refusal to accommodate donor needs.

The available literature pinpoint the importance of secured tenure rights for the successful functioning of PWS schemes as they require for land use changes contractual agreements with long term commitments. But the result of the cases examined is a mixed one. While the Heredia Public Service Enterprise scheme has benefited a lot from the secured land tenure of farmers, in the other schemes the link is the other way round in that the PWS schemes help strengthen land rights. In the Sumberjaya scheme, for example, farmers were allowed to obtain land tenure in return for protecting the remaining forest and planting trees in their coffee farms for a trial period of 5 years with the possibility of extension for 25 years. On the other hand, PWS have also threatened the property rights of poor and marginalised populations. This was the case in the Water Conservation Fund in Quito where the original land-owners were never compensated for their loss of land title needs.

In the Tanzanian case study the contractual framework under which soil conservation practices are adopted involves the aggregation of land-owners and disbursement of in-kind payments by village authorities, to avoid the higher costs of contracting individual land-owners. Also, since the land is public, farmers do not have land entitlements, while the village authorities

manage the land on behalf of central government and are entitled to enter into such contracts. A participatory approach is adopted in order to ensure the sustainability of the PWS programme. An Intermediary Group has been created involving the members from key sectors with a stake in forestry and water resources, particularly the Ministry of Water and the Wami-Ruvu Basin Water Office, local communities, private companies as well as the civil society organizations. This body will oversee the programme implementation, mobilize farmers, identify the institutions devoted to collect and distribute the payments to farmers, and lead the scaling up and replication of the scheme into other watersheds across Tanzania. These experiences shows that the implementation of PWS schemes can contribute to the creation of new property rights: PWS arrangements assumes that land users have the right to use the land as they want and if others do not like the negative externalities deriving from the on-going practices, they must pay the land user to change his or her land management systems.

Consistent with the theory which states that transaction costs are highest when there are multiple, small scale service providers and users, the transaction costs for Heredia Public Service Enterprise scheme were almost zero as it involves few large holder farmers while the situation in the Sumberjaya scheme was the contrary. The transaction costs in Sumberjaya were more than half of their average annual income of rural households in the province. In such circumstances institutional innovations are very important to reduce these costs but also to make the PWS schemes pro-poor as the transaction costs will be more severe for the poor in particular. Positive transaction costs determine the pattern and degree of ownership and thereby wealth distribution and as a result equitable distribution of resource allocation. Clearly assigning property rights is one area of institutional innovation to reduce transaction costs when they are high. Other areas where institutional innovations are needed include building social capital and the correct functioning of intermediaries. Without intermediaries, the potential of PWS at many of these sites and in developing countries in general would be probably not realized, at least in the short-run.

Discussion

With the three cases studies in Tunisia presented in this paper it was clearly stated that there is a conflict among sustainable use of forests and private income

demanding some kind of compensation for those farmers adopting sustainable land use practices. In this regard payments for environmental services in general and PWS could be of great importance in solving this conflict. However, these payments do not need to be necessarily in cash. It is important to use all forms of incentives possible to encourage sustainable management and use of forests. For example, in Ain Snoussi, forest resources control is shared by the Tunisian State and local inhabitants. The State property rights are therefore incomplete. Available literature emphasizes that in such cases where there is no secure property rights over an asset and/or a resource, farmers tend to maximize their short term benefits which in turn results in unsustainable use of natural resources. The case of Ain Snoussi forests could be a good example for such an argument where the farmers are mainly interested in maximizing current commercial income. This has again resulted in the steady degradation of forests that is accompanied by negative impacts on off-site beneficiaries of environmental services. In this regard sustainable use of the forest could be encouraged by, for example, assigning conditional incentives for those who applied sustainable practices. The experience of the Sumberjaya scheme in Indonesia could be a good lesson.

Insufficient enforcement of existing rules was also outlined to be another factor that contributed for the misuse of forests in Tunisia. However it is well recognised that without sufficient enforcement, laws by themselves cannot yield efficient outcomes. From the Maasin watershed scheme of Phillipines it can be learnt that enforcement of laws and regulations for conservation should be accompanied by a concerted activity of mobilizing both the on-site and off-site forest dwellers. Daly-Hassen *et al.* (2009) have stated that the local population is in fact little concerned with forest conservation or management decisions. In recent decades, the forest administration has focused on greater involvement of local inhabitants in forest development plans. This new approach began with the creation of forest associations. These associations can serve for both building and bridging social capital among the forest dwellers and thus ease understanding among on-site and off-site beneficiaries. They can be especially helpful to implement local development plans for improving crop lands and scrublands productivities and introducing alternative activities such as milk and cheese production for greater income generation. However, these incentives should be conditional with the control of forest resources allocation such as distance

from markets, access conditions, season of use, livestock species, etc. and the promotion of the sustainable management. From the analysis of the experiences of the PWS presented in this paper, it was observed that NGOs were behind the success story of almost all of the schemes considered. In Tunisia NGOs are already well introduced and this is a positive factor for PWS development. The NGOs could be even instrumental in generating donor funding as they are in a better position to attract more funds than the inefficient State bureaucrats. It is also important to recognize the role of such measures in reducing transaction costs for future implementation of similar projects.

Conclusions

Accounting for off-site, non market and social costs and benefits of Mediterranean watershed protection projects shows a remarkable high profitability. Introducing systems of payments for the environmental services can cover the gap existing between local land users' profitability and public gain deriving from sound watershed conservation practices. Developing financing arrangements that can put in practice the principle «beneficiary pays» can help not only to preserve water supply services, but also to contribute to biodiversity, climate change, and income generation goals, particularly for poor, forest dependent people. However, the setting up of institutions governing the interaction among various stakeholders involved in watershed management and establishing payment transfers for providers or sellers of the services face serious complexities. Under such institutional arrangements, potential transaction costs to organize and control the payment transfers can be extremely high, especially when there are multiple, small scale service providers and users, as it frequently happens in the Mediterranean region. In such circumstances clearly assigning land property rights is one area of institutional innovation to reduce transaction costs, while building social capital and the use of intermediary agencies can facilitate the running of equitable and efficient PWS schemes.

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