Chapter 7: A Value Transfer Approach for the Economic Estimation of Industrial Pollution: Policy Recommendations.

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In order to make possible an economic estimation of industrial pollution, which is one of the main polluters in the Asopos River Basin (RB), another method that of Benefit Transfer (BT) was applied and is presented in this chapter. The fact that gathering primary site-specific data is costly and time-consuming has made BT a more and more popular alternative for the valuation of ecosystem goods and services and it offers a considerable potential in the light of the EU Water Framework Directive (WFD) implementation. In a broad sense, BT method uses existing economic value estimates from one location to another similar site in another location. In this context, the objective of this chapter is to present an empirical application of the methodology of transfer value. A number of valuation studies in the European territory that have explored the impact of industry on water degradation are reviewed in order for a suitable 'match' to be made between the Asopos RB and a suitable existing valuation study from which to source economic value information and hence perform the valuation exercise. The chapter closes with conclusions and recommendations for policy design.

1. Introduction

As it was presented in Chapter 3 the broad Asopos area is the largest industrial region of Greece, supporting 1300 industrial facilities. It is reminded that in 1969 under a Presidential Decree, the dictatorial regime provided the industries in Athens with incentives in order to transfer their businesses in the Viotia region. The area started at that time to receive several industries, and Asopos River was proclaimed receiver of treated industrial waste. What characterized the location of those industries in the region was the lack of any planning and monitoring system for the control of the area's industries. In 1979, the Prefectures of Attica and Viotia determined the terms and conditions under which the industries would discharge their waste in the river, however, without establishing any monitoring system for the enforcement of those terms. Although today these terms are obsolete and in opposition with more recent laws and regulations, the treaty is still in effect. In addition, more permissions were granted for the operation of industries in the area of the region where the construction was forbidden under the 1969 Presidential Decree. Therefore, hundreds of industrial facilities have been dumping toxic waste in the Asopos River for decades, and as a result, the river and groundwater have been subject to long-term industrial pollution. According to Loizidou's study (2009) there are about 10.500 m^3 of industrial waste, 15 tones of organic waste, which fall on a daily basis in the river and which are not all degradable. Only about 5 tones are degradable while the rest is accumulated and creates serious problems in the wider area.

The most important industrial sector in the area is that of metallurgy and then the sector of food industries, the sector of plastic products and the sector of textile/dyeing/finishing. These sectors are responsible for the main flow of the produced industrial waste waters. The existing ways of waste water disposal in the area are the surface disposal, the underground disposal, the recycling of the treated out flow (within production activity), the disposal in a municipal wastewater treatment plant or in an authorized management body and the disposal in the Asopos River or its tributaries. Industrial sector in the area is responsible that waters along the river and at the coastal area are polluted with inorganic and organic load while its contribution to the pollution of groundwater with hexavalent chromium Cr (VI) is considerable. It is regarded that from 2005 to 2009 in the wider area of Asopos there have been imposed fines of €3.424.620 (Technical Chamber of Greece, 2009).

The WFD 2000/60/EC (CEC, 2000) sets the environmental quality standards at Community level. In particular, the chemical status is required to meet the environmental objectives for surface waters established in Article 4(1) (a). European Union legislation provides for measures against chemical pollution of surface waters in two levels - with Community wide selection of substances of concern and Community wide measures and a requirement that Member States take measures at river basin level against relevant pollutants. There is currently a transitional period until the year 2013 from the "old" framework of Directive 76/464/EEC to the new WFD.

The major part on Community strategy against pollution of surface waters control policy is set out in Article 16 of the WFD which requires the establishment of a list of priority substances and a procedure for the identification of priority substances/priority hazardous substances as well as the adoption of the specific measures against pollution with these substances. The Directive sets the procedure for the setting of chemical quality standards by Member States and expresses monitoring concerns.

The Priority substances Directive (Directive 2008/105/EC) setting environmental quality standards for the priority substances and certain other pollutants is the result of the requirements set in Article 16(8) of the WFD. In addition, the Annex II to this new directive replaces Annex X of the WFD referring to the list of priority substances. Member States shall take actions to meet those quality standards by 2015 as part of chemical status (Article 4 and Annex V point 1.4.3). For this purpose a programme of measures (according to Article 11) shall be in place by 2009, and become operational by 2012. In Annex I of this Directive, Environmental Quality Standards (EQS) for priority substances and certain other pollutants (about 33) are provided. Information concerns annual average, maximum allowable concentration while the unit employed is μg/l.

As the primary objective of this chapter is to determine the value of improvements to the quality and quantity of water resources which are facing considerable pressure due to industrial activity, the adopted approach includes an analysis of the impacts of industry on the environment and society beyond economic activities (welfare impacts). After impacts have been identified the focus is on quantifying as many of these as possible, for example the number of people affected or the extent of the area affected. We then move to an economic valuation, adapting values from existing literature to estimate the impacts of intervention in monetary terms. Conclusions and policy recommendations are offered at the end of the chapter where transfer values are compared with the cost of creating a central wastewater treatment plant in the Asopos area.

2. Identification of impacts of industrial pollution

The main objective of this chapter is the valuation of benefits associated with mitigation policies and measures that aim to improve matters in Asopos RB. At a first instance, the impacts will be felt on the environmental goods and services provided by the area, such as amenity, clean water and biodiversity. Generally, these are not traded in markets and consequently no market price is available to reflect their economic value. Values must therefore be derived and, for this reason, environmental resources are increasingly becoming defined in terms of the ecosystem services they provide. Generally, services include provisioning services (products obtained from ecosystems), regulating services (e.g. climate regulation, water regulation), cultural services (e.g. aesthetic values, recreation) and supporting services necessary for the production of all other services. The following table (Table 1) presents the estimated impacts of industrial sector on Asopos RB revealing environmental and social impacts.

Table 1: Identification of Environmental and Social Impacts of Industrial Pollution in Asopos catchment

Asopos RB	Impacts	
	Environmental:	
		Biodiversity (fish and invertebrates, birds on estuary)
		Pollution and reduction of groundwater
	Social:	
		Human health (from polluted agricultural products and groundwater consumption)
		Cost on local economy: increased cost for drinking water for households, increased cost for local agricultural producers, increased cost for food industries, decrease of tourists for local tourist companies
		Recreation (local residents and visitors)
Water bodies within Basin District		
River	Environmental:	Biodiversity (fish and invertebrates)
	Social:	Human health (from polluted agricultural products and water consumption)
Oropos lagoon and coastal zone	Environmental:	Biodiversity (birds on estuary and Oropos lagoon)
	Social:	Recreation (local residents and visitors)
Groundwater	Social:	Human health (from polluted agricultural products and groundwater consumption)

The baseline scenario is the current situation (*status quo*) in Asopos RB without any intervention, which is the “No Change” scenario. Under this scenario the ecological status of the basin is bad and high levels of pollution are related to serious health concerns. The alternative scenario assumes that mitigation measures (central wastewater treatment in the industrial zone or a build-in innovative technology for industries) to address environmental degradation and human health concerns are taken forward, which is the “Intervention Project” scenario. This is expected to result primarily in social and environmental impacts as well as in financial impacts on industry’s production (foregone cost). It should be noted that the emphasis of this chapter is on the first category of impacts.

3. Benefit Transfer methodology

A more cost-effective approach for the valuation of water quality improvements is expected to come through the application of BT. The fact that gathering primary site-specific data is costly and time-consuming has made BT a more and more popular alternative for the valuation of ecosystem goods and services. The potential of BT has been explored in a number of studies. An example is that of Johnson et al. (2008) who used BT in a stated preference study in England and Wales in order to calculate public WTP for a reduction in risk of illness resulting from swimming in contaminated river waters in Scotland. The study was framed in the context of the EU Bathing Waters standards and WFD. Furthermore, the application of BT in the context of the WFD has been examined and tested in Hanley et al. (2006a, 2006b) by applying Choice Experiment (CE) in two similar rivers and then exploring the possibility of using BT. Results from the two studies are different proving that BT is not a straightforward task to be applied in every case.

BT method uses existing economic value estimates from one location to another similar site in another location. In particular, it concerns an “application of values and other information from a ‘study’ site where data are collected to a ‘policy’ site with little or no data” (Rosenberger and Loomis, 2000, p.1097).

Bergland et al. (1995) discussed three main approaches to BT: (i) the transfer of the mean household WTP (ii) the transfer of an adjusted mean household WTP and (iii) the transfer of the demand function. Hence, while the first approach assumes similarity in good’s and socioeconomic characteristics between the study and target site, the other two approaches attempt to adjust the mean WTP and re-calculate it respectively, in order to account for differences between the two sites in terms of environmental characteristics and/or socioeconomic characteristics. More particularly, in the case of unadjusted mean value transfer the H_0 is: $WTP_{study\ site\ (s)} = WTP_{policy\ site\ (p)}$. On the contrary, the adjusted value transfer tests the hypothesis: *predicted* $WTP_p(\beta_s, X_p) = WTP_p$, where predicted $WTP_p(\beta_s, X_p)$ is the WTP at the policy site estimated using the parameters of the benefit function of the study site (β_s) and the X values (site attributes, socio-economic characteristics etc). In the case of benefit function transfer, the value function estimated for the study site is transferred to the policy site and the relevant test concerns the comparison of function parameters between sites: $\beta_s = \beta_p$.

It should be noted as well that meta-analysis can be used to inform the BT processes (Hanley et al., 2006a). When data are pooled across study sites to produce a BT model for predicting policy site values, the test is: $\beta_{s+p} = \beta_s$ and $\beta_{s+p} = \beta_p$ where, β_{s+p} are the parameters of the pooled regression models.

Generally, the benefit function option seems to be preferred as among others it accounts for differences in site characteristics and human populations between sites. However, function transfers are "limited by quality and availability of primary research, limited consensus on performance and validity of types of function transfers and lack of consensus on how to generate functions"[1] (Rosenberger and Johnston, 2009). It should be also noted that in terms of Transfer Error (TE)[2] function transfer does not seem to perform better than unit value transfer.

4. Findings of literature review and selection of the economic value evidence

It is a fact that we would expect values for a particular good to differ between different locations, for a variety of good reasons relating to context and the particular characteristics of an area. However, in order to minimise concerns, it is important to select the most appropriate value estimate from the most appropriate study site or good. Current best practice in terms of the application of value transfer to a specific project suggests that a number of key points should be taken into consideration when deciding which piece(s) of economic literature can provide the 'best value estimate' for a specific ecosystem service or habitat change.

We have conducted a thorough and detailed review of the economic valuation literature relating to benefit transfer and to industrial impacts in particular. The transferability of each study to the current situation has been assessed, with a focus on the good in question, the environmental change considered, the population and location. The number of valuation studies worldwide

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[1] R.S. Rosenberger's presentation on "Methods, Trends, and Controversies in Contemporary Benefit Transfer" joint paper with Robert J. Johnston. COST E45 EUROFOREX Training Course May 13-17 2009, Benefit Transfer – Introduction and Methods, Norway.

[2] TE is defined as the percent difference between the transferred-predicted (WTPT) and policy site-observed primary estimate (WTPP):

$$TE = \frac{|WTP_T - WTP_P|}{WTP_P}$$

related to river related improvements is quite extensive. In order to narrow down our search for estimates so as to not to comprise reliability and validity of results the following criteria were followed. Considered studies should have in common: (i) the stressor (ii) the baseline scenario and change in the provision of the good/service (iii) the affected population both in terms of its characteristics and geographical extent. Therefore, the study site should be a severely polluted mainly rural river affected considerably by industrial activities. In addition, the two catchments should demonstrate similar socio-economic characteristics which however typically vary between different countries, most notably when comparing developing and more developed countries.

We have considered studies undertaken in the European territory and Mediterranean whenever possible. It has to be noted as well that in general only a limited number of valuation studies have been undertaken in Greece and they generally relate to a very different kind of good from that of interest here. In addition, an effort was made in order to find studies that are motivated by the WFD and therefore share the same policy framework. Finally, scale is another issue of concern as a number of studies consider regional scale for example "rivers and lakes of East Anglia" (Bateman et al., 2006) or even national level (Baker et al., 2007).

However, it is not underestimated the fact that studies from other countries generally involve significant differences between the ecology of resources in the study sites, the affected populations and their socio-economic characteristics and those of the population within the Asopos RB. Often these studies are therefore not a good match with the current project. A number of studies have sought to estimate the value of social and environmental impacts arising from industrial activity. Several of the studies relate to a particular resource, the results of which are driven by specific attributes of the local area making them less desirable for inclusion within a value transfer. The findings of our literature review include two main categories and focus mainly on river freshwater degradation. However, a less extensive literature review encompasses also impacts on groundwater and wetland. The first category is related to environmental impacts caused by industrial pollution. The literature review includes:

a) Studies from European territory related to industrial pollution
b) Studies motivated by the WFD regardless of source of pollution
c) Studies having water element (in general) in Greece

The second category is related to human health impacts caused by industrial pollution. In addition, as previously mentioned literature review includes groundwater pollution from industrial and wetland pollution in order to consider Oropos lagoon degradation. An important instrument of our literature review was the EVRI[3] database. Several of the studies although relate to river quality their results are driven from various attributes of the local area making them less desirable for inclusion within a value transfer. Furthermore, there is a considerable group of studies that relate recreation to river improvements that have not been included as not such an interest is expressed in Asopos at the moment.

Table 2 presents valuation studies in the European territory where industry contributed considerably to water degradation.

[3] http://www.evri.ca

Table 2: Overview of studies considered for Benefit Transfer

Authors	Country	Water body	Method	Mean WTP values (per household/year)
Hanley et al. (2006a)	Scotland	Catchment River	Choice Experiment	£20.17 for the improvement of the ecology of the river from 'fair' to 'good'
Hanley et al. (2006b)	Scotland	Catchment River	Choice Experiment	£8.97 for the improvement of the ecology of the river from 'fair' to 'good' and £24.03 for the improvement of the ecology of the river from 'fair' to 'very good'
Martin-Ortega et al. (2009)	Spain	Catchment River	Choice Experiment	€81.2 for the improvement of the ecology of the river from 'bad' to 'very good' and 61.3€ for the improvement of the ecology of the river from 'bad' to 'good'
Kataria et al. (2009)	Denmark	Catchment River	Choice Experiment	491 DKK for the improvement of the ecology of the river from 'bad' to 'good' and 547DKK to 'very good'
Bateman et al. (2006)	England	Catchment River	Contingent Valuation	£15.24 for the improvement of the ecology of the river from 'bad' to 'good' and £22.89 to 'very good'
Birol et al. (2008)	Cyprus	Wetland	Contingent Valuation	18.25 cyp for the scenario of the maximum improvement of the ecology of the wetland
Birol et al. (2006)	Greece	Wetland	Choice Experiment	14.45 € for the scenario of the maximum improvement of the ecology of the wetland
Carlsson et al. (2003)	Sweden	Wetland	Choice Experiment	493.76 SEK for the improvement of the ecology of the wetland from 'bad' to 'good 'and 719.75 SEK from 'bad' to 'very good'
Birol et al. (2010)	Cyprus	Groundwater	Choice Experiment	0.014 CYP/per m^3 for the improvement of water quality to the maximum
Rinaudo (2003)	France	Groundwater	Contingent Valuation	77€ for the restoration of the very bad ecological condition
Bergstrom et al. (2004)	USA	Groundwater	Contingent Valuation	$47.81 for decontamination of nitrate loads

Hanley et al. (2006a), using CE analysed improvements to the ecology of the River Wear, in Durham, England and the River Clyde, in Central Scotland. These rivers were chosen as broadly representative of the kind of water bodies in the UK where moderate improvements in water quality are likely to be needed in order to meet good ecological status. The lower sections of the River Wear were heavily polluted by industry and mining, but have now recovered and support a migratory fishery. Existing problems include litter, algal growth and acidity problems due to mine drainage. Problems also exist with loss of bankside vegetation, increased erosion, and a decline in habitat and associated fish and wildlife populations. The river plays an important role in recreation and tourism. The River Clyde has recreational and tourist attractions, and encompasses areas of great beauty Falls of Clyde, but also has some of the most problematic stretches in terms of water quality. Most of this section was graded 'B' using the Scottish river classification system, which is equivalent to the 'C' grade for the Wear under the General Quality Assessment classification system (i.e. fair quality, but in need of improvement to reach 'good ecological status').

In their paper, Hanley et al. (2006b) analysed the case of two small catchments located in eastern Scotland: the Motray and the Brothock. This area has difficulties in meeting Good Ecological Status because of the presence of high nutrient levels (N and P) and low summer river flows. The use of fertiliser and manure applications by farmers is the cause of the high nutrient levels. They use CE in order to estimate willingness to pay (WTP) for improvements in the ecological status of the catchments (through stricter controls on irrigation and on diffuse-source pollution).

Martin-Ortega et al. (2009) used a choice experiment based on maps in order to elicit welfare measures for water quality improvements across sub-basins in the Guadalquivir River Basin in

Spain. The Guadalquivir River Basin (GRB) is the longest river in the south of Spain. Water quality is a significant problem throughout the river basin. The main sources of pollution include urban and industrial wastewater discharge, erosion, nutrient and pesticide runoff from agricultural land. Concentration levels of Nitrogen, Phosphorus, heavy metals and organic pollutants in surface and ground waters are expected to increase with about 30 percent in the near future.

Kataria et al. (2009), estimate the WTP for water quality improvements in the Odense River in Denmark using a CE study. The present quality of Odense River is affected by human activities and is classified as moderate. They found that the majority of their respondents find the improvement in the scenario described to them to be unlikely or rather unlikely. Thus, it appears to be a mistrust of the environmental improvements described in their survey, especially when it comes to achievement of the best water quality.

In their paper, Bateman et al. (2006) conducted a valuation of improvements to the water quality of the River Tame. This is an urban river that flows through the city of Birmingham in the UK and is classified as having very poor water quality by the UK Environment Agency. Fish stocks are virtually non-existent and other fauna and flora are severely limited. Direct human use is seriously limited with the river classified as being unsuitable even for boating. Nevertheless, the river has an ecological and recreational potential and passes through residential areas, playing fields and a country park. In the paper, applications of contingent valuation (CV) and contingent ranking (CR) methods were used.

Birol et al. (2006), used a choice experiment to estimate the values of changes in several ecological, social and economic functions that Cheimaditida wetland provides. This wetland includes Lake Cheimaditida, one of the few remaining freshwater lakes in Greece. It provides several of the important ecological functions. The value of the economic benefits generated by sustainable management of the wetland was estimated using data from 407 CE surveys that were administered in 10 cities and towns in Greece. Within the wetland the main economic activities include agriculture, forestry and fishing. Agriculture is a vital activity where alpha-alpha and maize are the main cash crops whose production is water and fertiliser intensive. Water opportunities from the lake for irrigation in agriculture, and pollution due to run-off from agricultural production, have adverse effects on water quantity and quality. These in turn affect the level of biodiversity that the wetland is able to support.

Birol et al. (2008), assessed an aquifer management plan to replenish a depleting aquifer with treated wastewater in Cyprus (a water-scarce region of the world). They conducted two distinct CEs on randomly selected members of two key stakeholder groups, allowing them to estimate the use and non-use economic benefits that may arise as a result of the proposed aquifer management plan. This aquifer faces water quality and quantity problems. Since the construction of the Kouris River dam, the aquifer's water inflow has decreased significantly, resulting in a lower water table. This has led to the intrusion of saltwater as the aquifer attempts to maintain its hydrological balance. Water quality in the aquifer has further deteriorated due to the intensive use of fertilizers and pesticides in the area's agricultural production. The quantity of water in the aquifer has been reduced due to uncontrolled and excessive pumping.

Birol et al. (2010) present their progress on the research of the Akrotiri aquifer. In this paper, they provide a methodology for assessing the viability of an environmental management plan to replenish this depleting aquifer with treated wastewater. The plan has long-run economic and ecological impacts. They conducted two distinct choice experiments in order to capture the different components of economic value of two stakeholder groups: local farmers and public located in the nearby city of Limassol. Their results reveal that the farmers and residents are not opposed to an aquifer management plan that proposes to replenish the aquifer with treated wastewater.

Birol et al. (2009) used a choice experiment to estimate the value of management options for the Bobrek wetland in Poland. It was implemented in the city of Sosnowiec, located in the Bobrek catchment in the Upper Silesia region of Poland. The region is an important industrial center located within the Upper Silesian Coal Basin. Five rivers run through the wider area, including the Biala, Brynica, Jaworznik, Wielonka and Rawa, making the region susceptible to flooding episodes. Extensive mining activities generated solid waste dumping in the form of spoil heaps which resulted in the degradation of the aquatic and terrestrial ecosystems. Waste dumping has also resulted in extensive pollution from heavy metals and other pollutants in this area.

Bergstrom et al. (2004), developed a conceptual model in order to analyse how the different payment vehicles of a special tax and a tax reallocation affects the WTP for ground water quality protection in Georgia and Maine, US. Their results show that WTP with a tax reallocation is higher than WTP with a special tax for ground water quality protection.

Carlsson et al. (2003), estimated individuals' marginal willingness-to-pay (WTP) for different attributes of a wetland in Staffanstorp, southern Sweden. In this area there has been a public discussion about the location, design and construction of a wetland. The respondents were the local population living in Staffanstorp. They found a negative mean WTP for the three attributes ''Meadow land'', ''Fenced waterline'' and ''Crayfish''. They conclude that an inclusion of these attributes will decrease social welfare.

Finally, Rinaudo (2003) analysed the case of a highly polluted area of the upper Rhine valley alluvial aquifer. The groundwater in this aquifer has been affected by different kinds of pollution. High concentrations of Nitrate, chlorinated hydrocarbons and pesticide pollution problems have been reported. The chloride pollution is provoked by the potash mining industry. For the drinking water sector, the estimated value of the economic damage is 17.5 M€ (60% of the total cost) and 5.5 M€ for the rest. Using the results of an existing contingent valuation study the economic value of the pollution of the aquifer was estimated at 6.6 million €.

5. Valuation exercise

As it was stated in the previous section, the main criteria for the selection of the studies were the (i) stressors (ii) the baseline scenario and (iii) the population. In the case of the valuation of river water quality, the paper by Martin-Ortega et al. (2009) was selected as the most appropriate study to be used in order to conduct a BT valuation exercise. The Guadalquivir River Basin has a Mediterranean climate. The study was motivated by the European WFD and therefore shares the same policy framework as the Asopos RB. In relation to the stressors, the main sources of pollution include urban and industrial wastewater discharge as in the Asopos RB.

Hanley et al. (2006a) is not appropriate since the rivers in their study are polluted not only by industry but also mining (the existing problems include litter, algal growth and acidity problems due to mine drainage), and have now recovered and support a migratory fishery. The mining feature is not shared by the Asopos RB. In the same way, Hanley et al. (2006b) is also not an appropriate study because the problems in their case study areas are high nutrient levels and low summer river flows. Problematic nutrient levels are mainly due to fertiliser and manure applications by farmers. Thus, the stressor's nature is different. The paper by Kataria et al. (2009) was rejected because it does not convey precise information about the stressors. On the other hand, the water quality in this river is classified as moderate (the river is suitable for boating with limited possibilities for swimming and angling. Pollution sensitive fish species are present but the presence of birds, plants and other fish species is limited). The baseline scenario is different: it values environmental improvements for the hydropower regulated rivers in Sweden. Bateman's (2006) study is not appropriate as the environmental good is not the same- urban river and the size of the catchment is very big and the sites where the goods are found are not the same as in the Asopos RB.

In the case of the valuation of wetland quality, Birol et al. (2006) was selected as the most appropriate study. They estimated values of changes in ecological, social and economic functions in Cheimaditida wetland. This wetland includes Lake Cheimaditida, one of the few remaining freshwater lakes in Greece and it provides important ecological functions.

Although Birol et al. (2008) could be considered appropriate because the baseline is quite similar they assessed an aquifer management plan to replenish a depleting aquifer with treated wastewater in Cyprus (a water-scarce region). Thus, Birol et al. (2006) is preferred above Birol et al. (2008). Finally, Carlsson (2003) was also not considered appropriate because the study focus is on the construction of wetlands.

In relation to groundwater valuation, the paper by Bergstrom et al. (2004) was not selected because the study area is mostly urban and not comparable with the Asopos RB. In the same fashion, the paper by Rinaudo (2003) was not selected because the source of pollution originates from potash mining waste dumps. Thus, Birol et al. (2010) was selected as the most appropriate study. The study was motivated by the European WFD and the valuation was about an aquifer management plan to replenish a depleting aquifer in a water-scarce region.

In this valuation exercise the Unit Value Transfer method is used. For the wetland case a simple unit value transfer is used. For the river and groundwater cases, a unit value transfer with adjustment for income differences is used (because the simple unit value transfer approach should not be used for transfer between countries with different income levels and costs of living). The value estimate is therefore adjusted from the time of data collection to current currency using the Consumer Price Index (CPI) for the policy site country (Greece). Since values are transferred from a study site outside the policy site country, first the values are converted to reflect the purchasing power in the year of data-collection, using PPP (Purchase Power Parity) corrected exchange rates in the year of data collection, and then the local CPI to update to current-currency values is used. Taking this into consideration, the benefit estimate (expressed as mean willingness-to-pay (WTP)/household/year) from the study site to the policy site (Asopos RB) is then transferred.

Following Navrud and Ready (2007), the adjusted WTP estimate B_p' at the policy site was calculated using the following equation: $WTPB_p' = WTP_S (Y_p / Y_S)^{ß}$ where WTP_S is the original WTP estimate from the study site, Y_S and Y_p are the income levels at the study and policy site, and *ß* is the income elasticity of demand for the environmental good in question. Income elasticity of WTP *ß* for different environmental goods are typically smaller than 1, and often in the 0.4 - 0.7 range. Navrud reports a multi-country CV study of Value of a Life Year (VOLY) that found the income elasticity to be about 0.2 and 0.5 for the EU-15 and the New Member Countries, respectively. In this valuation exercise an income elasticity of 0.5 is used. Gross Domestic Product (GDP) per capita figures have been used as proxies for income.

GDP per capita based on purchasing power parity (PPP) figures were obtained from the World Bank, International Comparison Program database. The GDP per capita (PPP) for Spain in 2006 (the year of data collection) was 30,333. The GDP per capita (PPP) for Greece in 2006 was 26,733. The GDP per capita (PPP) for Cyprus in 2008 (the year of data collection) was 31,816. The GDP per capita (PPP) for Greece in 2008 was 29,604. Table 3 presents the mean values for benefits of improving the water status for groundwater, wetland and river bodies. The value transfer estimates for improvement of the ecology of the river from 'bad' to 'very good' is €116.94. The value transfer estimate for maximum improvement of the ecology of the wetland is €14.45. Finally, the value transfer estimate for improvement of groundwater quality to the maximum is €0.021 per m^3.

Table 3. Mean WTP values (per household/year)

Martin-Ortega et al. (2009)		Birol et al. (2006)	Birol et al. (2010)
Improvement of the ecology of the river from ‘bad’ to ‘very good’	Improvement of the ecology of the river from ‘bad’ to ‘good’	Maximum improvement of the ecology of the wetland	Improvement of groundwater quality to the maximum
€81.20	€61.30	€14.45	CYP 0.014 per m^3
Unit transfer with income adjustments*			
€116.94	€ 88.28	€14.45	€0.021 per m^3

* GDP per capita based on purchasing power parity (PPP) figures and GDP deflator for Greece (base year 2005=100) were obtained from the World Bank, International Comparison Program database. PPP (Purchase Power Parity) corrected exchange rates were obtained from OECD.STAT. Figures are expressed in 2005 €.

6. Conclusions

In this chapter in order to assess the welfare impacts associated with improvements in water bodies of Asopos basin we are using existing valuation literature and our expertise in transferring values from relevant and comparable projects. During the selection of the economic value evidence a number of conditions were established. Only studies with a common environmental stressor (industrial pollution) were considered. They should value similar impacts, should share similar baseline scenario and good and the location should be as close to policy site as possible. Therefore, only studies undertaken in the European territory and Mediterranean were used. This was one of the main challenges since a limited number of valuation studies have been undertaken in Greece and they generally relate to a very different kind of good. An effort was made to find studies that are motivated by the WFD and therefore share the same policy framework. The findings of our literature review include two main categories and focus mainly on river freshwater degradation and also impacts on groundwater and wetland. The first category is related to environmental impacts caused by industrial pollution. The literature review includes studies from European territory related to industrial pollution, studies motivated by the WFD regardless of source of pollution and studies having water element (in general) in Greece. The literature review includes groundwater pollution from industrial and wetland pollution in order to consider Oropos lagoon degradation. Several of the studies although relate to river quality their results are driven from various attributes of the local area making them less desirable for inclusion within a value transfer.

The Unit Value Transfer method was used in the valuation section. For the river and groundwater cases, a unit value transfer with adjustment for income differences was used. The value estimate was adjusted from the time of data collection to current currency using the Consumer Price Index (CPI) for the policy site country (Greece). A simple unit value transfer was used for the wetland case. The obtained value transfer estimate for improvement of the ecology of the river from ‘bad’ to ‘very good’ is €116.94. The value transfer estimate for maximum improvement of the ecology of the wetland is €14.45. Finally, the value transfer estimate for improvement of groundwater quality to the maximum is €0.021 per m^3.

However, it should be noted that adding up estimates from separate studies on the value of various water bodies that may impact on the same ecosystem might result in some double counting of benefits. Furthermore, it should be also considered that the fact that substitution effects and budget constraints are often incompletely accounted for, may lead to over-valuation. Nevertheless, trying to aggregate values to the households of Asopos in order for example to estimate the social benefit from moving the river’s ecology from the *status quo* (baseline scenario) to "*Good Ecological Status*" (GES) as WFD dictates, reveals a value of about €2,690,000 per year considering that within Asopos RB there are 23,000 households which are permanently connected with the public system of water supply. The respective value for achieving a maximum improvement in the ecology of the wetland is about €332,000 per year. Contrasting the above estimate for river improvements to results of Chapter 6 regarding the moderate environmental improvements in all water bodies valued at €882,200 per year, we can see that the BT value is overestimated.

As far as costs of interventions are concerned, a measure suggested by Loizidou (2009) in order to alleviate the problem in the area was the construction of a Central Wastewater Processing Unit for the disposal of industrial and urban wastewaters. The total cost for the construction was estimated at €32.430.533 while the running cost was ≈ €0.611 per m^3 of waste. The annual running cost for an average daily provision of 16.762 m^3 was 0,611*365*16.762 ≈ € 3.738.177. In addition, the average depreciation cost (€ / m^3) of industrial waste (considering 40 years) was estimated at €0.137 per m^3. Dimaras et al. (2010) study also reports that only the construction of a new pipeline connection to provide Oropos area with clean water was estimated at € 9.400.000.

Overall, the reported estimates in this chapter provide additional evidence of the considerable welfare loss associated with the environmental degradation of Asopos RB as a result of unplanned industrial development. The estimated values provide a considerable contribution against the cost of necessary mitigation measures and show as well that the fines paid by the industry underestimate the cost imposed on the society (ecological, human health, forgone earnings) with fees being totally non-reflective of the pollution cost.

Therefore, our results can be used in the design of public policy in the area. The estimated values that people would place on improvements to the river's ecology (as envisaged under the WFD) suggest that social welfare can be increased by establishing a water/pollution management plan to control pollution in the Asopos RB.

Apart from close monitoring, regular inspections and audits, within this plan it is important that regulatory stakeholders adopt modes of operation in line with the opportunities presented within the full cost recovery options using polluter and user pays principle. Making the polluters accountable for the ecological damage they are causing to themselves and to their future generations and calculating revenue amounts for water services keeping in mind ecological costs is expected to lead to a more effective management. The polluter pays principle relies on incentive-based water pricing that will lead to behavioural changes for example, installing green technologies and on correct economic cost allocation. Hence, imposing "Green" taxes/penalties/ subsidies for polluting industries, depending on their pollutant loads, quantities and willingness to adopt environmental friendly practices, can enable local government collecting and generating new pollution revenues to be reinvested in the pollution management plan.

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