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**A COST-BENEFIT ANALYSIS OF BIODIVERSITY CONSERVATION PROGRAMMES IN THE
GARONNE VALLEY
French Case Study on Biodiversity Incentive Measures**

by Jean-Pierre Amigues and Brigitte Desaignes

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FOREWORD

This paper is one of a series of 22 case studies that describe practical experiences in OECD Member countries with the use of incentive measures for the conservation of biodiversity and the sustainable use of its components. These case studies were submitted by OECD Member countries to the OECD Working Group on Economic Aspects of Biodiversity as a contribution to the OECD study of the design and implementation of appropriate incentive measures for biodiversity conservation and sustainable use. In order to ensure maximum comparability between the case studies, all were developed under the common methodology described in “Incentive Measures to Promote the Conservation and the Sustainable Use of Biodiversity: Framework for Case Studies” [OECD/GD(97)125].

The practical experiences described in the 22 case studies were used as the basis for the policy advice developed in the Handbook of Incentive Measures for Biodiversity: Design and Implementation (OECD, 1999). This Handbook combines the lessons learned through the various experiences described in the case studies covering a wide range of ecosystems, economic pressures on biodiversity, and utilising various incentive measures with sound economic theory to develop a practical, step-by-step guide for policy-makers on the design and implementation of successful incentive measures for the conservation and sustainable use of biodiversity.

This paper was provided by the French Government and was written J-P. Amigues and B. Desaignes. It is released as an unclassified document under the responsibility of the Secretary-General of the OECD with the aim of bringing information on this subject to the attention of a wider audience.

This study, and the other 21 case studies submitted by Member countries, are available on the world wide web at <http://www.oecd.org/env>.

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Jean-Pierre Amigues¹ and Brigitte Desaignes²

EXECUTIVE SUMMARY

For this case study, a cost benefit analysis was conducted of a hypothetical plan for biodiversity conservation in the Garonne Valley in France, where the wetlands adjacent to the Garonne river are under pressure from agriculture through erosion and irrigation. Partly this is the result of a property rights problem, as the State is responsible for the river itself and the “regularly flooded areas” around it but, because of the movements of the river bed, these regularly flooded areas are not always easy to determine and the State responsibility for them is rarely enforced. Contingent valuation studies were used to elicit values from farmers of their willingness-to-accept (WTA) compensation for cessation of activities on the river banks which were harmful to biodiversity, and the willingness-to-pay (WTP) values of local residents for these measures. It was found that the WTP value over 5 years would cover a compensation programme of 25 years. However, while this indicates that the estimated benefits of conservation largely exceed the costs, problems with the implementation of incentives were identified. In particular, there was much mistrust between the local residents, farmers and the public authorities.

Ecosystem studied: inland freshwater ecosystems, arable lands

Incentive measures used: economic valuation, compensation for use restrictions, adverse incentives, positive subsidies, capacity building

Main lessons learned: The study highlights the need for community participation, awareness raising, and mutual trust and understanding between all relevant parties in the use of contingent valuation (CV) studies, as well as the importance of the policy-making context. The existence of significant scientific information about the pressures in this case was extremely useful.

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1. GENERAL DESCRIPTION

The study area is the middle part of the Garonne Valley. It is located downstream of the town of Toulouse, the largest city in the South West of France (650 000 inhabitants with the surroundings). The part of the valley under scrutiny is about 100 km long, running from Portet, located 20 km upstream of Toulouse, where the Ariège river (the main tributary of the Garonne in its Pyrenean part) meets the Garonne, and Moissac, 80 km downstream of Toulouse, where the main tributary rivers (Tarn, Lot and Aveyron) flowing from the Massif Central begin to meet the Garonne.

Anthropic pressures generated by the proximity of the city largely affect the ecosystem downstream of Toulouse. However it remains a fairly diverse ecosystem. For example an ecological survey of the area has found about 1 000 different plant species in only two patches. The valley is characterized by important shallowness with several abandoned channels. These zones play a key role for the development of juvenile fish because of their high diversification in water speed and depth. The riparian forest in the channels provides a nursery for fish and in a minor way for birds. Waterflow and biological conditions provide good opportunities for the epilithic biofilm to act as a natural denitrification device (the order of magnitude is about 5 to 10 mgN/m² of biofilm/h).

The natural ecosystem is undergoing important modifications because of human activities impact. The water waste treatment plant of Toulouse has a huge impact on phosphorus and ammonium concentrations in the river. The middle Garonne valley is one of intensive agricultural production (fruits and vegetable in particular). The development of agriculture in the sixties and seventies has led the farmers to cut trees along the river banks and to put in production areas previously natural. The dams programmes in the Pyrénées Mountains (for electricity production purposes) has reduced to a minimum level the risks of floods in the valley, thus creating new pressures on the riparian ecosystem (urbanisation in the neighbourhood of Toulouse, destruction of channels). More recently, the important development of irrigation in the valley generates new threats on the ecosystem in particular along summer periods (irrigation accounts for 90% of the consumption of water in the Adour-Garonne Basin at these periods). Sand and gravel extraction in the valley is also currently threatening the riparian ecosystem.

In the context of the SDAGE (*Schéma d'Aménagement et de Gestion des Eaux*), the Adour-Garonne Water Agency is now planning investments in the protection and conservation of the riparian habitats in the Garonne Valley. The purposes of this project are to improve the biological capabilities of the river and to use riparian forests as a denitrification device against agricultural pollution. The objective is to protect the riverbanks by a combination of set-aside measures and ecological improvements of the fluvial dynamics in the valley (reactivation of abandoned channels in particular). Set-aside compensations to riparian farmers are also under consideration in the Haute-Garonne and Tarn-et-Garonne districts under the agri-environmental programme heading.

2. IDENTIFICATION OF PRESSURES

2.1. Identification of the impacts on the ecosystem

The ecosystem under study is not in any way pristine. It has been submitted to various human pressures since the Middle Age. The Garonne has been used to navigation, sand and gravel exploitation, mills and hydraulic energy production for centuries. The fear of the huge floods resulting from the Pyrenean mountain topography has led to important programmes of dams construction and fluvial works in the valley since the XIXth century. These works had sensible impacts on the ecosystem by modifying the natural flow dynamics of the Garonne. An attempt was made in the mid-nineties to evaluate what would be the river “natural” hydrogram in current climatic conditions without any human intervention. This attempt was unsuccessful because of the complexity of the human decision interactions. So, the valley ecosystem is albeit natural, and since a long time its characteristics are mere consequences of various anthropic pressures and of the adaptation of the living species to the biotic conditions created by man.

However, the presence of keystone animal species can be identified. About 19 different tree species can be found in the valley. The scientific ecologists estimate at more than 1 000 the number of plant species along the river. An important microbial activity (about 10^{11} /g of organic matter) can also be observed. The river is subjected to large foreign plant species invasions: 420 different foreign plant species can be found in the valley. 40% of them appeared between 1750 and 1900. This invasive phenomenon is directly related to the proximity of large cities, another consequence of anthropic activity.

2.1.1. A cost-benefit analysis of a biodiversity conservation programme: benefits

The main topic of the case study is an economic evaluation of biodiversity in the Garonne Valley. The study is two fold. First we evaluate the benefits by contingent valuation method. This method is currently used in biodiversity valuation studies. It allows the evaluation of so-called existence or non-use values, which are important for such an environmental good. However, this has its drawbacks. All studies found that respondents to a contingent survey on biodiversity face difficulties to build a value for the good. People are unfamiliar to biodiversity (the Hanley and Spash, 1995, study concluded that more than 70% of surveyed people didn't know about what is biodiversity). Moreover, it is well known in contingent valuation methodology, that willingness to pay answers exhibit large standard deviations when existence values are important. This point led to heavy criticism on the contingent valuation method when it is applied in such contexts. It resulted in big debates among economists in the US about the validity and reliability of the method around the Exxon-Valdez case. The debate resolved in the so-called NOAA panel recommendations, a set of methodological guidelines for contingent surveys. In a survey of previous biodiversity studies, we found that the mean value of the non-use values/use values ratio is about 4, so one has to be careful in interpreting the contingent surveys results.

We tried to circumvent these problems by a careful design of the questionnaire. Instead of asking directly people about their willingness to pay (WTP) for biodiversity protection, we asked about their WTP for financing biodiversity conservation programmes of various sizes. We tried, whenever possible, to follow the NOAA panels guidelines. The NOAA panel advocates the use of closed-ended questionnaires to inhibit unreliable large WTP answers. Such an approach implies the design of large samples, what we could not afford for financial reasons. We built two smaller samples (200 people each). The first sample was faced with an open-ended question about its WTP for the programme. The other one has been faced with a closed-ended question in first round of questions. The proposed values were varying from 10 FF (1.55 ECU) to 500 FF (77.63 ECU). In a second round, people were asked about their current levels of local taxes paid, their gifts to other causes. Then they were proposed to modify their initial choice in an open-ended manner. The results from the two samples were then statistically compared.

The use of closed-ended questionnaire (the so-called referendum method) is subjected to what is known as an “anchoring bias”. People faced to a unique proposed value tend to think that it is the socially correct value. This kind of anchoring of the answers on the proposed value is especially relevant for environmental goods like biodiversity, largely ill known by the public. We test for this bias by performing comparisons with the open-ended answers given by the first sample. Two other possible biases have to be tested in biodiversity valuation questionnaires. The first one is called embedding bias. The notion of a desirable level or “quantity” of biodiversity is not easily captured by the public. The declared WTP in such situations appear to be quite insensitive to proposed levels of protection of biodiversity. In other words, people behave as if they consider the good as a whole, and their declared WTP cannot be interpreted as a measure of the surplus variation induced by a variation of a biodiversity index of the ecosystem. To detect this kind of bias, we asked people about different possible levels of protection: protect 20 km of riverbanks instead of the whole 70 km, protect biodiversity in all French watercourses.

The other source of bias frequently observed in biodiversity valuation studies refers to what the literature calls the “warm-glow effect”. When a small variation of the level of provision of an environmental good has not many consequences on welfare, people react to a contingent valuation questionnaire by declaring a kind of “gift value”. They feel in sympathy with the protection of the environment at large and the value they declare is more what they generally accept to contribute for “good causes”, than a monetary equivalent for their individual welfare increase if the environment is protected. A declared WTP inspired by a gift motive has two characteristics. It is of course submitted to the embedding effect. It is also highly volatile and sensitive to the interviewer behavior (the conformity bias in the Mitchell and Carson typology). We asked people about their gifts to other causes and perform tests on the importance of the warm-glow effect in the answers.

Note that these biases are the consequences of a large amount of existence values in the total value of a biodiversity protection policy. Altruistic and ethical motives are far the most important determinants of WTP of people for the conservation of biodiversity. While the contingent valuation method is in principle the only evaluation method which can recover existence values, the reliability of the results is in most cases affected by a too large amount of existence values in the total environmental value.

Since by definition the contingent method framework covers prospective returns in economic terms from proposed policy schemes, detailed description of the methodology and results will be given further in order to keep with the proposed presentation guidelines.

2.1.2. A cost-benefit analysis of a biodiversity conservation programme: costs

The second part of the case study analyses the issue of the costs of a biodiversity protection programme. These costs are direct and indirect. Direct costs include riverbanks protection, partial reforestation or conservation measures of biotic conditions. Indirect costs cover mainly the compensations to be given to landowners for the restrictions of property rights or land use implied by the conservation programme. Such costs are far more important, so we concentrate on the measurement of the landowner losses, especially of the farmers. In a first step we gathered some data on land productivity in the area and we tried to evaluate the mean payoff losses of the farmers. However one of the main problem in the implementation of a river protection programme is to achieve some degree of continuity along the watercourse of landowners participation. In the area we have studied, the farmers hold 70% of the land but there are also numerous small landowners, which have to be included in the programme. To measure the compensations to be given to these two main kinds of landowners, we performed a contingent study about their willingness to accept (WTA) to participate in the programme. If WTP are currently measured by contingent valuation, this is not the case for WTA, even if in theory the measures should be equivalent. The main reason for this is that WTA revelation doesn't entail the respect of a budget constraint and WTA may be typically rather large.

We tried different methods to overcome these difficulties. We designed three hypothetical levels of protection programmes. The lower level one is just a set-aside of 50 to 100 m of land along the riverbanks. The middle level one implies participation of the landowners in current management of the banks. The high level one include specific actions like reforestation, modification of the banks shape to improve water flow dynamics and the creation of totally preserved areas without access possibilities under the responsibility of the landowners. For each programme, people are asked about their required compensations to participate in it. We designed two separate samples. The first one was asked an open-ended question about their WTA. The second one was warned that only the landowners declaring the smallest compensations would be eligible for a subsidy in the programme context. These resulted in a significant decrease in the WTA declared (especially by the farmers).

The survey also included questions about the landowners preferred contractual arrangements to implement the programme: optimal contract duration and renewal, restrictions on land selling and sharecropping, payment vehicle (direct subsidies or tax cuts), etc... We will comment on these later.

2.2. Identification of sectoral activities and resulting pressures

The water quality of the Garonne in the studied area decreases from acceptable (upstream of Toulouse) to poor (20 km downstream of the city), following the Adour-Garonne water agency quality grid. The wastewater treatment plant of Toulouse is located along the river 5 km downstream of the river. The treatment capacity of the plant is about 400 000 eq/inhab (110 000 m³/day of water treated). The city is not equipped with a specific rain water depollution plant. Rainwater is for the moment directly driven to the river. To conform to European norms, the city is presently engaged in an important programme of water waste quality treatment. The main objective of this programme is to decrease the quantity of NH₄ waste from its present level of 5 t/day to 2.3 t/day in 2005. The water quality increases from 20 km downstream of Toulouse to Moissac (located 70 km farther). In this area fishing activity is possible. Industrial activity is low in this part of the river, and the water pollution is mainly agricultural: nitrate and pesticides pollution. After Moissac, the nuclear plant of Golfech creates a low thermic pollution.

The river flow is highly unstable during summer periods because of the recent development of irrigation in the area. The river morphology is also experiencing important modifications because of gravel and sand extraction.

Agriculture and residential activity are the main use of the riverbanks in the area under study. For the last twenty years, the development of agriculture has drastically transformed the riparian landscape. Traditional forests have been cut down, many fields coming at the immediate vicinity of the banks. The dams constructions programmes in the upper Garonne valley has virtually reduced to a zero level the risks of large floods, an important problem in old times. To fix ideas the present mean flow of the river at Toulouse vary between 160 to 180 m³/s, it was about 8 000 m³/s during the big flood of 1875. This resulted in the development of urbanization along the banks around the city of Toulouse. Areas periodically flooded are by now converted to intensive agriculture, mainly cereals. The traditional forests where they subsist are also converted to intensive forestry for the paper and pulp industry.

Biodiversity *per se* is not used as an economic resource in the area. However it provides indirect flows of services: banks protection, good biotic conditions for fish reproduction, natural denitrification device as a survival condition for the epilithic biofilm.

2.3. Identification of underlying causes of biodiversity losses

For historical reasons, the riparian ecosystem along the river has not been intensively exploited until nowadays. Records of the river divagations over the last two centuries show that the river shape has been continuously fluctuating in large proportions. So the exact definition of land rights in a conventional manner is itself difficult. To complete our cost study we used property census data. We observed that some properties legally recorded were in fact now in the riverbed. The landowners we surveyed frequently quote that they have lost during the twenty past years various pieces of their lands and recovered others. In practice this doesn't cause much difficulties because the Garonne River is a so-called "domanial" river, its management and exercise of property rights are placed upon the State responsibility. This public property characteristic is a first cause of property rights assignment failure. Note that the State domains extends to the "regularly flooded areas", a rather fuzzy definition in the present state of the river.

The most interesting living habitats are found in these areas. But despite important scientific works on them, the public authorities have not for the moment designed any effective strategy to protect them. It has been previously said that the biodiversity resource is not in fact exploited for itself except for controlled fishing activity. But the resource is currently threatened by negative externalities issued by the other river uses.

The scientific ecologist community has spent many efforts studying plants and animals biodiversity in the valley. More than 30 spots are currently studied since years. One could not speak of a lack of information from the part of the policy makers. The evolution of various relevant biodiversity indexes is well known the adverse consequences of the present changes in the riparian land also.

In principle entitled with a large power of control over the river use, the public authorities, by lack of financial capabilities, have many difficulties to control efficiently the behavior of the riparian landowners. Non authorised irrigation pumping in the river is frequently observed prohibited constructions along the banks also.

We tried to take into account these different considerations in the contingent scenarios design we used in our cost-benefit analysis. We started from a public leded project to preserve the river biodiversity.

Such a project implies in one way or another the participation of a significant part of landowners along the riverbanks. Because nothing has been done for the moment a necessary first step is to evaluate the willingness to pay of the general public for a biodiversity protection programme. The survey asked also questions about the riverbanks uses by the general public: walking, fishing, recreative activities. About 30% of the people effectively visit the riverbanks; they are in general favorable to the programme but rather skeptical about its probability of success: for them the farmers will not respect their commitments and there will be a lack of control by the authorities. These results confirm our previous remarks. The nature around the river is poorly known by the public, there is a lack of general concern to protect the environment by the landowners, especially the farmers.

2.4. Identification of adverse incentives

The development of intensive agriculture in the area is a consequence of the direct compensation mechanisms enforced after the CAP reform in 1992. Direct subsidies based on land areas have given strong incentives to farmers to extend the production of cereals (mainly irrigated maize in the South West of France). Such an extension has accelerated the riparian deforestation process and created new pressure on the water resource. Biodiversity losses in the Garonne valley are consequences of these evolutions. Irrigation has an indirect but important effect on biological diversity and ecosystem resilience as a whole because it creates sharp decreases of water availability in summer and contributes to increase water pollution as a concentration of toxic matters in water.

Irrigation is in itself highly subsidised by local (district or regional) and national (ministry of agriculture) authorities. For example irrigation equipment is subsidised at most by 65% by the *Conseils Généraux*, irrigation networks are also heavily subsidised. Irrigation also benefits from the subsidy differential between dry and irrigated crops. In the area the subsidy is almost twice for an irrigated land. At the national level the objectives of the agricultural subsidies system are to maintain farmers revenues and to compensate the effects of the price cuts of cereals. At the local level, the objectives of the policy makers are to maintain rural and agricultural activities in a region without major industrial activities. Not entitled with a high touristic value, the Garonne valley ecosystem doesn't benefit from any specific public funding for protection of the environment.

2.5. Other effects of adverse incentives

The question of the more indirect or general effects of adverse incentives against biodiversity is very complex. Most of the concerned policies look for employment creation or stand-by (in the agricultural sector). An agricultural policy reform more favourable to the conservation of biodiversity would have adverse effects on employment in the agricultural sector and beneficial effects if the subsidies are used to improve the ecosystem functions. To fix a balance is a difficult exercise. However this problem is different from the one of a more efficient allocation of public resources. The contingent benefits survey shows that more than 40% of the people don't want to finance a biodiversity protection programme in the Garonne Valley. One of the main reason for this kind of "protest behavior" is the general feeling in the public that public funding is not efficiently allocated. Some people which declared protest zero to WTP inquiries were asked another question: assuming that your fiscal contribution remains constant, what would be the amount of your own taxes that you think desirable to put on biodiversity protection? The answers were quite consistent with the positive WTP declared.

The fear of an inefficient allocation of public funds is confirmed by a more careful analysis of the verbal answers given to the interviewers during the face to face survey process. They confirm that the

main motives for a refusal by concerned people are a heavy criticism of the tax spending policy, more than a reluctance to finance biodiversity protection.

3. IMPLEMENTATION OF INCENTIVES MEASURES AND CONTEXT

3.1. Identification of actual or planned incentive measures

A consequence of the Water Act of 1992 has been the creation of SDAGE (Schémas Directeurs d'Aménagement et de Gestion des Eaux" at the water basin Agencies level. The SDAGE are planning documents but have no policy constraining power in fact. They are conceived as a general framework for local water policy. The actual binding contractual agreements between local authorities and the water agencies are the SAGE (Schémas d'aménagement et de gestion des eaux). If all the SDAGE are now completed, very few SAGE have been concluded at present. The Adour-Garonne SDAGE contains a chapter dedicated to ecological protection of watercourses. The Adour-Garonne agency officials are now thinking about different programmes of action for the conservation and protection of riparian habitats. The objectives are twofold: enhance biological quality of watersheds and ecological functioning of natural habitats, and develop preventive actions against agricultural non point source pollution.

The specific actions planned (apart from the usual programmes improving water quality by depollution of industrials and cities residuals) fall into three main categories. The first is to try to sustain higher water flows levels especially in summer periods, secondly, reintroduction plans for migratory fish species (salmon), and thirdly to set-aside of lands around the riverbanks to prevent nitrate pollution and protect the natural habitats.

Other policy programmes also share this set of objectives and actions: the Natura 2000 programme and more indirectly the various agri-environmental programmes. The only part of these programmes, which try to implement incentive measures, is the set-aside of land programme, based on contractual agreements with financial compensation between landowners and public authorities. Note that this programme is not primarily intended to protect the biological diversity in itself. This causes some confusion and ecologists have criticised heavily some of the planned actions as destroying biodiversity: monospecific tree plantation to fix riverbanks or to create "natural" nitrate pollution filters for example, or artificial reintroduction of economically valuable fish species in rivers they had never before been recorded.

In practice actual or planned programmes don't make intensive use of economic instruments. They are generally conceived as engineering devices to match general water management objectives. They are not evaluated by cost/benefit methods and biodiversity protection is a more a general reference than a precisely defined objective in the case we have studied.

The conception of the contingent programmes we used in the benefits and costs evaluation surveys has been strongly inspired by the above planned programmes. We had many discussions with water agency officials, and local authority officials to design a credible programme. Moreover, the identification of areas to preserve along the river, the cost estimation for a protection programme and the preparation of joint material for the survey (maps, photographs) has been done in continuous collaboration

with the scientific ecologists of CESAC-CNRS (Centre d'Ecologie des Systèmes Aquatiques Continentaux), which have studied the Garonne area for years.

Note that the proposed transfer scheme: the general public pays the landowners to protect the riparian habitats of the Garonne Valley is in accordance with the actual system planned by the policy makers. The rationale for it is that the landowners have implicit and explicit property rights on the land and they have to be compensated for the restrictions imposed by a biodiversity protection policy. However, it is clear that an appropriate redefinition of property rights can alleviate the need for compensations. It has been noticed before that in principle, land around the riverbanks of the Garonne is part of the public domain. Although this point was frequently raised in informal discussions with public officials, it seems to exist a large agreement to not use legal entitlement in order to impose a protective behavior to the landowners.

3.2. Identification of stakeholders

The benefits of a biodiversity protection programme are composed of use and non use values. Our survey showed that only 36% of the population are users, mostly for recreation motives and fishing. Most of the biodiversity values are non-use values. The survey concluded that the mean WTP of the population amounts to 66 FF/year (10 ECU) and per household for a five year period (the announced delay of completion of the programme). The resident population amounts 700 000 inhabitants (about 220 000 households). The total WTP is 72.6 millions FF (11 millions ECUs). Note however that 50% of the people surveyed declared a null WTP. The mean WTP of the households ready to contribute positively to the programme is about 140 FF/year for 5 years (22 ECU).

These results deserve some additional comments. About 70% of the sample are in favor of a biodiversity protection programme in the Garonne valley. But 50% of them refuse to contribute to the programme. The main reasons for that given in the interview are (in decreasing order): excessive present tax pressure, low income, lack of confidence about the real use of the collected funds, feeling that it is the responsible people (e.g. the farmers) which have to pay, lack of interest for the programme.

There is a rather high probability that the values declared reflect in fact the total WTP of the population for a biodiversity protection plan for the whole French territory. First note that faced with a choice of a 20-km long protection programme of the river versus a 70-km long programme, 45% of the individuals declare the same WTP. More interestingly, 18% of the *total* sample (including protest zeros) are willing to pay a total sum of 107 FF/year (16 ECU/y) for other sites in France. It seems that biodiversity in itself is largely unknown by the public (see 3. 4). So one can suspect that people confuse the protection of the environment as a whole with the protection of biodiversity, the sum declared corresponding to an "environmental budget". Another question is the "gift effect" or "warm glow effect". 25% of the sample is actually doing gifts to general causes (cancer cure research, world poverty,) with a mean gift of 450 FF/y. It seems reasonable (and confirmed by verbal answers during the interview) to think that there is no confusion (among the people surveyed) between the precise aim of the programme and an appeal to participate in "good causes". However 85% of the people declared that their financial participation to the programme would be added to their current gifts (if any) and without restrictions on their expenditures. This seems to point that the budget constraint is not active in the household WTP declaration. Faced with additional questions about their apparently contradictory behavior, people answer that they envision their contribution as an effort to be taken on an informal budget devoted to the public interest. A more rigorous econometric treatment of the presence of a gift effect concluded that it could not be statistically rejected at a 90% confidence level.

Finally, 60% of the sample prefer contribute to a special fund dedicated to the programme rather than by an increase in local taxes. This confirms that people are in general non-confident in the real destination of their money and would prefer to be more directive in its allocation by public authorities. Note also that a small part of the sample (about 15%) which express protest zeros find in fact that too much money is given to the protection of the environment. Their actual WTP is not equal to zero but in fact is strictly negative. This point has been confirmed by a specific econometric treatment of zeros WTP. The hypothesis of a WTP zero for people refusing to participate in the programme is statistically rejected and one has to consider that a significant part of the total sample would prefer a reduction in their fiscal contribution to environmental protection.

A complete identification of beneficial stakeholders implies to consider the socio-economic characteristics of the households explaining their WTP. Econometric estimation of different explanative models show that the income doesn't influence the WTP of people willing to participate (but not the behavior of the total sample as noticed before). WTP seem to decrease with the age of the household, it is more important for men than women, more important for fishermen and the level of education and number of children have a positive effect on the WTP. A positive gift behavior strongly influences the level of WTP. Since this behavior is positively correlated with a high-income level, WTP is in fact correlated with the budget constraint but in an indirect manner (via the gift effect). A more careful inspection of the survey answers shows that in fact the sample is composed of two distinct sub populations: a low WTP population (between 0 and 150 FF) and a high WTP population (between 200 and 800 FF). The gift effect is a characteristic of this part of the population.

Our biodiversity benefit estimate (around 66 FF/year) seems low when compared to the values found in similar studies (between 100 FF/y in Europe to 300 FF/y in US, a rough mean of recent biodiversity valuation studies). However, the general direction of the results is quite the same: non-use values represent a large proportion of the total biodiversity value. The answers to contingent surveys show some lack of reliability and consistency with the usual analogue between WTP and a surplus variation because of the embedding effect and the "warm glow" effect.

Turn now to the other stakeholders, the landowners. They will be the losers of the programme. Let us describe briefly their main characteristics. About 400 landowners are found which own lands near the Garonne riverbanks in the area we studied. We did an exhaustive survey by mail and obtained 95 answers (30%). 40% are farmers and the others are mainly residents. The agricultural exploitation mean size is about 57 ha; the mean property of non-farmers residents is below 5 ha. The farm size in our study area is a bit larger than the regional mean (44% of the farmers in the sample owns more than 50 ha, this category represents 19% of the farmers in the Midi-Pyrénées region). When we concentrate explicitly on the riverbanks, we find that the non-farmers population owns more than 50% of the banks. However farmers owns more connected fields along the banks than non-farmers. Farmers cultivate mainly cereals and plant trees (poplar) for the pulp industry. 40% of the non-farmers population owns artificial forests along the banks. 80% of the sample declare they left free from activity various areas near the banks, 50% left them totally unused. The non-used area is about 18 m from the banks (min 3-m to a max of 80 m). This fit roughly with the limits of the public domain around the river, thus contradicting the idea that more public enforcement could improve biological diversity along the river.

To estimate the land value losses because of various restrictions in land use, we proceeded along the same lines as our benefit study. Landowners were proposed three different protection programmes. The level 1 programme is simply a set aside of 50 m of land near the banks, the levels 2 and 3 implied set aside of lands and an active protective behaviour from part of the landowners. About 50% of the farmers and 43% of the non farmers accept to participate in a programme, the simple level 1 programme of set aside being largely preferred (more than 60% of participants landowners). It appears that the owners of the

class [10 ha, 50 ha] are the main supporters of the programme, small landowners are very negative, large owners also (more than 62% refuse to participate in the [0.5 ha] and [50 ha], + categories).

We concentrate on the results for the set aside programme. We found that the willingness to accept (WTA) of the farmers is about 2 700 FF/ha/year (419 ECU) and that the WTA of non-farmers amounts to 192 FF/ha/an (30 ECU/ha/year) for a ten years contract. Before commenting on these results we make some methodological remarks.

A classical problem in WTA estimation is the over declarations of surveyed people asked to the compensation needed to make them accept some deterioration of their situation. To get an estimate of this phenomenon, we divided the sample in two sub samples. The first half of the sample was faced with a simple open-ended question about their WTA (no competition situation). The other half was warned that for financial reasons, only people announcing the lowest WTA would be subsidised and included in the diversity protection programme (competition situation). The mean declared compensations decrease from 3 060 FF/ha/an (no competition) to 2 510 FF/ha/an (competition) for farmers, and from 285 FF/ha/an (no competition) to 85FF/ha/an (competition) for non-farmers. The differences are clearly significant. We give mean values of the two samples for the WTA, but feel conscious that this point needs more careful study.

Moreover we note that the compensations desired increase more than proportionally with the size of land owned around the river banks (the owners of less than one ha along the river ask generally for nothing, owners of more than 10 ha ask for more than 2000 FF/ha/an). The acceptance of the set aside programme is low for small land sizes (<23% for less than 1 ha), amounts 50% for land sizes between 1 and 10 ha, and is around 40% for more than 10 ha of the riverbanks. We also observe that farmers planning to stop their activity or to retire generally refuse to commit themselves to 10 years set aside of a part of their land.

The total compensation cost of the programme is as follows. 200 landowners are involved for a maximum total area of 2 000 ha (a 100 m band around the 100 km riverbanks). The mean compensation asked is about 1 400 F/ha/year, so a rough estimate of the total cost is 2.8 millions de F/year. It seems overestimated since non farmers ask for much less than farmers, but it has been shown that non farmers own less of the land, and one has to take into account implementation constraints, constraints which can imply a less differentiated treatment of the different types of landowners than necessary.

For a 5 years programme, the mean willingness to pay of the residents amounts to 60 F/year, so to a total of 300 F. There are about 25 000 households living in the area, so one can expect a total benefit of 75 millions FF. So a 25 years protection programme cost can be covered with such an amount. However, we have already noticed that there is a strong probability that the public surveyed has given in fact its willingness to pay for a *national* biodiversity protection programme, so one cannot take too seriously the evidence of a large social net benefit accruing from the programme.

3.3. Framework and context of implementation

One of the main difficulties of implementation for the protection programme is the mere status of the river. Land regularly flooded are to be considered as part of the public domain in the water legal framework. Moreover the waterbed and the water content are also in the public domain. Private owners along the banks are submitted to several constraints. They have to leave an access of 3.25-m (“servitude de marchepied”) and cannot plant trees at less than 9.75 m from the limits of the banks. The fees for the break off these rules amount to 1 800 F (in 1990). Note that this legal framework has been largely inherited from

the river navigation ages. Boats had to be pulled by horses along roads parallel to the banks, and the legal entitlements were meant to protect this use.

As part of the public domain (like roads), the management of the watercourse is done by the state administration, more precisely by the DDE (Directions Départementales de l'Équipement) in the case of domanial rivers like the Garonne. Note that DDE are also in charge of the main road network and of bridge constructions. Any activity in the watercourse has to be authorised by the state executive delegate in each district (the Prefet). The instruction of the authorisation is made by the DDE; administrative bodies placed under the authority of the Prefet. Similarly, smaller rivers are called non-domanial rivers (they are not in principle suitable for navigation). Another administrative body called the DDA (Directions Départementales de l'Agriculture) manages them. Note that the classification of rivers in domanial and non-domanial ones has been frequently revised over the past. It doesn't correspond to any simple characteristic of the river.

In principle the implementation of a diversity protection programme for the Garonne River can be undertaken in two ways. It can be done directly by the administration (the prefet with technical assistance of the DDE) or in the framework of the new possibilities of intervention given to the Water Agencies by the 1992 and 1995 water acts. The Water Agencies have no entitled policy power on the river, but they can perceive taxes from water users and distribute subsidies to landowners willing to participate in the protection programme. This can be done in the context of the SDAGE or a SAGE. This latter procedure which imply negotiations between involved parties (state administrations, local communities, users and landowners) seem far too complicated and administratively costly for such a programme however.

The policy scenario presently under study involves the participation of the Water Agency to a state programme. The administration would be the "maître d'œuvre" of the programme and would delegate some of the technical responsibilities to the Adour-Garonne Water Agency. The agency would share the programme implementation costs with the state administration, but the programme would not involve the creation of a specific tax upon water users nor an increase in existing tax. So the programme would have to be implemented inside the agency budget constraint by a reallocation of financial aids to a specific action in favor of biodiversity protection.

Such a policy mix appears reasonable in view of the difficulties created by the domanial character of the river. Our landowner survey has shown that many people have experienced in the past various modifications of the river profile and such that they have not many incentives to take protective measures. Another programme objective, which is to recreate naturally flooded areas around the riverbanks (a powerful biological diversity enhancement device) also, causes adverse incentives effects. Such a policy would in fact considerably increase the size of the public domain, a consequence that landowners try to avoid.

Cultural aspects are important too. The owners survey shows a strong agreement between them on the fact that "something has to be done for the riparian areas of the Garonne". However there are clear cut differences between owners about "what to be done" and a strong contradiction between owners opinions and what the scientific ecologists that have studied the area think that has to be done to protect biological diversity. For some owners (mainly non-farmers ones), the riverbanks are abandoned and the beauty and harmony of the landscape has to be restored (a gardener view of the riparian habitat). For the farmers, the main problem is to protect the banks from erosion or from river flooding. They favor policies trying to fix the banks by tree planting and so forth. These views strongly disagree with the ecologist programme, which try to recreate almost natural life conditions around the river. The only point of agreement between them is to try to prohibit any public access to the banks. This is clearly impossible in

the legal context, and causes a problem to the policy maker willing to finance the programme with public funds. A voluntary agreement of the owners to an ecologist's inspired programme seems then difficult to reach, and will require many negotiation rounds and explanation meetings.

3.4. The role of information

The landowners use the riparian lands in many ways (albeit from commercial uses, agriculture or forestry activity): they cut trees for house heating, they practice angling or hunting. Even if they don't know precisely their property along the river they have a good knowledge of the natural landscape in which they live (where to fish, to hunt or collect mushrooms for example). We have already noticed that the views they share about what would an "ideal" landscape around the river considerably disagree with the ecologist opinion. Even their agreement to prevent access to the river is primarily intended to exclude other users and not themselves. In order to convince them, the policy maker will have to prove that a biodiversity conservation programme will enhance the natural resources available to them (more fish or more valuable hunting species). There is a strong feeling between owners that the administration tries in fact to restrict their property rights in favor of not very well founded environmental protection policies. A strong point of disagreement is the Natura 2000 Programme, which is in principle intended to nature and biodiversity protection.

To fix ideas let us make an anecdotal parenthesis. During the owners survey completion, some landowners warned the hunters associations that people were trying to convince them to abandon their land against financial compensation. This point was raised (and severely criticised) in the local hunters congress. We were asked by the hunter's representatives to explain what we intended to do, who asked for our research, and what would be our conclusions. During the meeting, the principle of a financial compensation for an environmental set aside was heavily criticised. The hunters representatives arguing in favour of a jointly managed action between the administration and them to protect the natural habitat, without implementation of any individual contracting process with the landowners which could result in a limitation of their property rights on the lands.

The dynamics and characteristics of the biological diversity in the Garonne area are fairly well known because of the important research effort undertaken by the ecologists since years. So one cannot expect the existence of voluntary hidden species by landowners for commercial purposes. However the access rights to the river are for long a controversial issue between the owners and the public officials. Rights to fish or hunt in the riparian forests are often criticized by the landowners, which try to "privatise" the public domains informally (fence of ways going to river and so on).

The huge amount of information collected by the scientific ecologists which have worked on the Garonne since the seventies, has been acquired under various public research programmes: the PIREN-CNRS and PIRE programme, research programmes financed by the French Ministry of Environment or by local authorities (Midi-Pyrénées regional research programmes). Part of this research is completed under the heading of a specific GIS (*Groupement d'intérêt scientifique*) called ECOBAG (*Ecologie Economie du Bassin Adour Garonne*). The GIS is composed of the main scientific laboratories working on the Garonne and Adour water basins (hydrologists, ecologists, biologists, economists and sociologists). The Midi-Pyrénées and Aquitaine Regions, the Ministry of Environment, the CNRS, the Adour-Garonne Water Agency and some European funding finance it. Established since 1992, the existence of the GIS shows the interest of public authorities (local and national) in having access to scientific expertise in environmental policy design. The presented case study is a product of this interdisciplinary effort.

3.5. Process of implementation

The need for a specific policy action in favour of the biological diversity in the Garonne water basin has emerged after the Rio conference in 1992. As a project guideline, it has been included in the Adour Garonne SDAGE since 1995. We have described the intended policy scenario in Chapter 3.3. We know comment on the present state of the policy process. The case study results are now communicated to the regulating authorities. Coping with other information sources, the authorities favour a cautious approach to the problem. They plan to have several informal meetings with involved parties (especially farmers, hunters, and political ecologist representatives). Having to work in binding budget constraints, they ask themselves about the actual size of the action to undertake. One policy option currently under consideration is to put the action in the more general framework of agri-environmental policies. Farmer's representatives agree in some extent to the principle of participating in agri environmental programmes. During the completion of the case study we get in touch with the *Chambre Départementale d'Agriculture* that is in charge of designing such programmes. The questionnaire design for the owners' study has been strongly influenced by these meetings. By now farmers are already subsidized to undertake more environmentally friendly agricultural practices on their lands. These actions include lower fertilization and pesticides use, set aside of some land plots in ecological sensitive areas, and forests protective actions. The general agreement between policy makers is to wait for the ecological benefits of such programmes before engage themselves in more specific actions in favour of biodiversity protection.

Time (and uncertainty related) considerations are one of the main implementation problem faced by the policy makers. The actually planned scheme involves individual contracts describing a set of protective measures to be undertaken by the landowner coupled with a subsidy per ha and per year for the whole contract duration (usually between five and ten years). When signed, the contracts cannot be revised or broken until renewal at the end of the contract duration. If in principle contracts can be resigned in case of failure of execution by the landowners, this happens very rarely. However it seems that contracts are in fact to be renegotiated at their closing dates.

It is well known that this kind of dynamic contracting process has its drawbacks. If the subsidy is intended to compensate the owner effort, effort is generally unobservable. Conditioning the subsidy level upon observed results (in terms of the number of species protected for example) creates moral hazard problems if the results are uncertain. In a dynamic context one can be faced with a kind of repeated moral hazard problem. It is well known that such problems are in fact repeated adverse selection problems. Adverse selection occurs when the level of the subsidy is computed on the basis of unobservable landowner characteristics. For example the subsidy can depend of the productivity of set aside lands. The adverse selection phenomenon creates many difficulties in the implementation of a policy scheme. An optimal contracting process involves truthful revelation of their characteristics. However truthful revelation implies to give an extra subsidy (the so-called informational rent) to the agents. But in dynamics, after a truthful revelation, the information asymmetry is removed; so rents granting is no more necessary. Consequently, the agents will refuse to sign the contract, or the regulator will have to commit himself to not use the information (a sub optimal outcome). Others problems like the so-called "take the money and run" phenomenon can also occur.

In the light of the above economic analysis, the apparently sub optimal contracts used in protection policies can be justified. The regulator has to commit himself not to revise the contracts in order to get the acceptance of the landowners. He has to accept in some extent untruthful revelation of land characteristics and use almost uniform compensation scheme, thus ignoring the characteristics variability. By setting inefficient contracts, the regulator creates implicit or explicit welfare redistribution among the landowners.

The only means to alleviate these problems is to periodically revise the contractual scheme. In principle such a revision should be done in the light of the policy implementation results. In fact, the revision is generally done under three types of considerations. First the contractual system is in constant evolution. Second, the efforts required and the subsidies granted are renegotiated. Third, the financial and policy considerations are very effective. The life duration of the present policy orientation is much more depending upon the European policy guidelines (European funds are the main financing sources for such environmental programmes), and the national budget constraints, than the policy actual success.

4. POLICY RELEVANT CONCLUSIONS

4.1. Lessons learned

To comply with the Rio Conference commitment to protect the biological diversity, the French authorities try to implement various protection policies on the state territory. Our case study applies to one of these policies: the riparian habitat and watercourses protective action. We tried to perform a cost/benefit analysis of such a policy. Another objective of our work was to investigate the specific implementation problems it may imply. In the chosen area (the Garonne valley), an important research effort has been undertaken by scientific ecologists to measure the biological diversity of the ecosystem and to analyse its functional properties. So we start with a rather well known ecosystem and do not face the usual uncertainty problems encountered in many biodiversity studies. In collaboration with scientific ecologists and local water regulators, we elaborated a plausible policy scenario for biodiversity protection. This scenario involves various actions on the ecosystem: natural reserves creation in sensitive habitats, set aside policies to decrease the agricultural pressure on the ecosystem, reconstitution of naturally flooded areas. It would take the form of contractual agreements between public authorities and the landowners including a subsidy to people willing to participate.

To measure the social benefits of such a programme, we used the contingent valuation method to a statistically significant sample of the local population. We have been faced with an important proportion of protest values or payment refusal (about half of the sample). The mean willingness to pay of the local population (putting protest answers to zero) is about 66 FF/household/year (10 ECUs) for a five year protection programme. This leads to a total benefit estimation of 75 millions FF (11.5 millions of ECUs) for the whole programme. However we note that the declared willingness to pay are quite insensitive to the policy area size. So one suspects that the declared values correspond in fact to the willingness to pay for biodiversity protection over the whole French territory.

The main costs of such programmes are the compensations required to make participate the landowners (farmers or not). We use a contingent survey about willingness to accept to measure these compensations. We found that the willingness to accept of the farmers is about 2 700 FF/ha/year (419 ECU) and those of non-farmers amounts to 192 FF/ha/an (30 ECU/ha/year) for a ten years contract. On the area studied an upper limit for the total costs is about 2.8 millions of FF/year (0.43 millions of ECUs/year). It should be noted that many owners refuse to participate (about 50%). The main owners characteristics leading to acceptance are a medium land size (between 10 ha and 50 ha), the fact that owners are middle aged, the desire to protect the banks from erosion (for farmers), the desire to restrict access to the river by the general public (for all kinds of owners).

There seems to exist a confusion between the owner's expectations and the actual objectives of the programme. The landowners don't care much about biodiversity protection. A large information effort is thus needed to prevent misinterpretations of the policy objectives.

The survey included questions about the preferred compensation scheme and contract duration by the landowners ready to participate. Direct subsidy based on land size is the preferred transfer mean, many owners would participate under the condition that they could return to previous land use practices at the end of the contract.

It should be well understood that the farmer's behaviour is very contingent to the European CAP and its evolution. The farmers will be reluctant to commit themselves to protection programmes if they feel that the CAP could experience large modifications in the next years. They also don't feel secure with the life duration of the present agri environmental programmes and expect reallocations of public funds (some old programmes will be abandoned and new ones created) in the next future.

4.2. Transferability of the experience

We tried to build a research programme whose aims and methodology could be easily transferred to other comparable situations. We used standard contingent valuation methodology and questionnaire design in our cost/benefit analysis. We tried to conform to the NOAA panel ("Blue Ribbon") recommendations in the benefit estimation. Cost estimates based on willingness to accept measures are not so usual in the economic literature. This research area experiences important evolutions by now. We used the most recent available techniques to correct the estimation biases frequently encountered in such studies.

The policy scenario we evaluated is rather typical. In one way or another, biodiversity conservation programmes try to limit the landowners property rights or the access to the natural resources. This is precisely what our programme intend to do. To cover implementation problems, we designed contractual compensation schemes typically used in agri environmental policy, which become familiar to landowners, especially farmers. So our policy evaluation protocol can be used to other similar policy contexts.

4.3. Possible policy recommendations

A main lesson of our case study is that the acceptability of the planned protection policies is a real issue. Even if the Garonne banks are in the public domain, the regulator has to convince private owners to undertake some protective measures. However the consistency of a biodiversity protection programme depends upon a sufficiently large acceptance of the programme aims by the private owners. The durability of the programme is also an important related issue. We have noticed in our study that a majority of owners would try to preserve their rights to return to previous land use after some time. This problem has to be taken seriously by policy makers; their own commitment capacity to maintain a sufficiently high funding of the protection programmes being limited. One way to avoid these difficulties could be to create a specific funding institution that could guarantee the durability of the policy effort. We have seen in our benefit survey that an important part of the public would be in favour of such an institution.

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Country	Case study title
Australia	A Revolving Fund for Biodiversity Conservation in Australia
Austria	Austrian Case Study on Economic Incentive Measures in the Creation of the National Park Neusiedler See - Seewinkel: Summary
Austria	The Austrian Programme on Environmentally Sound and Sustainable Agriculture: Experiences and Consequences of Sustainable Use of Biodiversity in Austrian Agriculture
Canada	Revealing the Economic Value of Biodiversity: A New Incentive Measure to Conserve and Protect It
Canada	Using the Income Tax Act of Canada to Promote Biodiversity and Sensitive Lands Conservation
Denmark	Economic Incentives for the Transformation of Privately Cultivated Forest Areas into Strict (Untouched) Forest Reserves
Finland	The Act of the Financing of Sustainable Forestry and the Development of Forest Certification
France	A Cost-Benefit Analysis of Biodiversity Conservation Programmes in the Garonne Valley
Germany	UNESCO Biosphere Reserves Schorfheide-Chorin and Rhön
Greece	Incentives for the Conservation of the Nesting Grounds of the Sea Turtle <i>Caretta caretta</i> in Laganas Bay, Zakynthos, Greece
Japan	The Case of Oze Area: Case Study on the Japanese Experience Concerning Economic Aspects of Conserving Biodiversity
Korea	Case Study on Korean Experiences Relating to the Conservation of Biodiversity in Mount Chiri, with Special Attention to the Poaching of Bears
Mexico	Incitations Economiques pour la Protection des Espèces de la Vie Sauvage au Mexique: Le cas de l'Espèce <i>Ovis canadensis</i>
Netherlands	Green Investment Funds: Organic Farming
Netherlands	Green Investment Funds: PIM Project
New Zealand	Conservation of the Pae O Te Rangī Area
Norway	Valuation of Benefits Connected to Conservation or Improvement of Environmental Quality in Local Watercourses in Norway
Poland	Case Study on the Polish Experiences Relating to the Implementation of Economic Incentive Measures to Promote the Conservation and Sustainable Use of Biodiversity in the Biebrza Valley, with Special Attention to the Biebrza National Park
Turkey	The Development of Appropriate Methods for Community Forestry in Turkey
UK	Heathland Management in the UK
US	US Experiences with Incentive Measures to Promote the Conservation of Wetlands
US	Individual Transferable Quotas as an Incentive Measure for the Conservation and the Sustainable Use of Marine Biodiversity

