Using Payments for Environmental Services to Improve Conservation in a Tunisian Watershed

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Governments have often attempted to protect downstream water infrastructure by providing short-term subsidies for the adoption of conservation practices or low-erosion land uses. However, these efforts have often yielded disappointing results, with farmers either declining to adopt the recommended practices, or only adopting them temporarily (Pagiola 1999). The Payment for Environmental Services (PES) approach promises to provide a more effective and more sustainable system for inducing farmers to adopt conservation measures (Pagiola and Platais 2007). In this paper we examine current conservation subsidy policies in a Tunisian watershed, and discuss how they might be modified to incorporate PES principles so as to improve their effectiveness.

The Barbara Reservoir. Photo: G. Sterk.

The current subsidy system

Barbara watershed is located in a mountainous area in north-western Tunisia. It covers about 200 km^2, between 60 m and 1203 m above sea level, with high slopes. Cropland covers 39 percent of the watershed, forests 25 percent, intercropping olive trees with cereals 14 percent and grassland three percent. A reservoir with a potential water capacity of 59 million m^3 in the lower part of the watershed supplies water for domestic use and irrigation. The area has a high population density (124 inhabitants/km^2), most of whom are poor and dependent on subsistence agriculture.

Unsustainable agricultural practices such as cereal cropping and overgrazing cause serious erosion problems in the watershed, including landslides, river bank and bed erosion. They are believed to cause damages both on-site, such as reduced agricultural yields, and off-site, through decreasing water availability due to dam siltation. An erosion and sedimentation analysis in the watershed found that most of the sediment which reached the reservoir originated in gullies and adjacent areas (Sterk 2009). Accordingly, we focus only on these areas. Most land around gullies is privately owned and cultivated with cereals.

High erosion risk in the watershed prompted the Tunisian government to promote the adoption of conservation measures such as building stone walls or planting acacia in gullies. As can be seen in Table 1, all of these practices are less profitable for farmers than producing cereals alone. As a result, farmers are unwilling to adopt them without support. The Office for Sylvo-Pastoral Development of the North West (ODESYPANO) subsidises about 80% of the investment cost of these measures, while participating farmers are expected to provide the remaining investment costs (in kind), as well as the annual maintenance costs. With these subsidies, the attractiveness of conservation practices to farmers increases, as shown in Table 1, but often remain less attractive than just cereals. Thus, even with subsidies, some farmers have resisted adopting the recommended measures. In the case of stone walls in gullies, they have sometimes agreed to adopt the practice but declined to provide their in-kind labour contribution, thus effectively increasing the subsidy to investment costs to 100%. Subsequent

Table 1. Net returns from alternative land uses[1] in Barbara watershed (TND/ha)

Land uses[1]	Farmer's perspective[2]		National perspective[3]
	Without subsidy	With subsidy	
1. Cereals with no conservation measure in gullies	815	n.a.	-55
2. Cereals with stone walls in gullies	-330	720	-430
3. Cereals with stone walls and acacia in gullies	-450	710	-380
4. Cereals with acacia in gullies	715	835	160

1 In the land uses considered (1-4), cereals are located on private lands adjacent to gullies, and the conservation measures (stone walls, acacia, stone walls and acacia) are in gullies, on collective lands. The unit of analysis for each land use includes 1 ha of cereals and 0.1 ha of adjacent gully, which makes possible the comparison among the four land uses. The results reflect net present value over 20 years expressed in constant 2007 prices. 1 Tunisian Dinar (TND) = US $0.78.

2 From the farmer's perspectives, we consider the following costs and benefits for the land uses: 1) annual cost and benefit from cereals near gullies and annual benefit from grazing in gullies; 2) investment cost of stone walls, annual cost and benefit from cereals near gullies; 3) investment costs of stone walls and acacia plantation, annual cost and benefit of cereals; 4) investment and maintainance costs of acacia plantation in gullies, annual cost and benefit of cereals near gullies. Costs and benefits are estimated at financial prices and discounted at 10%.

3 The analysis from the national perspective includes the costs and benefits considered from the farmer's perspective and the cost of sedimentation occuring from each land use. The cost of sedimentation was estimated by applying the Morgan Morgan Finney (MMF) method at land use level, and Pacific Southwest Inter-Agency Committee (PSIAC) and Factorial Scoring Model (FSM) at watershed level (for more details, see World Bank 2009). The costs and benefits are estimated at economic prices and discounted at 10%. The economic prices are obtained by eliminatingthe distortions from the financial prices (eg. taxes and subsidies).

maintenance is minimal, reducing the useful life of the walls from an expected 15 years to eight or less.

In case of acacia in gullies, survival rates are quite low, at about 40%. As gullies are collective lands, the direct use benefits of trees go to the community, thus farmers have no incentive to undertake any maintenance (e.g. fencing). If supporting the cost of protection from others' grazing made this land use attractive to farmers (compared to cereals alone) they would most likely maintain the acacia. Thus, the net returns in Table 1 capture, in addition to the investment itself, also the cost of guarding the acacia plantation from community grazing.

Use of payments for environmental services

The current support programme to planting acacia in gullies could be considered an effort of the government to generate environmental services. However, though driven by the objective of soil and water conservation, this programme does not have some important characteristics of a conventional PES scheme. As it brings only a partial contribution to investment costs, it is not conditional, and does not compensate for expenses and forgone earnings after the first year. To increase the adoption rate and the survival rate of acacia trees, the current support policies could be modified in three ways, together or separately.

1) On the supply side, a few issues should be considered. First, payments should be made conditional to success indicators. A survey of participating farmers showed that about 60% of planted acacia dies due to lack of protection, including lack of maintenance by the farmer and damages from grazing by other members of the community. If payments were made for trees that survive instead of trees planted, many farmers would likely be inclined to support annual maintenance costs and prevent these damages.

Second, the level of payment should be sufficient to make the practice attractive for farmers. The minimum payment should equal the difference between the on-site benefits generated by the land uses before and after conversion. The maximum payment should not exceed the value of the service provided.

Figure 1a. PES scheme to convert cereals to cereals with acacia in gullies

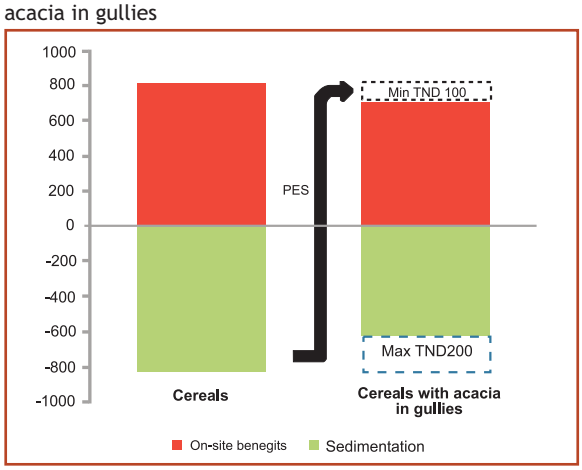
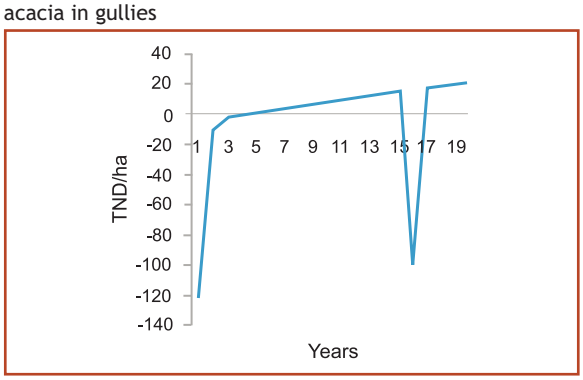


Figure 1b.[4] Additional net benefit caused by cereals with acacia in gullies



Based on the economic valuation of water services carried out within this study, the payment should range between TND100 and TND200 per hectare (in present value terms over 20 years, see Figure 1a).

Thirdly, the distribution of payment over time should depend on the difference between the on-site benefits generated by the two land uses. If the payment in certain years is lower than this difference, the farmers might be tempted to abandon the new practice in favour of the old. In our case the rotation period for acacia is 15 years, and a payment made every five years might be more successful than a one-time payment, if made conditional to the survival rate of the planted trees. This would imply planting a third of the total area with acacia every five years, rather than planting the total area in the first year.

2) On the demand side, the funding could be made more dependent on payments from water users, rather than exclusively from the government. Obtaining funding directly from water users (drinking water systems and irrigated areas) would increase the budget available for conservation, and it would contribute to more efficient use of water. For example, the economic analysis over 20 years shows that converting one hectare of cereals into cereals with conservation measures results in a benefit of reduced sedimentation of TND200/ha to water users.[5] It would also reduce the farmer's benefit by about TND100/ha.[6] As the additional benefits for water users are greater than the costs to the farmer, there is a potential to manifest this relationship within a PES scheme, without government support. The biggest challenge to this approach is convincing water users to pay for the services that they are receiving. In a context where water users are used to receiving these services for free - most of the time being paid by the government - they have little incentive to pay for conservation, even though they are the main beneficiaries.

3) Secure land tenure. Another approach would be to start from the institutional side, by strengthening the use rights of lands in gullies to ensure that the benefits from acacia are not collectively owned. If benefits from acacia were sufficiently large to increase the net benefit to the farmer above those of cereals, no additional PES scheme would be required.[7] If however they are insufficient to motivate farmers to plant and conserve the trees, the ownership of acacia products would reduce but not eliminate the need for additional payment.

4 In Figure 1b, the negative net benefit is due to the cost of planting acacia (every 15 years) and maintenance costs (safeguarding) every year.
5 This is the difference in the sedimentaion benefits reflected in the green bars of Figure 1a.
6 This is the difference in the on-site benefits reflected in the red bars of Figure 1a.
7 In this case, the estimated net returns from cereals and acacia in gullies presented in Table 1 should be updated to include also the benefits of wood fron acacia.

Conclusion

Analysis of the benefits of conservation measures indicates that it would be possible in principle to establish a user-financed PES mechanism in the Barbara watershed, with downstream water users paying upstream farmers. As the government is already financing conservation measures, however, it would be easier to convert the existing subsidy programme into government-financed PES – even though government-financed PES schemes tend to be less efficient that those that are user-financed (Engel et al. 2008). An alternative approach could be to establish a more secure use rights system in gullies that would allow farmers to derive all the benefits from plantations.

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