



Evaluating Economic Policy Instruments for
Sustainable Water Management in Europe

WP3 EX-POST Case studies
Negotiation and monetary incentives to
promote the use of reclaimed water at
Tordera River Basin.

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Executive Summary

Definition of the analysed EPI and purpose

The negotiation and the use monetary incentives to promote the use of reclaimed water is an EPI focused on the management of water resources. The EPI is focus on improving water management by using non-conventional water sources. It is considered a win-win strategy since all parties involved in the process improve their situation in economic terms or water availability.

The instrument has on the one hand, an economic objective which is to ensure the availability of water including in the summer and so maintain economic activity (agriculture and golf course). The environmental objective is to reduce the overexploitation of local aquifers by reducing water and energy consumption. The volume of water that should be reused as a result of the implementation of the instrument was not well defined.

The case has been chosen for:

- Its potential for extrapolation to other EU areas in which competition for water resources is high.
- Providing evidence that negotiation enables agreements to be reached that benefit both parties following a 'win-win' strategy.
- Demonstrating that non-conventional water resources are a valuable source in shortage areas and that they should be considered as an alternative to increase water supply.

The negotiation to promote the use of reclaimed water started at the Tordera delta in 2003. During that year, the Mas Pijoan Ranch reached an agreement with the managers of a nearby golf course to share water reuse infrastructure. The assessment of the outcomes derived from the instrument is only the measurement of the volume of regenerated water that is reused. The current status of the EPI is the result of a planned process.

Introduction

The instrument was implemented in the southern boundary of the Costa Brava in the North-Eastern Spain. It is an area with endemic water scarcity problems in which there has always been competition for water use. In the last 20 years, due to the development of golf courses water shortage problems have accentuated.

Since 1985 water has been reused for golf course irrigation in the Costa Brava and the social acceptance of water reuse is good, the water administration believed that a good alternative to address the growing regional water shortage and pressures on





the local aquifers was to promote the use of reclaimed water through negotiation and the use of monetary instruments.

After the implementation of the instrument, the urban demand of freshwater has decreased significantly since regenerated water is used for garden irrigation. Water availability has increased even during summer months at the time when the water demand from crops is highest. The adoption of the win-win strategy between farmers and golf-courses has enabled an increase in benefits mainly by sharing water reuse infrastructures.

The instrument can be considered effective and it can be adopted in other areas that face to water scarcity problems since it's adaptable to local circumstances and parties involved.

Legislative setting and economic background

For the choice, design, and implementation of the instrument there was no specific legislation or regulation. Given that the implementation was based on the promotion of negotiation between stakeholders, the Administration only acted as a catalyst. Nevertheless, the 2009 Catalan Water Reuse Program has been an impulse for new agreements.

For the success of the instrument it is not necessary to consider the external benefits achieved as a consequence of its implementation.

Institutional constraints significantly affect the performance of the instrument. Both national and regional legislation establishes the uses for regenerated water, and consequently affects the parties that can be involved in the negotiation process. The norm also determines the quality criteria for the regenerated water, and therefore water regeneration costs are an important issue to take into account when developing a water reuse project. Information also plays an important role in the sense that if parties are unaware of the benefits derived from the use of regenerated water, then the negotiation process never will start.

The implementation of the EPI started in an economic boom. Although the economic context has now generally changed, tourism in the area remains stable since it is exclusivity aimed at wealthier individuals. Hence, activity on the golf courses has not decreased and arrangements reached in the past with farmers could be maintained.

There were no economic distortions in the implementation of the EPI.

The stakeholders interested in the implementation of the instrument were mainly farmers and golf courses managers since both could improve their situation if agreements to use regenerated water were achieved. Because a win-win strategy was followed in the negotiation process, water rights did not affect the implementation or operation of the EPI.





Brief description of results and impacts of the proposed EPI

Positive environmental, economic, and social impacts have been generated as a result of the implementation of the EPI.

From perspective of economic efficiency, it should be highlighted that the negotiation between farmers and golf courses managers has enabled the incomes of both stakeholders to increase. The availability of water for agricultural irrigation has increased by 1.43 hm³/yr. This figure has represented an increase in the farmer income since the cost of water regeneration and distribution is less than the benefits obtained by increasing the irrigated area, as well as the savings for reducing groundwater pumping, the reduced use of fertilizers, and avoidance of the need to construct a new freshwater pipeline. When compared with the alternative of seawater desalination, the agreement reached with farmers was the cheapest alternative to maintain golf course activities.

Regarding environmental impacts, the main outcome is associated with the use of regenerated water for the irrigation of municipal gardens. This measure, together with increased user awareness, has meant a 20% reduction in urban demand of freshwater during the period 2003-2010 – despite the fact that the population increased 35% over the same period. This has resulted in less pressure on local aquifers. Another significant positive environmental impact has been the decrease in the use of chemical fertilizers since reclaimed water contains nutrients meaning significant energy savings and the increased availability of non-renewable resources such as phosphorus.

The main stakeholders involved in the implementation of the instrument were farmers, golf course managers, and residents. As a consequence, the increase in the irrigated area has meant the generation of new jobs. The social perception of the regenerated water by farmers has improved after the implementation of the EPI. The use of regenerated water has contributed to improving the social image of golf courses since the population perceives that they are not using local resources for business but are only take advantage of a resource that nobody else uses. The environmental awareness of citizens was raised after the announcement that some of the municipal gardens are irrigated with regenerated water. The implementation of the instrument has enabled awareness to be raised about the serious water scarcity problems in the area.

The transaction costs associated to the instrument are minimal, therefore, they do not affect the impacts of the EPI.

When the EPI was designed, environmental and economic objectives were defined in general terms, without specifying precise quantitative data. Therefore, it is not possible to quantify the difference between the intended and actual outcomes.





Conclusions and lessons learnt

The use of monetary incentives and negotiation for promoting water reuse has taught some lessons: (i) crop production and golf course irrigation is now independent from variable rainfall patterns and groundwater availability; (ii) a mutual win-win strategy reliability and flexibility can be offered to the parties involved; (iii) the social perception relative to water reuse has been improved by the EPI implementation; (iv) the culture of water reuse has conditioned the choice and the implementation of the instrument; (v) sharing the information relative to previous experiences was essential to develop new water reuse projects; (vi) overall, transaction costs are very low and are associated with monitoring the quality of the regenerated water; and (vii) the objectives of the instrument were vaguely defined and in qualitative terms.

The main enabling factors that have contributed to the success of the instrument can be summarized as follows:

- Strategy win-win: The negotiating process between the two or more parties should be governed by a win-win strategy, in other words, both parties must obtain benefits as a result of the cooperation.
- The social acceptance of the water reuse. All the stakeholders should be aware of water scarcity problems and the challenge that they face.
- Institutional framework. The existence of specific water reuse legislation helps the success of the instrument because many of the aspects to be considered are defined by law.

There is no room to improve the design and implementation of the EPI, since it is largely conditioned by legislation. The capacity of the WWTPs to produce water with enough quality also affects the implementation of the EPI.





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1 EPI Background

The area of the Tordera Delta is characterized by the fact that irrigation water is taken entirely from groundwater, with no surface supply. Because of the low rainfall, during summer the yield of the wells decreases significantly. Thus, water cannot be guaranteed at crucial crop growing stages. Moreover, the area is characterized by a high level of tourism activity with a significant number of golf courses. Taking into account that in Catalonia, there is a prohibition on the use of groundwater for golf course irrigation, competition for water is always high.

To address the growing regional water shortage and pressure on the local aquifers, the Catalonian Water Agency (ACA) considered that a plausible solution would be the use of reclaimed water mainly for irrigation. Because golf courses shifted in 1998 to the use of reclaimed water it was considered that negotiation between parties and the use of monetary incentives was a good instrument to promote the use of reclaimed water by farmers and municipalities.

The negotiation and monetary incentives to promote the use of reclaimed water has two main objectives:

- Economic objective: To ensure the availability of water even in the summer season, resulting in smaller pumping costs and an increased irrigated agricultural area.
- Environmental objective: To reduce overexploitation of local aquifers reducing water and energy consumption.

No specific goals and deadlines were defined. Moreover, taking into account the wastewater treatment capacity of the main WWTPs, it had been considered that a volume of water reuse of around 3 hm³/yr would be good.

The main advantage of the EPI is that is a win-win strategy in the sense that all parties involved in the process gain advantages if they cooperate.

The most paradigmatic project that describes the philosophy of the EPI is the case of the Mas Pijoan Farm which reached an agreement with the managers of a nearby golf course. Until 2003, the farm worked on 35 ha that was irrigated from the local aquifer. The yield of the wells at the beginning of the summer could reach 150 m³/h, but would decrease during the season to 20 m³/h, thus water could not be guaranteed at crucial crop growing stages. In this context, the Mas Pijoan Farm found that connecting to the reclaimed water pipeline of the Costa Brava Golf Course was a reasonable solution. The golf course irrigation is in operation from 9 pm to 7 am, and the water is supplied to agriculture during the rest of the day. The agreement between the golf course and the farmer includes the operation of a reversible pumping station to ensure that the golf course can be supplied from the storage pond of the farm using the well if necessary. The arrangement has provided reliability and flexibility to both users. This example shows the importance of the negotiation





between parties in order to promote the use of reclaimed water following a win-win strategy.

The cost of connecting the existence pipeline to the storage pond was 70% funded by the European Agricultural Fund for Rural Development. The farmer a signed a 25-year service contract to share the use and associated operation and maintenance cost of the reclaimed water pipeline from the golf course. Between 2003 and 2006 this arrangement enabled the farmer to increase total irrigated land from 35 ha to 41.6 ha, due to the reliability of the reclaimed water.

Because it was considered that the use of reclaimed water had no negative side effects, safeguarding mechanisms were not taken into account.

The impacts derived from the EPI have been assessment after its implementation and they have been quantified in terms of the volume of regenerated water used. The volume of water reused in 2010 was around 3.3 hm³/yr. Specifically, regenerated water is used as follows: (i) 1.43 hm³/yr for agricultural irrigation; (ii) 0.66 hm³/yr for golf course irrigation; (iii) 1.00 hm³/yr for groundwater recharge and Riadura ecological water flow and; (iv) 0.29 hm³/yr for municipal gardens irrigation.

Negotiation between the parties involved identifying the benefits that all the stakeholders involved could obtain as a result of the development of a water reuse project. Through negotiation and following a win-win strategy, all the participants could improve their situation. Therefore, the introduction of the EPI was non-controversial.

Regarding legal aspects, the main norm to take into account was the Spanish Royal Decree 1620/2007 of 7 December that limits the uses of reclaimed water, and lays down quality criteria that depend on the type of water use, and establishes the administrative process for obtaining the authorisation to use reclaimed water. At regional level, in 2009 the Catalonian Water Reuse Program was adopted and whose objective is to encourage water reuse as an activity of public interest.

In this context public participation did not play an important play in the design of the instrument but it was essential in the choice and implementation of the instrument. The water administration conducted environmental awareness campaigns and held informative meetings with farmers associations and managers of golf courses. We can say that the administration acted as a catalyst for the negotiating process.

Unexpected events that have influenced the performance of the instrument were identified.



2 Characterisation of the case study area (or relevant river basin district)

The delta of the river Tordera lies half in the southern boundary of the Costa Brava (Girona province coastline) and the other half in the north of the province of Barcelona, in north-eastern Spain (Figure 10.1). The Tordera River Basin (TRB) belongs to the Catalonia Basin District and covers an area of 894 km². The basin is structured by its main river, the Tordera, which runs 65 km to its mouth between the towns of Malgrat de Mar and Blanes.



Figure 10.1- Localisation of Tordera delta

Source: Consorci de la Costa Brava (CCB), 2011

The predominant climate is Mediterranean, with a high concentration of rainfall in spring and autumn, with summer being the dry season. It is important to note that in the period between 1988 and 2007 six periods of drought warning have forced the adoption of exceptional measures to guarantee water supply.

Water is used for various purposes, from environmental services such as the conservation of the Natural Park of Montseny in its upper course, to industrial uses (mainly chemistry and pharmaceutical) in its middle course, or supplying agricultural and tourism sectors in the lower course. In general, the main use of water in the basin is urban supply and this represents approximately the 77% (including industry services) while the remaining 23% is used for agricultural purposes.

Groundwater presents serious problems of contamination (volatile organic compounds from industrial discharges); as well as overexploitation that results in marine intrusion and the salinization of the water. Total underground resources exploited by the system are estimated at about 42.6 hm³/year. These resources are intended mainly for urban supply (32.9 hm³/year) and to a lesser extent for irrigation (9.7 hm³/year).

In the study area there are three wastewater treatment plants (WWTPs), two with tertiary treatment –Blanes and Tordera – and one with secondary treatment (Castell-Platjad´Aro). Effluent from the Blanes plant (around 3.5 hm³/year) is used mainly for reaching the aquifer, though a few farmers also use it for irrigation. The Tordera WWTP, produces around 1 hm³/year of reclaimed effluent which is discharged into



the Tordera river. The effluent of Castell-Platja d'Aro WWTP (5.5 hm³/year) is treated to secondary and tertiary levels, and is used for golf course watering, groundwater recharge, and agricultural irrigation, with the residue discharged into the sea.

The farm areas around Blanes WWTP present a total cultivated area of around 704 ha, of which 608 ha are used for horticultural crops. Irrigation water is taken entirely from groundwater, with no surface supply (the Tordera river bed is completely dry during the summer months at the time when the water demand from crops is highest).

The administrative division of the basin is used to economically characterize the area. For this purpose, firstly, the districts in the TRB are La Selva, Vallés Oriental, and Maresme. In a second step, the most important municipalities belonging to those districts have also been studied.

The distribution of the population in the TRB is very unbalanced, focusing especially on the urban centers of the Costa Brava near to the area of the river's mouth (Blanes, Lloret de Mar, Pineda de Mar, Malgrat de Mar). In these municipalities, the population density is greater than 2 000 inhabitants/km², unlike other municipalities in the basin with a density of 100 inhabitants/km². However, the seasonal variations due to tourism are very important because these can double the resident population. Table 10.1 shows the population and population density and their evolution for each district.

Table 10.1- Population and population density for years 1998 and 2010 in the TRB

Districts	Area (km ²)	Population (Inhabitants)		Population density (Inhabitants/km ²)	
		1998	2010	1998	2010
Year					
Vallés Oriental	851.9	295 399	396 691	346.8	466.2
La Selva	995.5	108 816	171 037	109.3	171.9
Maresme	396.9	329 488	430 997	830.2	1 020.4
TOTAL	2 244.3	733 703	998 725	528.7	654.9

Source: Catalanian Statistical Institute, (Idescat), 2011

Table 10.2- Gross value added at market prices by sector in percentage

District	Year	Agriculture	Industry	Services
Valles oriental	2001	1.7	33.9	64.4
	2006	1.1	31.3	67.6
La Selva	2001	2.2	45.2	52.5
	2006	1.1	44.3	54.7
Maresme	2001	1.7	33.9	64.4
	2006	1.1	31.3	67.6
TOTAL	2001	1.8	38.5	59.7
	2006	1.1	34.5	64.4

Source: Catalanian Statistical Institute, (Idescat), 2011





As regards to the economic activities of the TRB (Table 10.2), the main economic activity, for the three districts, is tourism since it represents more than half of the total gross added value. Moreover, between 2001 and 2006 the contribution of this sector increased slightly. The contribution of agriculture is very small since it represents less than 2% of the total gross value added, and the trend is downwards.

To conclude the economic characterisation of the TRB, Table 10.3 shows the gross domestic production for years 2001 and 2006. The highest increase in the GDP has been in the district of Maresme with a growth from the year 2001 to 2006 of 26%. On the contrary, La Selva is the district that has experienced the smallest increase with only 16%.

Table 10.3- Gross domestic production for TRB

District	Year	GDP (Million of EUR)	GDP per capita (EUR/person)
Valles oriental	2001	7 592.8	23 400
	2006	10 778.0	28 800
La Selva	2001	2 485.4	20 300
	2006	3 665.7	23 700
Maresme	2001	5 574.0	15 400
	2006	8 035.3	19 500
TOTAL	2001	15 652.2	19 348
	2006	22 479.0	23 827

Source: Catalanian Statistical Institute, (Idescat), 2011

3 Assessment Criteria

3.1 Environmental outcomes

In terms of environmental outcomes this assessment is focused on the changes in water supply for urban use and the farmers situation as consequence of the use of regenerated water. Note that most of the environmental outcomes would not have occurred in the absence of negotiation and monetary incentives to promote the use of reclaimed water. In this context, monetary incentives are linked to a win-win strategy in the sense that all parties involved improve their situation both from economic and environmental point of view.

The Castell-Platja d’Aro WWTP started to supply effluent to farmers around its plant in 2003. Most of this effluent is treated to secondary levels, contributing to reduce the quantity of fertilizers applied to the land. Moreover, the rest of the regenerated water is used for golf course watering and groundwater recharge.

The negotiation and monetary incentives to promote the use of reclaimed water in the Tordera Delta has involved significant environmental benefits due to the release of freshwater. By restoring aquifers and recharging the Tordera river, the water





availability in the watershed has increased and damage to the aquatic environment has diminished.

As a result of the implementation of the EPI, the municipalities of Plata d'Aro and Santa Cristina d'Aro have started to use reclaimed water for garden irrigation. Hence, as it is shown in Figure 10.2, that despite population growth from 2003 to 2010 (44% for Santa Cristina d'Aro and 32% for Platja d'Aro), urban water demand has decreased during the time period significantly in Santa Cristina d'Aro (50%) and slightly in Platja d'Aro (10%).

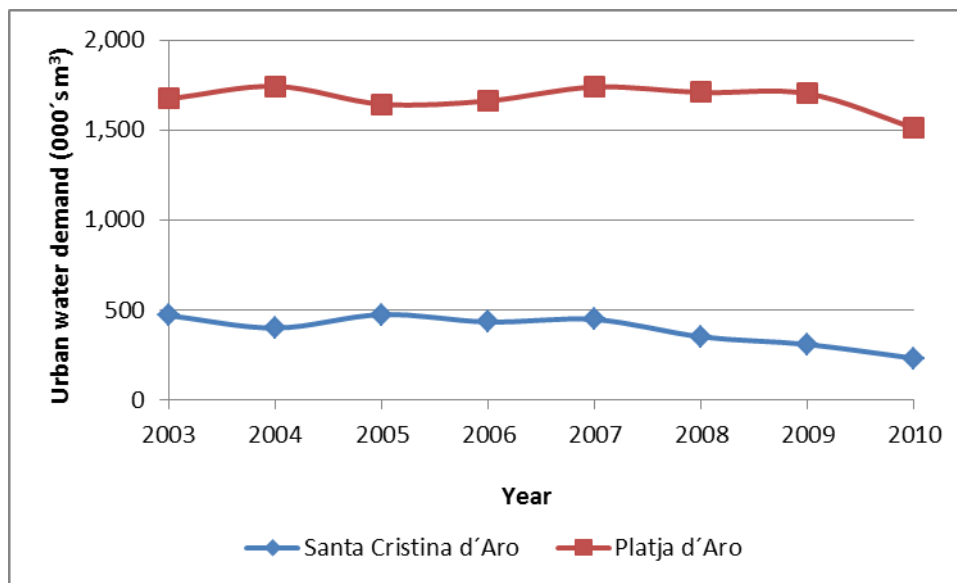


Figure 10.2- Urban water demand in two municipalities of the Tordera River Basin (000's m³), 2003-2010

Source: Own elaboration from Consorci Costa Brava (CCB), 2011

This reduction in the urban water demand is not exclusively attributable to the introduction of the EPI, but we must bear in mind that, in the municipality of Santa Cristina d'Aro, the average annual decrease in water demand has been 216 300 m³/yr and the volume of water reused for garden irrigation was around 126 000 m³/yr. In the case of Platja d'Aro, average urban demand reduction has been 227 400 m³/yr while the volume of water regenerated for municipal use was 162 000 m³/yr.

As has been described previously, one of the most successful water reuse plans in the Tordera Delta has been carried out by the Mas Pijoan Farm. The use of 0.137 hm³/yr of reclaimed water has involved changes in irrigation practices in comparison with the situation when no reclaimed water was used (See Table 10.4).

As Table 10.4 shows, the situation in 2006 differs significantly from the past in terms of cultivated land, crop yield, water use, and irrigation costs. The farmer irrigated in 2006 part of the land with reclaimed water, part with well water, and mixed water. Specifically, 25 ha were irrigated by reclaimed and 7.6 ha with mixed water, whereas the farmland irrigated with well water decreased from 35 ha to 9 ha. The extraction of well water was reduced from 175 000 m³/yr in 2003 by 59.3% in 2006 due to the use





of reclaimed water. The reliability of reclaimed water improved the water availability and raised the crop yield per hectare by 40%.

Table 10.4- Comparison between with and without use of reclaimed water at Mas Pijoan Ranch.

	Situation in 2003	Situation in 2006	Change 2003-2006 (%)
Total irrigated land (ha)	35	41.6	18.9
Land irrigated with reclaimed water (ha)	0	25	-
Land irrigated with well water (ha)	35	9	- 74.3
Land irrigated with mixed water (ha)	0	7.6	-
Crop water requirement (m³/ha)	5 000	5 000	0.0
Well water used (m³/yr)	175 000	71 240	-59.3
Reclaimed water used (m³/yr)	0	136 760	-
Crop yield (kg/ha)	50 000	70 000	40
Irrigation cost (EUR/m³)	0.075	0.115	53.3

Source: FAO (2010)

The decrease in the use of local underground resources has entailed other environmental outcomes. Energy savings, associated with the reduction of groundwater pumping, could be quantified approximately by 30 000 kWh/yr. According to the Spanish national electrical production grid (Spanish Ministry of Industry and Tourism, 2009), this figure means a saving of 10 800 kg of CO₂ equivalent per year. It has been verified that the level of the Tordera aquifer has increased by approximately 10 meters in some wells. This improvement is mainly in the coastal points and during the summer months, namely, when there is the greatest increase in water consumption. In recent years, the level of the aquifer has not been below zero meters above the sea level and so avoiding the aquifer salinization and contributing to the preservation of this strategic reserve.

Because reclaimed water contents nutrients, no chemical fertilizers are needed in the fields (25 ha) that are irrigated with reclaimed water. In this sense, the implementation of the EPI has enabled a reduction of 14 500 kg/yr of chemical fertilizer use and this means significant energy savings and increased availability of non-renewable resources such as phosphorus.

In the past during periods with extreme groundwater pumping rates, neighbours had difficulties withdrawing water. Crop production is now independent of variable rainfall patterns and groundwater availability. Constant water availability as a crucial productive factor, without variations in water cost and water volume during crop growth, means more stable planning in farming activity.

Because all treated wastewater was previously discharged into the sea, the use of reclaimed water for irrigation purposes, and for recharging the Tordera aquifer has





not affected the river regimes. The chemical parameters of the water and the biological and morphological indicators of the river remain unchanged.

The environmental benefits of the implementation of the EPI have not been estimated. As shown in the economic assessment, only the pumping costs savings have been considered as a proxy (surrogate value) for the environmental benefits derived from the recharge of the aquifer.

3.2 Economic Assessment Criteria

The main alternative to the EPI was the implementation of a seawater desalination project. By dividing the total cost of the use of reclaimed water (1 313 281 EUR/yr) by the volume of wastewater recycled (3 475 691 m³/yr), the unit cost is approximated to 0.38 EUR/m³. This unit cost may also be compared with the average cost of seawater desalination ranging from 0.45 EUR/m³ to over 1.0 EUR/m³. Obviously, the reuse of treated wastewater in irrigated agriculture is a preferable alternative to desalination projects.

The illustrative economic cost of the reclaimed effluent in the Tordera Delta (0.38 EUR/m³) is much higher than the cost of pumping groundwater (0.11 EUR/m³). There is no present source of cross-subsidy from farmers, where urban and recreational users could in principle afford the economic tariff. However, these users only account for a minor part of consumption.

Governmental subsidies are provided by the European Commission (European Fund for Rural Development). Such subsidies support the financing of water reclamation projects, even though they do not influence the economic efficiency of water transfer projects. However, they facilitate the implementation of such projects and can essentially influence the readiness of farmers to join in the use of reclaimed water.

As a first step to assessing the economics of the EPI, the water reuse project at Mas Pijoan Ranch was evaluated. Firstly, the cost-effectiveness of the project was evaluated. The additional yields due to the conversion of reclaimed water and the expanded farmland lead to an increase of sales revenue of 174 300 EUR/yr, which means an increase of 66.4% with respect to the situation without the use of reclaimed water. Groundwater pumping cost reductions save 7 782 EUR/yr (59.3%). The cost of fertilizing decreased by 3 588 EUR/yr (52.6%), albeit the cultivated farmland has been expanded. However, the use of reclaimed water leads to cost of 34 529 EUR/yr for carrying the water to the fields.

In comparison with the past, the farmer's income has been raised by 185 670 EUR/yr (76.5%) due to cost saving in pumping and fertilization and so that their income increase is 169 890 EUR/yr. Due to the high increase in income, the principle of cost recovery is 100% fulfilled since the users of the reclaimed water pay the entire cost of the treatment.





Furthermore, the investment of one euro in the use of reclaimed water yields an income increase in agriculture of EUR 11.80, if farmers do not pay the conveyance cost. If they pay these costs, the income return factor is 10.80. This result is in line with the expectations from the theoretical point of view.

The cost of water reclamation in Platja d'Aro WWTP can be summarised as follows: the investment cost of the tertiary treatment is EUR 1.2 million. Hence, by considering that the lifetime of the project is 25 years and the rate of interest is 6%, the investment cost is 93 840 EUR/yr. When taking into account that the volume of tertiary treated water is 990 489 m³/year and the cost is 0.05 EUR/m³, then the operation and maintenance cost is 49 524 EUR/yr. By considering investment and operating costs, the total annual cost of tertiary treatment at Platja d'Aro WWTP is 143 364 EUR/yr.

The improvement in economic efficiency of irrigation due to the use of reclaimed water from Platja d'Aro WWTP can be summarised as follows: the use of reclaimed water leads to economic net benefits of 169 890 EUR/yr, if only the conveyance cost is considered. If the tertiary treatment cost of 143 364 EUR/yr is included in the cost of reclaimed water, then the economic net benefit amounts to only 26,526 EUR/yr. Nevertheless, the reclaimed water cost is lower than the added value in agriculture.

The economic efficiency of expanding the current use of reclaimed water in nearby areas of the Mas Pijoan Ranch is assessed below. It will be proven that through negotiation the use of regenerated water can be encouraged and a more efficient water allocation achieved.

The strategy for Platja d'Aro was to increase the reclaimed water production reaching 20 000 m³/day with only one water quality, and build new pumping stations, pipelines, and water reservoirs. The construction costs of these facilities to provide reclaimed water is shared proportionally with each of the users as shown in Table 10.5.

Of the total investment cost of around EUR 7.7 million, 16% is required for the enlargement of tertiary treatment, 48% for the pipelines, and 33% for storage facilities.

The conversion from groundwater to reclaimed water in irrigated agriculture has led to several benefits for other water users and the aquatic environment. In particular, the release of groundwater has avoided the construction of a new pipeline to carry water from Ter River to meet the increasing water demand in the Costa Brava. An investment cost of EUR 27 million has therefore been saved.

The economic net benefit resulting from the use of reclaimed water at Tordera Delta area has been estimated by taking into account the total benefit and total cost. To quantify the total economic benefit the following items have been considered: cost savings for farmers (fertilization, water extraction, resource development); and increased sales revenues in agriculture. The total economic cost includes the





wastewater treatment, the conveyance, and storage of reclaimed water and the application of reclaimed water.

Table 10.5- Investment cost of reclaimed water use at Platja d'Aro area

	Request water (m ³ /yr)	Tertiary treatment (EUR)	Pipe lines (EUR)	Pumping (EUR)	Storage (EUR)	Amount by user (EUR)
Municipality						
Platja d'Aro	162 000	78 192	618 387	39 194	148 065	883 837
Santa Cristina d'Aro	126 000	60 816	371 127	32 727	118 227	582 898
Golf						
Pitch & Putt Platja d'Aro	24 000	11 584	91 613	5 806	21 935	130 939
Golf d'Aro*	210 000	-	-	-	-	0
Finca Lara	30 000	21 471	25 342	978	27 907	90 178
Pitch & Putt Mas Torrelles	28 000	13 515	82 473	7 273	26 273	129 533
Golf Costa Brava*	250 000	-	-	-	-	0
Pitch & Putt La Llave	116 200	56 086	181 320	3 790	108 093	349 289
Farmers						
Mas Pijoan Ranch	136 760	-	124 052	25 125	125 253	-
Plots near the WWTP*	91 250	-	-	-	-	0
Farmers in Soilius*	171 500	-	-	-	-	0
Farmers in Llagostera	1 000 000	482 664	1 579 684	127 616	2 100 000	4 289 964
ACA						
Ecological water flow	1 000 000	482 664	715 684	32 616	-	1 230 964
Cost of each action (EUR)		1 200 000	3 687 100	250 000	2 550 500	7 687 600
Total request water (m³/yr)	3 345 710					

* Old user.

Source: FAO (2010)

The total cost of the use of reclaimed water in the Tordera Delta, is around 1.3 million EUR/yr, of which 27.7% and 72.3% are for tertiary treatments and conveyance, respectively. The total benefits amount to around 3.3 million EUR/yr, of which 26.7% are due to increases in crop sales and 69.1% due to cost savings in transmitting distant resources. The economic net benefit of the use of reclaimed water is estimated to be approximately 2 million EUR/yr. Tables 10.6 and 10.7 provide information in greater detail.





Table 10.6- Costs of water reuse at Platja d'Aro area

ANNUAL CAPITAL COSTS PLUS O&M COST		
TERTIARY TREATMENT	Volume (m³/yr)	Cost (EUR/yr)
Pijoan Ranch	136 760	19 784
Other farmers	1 080 235	99 356
Golf courses	699 898	90 479
ACA	271 798	39 282
Municipalities	1 288 000	113 015
Total tertiary treatment	3 476 691	361 916
CONVEYANCE	Volume (m³/yr)	Cost (EUR/yr)
Pijoan Ranch	136 760	34 529
Other farmers	1 080 235	343 271
Golfs Courses	699 898	207 714
ACA	271 798	126 715
Municipalities	1 288 000	240 216
Total conveyance	3 476 691	915 905
GRAND TOTALS		1 313 281

Source: FAO (2010)

Table 10.7- Benefits of water reuse in the Platja d'Aro area

Increase in sales revenues	Benefits (EUR/yr)
Pijoan Ranch (increased irrigated area from 35 ha to 41.6 ha)	174 300
Other farmers (increased irrigated area from 40 ha to 291.6 ha)	874 800
Reduced groundwater pumping	
1,070,755 m ³ /yr * 0.11 €/m ³	110 000
Reduced use of fertilizers	
352,9 ha * 58.5 €/Yr ha	20 646
Avoided freshwater pipeline	
Annual capital cost plus O&M cost	2 260 800
Environmental benefits	
Recharge aquifer (263,118 m ³ /yr * 0.11 EUR/m ³)	28 943
GRAND TOTALS	3 469 489

Source: FAO (2010)

Cost-effectiveness analysis was not made to choose and design the EPI. However when taking into account that, according to the institutional framework, golf courses in Catalonia cannot use freshwater for irrigation, the negotiation and monetary





incentives to promote the use of reclaimed water jointly with farmers was the cheapest alternative.

The implementation of the EPI has not lead to a cost saving for water users since according the economic feasibility study, the unit cost of regenerated water is approximated 0.38 EUR/m³, while the cost of pumping groundwater is only 0.11 EUR/m³. However, the EPI has delivered additional benefits such as an increase in farmer income and an improvement in their water availability. Golf courses have also improved their water availability – mainly in the summer. Relating cost reductions, the implementation of the EPI has involved savings in groundwater pumping cost, in fertilizer costs, and has avoided the need to build a freshwater pipeline. At the same time, it has enabled an increase in irrigated land (Table 10.7).

The EPI is a clear example of win-win strategy. Through negotiation, all the participants can improve their situation with regard to their current state. The cost of implementing the EPI is mainly that of the tertiary treatment for the regeneration of the water and the conveyance cost which is paid by water users in a proportion that depends on the volume of regenerated water used.

Because the area is characterised by the use of groundwater with no surface supply for irrigation purposes, golf courses, the course managers and farmers consider that the most important benefit of the use of reclaimed water is that the guaranteed availability of water all year, even in summer when the yield of the wells decreases significantly. Hence, the EPI has an important risk-reducing role in the area.

The cost of the additional treatment for regenerating the treated water and its distribution is paid by farmers and golf courses. Though a negotiation process between them the percentage paid by each is different. The EPI has been designed to recover all the costs. The revenue is collected by the Consortium of the Costa Brava (CCB) which is the institution that manages the water cycle in the TRB. The revenues are earmarked to pay for the regeneration and distribution of the water.

3.3 Distributional Effects and Social Equity

The use of reclaimed water for golf courses is generally accepted by the public. In fact, in the Tordera Delta area, the administration has not received any complaints regarding the project. However, the irrigation of crops with reclaimed water is still a subject of debate.

To assess the distributional effects and social equity of the use of reclaimed water, some interviews have been made with different group of stakeholders such as farmers, golf courses managers, and residents.

Firstly, we will present the main indicators found for the farmers group. Because the use of reclaimed water, the irrigated area has increased meaning an economic net benefit of EUR 552 160 per year. Although the use of reclaimed water may lead to biological and chemical risks, in our area of study, we can consider these are minimal





since the Royal Decree 1620/2007 sets out strict parameters to be met by the reclaimed water according to its use. Education and monetary incentives are two key issues to encourage the use of reclaimed water. In the study area, important information campaigns addressed to both farmers and the general public have aimed to raise awareness about the positive effects and restrictions on the use of reclaimed water. The use of reclaimed water has enabled an increase in the irrigation area and consequently, new jobs have been generated. Although there is no statistical information relative to how the use of reclaimed water has altered employment, the farmers in the area estimate that there has been an increase of approximately 25%.

Farmers are very satisfied with the quality of the reclaimed water. Because the area is characterized by the use of groundwater with no surface supply for irrigation purposes, farmers consider that the most important benefit from using reclaimed water is that the year-round availability. Farmers have been a very important part of the promotion of the use of regenerated water in the Tordera Delta. From the beginning, the administration was aware that the project would be successful if it had the support of farmers. For this reason, farmers have actively participated in the decision-making process and they feel that are an important participant that the Administration takes into account before making decisions in the field of water management. From a social point of view, the connection between the farmers and managers of the nearby golf courses should be highlighted.

Since 20% of the reclaimed water is used for golf course irrigation it was considered important to understand the perception of this stakeholder. For the golf courses, the use of regenerated water, rather than an increase in the benefits, has meant ensuring the availability of water for irrigation and, consequently the maintenance of its activity, especially in the summer when demand is higher. Golf course workers are informed about the fact that the irrigation is done with regenerated water. There is a special care to avoid contact with water. In any case, no health problems have been detected in workers associated with the use of reclaimed water. In some cases, the fact that the golf course is irrigated with regenerated water is visibly announced in order to show the commitment of the company to the environment, and so contributing to the environmental awareness of clients.

According to golf courses managers, the use of reclaimed water has helped maintain stable employment since if courses had to be irrigated with conventional resources, some courses would probably have had to stop their activity due to increasing water scarcity problems. For this economic activity, the most important benefit derived from the use of reclaimed water is the guarantee of water availability throughout the year. From the social point of view, the perception on the use of regenerated water for golf courses irrigation has had very good acceptance by the local population. In fact, it has contributed to improving the image of this type of business.

The third group of stakeholders are the inhabitants of the municipalities affected. Because a proportion of the reclaimed water is used for the irrigation of municipal gardens and to improve the water flow of Ridaura River, the opinion of wider public is also important. Before the use of regenerated water for the irrigation of gardens,





the administration launched a major information campaign that included publication of brochures, lectures at schools, institutes, councils, associations of neighbours, cultural associations, etc. Education is perceived as a key issue to ensure the acceptance of the use of reclaimed water. Local people are aware of the fact that part of the improvement of the environmental quality of the River Ridaura is a direct consequence of the considerable efforts made in the treatment and regeneration of wastewater. In this case, transparency in decision-making process and the access to information have played key roles. Given that the water regeneration involves high costs, it was considered vital that the local population knew the causes for the development of water reuse projects and their associated benefits.

As a result of the implementation of the EPI, health problems have not been detected. To avoid contact with regenerated water, information boards have been placed in the gardens irrigated with reclaimed water. The use of regenerated water has changed neither the employment nor the time for leisure purposes of the citizens. The local environment, and the appearance of the garden has not declined after irrigation with regenerated water. The environmental organizations of the area have publicly shown their satisfaction with the use of regenerated water for garden irrigation and for the maintenance of the flow of the Ridaura River. Social connections have not been altered after the implementation of the EPI.

3.4 Institutions

The culture of the reuse water in the TRB has positively conditioned the design and implementation of the EPI. The planned reuse of water in Catalonia began in 1985 when the Costa Brava used a disinfected secondary effluent for golf course irrigation. On April 7, 2005, the council of administration of the Catalan Water Agency published an edict (21 April 2005) concerning the criteria for the processing and administrative procedures for using treated water for the irrigation of golf courses and similar facilities. This agreement provides that in general, the irrigation of golf courses and similar facilities must be done by reclaimed water from private or public WWTPs.

Due to water scarcity problems, water reuse has become an important resource in Spain. Therefore, in 2007 the Royal Decree 1620/2007 of 7 December established the legal framework for the reuse of regenerated water. The norm defines the concept of water reuse, introduces the concept of reclaimed water, determines the requirements for reusing reclaimed water, and the procedures to obtain legal authorization. Moreover, it includes provisions relating to the acceptable uses and precise quality requirements for each case. The Royal Decree was promoted by the Environment Ministry but has many links to Health Ministry.

The authorization procedure requires that the petitioner submit a water reuse project, and stipulates that the river basin authority is responsible for examining the documentation presented and must report on the compatibility of the application





with the Basin Hydrological Plan. In all cases, the river basin authority will request a report from the health authorities.

This is the general outline for water reuse projects in Spain. However, given that the TRB lies entirely in the region of Catalonia, the scheme differs slightly. In this case, the Administration responsible for developing and monitoring the entire process is the Catalan Water Agency (ACA).

However, within the territory of the TRB there is another water administration that is responsible for the direct management of the water resources of the area: Consortium of the Costa Brava (CCB). It is an autonomous organism created in 1971 and composed by 27 municipalities along the Girona coast. It is worth noting that the CCB is one of the pioneering institutions in Spain in the development of water reuse projects.

The participation of the CCB in the negotiating process has been essential for promoting the use of reclaimed water. This Administration has not only provided the legal and institutional framework to develop the projects but it has actively participated in making water reuse a reality. Likewise, the experience gained in projects previously developed by the same administration facilitated the implementation of the project in the Tordera Delta.

The existence of a wide legislation in the field of wastewater reuse has affected both the design and implementation of EPI. The fact that Royal Decree 1620/2007 does not allow the use of regenerated water for urban supply, determined the design of the EPI. The fact that golf courses cannot irrigate with freshwater has also favored the implementation of EPI.

The EPI has no impact on the existing institutions and has not established no legislation. However, the wide experience of the CCB in the negotiation and the use of monetary incentives to promote water reuse can be used to implement a similar EPI in other areas with water scarcity problems.

Taking into account the positive results of the TRB we can say that the EPI has not failed because the negotiation between farmers and golf courses has enabled to increase the volume of regenerated water and so provide benefits for all the parties involved as a consequence of the implementation of a win-win strategy.

3.5 Policy Implementability

The use of monetary incentives and the negotiation process as a mechanism to promote the use of reclaimed water is a very flexible instrument that can be adapted to local conditions ex-ante and ex-post implementation. The conditions of the negotiation are adjusted depending on the actors involved in the process and their water needs. Hence, the flexibility of the EPI facilitates its implementation.

In the field of water reuse, public perception and participation play key roles. It is necessary that society understands the benefits and the risks associated with the use





of reclaimed water. For example, if the regenerated water is used for agricultural purposes, the consumers of fresh products irrigated with regenerated should be informed. When reclaimed water is used for the golf courses irrigation, it can be announced so that the users are made aware of the environmental performance of the company. In this context, farmers were very satisfied with the quality of the products obtained by using reclaimed water and the perception of the use of regenerated water for golf course irrigation has had very good acceptance by local population. The good acceptance of the use of regenerated water for different purposes has influenced positively the implementation of the EPI.

In this context, public participation did not play an important part in the design of the EPI but it was essential in the choice and implementation of the instrument. Undoubtedly, the use of monetary incentives is an appropriate instrument to encourage the use of regenerated water – providing there is a social acceptance of this resource. Therefore, before choosing the instrument, the water administration conducted environmental awareness campaigns and held informative meetings with farmer associations and managers of golf courses. We can say that the administration acted as a catalyst for the negotiating process.

Cooperation between stakeholders, namely farmers, golf courses managers and residents, is a key aspect for the success of a water reuse project. None of them had a dominant position which influenced the implementation of the EPI since the strategy applied was win-win. The legislation that governs the entire process is at the national level and therefore, the quality requirements of the reclaimed water and the administrative procedure must conform to this legislation. It must be stressed that the procedure specified by this standard requires the collaboration of the ministries of health and the environment. The next hierarchical level is determined by the regional legislation which develops and applies the state legislation. However, we must not forget that given the special feature of this type of projects adaptation must be made to local conditions. For this reason, cooperation between the regional and local administration was key.

The Royal Decree 1620/2007 can be considered an element that has favored the implementation of the EPI because as it establishes the quality criteria for water depending of its use, and so the uncertainty and risks relative to quality are minimized. Moreover, the fact that the Royal Decree describes the administrative procedure for obtaining the authorization for water reuse also facilitated the implementation of EPI. In this context, the authorization procedure requires that the petitioner submit a water reuse projec, being the River Basin Authority the responsible to examine the documentation presented and report on the compability of the application with the Basin Hydrological Plan. The River Basin Authority request to the health authorities a report being it binding. The existence of a clear norm both relative to the administrative procedure and the water quality criteria faciliated the implementation of the EPI.

No sectorial policies have affected the implementation of the EPI.





3.6 Transaction Costs

There is no definition of transaction cost in the literature about this instrument. This is not to say that there were no transaction costs in the negotiation, and the use of monetary incentives to promote the use of reclaimed water.

Because the instrument is based on the negotiation process to promote the use of regenerated water, the main participants involved were farmers and golf course managers. Nevertheless, the water administration, mainly the CCB, also has a representative role in the sense that by the use of monetary incentives it also promotes the use of reclaimed water and all the legal authorizations required are approved by it.

The tradition of water reuse in the area was a key factor in selecting the EPI – which was implemented in several phases. One of the first negotiations to promote the use of reclaimed water was established in 2003 between the Mas Pijoan Ranch and the nearby golf course. In subsequent years, other farmers and golf courses have negotiated the use of reclaimed water by sharing infrastructure and costs. The administration procedures are mainly associated with obtaining the legal authorization for water reusing.

There has not been any guidance and no decision-support tools were used to understand the instrument.

There were no problems relative to asymmetric information since both farmers and golf courses shared information relative to the costs of implementing water reuse projects.

One of the premises to develop the water reuse project was that the users paid the total cost of the regeneration and conveyance of the water. The fact that much of the initiative to develop the project has been by water users has facilitated the work. While it is true that there are additional costs for the regeneration and distribution of water, such as administrative costs, these can be considered as negligible.

The negotiation process and the use of economic incentives to encourage the use of reclaimed water have played a vital role for the success of the projects developed subsequently. However, it is true that the negotiation between the ACA-CCB and users was not overly complex since the need to increase the supply of water was very clear. In this sense, the ex-ante transaction costs were minimal.

Ex-post transaction costs are basically associated with the monitoring of the quality of the reclaimed water. In this sense, an analysis is needed every month in order to check that the reclaimed water meets the quality criteria required by Spanish law. It is estimated that the annual cost of these analyses is approximately 1 000 EUR/yr.





3.7 Uncertainty

The objective of the EPI was not clearly defined, but it simply encouraged as far as possible the use of regenerated water – but without specifying the volume, nor the uses.

The fulfillment of the objective can be quantitatively determined in the sense that is possible to measure the volume of regenerated water that is used and the number of cooperative agreements between stakeholders (farmers and golf courses) but not in a quantitative point of view. Hence, it is impossible to quantify the difference between the intended and actual outcomes.

An important part of the increase in the use of reclaimed water is attributable to the EPI but there have also been other factors such as the adoption of specific legislation which has contributed to the promotion of reclaimed water. It is not possible to know the percentage due to each factor.

The use of monetary incentives was introduced because in general terms the social acceptance of the use of reclaimed water was good. While there were some groups of farmers who disapproved of the use of reclaimed water, it can be said that they were not significant.

4 Conclusions

The area of Tordera Delta is characterized by high level of competition for water. Water for agricultural irrigation is taken entirely from groundwater and water is not guaranteed at crucial crop growing stages. However, in the area there are several golf courses for which there is a prohibition on the use of groundwater for irrigation.

In this context, the water administration considered that it was necessary to introduce monetary incentives and promote cooperation between stakeholders in order to promote the use of regenerated water and therefore decrease the pressure on the local aquifers.

4.1 Lessons learned

The EPI has succeeded since its main objective was to promote the use of reclaimed water and following its implementation a significant volume of regenerated water has been reused. Moreover, following a win-win strategy, as it is shown in the case of the Mas Pijoan Ranch, the negotiation between farmers and golf courses has provided mutual reliability and flexibility.

When assessing the use of monetary incentives and negotiation to encourage water reuse, the main lessons learned are as follows:





- Environmental outcomes: crop production is now independent from variable rainfall patterns and groundwater availability. Water cost and water volume is more constant, enabling more stable farming production. Because reclaimed water is also used for municipal gardens irrigation, the urban demand of freshwater has decreased.
- Economic assessment: the win-win strategy has provided mutual reliability and flexibility to farmers and golf courses. The use of reclaimed water has an important risk-reducing role in the area. The implementation of the EPI has improved the economic efficiency of irrigation.
- Distributional effects and social equity: the use of reclaimed water in the irrigation area has increased and new jobs have been generated. The social perception relative to water reuse has been improved by the informative campaign made in the framework of the EPI implementation. For the success of the project it is essential that local people are involve from the beginning of the process.
- Institutions: the norm that prohibits the use of groundwater for golf course irrigation was key in the design of the EPI. Some 25 years of experience in the use of regenerated water in the area of study has contributed positively to the implementation of the EPI and to the social acceptance of water reuse.
- Policy implementability: although the main stakeholders involved in the implementation of the instrument were farmers and golf courses managers we can say that the administration acted as a catalyst for the negotiation process. It informed farmers about the benefits derived from water reuse and this was essential for the success of the instrument. Sharing the information relative to previous experiences was essential for developing new water reuse projects.
- Transaction cost: the tradition of water reuse in the area was a key factor in selecting these instruments. Overall, transaction costs are very low and associated with monitoring the quality of the regenerated water.
- Uncertainty: The objective of the instrument was defined only in qualitative terms. The increase in the use of reclaimed water is not only as a consequence of the use of monetary incentives. It is impossible to know the contribution of the EPI.

An indirect consequence of the EPI has been the awareness users about water scarcity problems. The result has been a decrease in the urban demand for water.

There is no room to improve the design and implementation of the EPI since it is largely conditioned by legislation (Spanish Royal Decree 1620/2007 and Catalanian Water Reuse). The capacity of the WWTPs to produce water with enough quality also conditions the implementation of the EPI.





4.2 Enabling / Disabling Factors

The main enabling factors that have contributed to the success of the instrument are as follows:

- Win-win strategy: the negotiating process between the two or more parties should be governed by a win-win strategy, in other words, both parties must obtain benefits as a result of the cooperation. The agreement must be flexible, in the sense that if after its implementation one of the two parties is not entirely satisfied it can renegotiate. The agreement should be approved directly or indirectly by the administration since it has to authorize the water reuse project.
- The social acceptance of the water reuse. All the stakeholders should be aware of water scarcity problems and the challenge that they face. In the case of farmers, it is necessary to carry out information campaigns to show them the benefits to be gained by collaborating with other water users (golf courses) rather than competing with them. In the case of golf courses, they have to be made aware that, given the restrictions on the use of freshwater water for the maintenance of the greens it is necessary to reach agreements with farmers. Finally, it is vital that local people knew the causes for the development of water reuse projects and their associated costs and benefits.
- Institutional framework. If the parties reach agreements but the institutional framework is not well defined, or is not conducive to water reuse, then implementing the project will be difficult. The existence of a clear norm both relative to the administrative procedure and the water quality criteria facilitates the implementation of the instrument.

Regarding disabling factors, if the economic assessment of the water reuse is negative for one or two parties involved there is no room for the negotiation. The stakeholder who takes the initiative in the negotiating process must previously ensure that the other party will also obtain benefits. Otherwise, the process will be a waste of time and resources.

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7 Annexes

Subsequently is presented the matrix regarding distributional effects of the EPI implementation from the point of view of farmers, golf course managers and residents.

FARMERS:

Indicator	Direction of change				
	--	-	0	+	++
Material Living Standards				■	
Health			■		
Education			■		
Personal Activities			■		
Employment			■		
Environment			■		
Security				■	
Political Voice			■		
Social connections and relationships				■	

Key

■ Grades assigned directly by interviewees





GOLF COURSE MANAGERS:

Indicator	Direction of change				
	--	-	0	+	++
Material Living Standards				[Green bar spanning + and ++]	
Health			[Green bar spanning 0 and -]		
Education				[Green bar spanning + and ++]	
Personal Activities			[Green bar spanning 0 and -]		
Employment				[Green bar spanning + and ++]	
Environment			[Green bar spanning 0 and -]		
Security				[Green bar spanning + and ++]	
Political Voice				[Green bar spanning + and ++]	
Social connections and relationships				[Green bar spanning + and ++]	

Key

[Green bar] Grades assigned directly by interviewees





RESIDENTS:

Indicator	Direction of change				
	--	-	0	+	++
Material Living Standards			█		
Health			█		
Education				█	
Personal Activities			█		
Employment			█		
Environment			█		
Security			█		
Political Voice			█		
Social connections and relationships			█		

Key

█ Grades assigned directly by interviewees

In order to complete the assessment of the uncertainty, pedigree matrices for the environmental outcomes and economic objectives of the instrument are as follow:

Table A.1- Pedigree matrix for environmental outcomes

	Reduction water demand for urban use	Restoring aquifers
Objective to be assessed	Use reclaimed water for gardens irrigation	Not defined
Proxy	3	2
Empirical	3	2
Method	3	2





Table A.2- Pedigree matrix for economic objectives

	Increase farmers' income	Keep constant golf courses activity
Objective to be assessed	Increase in irrigated land	Not defined
Proxy	4	2
Empirical	3	2
Method	3	2

