Netherlands Commission for Environmental Assessment

Valuation of Ecosystem Services and Strategic Environmental Assessment

Influential Case Studies

Cover page: Ecosystem services around the world

Top right: Pantanal, Brasil: the world's largest freshwater wetland, is a paradise for bird photographers. Nature tourism is booming in the area.

Left: Kerala, India: the Kuttanad backwaters are protected from storm surges by a coastal belt of coconut trees. The coconuts provide fiber for a large coir industry. The backwaters provide the only means of transport in the area.

Centre: Benue valley, Cameroon: in rural Africa wood still is the main source of energy. When resources suffer from overexploitation, women (and children) have to walk ever-increasing distances to collect firewood.

Bottom right: Madeira, Portugal: often referred to as the island of flowers, here sold on the local market.

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Contents

1. Introduction

Since the appearance of the Millennium Ecosystem Assessment (MA), a growing body of knowledge on ecosystem services is developing. After years of academic developments of the concepts, the approach is now increasingly applied in practice, supporting decision-making and guiding development into a more sustainable direction. For some reason, the Strategic Environmental Assessments (SEA) community has hardly taken advantage of opportunities provided by the use of ecosystem services as a means to translate the biophysical environment into societal benefits. Even though we have looked for SEA case material very seriously, only few SEA cases were available with a clear recognition of ecosystem services. It is therefore impossible to conclude that the application of the ecosystem services concept is effective in the SEA context.

For this reason, we have documented cases where the recognition, the quantification and valuation of ecosystem services has significantly contributed to strategic decision-making. In other words, the use of the ecosystem services concept has enhanced decision-making by providing better information on the consequences of new policies or planned developments. In less than half of the cases SEA or a process similar to SEA was followed. Yet, in all cases valuation of ecosystem services, in one form or another, resulted in major policy changes or decision-making on strategic plans or investment programmes.

The study started with the creation of a long list of 24 potentially relevant cases, all recognising ecosystem services, and all having resulted in concrete decision-making at strategic level (i.e. above project level). From this list, 10 cases were selected for further elaboration (see Table 1.1). This selection aimed at an even distribution over geographical regions and among different sectors, with a preference for cases from non-industrialised countries. As most relevant material comes from industrialised countries, these are still overrepresented. It is also evident that cases linked to water or "wet" environments are very dominant in the list of cases. Apparently, the multifunctional character of water triggers the need for an ecosystem services assessment. A number of cases that have not been elaborated in detail re-appear in textboxes to provide reference of similar findings in other cases (see Table 1.2).

We hope this report contributes to closing the gaps between the three main communities targeted with this report: (i) the ecologist and environmental economists predominantly based within knowledge institutes, (ii) the strategic environmental assessment community, consisting of competent authorities, consultants, and environmental agencies, and (iii) the decision makers at all levels of government. Note that a synthesis of the assessment of the case studies is provided in Slootweg and van Beukering (2008)[1].

For reasons of consistency in the analysis of cases, the cases have been written in a (more or less) fixed format. Whenever possible, the following items have been addressed in the order provided below:

[1] Slootweg, Roel, and Pieter J.H. van Beukering (2008) Valuation of Ecosystem Services and Strategic Environmental Assessment: Lessons from Influential Cases. Report for the Netherlands Committee for Environmental Assessment, Utrecht (*forthcoming*).

1. *Introduction to the case*: description of the issue, social and environmental setting, sector, location.
2. *Context of the case study*: where and how was the valuation study used in the planning process, or what was the policy context of the study. Where in the process did the study fit.
3. *Assessment context*: was the study carried out as (part of) a formal SEA (or EIA) procedure?
4. *Ecosystem services*: the type of ecosystem services, the way in which ecosystem services were included in the assessment, and type of valuation applied, role of stakeholders in the process.
5. *Decision-making*: in what way did valuation of ecosystem services influence decision making? What constraints where encountered in using ecosystem services to inform decision-making.
6. *SEA boundary conditions*: relation between study effort and magnitude of the decisions involved; source of data; what level of detail required at what level of planning; timing of the assessment in the process.
7. References / Sources of information: when unpublished, available websites are provided.

Table 1.1 Case studies elaborately explained in separate chapters

#	Study	Ecosystem	Country	Policy context
1	Water Conservation & Irrigation Rehabilitation	Reclaimed desert and river delta	Egypt	Stakeholder engagement
2	Wetland Restoration Strategy	Wetland	Aral Sea	Investment decision
3	Strategic Catchment Assessment	Watersheds	South Africa	Awareness raising
4	Making Space for Water in Wareham	Wetlands	United Kingdom	Investment decision
5	Climate policies and the Stern Review	Climate	Global	Awareness raising
6	Natural gas extraction in the Wadden Sea	Wetlands	Netherlands	Investment decision
7	Management of marine parks	Coral reefs	Dutch Antilles	Sustainable financing
8	Watershed rehabilitation & services provision	Forest	Costa Rica	Payments for Env. Services
9	Water scarcity & transfer	Rivers	Spain	Investment decision

10	Exxon Valdes oil spill in Alaska	Coastal resources	United States	Damage assessment

Table 1.2 Case studies briefly addressed in boxes

#	Study	Ecosystem	Country	Policy context
1	Impact of dams on wetlands & livelihoods	Wetlands	Mali	Investment decision
2	Livelihood & conservation of Korup National Park	Tropical forest	Cameroon	Nature conservation
3	Large scale wetland restoration	Wetlands	Everglades	Nature conservation
4	Management of Durban's open spaces	Open spaces	South Africa	Environmental planning
5	Cost of policy inaction for biodiversity	Biodiversity	Global	Awareness raising
6	Carbon offset investments in Iwokrama National Park	Tropical forest	Guyana	Investment decision
7	Mangrove rehabilitation	Mangroves	Philippines	Nature conservation
8	Voluntary user fee system for divers	Coral reefs	Hawaii	Sustainable financing
9	Watershed rehabilitation for drinking water	Rural areas	New York	Payments for Env. Services
10	Penalty system for coral reef injury	Coral reefs	Florida/Hawaii	Damage assessment

For those unfamiliar with ecosystem services, Annex I provides a natural resources management framework and the conceptual basis of the Millennium Ecosystem Assessment. It introduces the core terminology such as “drivers of change”, “ecosystem services” and “human well-being”.

As a last source of information, Annex II provides background information on how ecosystem services can be linked to the 12 entry points for SEA as defined in the OECD-DAC SEA Guidelines. The table is composed with the help of the 2006 Guidance on Biodiversity in SEA by the Convention on Biological Diversity. The table will also appear in adapted format in the Advisory Note “Ecosystem Services and Strategic Environmental Assessment” drafted by the OECD-DAC SEA task force.

2. West Delta Water Conservation and Irrigation Rehabilitation Project, Egypt

Main messages

- In early planning stages, recognition of ecosystem services and identification of stakeholders can provide important clues on poverty and equity issues.
- Benefits and costs associated with ecosystem services can occur in geographically completely separate areas and affect different stakeholders, belonging to different divisions of society.

2.1 Introduction to the case

Since the nineteeneightees Egypt is expanding groundwater based agriculture on the desert plains west of the Nile delta, an area with the confusing name West Delta. A highly productive and economically important, export-oriented agriculture has developed, based on modern irrigation technology and advanced agricultural practices. However, the rate of groundwater exploitation by far exceeds the rate of renewal, and therefore is not sustainable. Groundwater is rapidly depleting and in some places already turning saline. In order to reverse the deteriorating situation, to save the economic potential (about US$ 500 million annually) and the many jobs in “on” and “off” farm activities, the Government of Egypt has proposed the West Delta Water Conservation and Irrigation Rehabilitation Project (WDWCIRP) to supply Nile water to the area. The Government of Egypt is preparing a public-private partnership project to pump fresh Nile water from the Rosetta Nile branch into the project area and distribute it over 40,000 ha. of farmland in the West Delta area at full cost recovery.

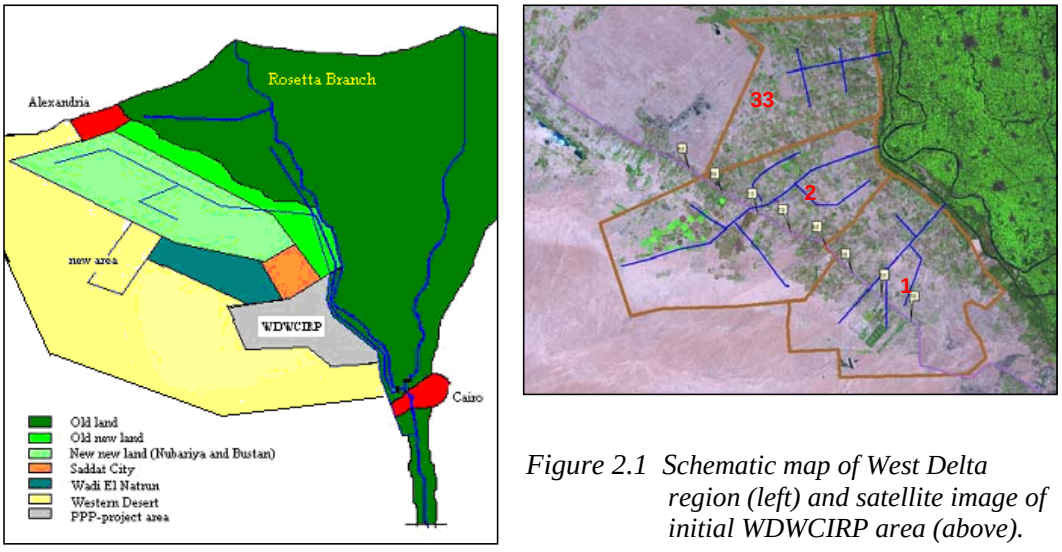

Figure 2.1 Schematic map of West Delta region (left) and satellite image of initial WDWCIRP area (above).

Source: Attia et al, 2006.

2.2 Context of the case study: the planning process

Egypt's National Water Resources Management Plan (NWRP, 2000) is based on a strictly defined amount of available water, agreed upon by the Nile basin states. Within this limitation, the NWRP describes measures to save water in the existing water resources management system, to facilitate expansion of irrigation works in desert areas. Water saving measures include the ongoing urbanisation of farmland (thus saving on irrigation water), waste water treatment, shifts in the cropping pattern (restrictions on rice and banana's), and irrigation improvement projects. At the time of the study a timetable for the implementation of these water saving measures still needed to be devised.

The West Delta is one of the identified areas for further land reclamation for irrigation development. The first planning step was a study on a "Conceptual Framework and Transaction Model for a Public-Private Partnership in Irrigation in the West Delta". This study provided a conceptual design based on public-private water management partnership and the willingness of the beneficiaries to connect on a full cost recovery basis. The study was conducted under the condition that 1.6 billion cubic meters (BCM) of Nile water would be available amounting to about 16% of the total flow in the Rosetta branch.

2.3 Assessment context

The creation of a Public - Private Partnership is a relatively new procedure. How to deal with environmental and social impact assessment in such circumstances had yet not been clearly defined. Figure 2.2 provides a simplified overview of the steps in the planning process and the points where impact assessment played and still has to play its role. The WDWCIRP started with a preliminary technical design providing a general framework on how to address the predictable future problems of groundwater availability. This preliminary study provided the basis for a Drainframe assessment, i.e. an SEA-like assessment of the provisional plan, following an approach developed by the World Bank Agriculture and Rural Development Division (Abdel-Dayem et al, 2004).

Drainframe is a water resources planning approach that ensures the integration of the multiple services provided by natural resources into the planning process, taking into account the interests of stakeholders. It has the characteristics of an integrated SEA. Integrated in the sense that economic, social and environmental aspects are taken into account; strategic in the sense that it offers options for decision-making in early stages of planning (Slootweg et al, 2007). At the time of study no decisions had been taken yet on the exact location and size of the project intervention area, irrigation technology, or institutional arrangements. The Drainframe assessment is subject of this case description.

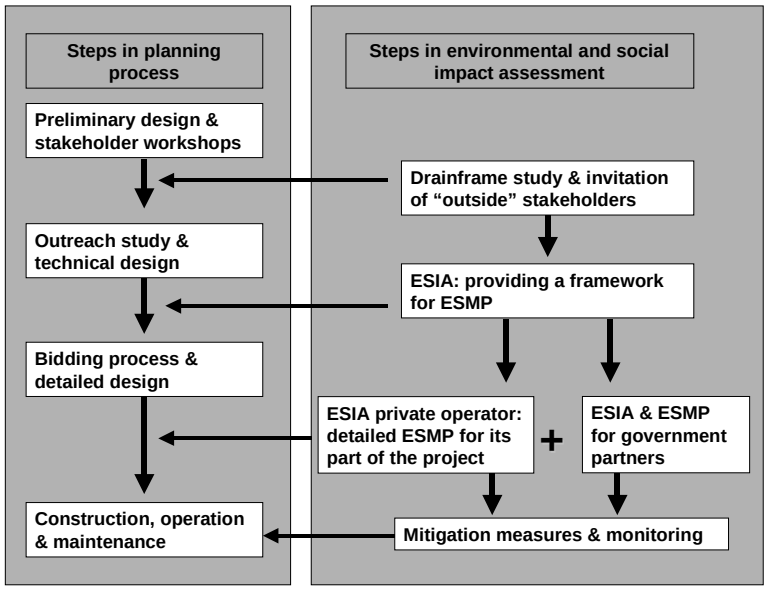

Figure 2.2 project planning process including environmental and social assessment

Source: Slootweg et al., 2007

The preliminary study was based on a number of stakeholder workshops and interviews throughout the project area. The focus was on identifying the needs and aspirations of farmers in the West Delta area. The Drainframe SEA study has extended participation to other stakeholders who, based on the assessment of affected ecosystem services linked to surface and groundwater, could be identified as potentially affected by the project. The outreach study made all farmers in the area aware of the process (instead of sampled groups only) in order to guarantee broad knowledge of and contributions to the planning process. Drainframe and outreach studies have determined the scope of a further detailed technical study. This technical study, however, is NOT a final design, but provides the boundary conditions for the bidding process.

The environmental and social impact assessment (ESIA), required in the project preparation cycle of the World Bank, moved from the broad overview provided by the Drainframe study, to more detailed project level impact assessment. However, as the final design of the project is not available yet and many issues remain unresolved the impact assessment in many instances could not go further than defining the various tasks and responsibilities of both private and public partners in the remaining phases; the ESIA provided a framework for further work. The final design will be made by the private service provider who wins the bid for the PPP project. At the time of writing, the process has not reached this phase yet.

2.4 Ecosystem services & valuation

A first round of qualitative analysis resulted in an overview of affected ecosystem services through the identification of main drivers of change:

- *Withdrawal of water from the Rosetta Nile branch* - The reduction of water availability downstream of the intake by 16% affects water supply to tens of thousands of smallholder farms (many of these being among the poorest of Egyptian society), public water supply in Beheira Governarate and the city of Alexandria, the ecological status of coastal lagoons (one Ramsar site) and their fisheries productivity.
- *Surface water supply to West Delta* - Transferring this water to the project area can lead to reduced exploitation of groundwater in the project area, but it can also lead to intensified agricultural exploitation by jointly using imported surface water and local groundwater. This results in complex groundwater level fluctuations in the aquifer underlying the entire West Delta.
- A permanent supply of water will induce increased social and economic development in the West Delta Region. This aspect is left untouched in this case study description.

Stakeholders in ecosystem services were invited to a workshop to make an assessment of the relative importance of the affected ecosystem services. This resulted in the identification of main issues. A second round of analysis included a comparison of alternative project concepts based on quantified impacts. Relations between interventions, the changes that were expected, their effects on ecosystem services, and the impact on societal values of these services were first described. These relations in most cases were modelled in simple mathematical equations. The team also took advantage of two existing computational models for simulation of water availability and yield relations in the Nile Delta, and for simulation of groundwater behaviour in the West Delta region. The results were presented and discussed in a second workshop with approximately 60 stakeholders from both the private sector and the government.

The Drainframe study considered three alternative strategies for water supply to the project area, including various sub-alternatives. *Strategy A0* representing the case of leaving things as they are, pumping of groundwater continues at unsustainable levels. S*trategy* A1 using surface water for irrigation in conjunction with groundwater use for peak demands; the water conveyance infrastructure is modest and the surface area potentially cultivated is largest. *Strategy A2* considers no ground water use at all; the capacity of the conveyance system has to be significantly larger to meet peak water requirement.

The evaluation exercise concentrated on the following main impacts expected to result from the considered alternatives in the study area:

- *Net economic benefits of an average farm in the project area (quantitative);* As shown in Table 2.1, conjunctive use of surface and groundwater gives highest net present value. At a discount rate of 10% the continuation of the present practise of groundwater pumping remains more beneficial than investing in a system that fully depends on Nile water (A2). This is explained by the fact that rapid deterioration of groundwater only takes place after 2013, while investment costs for the A2 alternative would be huge.

Table 2.1 Eonomic performance of three alternatives (not taking into account of-site and indirect impacts)

	A0	A1	A2
Benefit / cost ratio in 2017	0.99	1.07	1.05
Income per feddan in 2017 (LE/feddan)	-70	521	398
NPV (r=10%) million LE	975	1013	588

- *Numbers of permanent and seasonal jobs in the project area (quantitative);* As shown in Table 2.2, the different strategies generate different levels of employment, with strategy A1 being the most labour intensive approach.

Table 2.2 Performance of strategies on job creation

Number of jobs	A0	A1	A2
Seasonal jobs	-29,809	273,255	210,070
Permanent jobs	0	54,607	41,897
Total jobs	-29,809	327,862	251,966

- *Impact on the production in the downstream area of the Nile Delta (quantitative):* As shown in Table 2.3, the potential losses in production value in the Nile Delta were calculated for two situations: the water is only taken from the Rosetta branch, or the water is taken from the entire delta. Two scenarios where evaluated: 1) the loss of net return of agriculture when the cropping pattern remains unchanged; and 2) the loss when farmers cope to the best of their ability, with increasing water scarcity. The alternatives A1 and A2 would both take the same amount of water.

Table 2.3 Hypothetical annual production loss in the Nile delta as a result of 1.6 BCM annual water withdrawal (in millions of US$).

	Impacts distributed over entire Nile Delta	Impacts on Rosetta branch only
Cropping pattern unchanged	263.731	132.678
Cropping pattern adapted	77.353	78.563

- *Fishery benefits:* Fisheries productivity of the coastal lakes amounts to 152,295 tonnes annually, caught by 18,000 boats, providing employment to 48,000 persons. No attempt was made to calculate production losses.
- *Impact on drinking water availability (qualitative):* Beheira governorate depends on ground water for 60% of its population (2.4 million people). The remaining 40% of the population (i.e. 1.6 million) depends on surface water. Mahmoudia canal, taking water from the Rosetta branch, is the only source of public water supply to Alexandria, serving between 6 million inhabitants in winter and 8 million in summer.

Any reduction in water supply will have severe consequences, as water supply is already under stress.

2.5 Decision making

The use of strategic environmental assessment at the earliest possible stage of the planning process has guaranteed that environmental and social issues beyond the boundaries of the project area were incorporated in the design process. Valuation of ecosystem services focussed on the services linked to water resources in the area under influence of the major driver of change, i.e. transfer of water from the Nile to the West Delta desert area.

Very simple quantification techniques, in terms of net present value and benefit/cost ratio of investments at farm level, job creation, numbers of people negatively affected, and overall production losses in the Nile delta, provided strong arguments for decision makers at the Ministry of Water Resources and Irrigation and the World Bank to significantly reduce the scale of the initial pilot project. The diversion of water from relatively poor smallholder farmers in de Nile Delta to large investors in de West Delta poses equity problems unacceptable to both stakeholders and government decision makers.

All experts and stakeholders agreed that water withdrawal from the Rosetta branch should be fully compensated by measures to save water in the entire irrigation system. Water quality in the Rosetta branch is already below the needs of the command area, water quality in the coastal lakes is similarly under serious stress, agriculture in the Nile delta would face serious losses under reduced water availability, and public water supply to Alexandria is of such overwhelming importance that any reduction in water supply to the Rosetta branch has to be avoided.

However, the National Water Resources Plan does not give a timetable of water saving measures and therefore does not provide any clues to the timing of water savings. At present an implementation programme for water savings measures is developed. It was considered important to harmonise implementation of the West Delta project with the necessary measures to save the required amount of water.

It is decided that the WDWCIRP project will have a phased approach, providing room to implement the water savings programme. Short-term measures can produce necessary first savings to allow for the first, relatively small pilot phase of the WDWCIRP project. Further water saving measures will provide room for further expansion of the WDWCIRP project.

2.6 SEA boundary conditions

The Drainframe assessment has been carried out over a period of three months. Time expenditure included hiring of three expatriate and two local consultants for one month each. Furthermore, farm surveys were carried out by local agricultural extension workers. The study was carried out in close collaboration with those responsible for project planning, at the Ministry and World Bank. The cost of the study was approximately US$ 80,000, on a total estimated project budget of around US$ 100

million. As a result of good coordination the study was fully integrated in the planning process. This process did not experience any delays.

Data were obtained from project planning documents, government statistics, farm surveys, two computational ground- and surface water models, as well as a number of additional field visits and on-farm interviews were carried out for verification. Two stakeholder workshops provided relevant scoping information and discussion on the outcome of the study. The level of detail and reliability of information was sufficient to guide the planning process. Where links between hydrological changes and impacts were very difficult to quantify in economic terms, the impact description was limited to the identification of numbers of affected people. The subsequent detailed technical design was subject to a fully-fledged ESIA, which could zoom in on a limited number of issues to provide more detailed information.

Box 1. More sustainable management of the Niger river in Mali

One million people in the Inner Niger Delta make a living from arable farming, fisheries and livestock. Upstream dams (one built for electricity generation and one for irrigation) affect this downstream multifunctional use of water. Additionally, the Inner Niger Delta, which is one of the largest Ramsar sites in the world, is a biodiversity hotspot and accommodates two of the largest known breeding colonies of large wading birds and staging waterbirds, residents and migrants from all over Europe and western Asia. The hydrological and related ecological conditions in the Inner Delta largely determine the health of the ecology as well as the economy.

The main aim of a three-year study was to develop a decision-support system for river management in the Upper Niger, in which ecological and socio-economical impacts and benefits of dams and irrigation systems are analysed in relation to different water management scenarios. The study involves various components: hydrology, arable farming, livestock, fisheries, ecology and socio-economics (Zwarts et al. 2005).

An economic analysis has been conducted to determine the role of dams in the economy of the Inner Niger Delta and the Upper Niger region. By innovatively combining the above information on hydrology, ecology, fisheries, and agriculture, the study shows that building new dams is not an efficient way to increase economic growth and reduce poverty in the region. In fact, such efforts are counter-effective and, at best, transfer welfare from the Inner Niger Delta to the Upper Niger region (Zwarts et al. 2006).

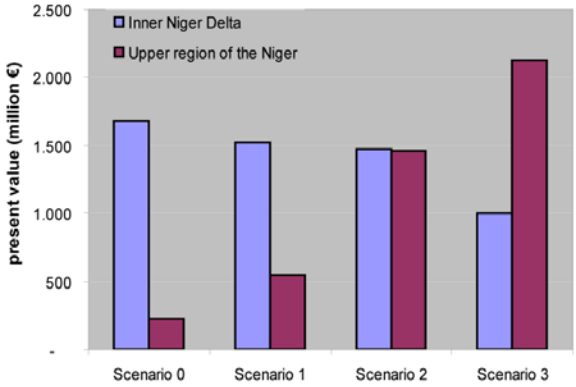

Figure Distribution of welfare transfers from downstream to upstream regions with each additional dam build in the Upper region of the Niger (Note that "Scenario 0" has no dams, "Scenario 1" has one dam, "Scenario 2" has two dams, etc.)

Rather than building more dams in the Upper Niger, the study advises to aim additional efforts at improving the efficiency of the existing infrastructure and current economic activities in the Inner Niger Delta itself. This approach will also provide greater certainty for the essential eco-regional network functioning of the Inner Delta. Several of these recommendations seem to have been adopted by the Mali government. The attention of economic development within the Inner Niger Delta has increased, as well as the continued efforts to improve the irrigation efficiency in the agriculture sector upstream.

Zwarts, L., P.J.H. van Beukering, B. Koné, E. Wymenga and D. Taylor (2006) The Economic and Ecological Effects of Water Management Choices in the Upper Niger River: Development of Decision Support Methods. Water Resources Development, 22(1), 135–156.

Zwarts, L., P.J.H. van Beukering, B. Koné, & E. Wymenga (Eds.) (2005). The Niger, a lifeline: Effective water management in the Upper Niger Basin. RIZA, Lelystad / Wetlands International, Sévaré / Institute for Environmental Studies (IVM), Amsterdam / A&W ecological consultants, Veenwouden. Mali / The Netherlands. p.304. (ISBN 90-807150-6-9)

Box 2. Nature conservation at the cost of local livelihoods?

From a conservation and development perspective a strong statement is provided by Schmidt-Soltau (2002) in a description of an impact assessment in a national park project in South-West Cameroon. In 1986 Korup National Park was created, covering an area of 1,259 km^2. It soon became famous; the British Sunday newspaper "The Observer" introduced Korup National Park to the world with a special full-colour supplement entitled "Paradise lost?"

Here the paper could have ended, if the area had been solely inhabited and utilised by mammals, fish, birds and insects; but the perception of Africa as a continent of a vast wilderness with abundant freel-ranging wild animals waiting for tourists and researchers to enjoy is flawed. In reality, there is no 'no man's land' in Africa. The wilderness is often communal land shared between villages. In the case of Korup National Park the land is home to 1,400 people. Nearly 30,000 individuals from 187 villages are utilising the park and its surrounding area for their livelihood as hunters, gatherers, fisher-folk and farmers.

An assessment of the impacts of prohibiting any further exploitation of the forest showed that even if the project were to use its entire budget to compensate the traditional owners on an annual basis, the villagers – not considering the impact on their subsistence - would be forced to contribute €31- per person (or 19 % of their annual cash income) to the conservation of rainforests. Yet, 81% of respondents saw the forests as their source of livelihood and therefore supported the idea of forest conservation, but with a desire to be more involved in park management and to be allowed to continue traditional exploitation.

Obviously this clashing interest between strict protection and sustainable use of nature conservation areas requires an analysis from both a biophysical and a social-economic point of view. Valuation of ecosystem services within an impact assessment framework provides an effective tool.

Cerneaa, M.M. and K. Schmidt-Soltau (2006). Poverty Risks and National Parks: Policy Issues in Conservation and Resettlement. *World Development* 34(10); 1808-1830.

Schmidt-Soltau, K. (2002). Human activities and conservation efforts in and around Korup National Park (Cameroon). The impacts of an impact assessment. Proceedings of the 21st Annual IAIA Conference, The Hague, The Netherlands, June 2002.

2.7 References / Sources of information

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Abdel-Dayem S, Hoevenaars J, Mollinga PP, Scheumann W, Slootweg R, Steenbergen F. van 2005. Agricultural drainage - Towards an integrated approach. Irrigation and Drainage Management **19**: 71-87.

Attia F., Fahmi H., Gambarelli G., Hoevenaars J., Slootweg R. & Abdel-Dayem S. (2005) West Delta Water Conservation and Irrigation rehabilitation Project. Drainframe Analysis. Main Report. Internal report. Arab Republic of Egypt, Ministry of Irrigation

and Water Resources / World Bank.

Ministry of Water Resources and Irrigation. 2005. Integrated Irrigation Improvement and Management Project. Project Appraisal Document.

NWRP Project (2000). National Water Resources Plan for Egypt - Fisheries and Water Resources. NWRP Technical Report No. 6. WL/Delft Hydraulics

Slootweg, R., J. Hoevenaars & S. Abdel-Dayem (2007). Drainframe as a tool for integrated strategic environmental assessment: lessons from practice. Irrigation and Drainage Management56, S191-S203.

World Bank. 2005. Conceptual Framework and Transaction Model for a Public-Private Partnership in Irrigation in the West Delta, Egypt. Internal report

3. Aral Sea Wetland Restoration Strategy

Messages

- Semi-quantitative valuation of ecosystem services, expressed in terms of each service delivered (i.e. not monetised) works well for comparison of alternative intervention strategies (high strategic level). Participatory MCA is an effective tool, capable of dealing with limited level of detail in data.
- Monetisation of services in a CBA works well at project level when discussing concrete and well-defined investments within the framework of the selected overall strategy.
- Construction of an "ecosystem services-values" table provides a good visualisation of the variety of services and is a good communication tool.
- Valuation of ecosystem services leads to better, more sustainability oriented decisions.

3.1 Introduction to the case

In the early sixties the Government of the former Soviet Union decided to intensify and expand its irrigation activities in Central Asia. The irrigation water was taken from Amudarya and Syrdarya, the two main rivers contributing water to the Aral Sea. The result of this large-scale intensification of water use for irrigation has been the shrinking of the Aral Sea, desiccation of large areas around the Aral Sea, and increasing salinisation of its waters. The Aral Sea today is practically devoid of higher forms of life because of its salinity. Other environmental effects concern the reduced availability of (flood)water in the deltas of the Amudarya and Syrdarya, considerable loss of biodiversity, loss of vegetation and fisheries, the occurrence of salt and dust-laden winds and the deteriorating health conditions because of salinisation of groundwater. In 1995, about 10% of the original wetlands remained in the delta's, largely maintained by a mix of incidental floodwaters and saline drainage water flowing into constructed water reservoirs.

Amu Darya delta south of the Aral Sea

Lake Sudoche and wetlands

Figure 3.1 Satelite images of Amu Darya delta and Lake Sudoche

Source: Nasa World Wind: Geocover 2000

3.2 Context of the case study: the planning process

In 1992, after the collapse of the Soviet Union, five Central Asian States: Kazakhstan, Uzbekistan, Kyrgyzstan, Turkmenistan and Tajikistan decided to tackle what had become known as the Aral Sea crisis. They signed an agreement for cooperation on management, utilisation and protection of water resources in the Aral Sea catchment area. The international community offered aid, coordinated by the World Bank in the Aral Sea Programme (ASP). To manage the ASP, the Interstate Council on the Aral Sea (ICAS) was set up.

The Aral Sea Programme is based on 7 decisions made by the Heads of State of the 5 Republics. The Aral Sea Wetland Restoration Project (ASWRP), which is the subject of this case description, was created to answer to decision No. 4, which states: "*To undertake research work and to decide upon the existing engineering options, to prepare projects and to create artificially watered landscape ecosystems in the deltas of the Amudarya and Syrdarya rivers and on the exposed Aral Sea beds. Furthermore to undertake the required melioration work in order to restore the original environmental landscape in the above-mentioned areas*". The geographical area of study is the Amudarya delta south of the Aral Sea, in the semi-autonomous republic of Karakalpakstan, Uzbekistan. Through a World Bank Trust Fund, the Dutch Government provided funding for the study.

The problems of desiccation, desertification, loss of productive resources and decline in living conditions have been documented extensively by local NGO's and the Uzbek authorities. Highly contradictory reports on living conditions in the Amu Darya delta and a wide array of sometimes unrealistic solutions developed by different institutes has resulted in the ICAS's request for a comprehensive study of all existing information and the development of a coherent strategy for the delta.

In consultation with the World Bank, the ICAS had drafted the T.o.R. for the study. In close consultation with local Uzbek institutes, a consortium of Dutch consultants has in 1995 developed a coherent strategy for the restoration of the Amu Darya delta, broadly accepted by local stakeholders and government authorities, and an investment programme of priority pilot projects. One pilot project, the restoration of the Sudoche wetlands, was designed in detail, which at the time of writing (2007) has been successfully implemented.

3.3 Assessment context

The main objective of the study was to bring a halt to and if possible mitigate the deteriorating environmental conditions and their detrimental effects on the local population in the Amu Darya delta by wetland restoration. The objective links human wellbeing directly to environmental conditions. Even though ecosystem services were not mentioned as such, the project description very obviously referred to the concept. In their work plan, the consultants took the ecosystem services of a dynamic semi-natural

wetland system as point of departure, and used valuation of these services as a means to structure the decision-making process around a future development strategy of the delta.

The study has all characteristic of an SEA integrated into a strategy development process. It started with a base line study on major environmental, hydrological and social-economic issues in the region. The strategy development process was based on the development and comparison of alternative strategies, in a participatory manner, making use of local knowledge. It was aimed at providing relevant social, economic and environmental information for decision making with regard to the future development of the Amydarya delta. A large number of local experts/scientists summarised available scientific information, existing plans and ongoing activities in the area. This information proved to be extremely valuable[2].

The possibilities to restore wetlands in the Amu Darya delta depend on the future availability of water which cannot be managed by interventions in the delta. Three scenarios of future river discharge were considered: availability of water in the delta will (i) decrease due to further wasteful irrigation practises; (ii) will increase due to a successful Aral Sea programme; (iii) will not change. With the development of strategies in mind, the first option was considered to be unworkable, as less water would render any restoration effort useless. Within these scenario boundaries, five alternative strategies were developed which differed in the surface area of wetlands to be restored, the amount of water allocated to each watershed, and in mixed or separate use of river discharge and (saline) drainage water from the irrigation schemes.

3.4 Ecosystem services & valuation

Three main ecosystems were identified in the Amu Darya, providing key ecosystem services: permanent lakes and marshes, seasonally flooded plains, and drylands with groundwater at 2 - 5 meters supporting dense vegetation. Nowadays, the larger part of the delta consists of degraded steppes, no longer functioning as part of delta ecosystem and not providing any relevant services. The upstream part of the delta is converted to irrigated land.

The Amu Darya delta ecosystem services were first determined qualitatively and later on quantified where possible, based on information from local scientists and a socio-economic survey. Services were assessed for three situations:

1. The former natural state when 90% of the delta could become flooded during summer floods;

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[2] Significant inputs have been provided by the Central Asian Scientific Research Institute for Irrigation (SPA SANIIRI), the Design Institutes Uzgipromeliovodkhoz and Vodproekt, the State Committee for Nature Protection (Goskompriroda), Karakalpakvodhoz based in Nukus in Karakalpakstan, and the Karakalpak Branch of the Uzbek Academy of Science in Nukus.

2. The present state, leaving only 10% of the original wetland area, mainly artificially maintained;
3. Restoration potential with the presently available quantity of water.

Social, economic and ecological values derived from wetland ecosystem services were quantified in semi-quantitative terms. Values referred to (estimates of) numbers of beneficiaries, jobs, or production levels of various land use forms. For the pilot project a number of services was monetised in a financial and economic cost benefit analysis. Local scientists from the Nukus Academy of Sciences, government agencies of the autonomous region of Karakalpakstan and representatives from the delta population provided input.

Lakes and marshes	Floodplains	Drylands (groundwater)
Maintenance of groundwater level counteracting desertification (prevention of dust transport by winds).		
Maintenance of biological diversity (medicinal herbs, genetic resources, etc.)		
Fish reproduction and growth		
	Quality and regeneration capacity of pastures (livestock)	
Water supply for agri/aquaculture		
Reed production for construction / processing		
Hunting for muskrats (and water fowl / other animals)		
	Wood and liquorice production	
	Protection of infrastructure	

Figure 3.2 Most important ecosystem services of the Amu Darya delta ecosystems

Maintenance of biodiversity was supported by various legal instruments: Five mammal and eight fish species were listed in the "Uzbekistan Red Book" of threatened species – some were considered extinct. Approximately 13 of 22 threatened bird species in Uzbekistan occur in the delta.

With the available information an ecosystem services-values matrix was constructed to provide insight in the multifunctional character of the natural environment in relation to human activities.

Table 3.1 Simplified ecosystem services - values matrix for Amy Darya wetlands

Wetland services	**Social values**	**Economic values**	**Ecological values**
Recharge of groundwater	Fundamental function for the maintenance of all other ecological processes		
Prevention of dust/salt transport by wind	living conditions / health	Protection of irrigation schemes	
Maintenance of biological diversity		genetic reservoirs (wild ancestors / medicinal)	Many red listed / threatened species.
Fish spawning /nursing		fisheries and canning plant	survival aquatic organisms.
Pastures		cattle raising	
Reedlands		processing industry	
Water supply		agriculture, aquaculture	
Muskrat, waterfowl	Local hunting (meat /skins)	Fur & meat industry	
Liquorice production and other wood resources	Fire and construction wood for local use.	Liquorice roots for export. Dried plants for fodder.	

In order to perform a multi-criteria analysis, a decision hierarchy for evaluating alternative water management strategies for the delta was constructed, based on the valuation of ecosystem services. A decision tree was constructed during a workshop with all international and local experts involved, reflecting the outcome of intense debate. Components were based on the values of wetlands for society, devided into the three main groups: living conditions, local economy and ecology. Criteria were, where necessary, further divided into sub criteria. For example resource productivity was subdivided into livestock, fisheries, reed industry, liquorice industry, muskrat (fur) industry. Since water is such an overwhelmingly important aspect, hydrology was considered to be a fourth main component taking into account previously neglected values or values of possible future importance (e.g. tourism).

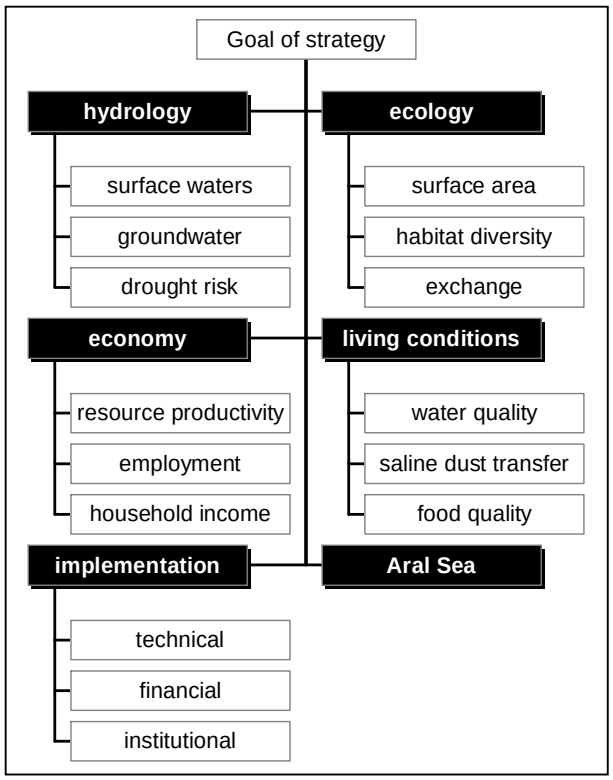

Figure 3.3 Decision tree for strategy selection

Two other important components to determin the choice of a strategy were defined: the implementation feasibility of the proposed strategy, and the existence of the Aral Sea. (Any management strategy for the delta has its impact on the quality of the Aral Sea itself.).

The performance of each criterion under the five strategies was compared and ranked (for example: for surface water strategy 1 performs better than strategy 4, 4 performs better than 3, etc.). This ranking was carried out during a workshop in which all local and external experts were present, with additional input from local special interest organisations. The outcome of the exercise was broadly acknowledged.

The final weighing of the main components took place in a workshop with high-level regional and national decision makers who had to determine whether for example the economic component should carry more weight than the ecological component. The outcome of this weighing is an overall ranking of the different strategies, reflecting the input of expert and local stakeholders in the criteria and the decision makers' input in the relative importance of the components. This intense process created a sense of shared responsibility for the outcome between local stakeholders, and local and national authorities.

The final step in the project was to define and prioritise a series of concrete pilot projects, based on the chosen strategy. A programme design, including cost-benefit analysis, was included.

Valuation of ecosystem services in the CBA of the pilot programme

The monetary benefits of the pilot programme have been calculated on the basis of the incremental benefits of the project (with minus without). The calculated incremental benefits of the pilot project are based on the main product categories (or provisioning services) of the project area, which are muskrats, ducks, cattle, liquorice, reeds, fisheries and aquaculture. The benefits have been calculated on the basis of "off-farm" prices only. No downstream activities that may create added value of products (e.g. production and sale of canned fish) have been included. Other additional benefits not included are reduced costs for repairs of civil works (restored wetlands control erratic floods), reduced production losses, and value of constructions for added safety and health of the local population.

This resulted in an internal rate of return (IRR) of 10,9% versus 10,2% for the financial versus economic CBA. The conclusion was that the programme was acceptable, especially in view of the many additional benefits and downstream effects. The project may, for example, give rise to additional investments such as fish farming, rehabilitation of a fish cannery, and increased small-scale agricultural activities for vegetables and fruit trees. These activities are not necessary for the pilot project and their benefits have not been accounted for in the financial and economic analysis.

The Sudoche Lake Rehabilitation Project, was funded by GEF. A preliminary environmental appraisal revealed that further EIA was not required for this project. A rapid 5-day appraisal of the impact, four years after completion, revealed that (Karimsakov – 2006 - through De Schutter, pers. com.):

- Incomes of both poorest and richest households have increased;
- The number of cattle has increased;
- Production of hay for own use and selling on regional market has increased;
- Cutting of reeds and selling of reed-fiber mats (boards) has increased;
- Fish consumption has increased up to 15 kg a week per family;
- Population of muskrats increased.

According to data of the Ministry of Agriculture and Water Resources of the Republic of Karakalpakstan, fish catches in Lake Sudoche are shown in the figure above.

In all villages visited, proof of improved well-being of the local population is evident (new motorcycles, boats, fishing nets, satellite antennas, new buildings, as well as herds of sheep and goats). Maybe the most convincing argument of all: the number of young families has increased. Expansion of restoration efforts further downstream is considered possible with the available amount of water. A more detailed quantitative study would be interesting, but is not foreseen.

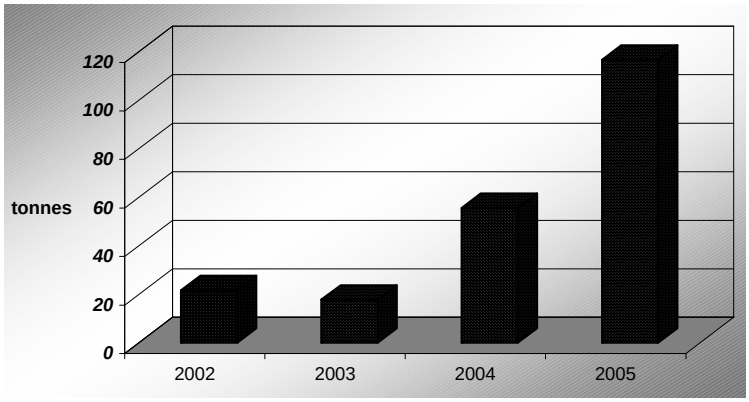

Figure 3.4 Yearly fish production Lake Sudoche

3.5 Decision making

With the outcome of the final weighing for the selection of the best strategy, high level decision makers showed they were well aware of the ecological disaster taking place in the delta. Ecological values received highest rankings, followed by social-economic values and implementation feasibility, rating equally important. From a strategic perspective it was apparent to all, restoration of the ecology of the area had to receive first priority since “everything else depends on the health of the environment”, as pointed out by one representative. The Aral Sea rated lowest, indicating that people, for the time being, have given up on the Aral Sea itself in favour of the delta area.

The services-values matrix was a helpful tool as it provided immediate insight in the social, economic and ecological consequences of interventions. Presenting the matrix for the former, the present and possible future restored situation, proved to be a very strong tool to convince decision makers of the values of wetlands. It proved that restoration of (natural) wetland services might be a better option than the continued construction of water retention and irrigation works. The former focus on one service only, i.e. water supply for irrigation,implies that other services don’t exist. Moreover, multifunctional wetlands can cope with the dynamics of the delta system and stop further land degradation.

The presence of many threatened animal species provided important arguments for the donor to invest in the pilot project, although the main arguments to start the pilot project were of a socio-economic character.

Valuation of ecosystem services was instrumental in changing the course of development from technocratic and unsustainable interventions, to the restoration of natural processes. These are much better capable of creating added value to inhabitants under the dynamic conditions of the water stressed delta. The process followed created a strong coalition of local stakeholders and authorities, resulting in necessary pressure to convince national government and the donor community to invest in a pilot project.

Box 3. Comprehensive Everglades Restoration Program – Florida, U.S.A.

The Greater Everglades ecosystem covers more than 69,000 km2 and is a mosaic of interrelated terrestrial, freshwater and marine systems. Changes in land use and hydrology reduced the spatial extent of the Everglades wetland system to less than 50% of its original area by 1990 and dramatically altered the natural flow of water. Agricultural drainage waters caused eutrophication. In December 2000, the US Congress approved the 7.8 billion dollar Comprehensive Everglades Restoration Program (CERP). Fifty-two engineering projects with associated land purchases were proposed.

The initially calculated restoration costs included land acquisition ($93 million), construction ($218.3 million), operation and maintenance ($81 million), and monitoring ($10 million) expenses in an average year during the 50-year planning period. Annual use benefits amounted to $29.2 million resulting from additional water supplies to agricultural and municipal water users in South Florida. In the initial studies no estimates were provided for recreational or non-use benefits. If the usual criterion that total benefits equal or exceed total costs is applied, the unquantified recreational and non-use benefits would need to be around $370 million per year.

Milon and Hodges (2000) point out that public policy should not be based on a presumption of very large non-use benefits for each and every ecosystem restoration project. They refer to a 1998 interview survey among 500 households where respondents were asked to select between alternative plans that differed in the extent of ecosystem restoration and dollar costs the household would pay through increased utility taxes, restrictions on household water use, and reductions in farmland acreage in South Florida. This resulted in a willingness to pay ranging from $ 54 million to $ 355 million annually. This type of surveys shows significant non-use benefits accruing to Floridians from Everglades restoration and Floridians express a willingness to pay a significant part of the estimated costs. Whether these benefits extend to people who live outside Florida, and whether non-Floridians are willing to make a financial commitment to Everglades restoration, remains to be determined.

Englehardt (1997) provides a similar argument by turning the reasoning around. Billions of dollars have been contributed voluntarily to pay for the protection of natural areas. This success suggests that society values environmental benefits in preference to other consumption, and that remaining natural areas can be protected in public policy decisions by evaluating ecological benefits explicitly.

Milon J.W. (2000). Who Wants To Pay For Everglades Restoration? The Magazine of Food, Farm and Resource Issues, Summer, 2000. (http://findarticles.com/p/articles/mi_m0HIC/is_2_15/ai_66918325).

Milon, J.W. & D. Scrogin (2006). Latent preferences and valuation of wetland ecosystem restoration. *Ecological Economics* 56, 162– 175

Englehardt, J.D. (1998). Ecological and Economic Risk Analysis of Everglades: Phase I Restoration Alternatives. *Risk Analysis* 6, 755-771.

3.6 SEA boundary conditions

Duration of the strategy development, including all preparatory studies and participatory process, was 12 months. Total costs of the studies amounted to US US$1 million.

Investment cost for the proposed programme of projects was US US$ 20 million. The Sudoche pilot project was implemented at an approximate cost of US US$ 4 million.

Level of detail was sufficient for MCA exercise. By focussing on multiple values of ecosystem services instead of translating services directly into monetary values, it became apparent that for local stakeholders as well as government representatives, ecological values, expressed in their own terms, received highest ranking. Discussing values expressed in their own terms, and more importantly, recognising stakeholders for each ecosystem service did not distract the discussion to aggregated figures on money.

In a later stage, when discussing concrete investments, cost benefit analysis was the proper tool to provide sufficient and convincing arguments that the investments are justified. First-hand accounts from the region give the impression that the decisions turned out to be good ones.

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4. Strategic Catchment Assessment in uMhlathuze municipality, South Africa

Messages

- Identification and valuation of ecosystem services can inform a local spatial planning process on development constraints and opportunities.
- Monetisation of ecosystem services puts environmental considerations on the decision makers' agenda.

4.1 Introduction to the case

The towns of Richards Bay and Empangeni are situated approximately 200 km north of Durban, Kwazulu-Natal, overlooking the Mhlathuze Estuary. Richards Bay is the closest port to Johannesburg, South Africa's economic center. In 2002, Richards Bay and Empangeni as well as the surrounding rural and tribal areas merged to form the City of uMhlathuze, with 300 000 inhabitants, covering 796 km². Unemployment is high (41%). However, economic activity in tribal areas such as production for own use, arts and crafts and informal sales are generally disregarded (uMhlathuze Municipality, 2004). The tribal population creates their own informal employment, thus highlighting the importance of an environment providing free ecosystem services to sustain their livelihoods.

Industry has consistently shown the highest growth rate in the country. With the natural environment already 75% transformed, it is evident that conflict between the environment and development will continue to grow in uMhlathuze, unless proper planning takes place. Biodiversity issues in the City of uMhlathuze have lead to various conflict situations during the past couple of years. The classic "development" versus "conservation" situation exists, with the local municipality mostly in favour of development as a result of the poor social-economic climate that exists in Kwazulu-Natal. The area has, however, been identified as a biodiversity hotspot, and in order to alleviate the conflict and time delays that arise during Environmental Impact Assessments, the uMhlathuze Municipality opted to undertake a Strategic Catchment Assessment.

4.2 Context of the case study: the planning process

Environmental sustainability and quality of life are becoming major points of focus for politicians and officials at local level involved in development planning. A combination of growing community awareness and new legislation is the key driver behind this new focus. The uMhlathuze Municipality has the task to enable sustainable development, which inevitably leads to conflict between environmentalists and developers during EIA procedures, because of two key reasons:

- Few workable processes are in place to guide planners towards sustainable development; and
- Very little environmental information is available to inform planning decisions.

Critics are largely arguing that the uMhlathuze Municipality has no "plan" for the management of its natural biodiversity assets and therefore every piece of untransformed land that is proposed for land conversion has to be rigorously challenged during EIA processes. At this moment, the Municipality has no means or criteria to judge the role or usefulness of any particular land parcel in terms of its use for sustainable development or conservation. This lack of direction gives critics ample scope for litigation and legal challenges. Therefore, in order to ensure sustainable land use planning and decision-making, the City of uMhlathuze appointed FutureWorks as consultants, who developed a catchment-based process for assessing, incorporating and monitoring environmental sustainability into strategic planning.

All municipalities in South Africa are required by the Municipal Systems Act (Act 32 of 2000) to undertake an Integrated Development Planning (IDP) process to which SEA can add value, by providing a practical guide to integrating the concept of sustainability into the planning process. The Performance Management Regulations of this Act states that the Spatial Development Framework, reflected in the IDP, must "*contain a strategic assessment of the environmental impact of the spatial development framework*." In terms of the White Paper on Spatial Planning and Land Use Management each Municipality must compile a spatial development framework of which one of the components must be an SEA.

Biodiversity Management Plans, as well as the Invasive Species Monitoring, Control and Eradication Plan, must form part of the Municipality's Integrated Development Plan (IDP). The Integrated Development Plan is therefore a powerful sustainable development tool for Local Authorities through which biodiversity management and planning can be encouraged and linked to existing planning procedures and processes.

4.3 Assessment context

The Strategic Catchment Assessment aims to plug key information gaps such that Municipal Planners and Land Managers will have a strategic decision-making tool. The question may be asked why this project focussed on providing a tool for urban planners and not for environmental practitioners? Planning integrates the social and economic development needs of an area with the environmental resources available to it. Formerly, urban planning has focused primarily on the finance, skills and infrastructure available for development. However, this planning focus now has to expand to include the environment as a priority. The Strategic Catchment Assessment (SCA) focused on evaluating the environmental sustainability status only; it did not assess social and economic issues in the area.

The SCA followed a four-step approach:

1. For reasons of transparency and to encourage cooperation a Catchment Forum Group was formed consisting of local specialists as well as interested parties, 20 persons in all. Feedback meetings ensured continued stakeholder interaction and decision-making..

2. Hydrological units were defined that contain both the surface and sub-surface drainage systems of specific land areas, and ecosystem services were defined in a landscape assessment.
3. A status quo assessment of the catchment units provided information on the current environmental sustainability of the catchment areas.
4. Strategic land use planning and management interventions were developed in response to the observations from the present status of each catchment unit. This information should be used to proactively inform strategic and sectoral planning.

The balance between supply of, and demand for, environmental goods and services in each Catchment Unit is determined based on a key set of environmental goods and services demanded by people in the catchment. Each catchment was then rated RED, ORANGE or GREEN. Green catchments are in good condition and currently developed within environmentally sustainable limits. They are generally environmental opportunity areas under proper management and proactive action. Orange catchments are in moderate condition and are a nearing unsustainable state. These catchments are being stressed by current land use, and environmental quality is declining. A combination of remedial, management and proactive action is required. Red catchments are in poor condition and already unsustainable. These catchments are under stress and the environmental quality has already declined significantly. Remedial and management action is required.

4.4 Ecosystem services & valuation

Catchments have been shown to be effective environmental entities for assessing the synergistic impacts of urban development and for integrating the environment into urban planning. The Strategic Catchment Assessment Process accounted for the balance between supply of environmental goods and services by the natural environment, and the demand for these goods and services by people. These ecosystem services are currently used free of charge.

The Strategic Catchment Assessment revealed that:

- 2 of the 8 catchment units are rated RED. The use and demand for environmental services have largely exceeded supply, and remedial measures are needed.
- 5 catchments are rated ORANGE. The use of environmental services has affected the ability of the natural environment to provide good quality and high volumes of environmental services. In some cases remedial action is required, but for all these areas future development must proceed with caution.
- 1 catchment is rated GREEN. This catchment is a high-opportunity zone for sustainable development, maximising the benefits provided by high environmental service supply.

It is estimated that, in uMhlathuze, the overall value of the ecosystems supplied is approximately R1.7 billion per annum. Nutrient cycling and waste management, water supply, water regulation, flood and drought management are some of the most highly

valued services. If the above results are taken into consideration, it is clear that the value of ecosystems in uMhlathuze is being eroded by unsustainable practices. If the Municipality wants to ensure the continuation of free service delivery by the environment, it would have to put in place management actions (FutureWorks, 2004).

Table 4.1 presents the annual value of each of the key ecosystem services supplied by the natural assets of the uMhlathuze Municipality. As different habitats deliver these services in different combinations, it is important to understand the total value of these habitats. It is clear that water-related habitats generate some of the greatest values in terms of service delivery. Wetlands have a particularly high value, relating to the high costs of trying to replace a vital but finite resource.

Table 4.1 Annual value of individual ecosystem services and of services per ecosystem.

Value of ecosystem services (Annual value in R. millions)	
Atmosphere regulation - CO2, etc	23,39
Climate regulation - urban heat sinks	0.00
Flood and drought management	244.11
Water regulation - timing, rate	137.39
Water supply – volume	297.92
Erosion control	16.10
Soil formation	0.65
Nutrient cycling	714.90
Waste treatment - assimilation and dilution	137.74
Pollination - legume and fruit crops	1.53
Disease and pest control	9.74
Refugia – wildlife and fish nursery	15.90
Food production	30.18
Raw materials - housing, medicinals, craft	20.90
Genetic resources – chemicals	2.33
Recreation	37.73
Cultural	67.20
Annual total value	**1,757.71**

Value of services per ecosystem (Annual value R. millions)	
Dams & lakes	162.54
Floodplains – disturbed	32.54
Floodplains - undisturbed	27.42
Forest – coastal	34.12
Forest – dunes	37.36
Forest - riparian and swamp	29.62
Grasslands – primary	9.37
Grasslands – utility	0.06
Grasslands – secondary	4.62
Rivers & streams	49.47
Sandy beaches & foredunes	1.67
Thicket – alien plants	3.53
Thicket	3.90
Wetlands – estuarine	433.47
Wetlands	570.89
Savanna/woodlands	9.52
Nearshore ocean	347.62
Total annual value	**1,757.72**

The Status Quo Report, prepared for the uMhlathuze Municipality, is presented in four poster-like pages (see Figure 4.1):

- Page 1 – Pictorial Catchment View:

- Page 2 – General Catchment Information: summary of the Sustainability Status Quo including different land covers, catchment population, levels of engineering services, key environmental services and their value; positive and negative environmental aspects of the catchment.
- Page 3 – Environmental Sustainability Status Quo contains colour coded indicator information for the catchment: RED: ORANGE: GREEN: When comparing different Catchment Units, this page is very useful.
- Page 4 – Implications & Interventions / Guidelines: provides the implications for land use planning and management, including key environmental opportunities and constraints, legal and other implications for current development scenarios.

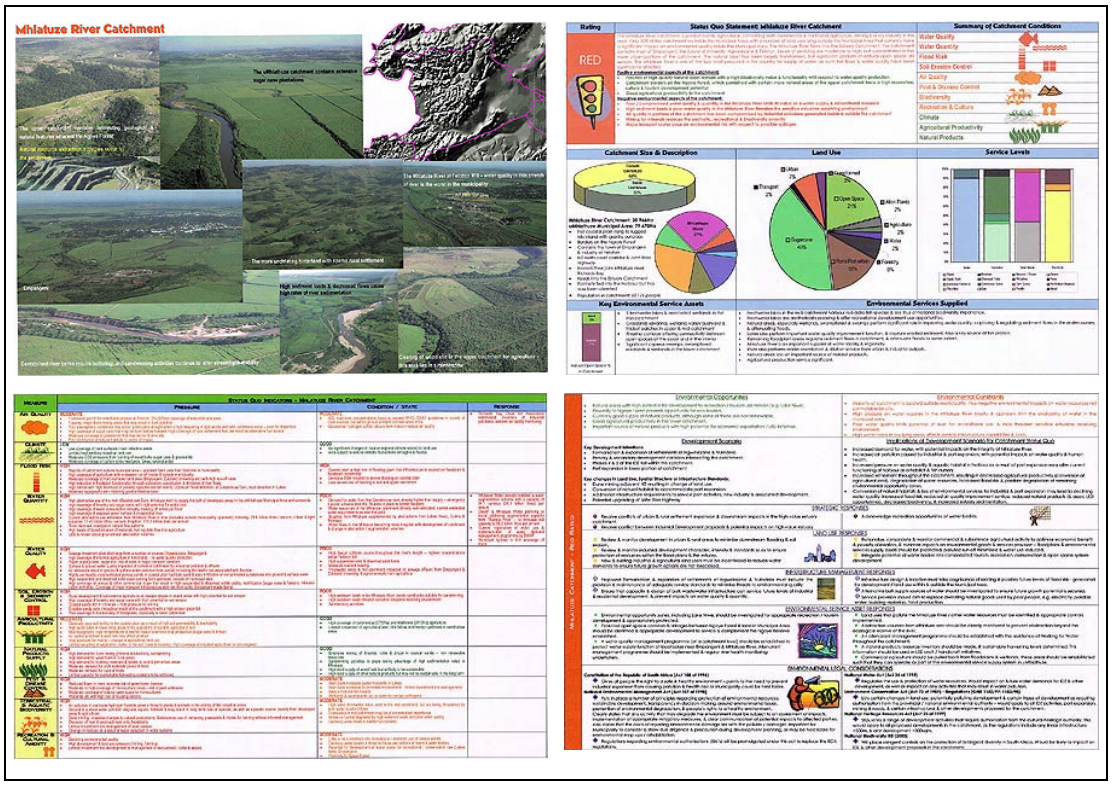

Figure 4.1 Communication-oriented output of the strategic catchment assessment to inform planners and decision makers: a 4-page (A3 size) Status Quo Report.

4.5 Decision making

Instead of identifying and declaring conservation-worthy areas a “no-go”, the study stresses the ecosystem services” that the environment provides free of charge to this Municipality. The experience has been positive. Politicians reacted negatively to the term “biodiversity”, but more positively once they realized that environmental services have an economic value.

The land cover mapping, produced for the SCA, provides the relevant information that could be used to identify sensitive habitats and linkages between ecosystems that need to be maintained. The Municipality embarked upon a process to negotiate these areas in an effort to identify (1) sensitive ecosystems that should be conserved, (2) linkages between ecosystems and (3) areas that could be developed without impacting on the area's ability to provide environmental services. More importantly, (4) it would identify the management actions that need to be implemented in the area in order to ensure not only the survival for key biodiversity assets, but also the sustainable use of biodiversity resources to benefit all residents of uMhlathuze.

Box 4. Environmental Services Management Plan – Durban, Republic of South Africa

The planning of Durban's social and economic upliftment agenda relies to a large degree on the most appropriate usage of the city's open spaces. These open spaces provide important services, such as water for sanitation and drinking and raw materials for building, and protect citizens from natural disasters such as floods. Open spaces also that enhance Durban's stature and attractiveness as a lifestyle city and a popular tourist destination. Visitors to the city are very often impressed by the abundant greenery and well-maintained open spaces that are available for leisure, recreation and tourism.

To this end, the eThekwini Municipality has prepared an Environmental Services Management Plan (EESMP) that aims to protect and enhance the value of a network of open spaces throughout the city precincts, and which will ensure the continued supply of environmental services for the benefit of all residents. Various types of open spaces and ecosystems provide varying mixes of environmental goods and services; e.g. wetlands are worth around R 200,000 per hectare per annum while forests have a value of around R 21,000 per hectare per annum. Research in the field is ongoing, but currently available figures are widely accepted as a useful guide and tool for providing 'order of magnitude' estimates of the value of open space to humanity. It has been estimated that the total replacement value of the environmental goods and services supplied by the 2002 open space system is R 3.1 billion per annum. It is noteworthy that this excludes the value of the role of open space in the tourism industry of Durban which itself was estimated to be worth R3.3 billion in 2001 (about € 330 million).

The Plan was developed from a review and refinement of the potential Durban Metropolitan Open Space System (D'MOSS). Central to the Plan is a system of linked open spaces, which deliver a range of environmental services to the citizens. River catchments were used as logical units to assess the supply of, and demand for, environmental services. There is undeveloped land throughout the Unicity, all of which supplies environmental services. Of this undeveloped land, 62 000 ha is the critical or minimum amount, identified in the plan, that is required to sustain the supply of environmental services. By including only critical areas in the system to ensure the supply of environmental services, about 18% less land is required than in the 1999 D'MOSS Framework Plan.

In March 2003 the EESMP was approved by the eThekwini Municipal Council as their official policy for the planning and management of the city's open space system. This has paved the way for active implementation of the open space plan.

Source: eThekwini Municipality (2002). Durban Environmental services management plan. (www.durban.gov.za/durban/services/departments/environment/documents_reports/desmp/).

One of the first strategic responses to the assessment was to review the Industrial Expansion Strategy with respect to:

- Destruction of the nationally significant natural habitats;
- Downstream impacts on a regional fisheries resource;

- The Municipality's primary tourism and recreation zone;
- Human & environmental health risks;
- Water supply constraints.

An Environmental Services Management Policy and Plan has been established with the aim to include provincial conservation targets into local biodiversity planning; to resolve conflict between "conservation" and "development" parties and to form a partnership; to alleviate delays during EIA's as a result of biodiversity concerns; to identify sensitive areas upfront in planning and to avoid impacts; to define functional spatial management units for management to optimise the delivery of environmental services; and to develop management plans to secure these services.

This resulted in Environmental Services Management Plan Zones distinguishing different planning zones:

- "Red" – Conservation Zone (Level 1)
- "Green" – Open Space Buffer or Linkage Zone (Level 2)
- "Clear" – Development Zone (Level 3)

The way forward is considered to be the integration of the Environmental Services Zones into the Spatial Development Framework (SDF) and Land Use Management System (LUMS) processes and the establishment of Nature Reserves by means of proclamation for core areas.

Two main lessons indicated by the municipality staff in charge of the process:

- The use of ecosystems services and focus on the value of these services for society was of key importance to convince local councils that biodiversity conservation makes economic sense;
- Planners are in the best position to influence sustainable development, so educate them.

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5. Wareham Managed Realignment in the UK

Messages

- Absolute monetary values of ecosystem services are difficult to establish when relying on meta-data or transfer of data from other areas. Local data collection is needed, but laborious.
- When dealing with different alternatives, relative difference in values provides a good basis for comparison.
- Sensitivity analysis is an important tool to avoid the risk on majors errors, and to focus efforts for further research on most relevant issues.

5.1 Introduction to the case

Near the village of Wareham (Dorsett, UK), 400 ha. of grazing land and 26 properties are protected by 20 kilometres of tidal flood banks. These banks are in poor condition and are nearing the end of their design life. The responsible authority (Environmental Agency – EA) recently started a process to decide what action should be taken to manage flood safety.

5.2 Context of the case study: the planning process

Flood and Coastal defence (sea level rise): Since 2002, the national policy on Flood and Coastal Erosion Risk Management is based on the *"Making Space for Water"*. This is a strategic approach focusing on sustainable management of flood risks in an environmental, economic and social sound manner. On the local level this approach is elaborated in Local Shoreline Management Plans (SMP's). All SMP's are subject to public consultation and take account of wider social, environmental and economic objectives.

Under the *Habitats Regulation* compensation for the loss of habitats is required. One of the consequences from climate change is loss of inter-tidal habitats (salt marshes). These can be created in Wareham when the managed realignment options (see below) are practiced.

For any project, plan or change in present flood risk management a policy appraisal is required, paying attention to environmental costs and benefits. Because several impacts on ecosystem services will need to be taken into consideration, there is a wider scope for the use of economic valuation techniques as part of the appraisal process.

5.3 Assessment context

An earlier policy appraisal, focusing on the promising alternative of managed realignment, did not apply economic values to any environmental or non-market

impacts. That is why in this case study economic values are applied to ecosystem service changes under different scenarios.

Scenario's include the following:

1. *Doing nothing / baseline*: This is not a viable option but used as baseline;
2. *Do the minimum*: A continuation of the present level of maintenance that delays failure;
3. *Improvement*: Maintaining appropriate standards of defence in the face of sea level rise;
4. *Managed realignment (unconstrained)*: Removing all tidal flood banks. Some secondary defences will be maintained in order to protect a small number of key habitats that can't be replaced elsewhere.
5. *Managed realignment (constrained)*: Removal of tidal flood banks in some sections, with secondary defences for selected habitats and maintenance of flood banks in other sectors.

The study is conducted as case material in the handbook Economic Valuation of Environmental Effects that is being developed for the EA. The focus lies on how valuations of ecosystem services in one place (existing studies) can be used in other situations.

5.4 Ecosystem services & valuation

Key ecosystem services identified where:

- *Supporting services*: nutrient storage (regulating services: water purification); soil formation, primary production;
- *Provision services*: loss of (marginal) grazing land, fisheries changes, nursery function
- *Regulating services*; carbon storage (climate regulation), erosion regulation is was captured in scope of appraisal;
- *Cultural services*: recreation and tourism (fishing, navigation, bird watching, shooting, walking, local business), aesthetic values (warning for double counting), cultural heritage values

Initial identification of ecosystem services and key costs (flood damage, loss of land, new habitat creation, recreation, archaeology and local economy) where discussed in a workshop. Key stakeholders provided comments and more detailed information.

Quantitative valuation in the case study is based on data transfer from other studies in similar (wetland) circumstances:

- Agricultural land is 65% of the agricultural market value;
- Recreational services are quantified but rarely in monetary terms (travel cost, stated preference). Here entrance fees are used.
- Other services (fisheries, carbon storage, nutrient cycling, navigation) are not included in appraisals because they are not translated in monetary terms.
- Focus lies on the economic valuation of habitat changes, based on existing valuation studies (meta-analysis) of wetland habitats. The main methodological problem was

that it is not always clear which services (fisheries, water supply, etc.) are included in the analysis of the wetland type value. Meta-analysis is not suited to valuation of specific services because functions are used to provide a general 'habitat' value. It may be possible that some or all of the other services identified are already included in the general habitat value estimates. Besides, values are given in absolute figures while alternative use (of the wetland type) is always possible (other types of tourism or fisheries). Concerning habitat valuation in relation with compensation, valuation is different because compensation is legally required; than valuation is irrelevant. Last, values are given for a certain year (say 2006) and can't be used directly in, say, 2012.

- The above reasoning is also true for recreation values; they may be included in the general wetland ecosystem services benefits.

So, there is substantial uncertainty about most elements of the case study and the appropriate monetary values to apply to these due to:

- Scientific evidence gaps on a.o. timing of defence failures, sea level rise, types of habitat created, sediment availability, carbon and nutrient sequestration in different habitat types, fish population and species / people using different habitat types;
- Economic /human behaviour evidence gaps on a. o. river based tourism, trips across flood banks, recreational boating and recreation in new habitats;
- Valuation evidence gaps on archaeological values, recreational values, nutrient sequestration values and dealing with uncertainties.
- Methodological uncertainties: see above.

Results of the valuation can be divided in: (a) Estimates of the absolute value of the ecosystem services; and (b) Estimates of the differences in value between the baseline and each of the other options.

When valuing the ecosystem services, the *improve* option appears to be by far the least beneficial option as well in a) as in b). The absolute as well as the relative value of ecosystem services is the highest in option *MR unconstrained*, with *do nothing* and *MR constrained* second and third. Additional sensitivity analysis demonstrates that the absolute value of the ecosystem services is highly uncertain and it suggests that the *improve* option is a poor performer under a wide range of assumptions.

Habitat valuing makes the difference between *do nothing* and *MR*: the increasing area of reed beds in *do nothing* is valued higher than the grazing lands that are protected in *MR* variant. The relative value of reed bed thus is a key issue to be examined further. A relatively small adaptation in values can change the balance in favour of another option.

The main barriers for incorporation of impacts on the value of ecosystem services into project appraisal are:

- The high level of uncertainty regarding data and economic value estimates (scientific data: habitats created, exact timing of defence failures, sea level rise, sediment availability etc; data on economic/human behaviour: tourism, boating, etc.).

Via an audit system uncertainties should be documented so that other parties can always verify results;

- The complexity involved in applying benefits from one situation to another and the implications for those conducting appraisals (methodological issues).

The potential for valuation to provide useful input to policymaking, discussions, option formulation and prioritisation is recognised. However, valuations should be robust. In practice this is difficult because of the barriers mentioned. Introduction of standard values, clear guidance, templates and training will help.

5.5 Decision making

On the balance it seems highly likely that the favoured *MR* options will be significantly better in Net Present Value Terms. However, these results are preliminary and highlight a number of key uncertainties: recreation, local economy, fisheries, etc. A next stage will focus on how to distinguish between various MR options. It is a staged process and ecosystem service valuation can be helpful in planning and prioritising stages. The case study does not go into detail on influence on decision making because it is still to early in the process. However, the authors of the case study argue that inclusion of ecosystem services in the appraisal provides evidence that, in the context of climate change and biodiversity loss, some schemes have a higher cost-benefit ratio. This makes expenditure of public money more efficient.

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6. Climate policies and the Stern Review

Messages

- The most far-reaching policy changes for improving the functioning of ecosystem services can be achieved by making the Treasury the champion of the economic valuation study. They have both the authority and the means to follow up the recommendations.
- Boundary conditions such as timing, communication and ownership are more important in terms of generating societal impact than the quality of the study.

6.1 Introduction to the case

The global climate is an overriding condition for the functioning of all ecosystems and the ecosystem services they provide. Reversely, ecosystems themselves play an important role in climate stabilisation and regulation. The intricate relations between climate and ecosystems work at a global level; from a climate perspective the globe is functioning as one large ecosystem. Changes in the global climate lead to fundamental changes throughout the world's ecosystems, and therefore also affect the economic sectors that depend on these ecosystems. The Stern Review is one of the best-known assessments to estimate the economic impact of climate change.

The Stern Review on the Economics of Climate Change is a 700-page report released on October 30, 2006 by economist Lord Stern of Brentford for the British government It discusses the effect of climate change and global warming on the world economy. Although not the first economic report on global warming, it is significant as the largest and most widely known and discussed report of its kind. The Stern Review was prepared by a team of economists at HM Treasury. Independent academics were involved as consultants only. The Stern Review emphasised the need for urgent action to be taken to mitigate climate change.

6.2 Context of the case study: the planning process

After fierce political debate in the UK during the period 2003 and 2004, the Chancellor of the Exchequer, Gordon Brown announced that he had asked Sir Nicholas Stern to lead a major review of the economics of climate change, to understand more comprehensively the nature of the economic challenges and how they can be met, in the UK and globally. This request was made on 19 July 2005. The debate preceding the request from Gordon Brown concentrated around several issues:

- *Lack of political consensus on climate change in the UK*: This motivated the former UK Chancellor of the Exchequer, Nigel Lawson, to write a letter to The Times criticising this political divide.

- *Lack of knowledge on the economic of climate change*: In 2005, the House of Lords Economics Affairs Select Committee, of which Nigel Lawson was a member, undertook an inquiry into the economics of climate change. The committee's report, The Economics of Climate Change, recommended the UK Government to make greater efforts to assess the costs and benefits of climate change mitigation and adaptation.
- *UK's divide on the position regarding the Kyoto Protocol and the Intergovernmental Panel on Climate Change (IPCC)*: This divide was illustrated by a debate between two eminent scientists. Michael Grubb, Chief Economist of the Carbon Trust, said that Kyoto's sequential targets helped to achieve many of the things the House of Lords report wanted. David Pearce, the senior advisor to the House of Lords committee, criticised the IPCC for the lack of input of economists in climate policymaking, and recommended that HM Treasury take a more active role. The House of Lords report pointing at the mismatch between the costs and benefits of climate policy as estimated by independent academics and as assumed by politicians.

6.3 Ecosystem services & valuation

The Stern Review starts by explaining the possible climate change scenarios. Average temperatures could rise by 5°C from pre-industrial levels if climate change goes unchecked. This temperature change will affect all countries globally, but the poorest countries will suffer earliest and most. Global warming will result in many millions more people being flooded. By the middle of the century 200 million may be permanently displaced due to rising sea levels, heavier floods and drought. Global warming is likely to also seriously affect global food production and could result in the extinction of 15-40% of species.

Before the industrial revolution the level of greenhouse gases in the atmosphere was 280 parts per million (ppm) CO_2 equivalent (CO_2e); the current level is 430ppm CO_2e. The level should be limited to 450-550ppm CO_2. Anything higher would substantially increase risks of very harmful impacts. Anything lower would impose very high adjustment costs in the near term and might not even be feasible.

The main message of the Stern report is that what we do now can have only a limited effect on the climate over the next 40 or 50 years, but what we do in the next 10-20 years can have a profound effect on the climate in the second half of this century. In other words: the benefits of strong, early action considerably outweigh the costs. Unabated climate change could cost the world at least 5% of GDP each year; if more dramatic predictions come to pass, the cost could be more than 20% of GDP. The cost of reducing emissions could be limited to around 1% of global GDP. Each tonne of CO_2 emitted causes damages worth at least $85. At the same time, emissions can be cut at a cost of less than $25 a tonne. Shifting the world onto a low-carbon path could eventually benefit the economy by $2.5 trillion a year.

Stern characterizes climate change as "the greatest and widest-ranging market failure ever seen". To correct this market failure several elements of policy are required for an effective response:

- *Carbon pricing*, through taxation, emissions trading or regulation, will show people the full social costs of their actions. People should be charged more for carbon-

intensive goods. The aim should be a global carbon price across countries and sectors. Emissions trading schemes, like that operating across the EU, should be expanded and linked.

- *Technology policy* should drive the large-scale development and use of a range of low-carbon and high-efficiency products. Globally, support for energy research and development should at least double; support for the deployment of low-carbon technologies should be increased by up to five times. International product standards should also be introduced.
- *International action* is needed in various ways. First, climate change should be fully integrated into development policy, and rich countries should honour pledges to increase support through overseas development assistance. Second, international funding should be targeting: (a) exploring the best ways to curb deforestation should be started very quickly; (b) improved regional information on climate change impacts; (c) researching new crop varieties that will be more resilient to drought and flood.

The Stern Review has been heavily criticized by some economists, saying that Stern that he used an incorrect discount rate in his calculations, that he did not consider costs past 2200, and that stopping or significantly slowing climate change will require deep emission cuts everywhere (Tol and Yohe, 2006; Nordhaus, 2007). A comprehensive overview of the concerns is provided in Table 6.1. These critiques come at no surprise since earlier studies showed a much less severe impact of climate change than the cost estimates published in the Stern Review (see Figure 6.1).

Table 6.1 Reasons for concern over damage estimates in the Stern Review

Source of concern	Reason for concern
No new literature and no new models supporting damage estimates	Damage estimates are three standard deviations higher than the mean of earlier peer-reviewed estimates
Impacts of climate change	*Water*: does not address adaptation *Sea level rise*: does not address adaptation *Food*: ignores growth *Health*: ignores growth *Refugees*: uses most pessimistic scenarios *Catastrophic risk*: Double-counts its sources
Very low discount rate employed in damage estimates	Future impacts weigh heavily High residuals past 2200 Leads to inefficient investment
Mitigation cost estimates truncated at 2050	Mitigation must continue past 2050
No justification of the 550 parts-per million target	Lower target implied Damages metric not comparable

Source: G. Yohe and R. S. J. Tol, 2007 (Table xx, page xx).

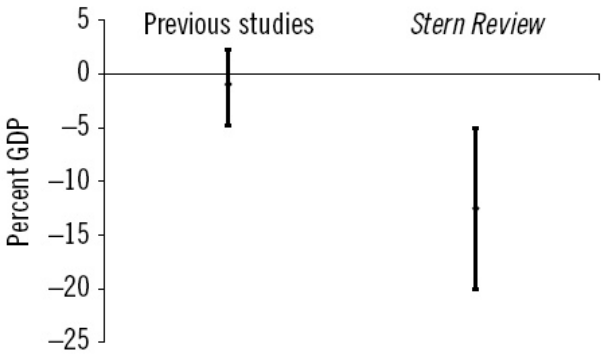

Figure 6.1 Estimates of the damage of climate change costs

Source: adapted from Tol and Yohe, 2006 (Figure 1)

Box 5. Cost of Policy Inaction on Biodiversity

Impressed by the impact of the Stern Review on the Economics of Climate Change, the European Commission requested a consortium of researchers to conduct a similar study for the economic impact of biodiversity loss. The study was commission in late 2007 and the first results were presented on 29th May at the 9th Meeting of the Conference of the Parties (COP9) to the Convention on Biological Diversity, in Bonn.

One of the main components the economic review is the assessment of the Cost of Policy Inaction (COPI) with regard to the conservation of biodiversity. The COPI research was carried out by a consortium of institutes led by Alterra in the Netherlands. The COPI study starts off by stating that the 2010 targets for biodiversity will not be reached under continuation of the present biodiversity policies. It demonstrates that the absence of additional biodiversity policies come at a considerable price. These costs result from the fact that natural systems will no longer be able to supply valuable services, such as carbon storage in forests and the supply of sufficient amounts of clean freshwater. A very first coarse estimate shows this loss to be around 7% of the Gross World Product (GWP), by 2050.

Table 6.2 The Cost of Policy Inaction (COPI)

Ecosystem service	Annual loss (billion €)
Food, fiber, fuel	192
Air quality maintenance	-2,019
Soil quality maintenance	-1,856
Climate regulation	-9,093
Water regulation & purification	-782
Culture & recreation	-303
Total Economic Value	-13,861

L. Braat & P. ten Brink (eds.) (2008). The Cost of Policy Inaction: The case of not meeting the 2010 biodiversity target (Executive Summary). European Commission, DG Environment. Brussels.

6.4 Decision making

The Stern Review attracted more attention than any other economic valuation study in history. Influential people from all over the world were inspired by the Review to stress the urgency of immediate action.

A range of *industrial stakeholders* responded positively to the Stern Review, considering the climate challenge as a business opportunity rather than a threat to their industry. For example, the Prince of Wales' Corporate Leaders Group on Climate Change, formed by 14 of UK's leading companies, expressed the hope of the group that business and Government would discuss how Britain could obtain "first mover advantage" in what he described as "massive new global market". Obviously, more conservative responses were also made. Many UK and EU industries responded that without countries, like the US, China or India making decisive climate commitments, EU and UK competitiveness will certainly suffer if they act alone.

A number of esteemed *scientists* embraced the Stern Review, stressing the need to act now rather then later, thereby advising governments worldwide to follow the recommendations made by the Review. These included a number of economic Nobel Prize winners such as Robert M. Solow (Nobel prize economist 1987), James Mirrlees (1996), Amartya Sen (1998), and Joseph Stiglitz (2001). The latter stated that the Stern Review "makes clear that the question is not whether we can afford to act, but whether we can afford not to act. To be sure, there are uncertainties, but what it makes clear is that the downside uncertainties—aggravated by the complex dynamics of long delays, complex interactions, and strong non-linearities—make a compelling case for action." (HM Treasury, 2006). Although, the scientific community was certainly not unanimous about the underlying assumptions and calculations, the majority supported Stern's conclusion that the expected benefits of tackling climate change far outweigh the expected costs.

The most significant impact of the Stern Review was seen in the *policy* arena. A number of governments responded by announcing expansion of their climate policies. British Prime Minister, Tony Blair, stated that the Review demonstrated that scientific evidence of global warming was "overwhelming" and its consequences "disastrous" if the world failed to act. A number of measures would follow soon after this recognition (see next Section). Australian Prime Minister, John Howard, responded by announcing that AU$60 million would be allotted to projects to help cut greenhouse gas emissions. Much of this funding was directed at the non-renewable coal industry. The European Commission also strongly acknowledged the Review by stating the need to act now.

Since publication, the team of the Stern Review widely discussed the results of the Review with policymakers, academics and business leaders across the world, in particular in the EU, China, India, Japan, Indonesia, Africa and USA, Canada and Australia. Being struck by the progress on developing policy to reduce energy intensity as well as overall emissions, Stern published a working paper in which he reflected on

these positive policy changes (Stern, 2007). Among others, he reports the following progress in climate change policies from around the world:

- In the *UK*, the Climate Change Bill was introduced in Parliament on 14 November 2007 and completed its passage through the House of Lords on 31 March 2008. It will shortly go to the House of Commons for consideration. The aim is to receive Royal Assent by summer 2008. The Climate Change Bill contains provisions that will set a legally binding target for reducing UK carbon dioxide emission by at least 26 per cent by 2020 and at least 60 per cent by 2050, compared to 1990 levels.[3]
- The *EU* took a more stringent position on carbon trading, sending a strong signal on the role of carbon markets at the centre of the EU's strategy to deliver deeper emissions cuts. The member states also agreed on a new independent EU commitment to reduce greenhouse gases by at least 20% by 2020, and pledging to go further up to 30% compared to 1990 levels by 2020, as part of an international agreement by other developed economies. Moreover, the EU has agreed mandatory targets on renewable sources in energy use, and the phasing out of the traditional light bulbs.
- *China* is beginning to implement energy efficiency measures, which involve energy efficiency and changes to taxation of vehicle sales. Also, a new tax on energy-intensive products for export has been introduced.
- In *India*, the Integrated Energy Policy under the 11th Five Year Plan is being taken forward—including changes to energy subsidies, plans for more efficient coal-fired power plant and further development of innovative new technologies for renewable energy.
- Willingness to act in *Japan* is mainly shown during debates between government, industry and civil society on the challenges of designing further domestic and international action. Rapid technological progress is made in plug-in hybrid vehicles and solar technology. Japan's responsibility in climate issues in trade and foreign investment, particularly with China and India, is also recognized.
- In *Africa*, climate change has risen sharply up the agenda. By making climate change one of the key themes for the Summit in January 2007, African leaders have become increasingly aware of the vulnerability of their countries, as well as the opportunities for adaptation, sustainable land management and low-carbon development.
- Also in the *US*, there have been some significant initiatives to reduce dependency on fossil fuels, and some states, cities and businesses have set objectives to limit

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[3] In more detail, the Bill involves the following aspects (www.parliament.uk):
- Requires the Government to publish five yearly carbon budgets as from 2008;
- Creates a Committee on Climate Change;
- Requires the Committee on Climate Change to advise the Government on the levels of carbon budgets to be set, the balance between domestic emissions reductions and the use of carbon credits, and whether the 2050 target should be increased;
- Places a duty on the Government to assess the risk to the UK from the impacts of climate change;
- Provides powers to establish trading schemes for the purpose of limiting greenhouse gas;
- Confers powers to create waste reduction pilot schemes;
- Amends the provisions of the Energy Act 2004 on renewable transport fuel obligations.

greenhouse gas emissions. For example, California has committed to making a 25% reduction in emissions compared to 1990 levels by 2020, and 80% reductions by 2050. Regional emissions trading schemes, covering most of the North Eastern states of the US, are developing rapidly. At the national level, the government presented plans to improve efficiency, reduce emissions and improve energy security particularly in the transport sector.

Box 6. Carbon trading in the Iwokrama Forest, Guyana

The Iwokrama Forest in central Guyana has nearly one million acre (371,000 hectares) of mostly primary rainforest. It is managed by the Iwokrama International Centre for Rainforest Conservation and Development with the aim to show how tropical forests can be conserved and sustainably used to provide ecological, social and economic benefits to local, national and international communities.

By integrating human needs and values into business development and conservation strategies, partnerships with local communities are established by Iwokrama so they can assist in forest management and get direct benefits through joint business development such as ecotourism and sustainable forestry.

Late March 2008, the Centre announced a deal with a British-led international investment company with the aim to secure the future of the Iwokrama forest, while opening up the way for financial markets to play a key role in safeguarding the fate of this forest in Guyana (WBCSD 2008; Howden, 2007). The director of Canopy Capital, who sealed the deal with the Iwokrama rainforest, said: "How can it be that Google's services are worth billions but those from all the world's rainforests amount to nothing?" The deal is the first serious attempt to pay for the ecosystem services provided by rainforests, such as carbon storage and other ecosystem services. Canopy Capital expects to sell the carbon storage and other rights at a profit within 18 months.

Late 2002, an economic valuation study was conducted in which a first estimate was made of the Total Economic Value of the Iwokrama Forest (Van Beukering and van Heeren, 2002). Sustainable management of the forest was estimated to generate higher economic returns in the order of US$15-31 million over a 30-year period, and proved to benefit especially the local communities. The study also emphasizes the need to invest in the early stages of the management in order to generate higher and more sustainable benefit flows over the longer term. The deal with Canopy Capital seem to follow this route.

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6.5 SEA boundary conditions

The Stern Review was conducted in a period of slightly more than a year. The Review was announced in July 2005 and was ultimately published on October 30 2006. The Stern Review was prepared by a team of economists at HM Treasury. Independent academics were involved as consultants only. The team was lead by Lord Stern, the then Head of the Government Economic Service and former World Bank Chief Economist.

The Stern study is a review of existing studies on the impact of climate change. The data used in the study are therefore not original. Stern based his study largely on the 2001 IPCC and said that the more up to date information from the latest report gives stronger warnings than the 2001 report. In April 2008 Stern said that his findings were vindicated by the 2007 IPCC report. Critics of Stern blame him for cherry picking, selecting the scenarios and assumptions that fit best to the message he wants to get across.

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7. Natural gas extraction in the Wadden Sea, the Netherlands

Messages

- Economic valuation increases the transparency of complex systems. By explicitly highlighting the crucial uncertainties of certain economic activities, environmental conditionality for continuation of projects can be defined in the approval procedure.
- Economic valuation does not necessarily prevent actual implementation of projects that impact ecosystem services, but it may affect the design of the intervention such that costs and benefits are traded off in a rational manner.

7.1 Introduction to the case

The Dutch Wadden Sea is a shallow, semi-enclosed part of the North Sea, mainly consisting of tidal mud flats, sand flats, sea gullies and salt marshes. The area is bordered by a series of dune barrier islands, the "Wadden islands". The Wadden Sea stretches along the North Sea coast from Den Helder in the Netherlands up to Esbjerg in Denmark and is the largest tidal wetland area in Europe. Most of the sea and the uninhabited islands are National Nature Reserve, which is regulated by the Nature Conservation Law and a spatial planning act (PKB). The area is owned by the State and managed by the Ministry of Nature management, Agriculture and Food quality (LNV) and Ministry of public Works, Transport and Water Management (V&W).

The entire area constitutes approximately 250,000 hectares; the nature reserve is ca. 150,000 ha. The Wadden Sea is of international importance being a nursery of marine life, a resting, moulting and feeding area for several millions of migratory birds, and a habitat for thousands of birds, seals and many other species. The area has been selected for European protection as part of the Natura 2000 Network (EUCC, 2008).

The Wadden Sea is not only a region of ecological importance, but provides many economic benefits as well. The region, especially the Wadden islands, is a key recreational area for the Netherlands and Germany. Other important activities include for example fisheries, military practices, wind energy and gas exploitation. Amongst these activities, probably because of its extractive nature, gas exploitation has been a key issue in research and policy debate over the past years.

An estimated 200 billion cubic meters of gas are located below the Wadden Sea distributed over several small fields. In 1969, the ‘Nederlandse Aardoliemaatschappij B.V.’ (NAM), Mobil and Elf Petroland received a concession with respect to gas exploitation from the Wadden Sea. Due to increasing environmental concern, a moratorium was agreed from 1984 to 1993. In the mid-1990’s, the NAM started several test drills from three locations on the mainland. Six gas fields were found and NAM intended to start exploitation again (NAM, 2006).

These plans resulted in public debate and research efforts on the effects of gas exploitation on the Wadden Sea. Van Wetten et al. (1999) in their economic valuation study indicated that negative impacts from gas exploitation on ecology and societal losses could amount to 7 to 32 billion guilders (€3 billion to €15 billion). In 1999, the government rejected the plans of the NAM and exploitation was cancelled. However, an

advisory board ('Committee Meijer') was appointed to further investigate the actual consequences of exploitation. The committee concluded that negative effects on ecology were very limited and gas exploitation should be allowed under strict regulations. As a result, the government approved the plans of the NAM and gas exploitation has started in 2007. Before the actual licences were appointed, the NAM performed an Environmental Impact Assessment (EIA) that further underlined the conclusion of the 'Committee Meijer': there are no ecological reasons to prohibit gas exploitation.

7.2 Context of the case study: the planning process

Nature management in the area is determined by the Key Spatial Planning Decision (PKB Waddenzee), a national planning instrument to combine economic development with environmental protection of the area. Through the various PKB's the government promotes sustainable development by controlling the extent of fisheries, gas exploitation, recreation, tourism and military activities. The PKB is binding upon all national, provincial and municipal authorities. The 3rd draft PKB determining the future of the area for the next 10 years is still under discussion (EUCC, 2008).

One of the key issues in the policy debate is the exploitation of gas from the Wadden Sea. Gas exploitation from the Wadden Sea is an important contributor to the Dutch economy, providing a yearly benefit of approximately €5 billion per year, which is substantial part of the total revenues of fossil fuels in the Netherlands (see Figure 7.1). In addition, by reducing the dependency on fuel imports from the Middle East, Dutch natural gas plays an important role in the European Union as well (MinEA, 2004).

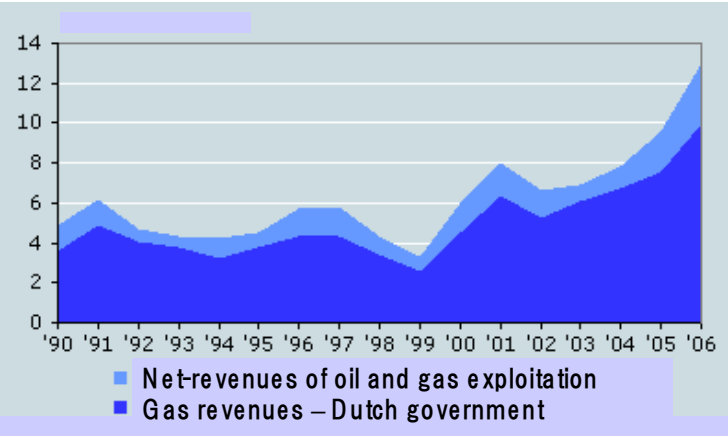

Figure 7.1 Economic importance of natural gas for the Dutch economy

Source: CBS, 2008

Besides economic benefits, gas exploitation may also have an impact on the environment. Gas exploitation can, for instance, cause subsidence of the sea floor, which would affect the area's tidal mud flats, sand flats, sea gullies and salt marshes, including its flora and fauna (NAM, 2006). As the Wadden Sea is an internationally important

wetland from nature conservation point of view, the proposed gas exploitation raised fierce public debate.

The 'Soil Subsidence Study Wadden Sea' commissioned by NAM (1998) was one of the first studies to determine the effects of soil subsidence from gas exploitation in the Wadden Sea. The study determined the abiotic and biotic changes in the Wadden Sea and concluded that the effects of gas exploitation on ecology would be very limited.

In response to this study van Wetten et al. (1999) published the report 'The Dark Side of Wadden Gas'. They argued that NAM (1998) did not take into consideration the effects on ecosystem services such as water regulating, drinking water supply, tourism etc. In addition, van Wetten et al. (1999) point out that the economic value of these ecosystem services has been underestimated and not properly defined in previous studies. Therefore, they conducted an economic valuation study of the Wadden Sea, including a Cost-Benefit Analysis (CBA) of gas exploitation. The Total Economic Value (TEV) of the Wadden Sea should than be taken into account in decision making instead of the sectoral approach taken before.

7.3 Assessment context

In 2005 the NCEA advised several times on the Wadden Sea and its immediate surroundings:

– The Dutch cabinet's latest viewpoint is that the exploration of gas from fields beneath the Wadden Sea and the Lauwers Lake should in principle be possible, on condition that it remains within natural boundaries. The NCEA's advice on scoping guidelines for the EIA report concentrated on the effects of subsidence on the Wadden system and on the water system of the Lauwers Lake. Because important nature conservation values exist in both areas it will be necessary – in addition to geological, hydrological and morphological changes – to offer a good insight into the effects on the natural environment. The cabinet suggests a 'hand-on-the-tap' approach: exploration can only take place within the natural boundaries. If these boundaries are exceeded, the production will be reduced or even stopped (a clear example of application of the precautionary principle). Commissioned by the government, the NCEA was involved in the realisation of this approach.

– Practically at the same time as the advice on gas exploration, the government started an SEA procedure for alterations to the national spatial plan of the Wadden Sea. As a result of the SEA Scoping memorandum , the NCEA concluded that the issue at stake is how the suggested nature assessment should be interpreted: is it a matter of appropriate assessment or is it – due to (still) lacking conservation targets for qualifying species and habitats – just an indicative picture of the effects on the natural environment? The NCEA advised to offer a deeper insight into the intervention-effect relationship, for every activity and every qualifying habitat and/or species: i.e. which mechanisms will be affected, what is the magnitude of the effect, on which scale, how long will the impact last and how long will it take to recover? Source: NCEA, 2006

Box 6. Private sector and the Pagbilao mangrove forest in the Philippines

Mangrove forests and swamps are rapidly declining in many parts of the world. This has resulted in the loss of important ecosystem services, including forest products, tidal wave control, breeding ground for fish etc (Spaninks and van Beukering, 1997). One of the major threats to mangroves in the Philippines is the rapidly increasing aquaculture industry.

The Pagbilao mangrove forest is one of the last remaining mangrove forests on Southern Luzon. Even before World War II, the area was a favourite to poachers who gather the "bakawan" which is a good material for charcoal. Already in 1975, the 145 hectare area was declared as Pagbilao Mangrove Experimental Forest by virtue of Bureau of Forest Development (BFD) Administrative Order No. 7 (s. 1975). This declaration provided the necessary protection (and funding) and further poaching was prevented. In the eighties and nineties, aquaculture was the main driver of further conversion of the Pagbilao forest.

In the 1996, an economic valuation study was conducted with the aim to demonstrate the importance of the Pagbilao mangrove forest. Comparisons were made between the total value of conservation of mangroves and the economic value generated by alternative uses such as aquaculture and forestry. In addition to economic value, equity and sustainability objectives were taken into account and analyzed according to the perspective of different types of decision makers involved. Combining economic valuation and cost benefit analysis the study concludes that if economic efficiency is maximized, conversion to aquaculture is the preferred alternative. However, if equity and sustainability objectives are included in a multi-criteria setting, more sustainable use is the preferred alternative (Janssen and Padilla, 1999; Gilbert and Janssen, 1998).

For decades, government funding was insufficient to properly manage this wetland. Partly inspired by the results of the valuation study, the private sector, such as the coal-fired plant owner Mirant Philippines, came in and joined in the effort. They dubbed this project "Carbon Sink Initiative" and helped rehabilitating forest zones to help absorb pollutants in the air like carbon. Moreover, new investments were made to revitalise the wetland experimental functions. Nowadays, the mangrove forest is claimed to be the living proof of a successful rehabilitation effort.

Janssen R. & J.E. Padilla (1999). Preservation or Conversion? Valuation and Evaluation of a Mangrove forest in the Philippines. *Environmental and Resource Economics* **14(3)**; 1573-1502.

Gilbert, A.J. & R. Janssen (1998). Use of environmental functions to communicate the values of a mangrove ecosystem under different management regimes. *Ecological Economics* **25(3)**, 323-346.

Spaninks, F. & P.J.H. van Beukering (1997). Economic valuation of mangrove ecosystems: potential and limitations. *CREED Working Paper* **14**. p.44.

7.4 Ecosystem services & valuation

Van Wetten et al. (1999), following De Groot (1992), define four ecological functions: regulation functions, habitat functions, information functions and production functions. For each of these functions, the ecosystem services of the Wadden Sea are selected and valued. Bequest and existence values were not included in the study. Using several

valuation techniques, Van Wetten et al. (1999) estimated the TEV at approximately € 4.4 billion (see Table 7.1)

Table 7.1 Total Economic Value of the Wadden Sea in million euros per year

Ecosystem function	Valuation method	Value (million €)
Regulation functions		
- CO_2 storage	Benefit transfer	35
- Flood protection	Damage cost avoided	213
- Protection against salt spray	Shadow price	4
- Strategic drinking water supply	Shadow price (replacement costs)	353
- Seawater purification	Benefit transfer	649
- Pest control potatoes	Shadow price	737
- Natural accession land	Shadow price (replacement costs)	0.45
Habitat functions		
- Refuge nature	Shadow price (investments by public bodies)	266
- Breeding ground mussel	Market price	154
- Breeding ground plaice and sole	Market price	803
- Breeding ground shrimp	Market price	92
Information functions		
- Tourism and recreation	Market price	771
Production functions		
- Production mussels	Market price	231
- Production cockles	Market price	21
- Production lugworm	Market price	0.90
- Production shrimp	Market price	83
Total Economic Value (TEV)		*4,416*

Source: van Wetten et al., 1999

In contrast to NAM (1998), Van Wetten et al. (1999) state that gas exploitation can lead to considerable negative effects and damage to the Wadden Sea ecosystem. They estimate the damage to ecosystem functions that depend on sand flats, sea gullies, salt marshes, beaches and dunes are one third of their estimated value (these include purification seawater, refuge nature, breeding ground, recreation & tourism and production). Estimations of damage to other functions are based on the effects described by NAM (1998). The total costs, in case serious effects occur as a result of gas exploitation, are approximately € 1.1 billion (see Table 7.2).

The economic benefits of gas exploitation on the Wadden Sea were estimated based on three different scenarios, each with a different time period in which exploitation takes place. Applying a 4% discount rate under the baseline scenario (realization period 2011-2025), van Wetten et al. (1999) estimate the aggregated (present) value of the benefits between €3 to €18 billion over the same period.

Finally, these results were applied in a CBA for three different scenarios. The least harmful scenario (no damage in year 1-5, 50% damage in year 6-10, 100% damage in year 11-50), results in a societal loss of €3 to €15 billion as a result of gas exploitation from the Wadden Sea. Van Wetten et al. (1999) admit that these results are based on limited scientific knowledge of several of the presented values and include many

uncertainties. Therefore, the results might involve double counting and overestimation of costs and benefits. On the other hand, intrinsic values were not included and contingent valuation studies to estimate such values were lacking.

Table 7.2 Costs of gas exploitation in the Wadden Sea (in million € per year)

Ecosystem function	Costs (million €/yr)
Flood protection	3
Strategic drinking water supply	47
Seawater purification	216
Damage from water to agriculture/houses	10
Loss of land	28
Refuge nature	89
Breeding ground	350
Tourism and recreation	257
Production	112
Total costs	*1,111*

Source: Van Wetten et al., 1999

7.5 Decision making

In December 1999, the government eventually decided not to give permission for gas exploitation. However, uncertainties and discussions about the effects of gas exploitation continued. In 2003, the government appointed the 'Committee Meijer', an advising committee, to give an integral advice on the Wadden Sea. The committee published their findings in a report: 'Space for Wadden' (Meijer et al., 2004). They concluded that there are no ecological reasons to prohibit exploitation. The main reason for this conclusion is that the dynamic system of the Wadden Sea compensates for soil subsidence. Due to natural dynamics and the supply of sand and mud from the North Sea, the effects of soil subsidence resulting from gas exploitation will be balanced by increased sedimentation and soil accretion. Gas could be exploited without negative consequences. The committee therefore recommended that gas exploitation from the Wadden Sea should take place under strict regulations.

After the advice of the 'Commissie Meijer' the government in 2004 approved gas exploitation from the Wadden Sea. In 2006, NAM published the Environmental Impact Assessment. The main conclusion of the EIA is that gas exploitation does not have negative consequences for the environment. An independent committee confirmed this conclusion and the government issued the licenses. Since February 2007, gas is being extracted from two new gas fields at Moddergat (province of Friesland). From 2008 and 2009, gas will also be exploited from other location in the province of Groningen. Exploitation will continue for 35 years. In total, gas exploitation involves six gas fields, containing about 25 billion cubic meters of gas (NAM, 2008).

Although the economic valuation studies did not halt the project, it increased the awareness of policy makers about the potential economic losses of ecosystem services

and thus affected the design of the gas exploitation infrastructure. Gas exploitation can only take place from outside the boundaries of the Wadden Sea, with oil pipes entering the gas reserves in a sideward direction.

Moreover, clear conditions were set with regard to possible unforeseen environmental impact that may occur in the future. The Dutch cabinet introduced a 'hand-on-the-tap' approach: exploration can only take place within the natural boundaries. If these boundaries are exceeded, the production will be reduced or even stopped. Commissioned by the government, the Netherlands Commission for Environmental Assessment (NCEA) was involved in the realisation of this approach.

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8. Sustainable financing of marine parks in the Antilles

Messages

- Contingent valuation as a means to value ecosystem services can be effectively applied, in this case leading to implementation of measures guaranteeing better management of national parks and financial sustainability of the management operations.

8.1 Introduction to the case

The ecosystems of the Netherlands Antilles[4], with their coral reefs, humid elfin forests and semi-desert scrublands, not only contain the richest biodiversity in the Kingdom of the Netherlands, but also represent an irreplaceable tourism resource – the most important source of income for the islands. The marine ecosystems along the coasts (i.e. coral reefs, seagrass beds, mangroves) are also essential for healthy fisheries and both the marine and terrestrial ecosystems provide a buffer against erosion and hurricane damage. According to a recent report by the World Resources Institute the tourism and ecological value of all the coral reefs of the Antilles is estimated at US$ 24–144 million per year (WRI, 2004).

Well-managed nature reserves are the cornerstone of nature policy and both marine and terrestrial nature parks have been established, or are in an advanced stage of establishment, on all the islands. Good management requires funds for infrastructure, personnel, maintenance, education and public information, but funding for the recurrent annual operating costs of the nature parks has been plagued by instability and deficits. This is caused by dependency on one-time project subsidies, limited ad hoc financial assistance from local government authorities and fluctuating revenues from tourism (Spergel, 2005).

The experience in the region to date demonstrates that self-financing is a viable option for many of the region's protected areas, particularly those that attract large numbers of visitors. Several protected areas, such as the Bonaire and Saba Marine Parks, now have effective revenue generation strategies, and as a result are among the best managed in the region (Geoghegan, 1998). Economic valuation studies helped to establish these systems of sustainable financing.

[4] The Netherlands Antilles, previously known as the Netherlands West Indies or Dutch Antilles/West Indies, is part of the Lesser Antilles and consists of two groups of islands in the Caribbean Sea: Curaçao and Bonaire, just off the Venezuelan coast, and Sint Eustatius, Saba and Sint Maarten, located southeast of the Virgin Islands.

The Bonaire Marine Park (BMP) study (Dixon et al., 1993a) played an important role in the establishment of the financial systems underlying the marine parks in the Antilles. It is a representative case study for the region and explicitly combines analysis of ecological and economic factors. The BMP study took place during the early 1990s, a period in which the management of the Park was being revised and improvements were necessary because of serious concerns about the lack of formal management, an increase in diver activity and the consequences of coastal development in general. The results indicate that proper management can yield both protection and development benefits, but questions of ecosystem carrying capacity and national retention of revenues raise important issues for longer term sustainability.

8.2 Context of the case study: the planning process

Throughout the last two decades in the Caribbean as in the rest of the world, there has been a rapid increase in the number of declared protected areas. A 1992 survey identified 175 protected areas in the insular Caribbean, and that number is likely to have increased in the intervening years. However, only a very small percentage of these declared protected areas exist in actual fact. Most are paper parks in which no management occurs. The motivation to establish protected areas is often based on the perception that such areas enhance a country's competitiveness in the tourism sector. However, while the political will to establish protected areas may be strong, the will to budget for their management has shown itself to be very weak, in the face of urgent national priorities and continuous fiscal crisis (Geoghegan, 1998).

In recent years there have been increasing calls to transform paper parks into managed protected areas, and to establish new protected areas to tap the ecotourism market and to provide a measure of protection against development pressures, particularly in the coastal zone. Given the limited ability of most governments in the region to meet the costs of management, alternative sources of revenue are being explored. Pressure to establish self-financing protected areas is also coming from international development and lending agencies, which often bear the capital start-up costs of protected areas and want to assure that their investments are secure. The implementation of mechanisms for financial sustainability has become a routine conditionality of loans and grants for protected areas. Governments in the region are therefore looking at alternatives to government revenues for financing protected areas (Geoghegan, 1998).

Park development in the Netherlands Antilles has not followed the more traditional sequence of events whereby enabling legislation is passed first, followed by the designation of one or more protected areas. De facto establishment and even management of the parks were initiated prior to their legislation. Management of protected areas by NGO's is also rather unique in the Caribbean region. STINAPA (National Parks Foundation) and its sister NGO's on the various islands are managing protected areas irrespective of land tenure. The Bonaire Marine Park is managed under contract by STINAPA Bonaire, but in the case of the marine parks in Curacao and Saba management agreements with Governments are non-existing or less formal. Nevertheless the partnership between Government and NGO's has served the protected area system well (van 't Hof, 1991).

After its establishment in the early 1980s, the failure to introduce a visitor fee system in 1981 created serious financial difficulties for the Bonaire Marine Park (BMP).

Eventually, with no staff or funding, the Park became a "paper park"; management and control of access were left to the dive operators.

In 1990, the Island Government of Bonaire commissioned an evaluation of the situation, which resulted in the following major recommendations:

- Introduce a visitor fee system;
- Introduce a licensing system for commercial water sports operators; and
- Create a new institutional structure for BMP, including representation from the tourism industry

On the basis of these recommendations the Dutch Government approved funding and technical assistance for the revitalization of BMP for a period of 3 years: US$125,000 for operational costs and capital expenditure plus US$28,000 in technical assistance was allocated for the first year, and US$250,000 was reserved for subsequent years. Allocation of funding in the second and third year of the project would be subject to approval of annual budgets. One condition to the grant was the requirement that a visitor fee be introduced, which would eliminate the need for further financial assistance beyond 1993.

The Park was re-established and revenues were being generated by the introduction of an annual admission fee of US$10 per diver to help pay expenses. In 1992 the fees (called ‘admission tickets’) raised over US$170,000, which was enough to cover salaries, operating costs and capital depreciation. Revenues were also produced by sales of souvenirs and books, and from donations (Dixon et al., 1993a).

Nowadays, Bonaire has one of the most sustainable marine parks in financial terms, in the world. Table 9.4 provides an overview of the relative contributions from various financial sources of the nature parks in the Netherlands Antilles, as well as the level of self-sufficiency.

Table 8.1 Relative contributions from various financial sources and the degree to which these cover the basic requirements for two nature parks per island (one park on St Maarten) (Spergel, 2005)

	Island government 2002-03	Other grants 2002-03	Self-generated revenue 2002-03		Available budget as percentage of basic requirements 2002
Saba	17%	30%	53%	100%	40%
St Eustatius	21%	51%	28%	100%	17%
St Maarten	17%	78%	5%	100%	21%
Bonaire	6%	4%	90%	100%	78%
Curaçao	26%	5%	69%	100%	59%

8.3 Ecosystem services & valuation

Bonaire, a crescent shape island with an area of 288 km^2, is located in the Caribbean Sea approximately 100 km north of the coast of Venezuela. The reefs around Bonaire form a

narrow fringing reef, which starts practically at the shoreline and extends to a maximum of 300m offshore. Approximately 55 other species of coral can be found on the reefs. The whole area is protected as part of the Bonaire National Marine Park since 1999. The site is of international importance being designated as a RAMSAR site (STINAPA, 2008).

To evaluate the success of the BMP in providing protection to the marine ecosystem, a visitors' survey was conducted of among SCUBA divers to obtain their perceptions of the condition of the Park and their rating of selected parameters in comparison to other Caribbean areas or to the condition of BMP in the past. These questions helped to assess the environmental carrying capacity of the BMP from a diver's perspective. Second, photo analysis was carried out to analyse coral cover and species diversity.

The majority of the divers interviewed rated the condition of the reefs high and the overall condition of the reefs in Bonaire better than or equal to any other destination they visited. The results of the photoanalysis indicated that increased diver use was having an adverse impact on the coral reefs, i.e. the extent of coral cover has decreased significantly at the most frequent dived sites. The results of the analysis suggest that there may be a critical level of 4,000 to 6,000 dives per year above which impact becomes significant. Based on the number of available dive sites, Dixon et al. (1993a) estimated the 'annual carrying capacity' at 190,000 to 200,000 dives per year (the average visiting diver makes 10 or 11 dives during his or her stay on Bonaire). Annual use was already more than 180,000 in 1992, so the threshold was likely to be reached with an expected loss of reef biodiversity.

The quantification of the costs and benefits derived from the ecosystem services provided by the BMP was based on the assumption that Bonaire is attractive because its unique resources are protected. Aided by its protected status, a significant privately operated sector is successfully marketing Bonaire as a tourist destination. However, if protection of the marine ecosystem is not maintained, much of Bonaire's attraction would be lost, and along with it the associated revenues currently accruing to the private and public sectors.

The main categories of benefits included in the economic analysis are gross revenues to the private sector and BMP user fees. Of the primary uses of the waters contained in the Park, only revenues from dive-based tourism are considered, as the other uses of BMP waters are less dependent on the protection offered by the Park. Land-based supporting activities to dive-tourism include hotels, restaurants, souvenir sales, and car rental. Table 8.2 lists the main revenues and costs, including divers' fees, associated with Bonaire Marine Park. In 1992, diver and other direct use fees, the one source of "direct" revenues from use of BMP, summed up to about US$190,000. This amount is very small in comparison to other park-related gross revenues.

Given the controversy surrounding the institution of a user fee system, a contingent valuation survey was conducted in late 1991 to get inference of visitor's general perception of and willingness to pay user fees for the BMP. An overwhelming 92 percent agreed that the user fee system is reasonable and would be willing to pay the proposed rate of US$10/diver /year.

Approximately 80 percent of those surveyed said that they would be willing to pay at least US$20/diver/year, 48 percent would be willing to pay at least US$30/diver/year,

and 16 percent would be willing to pay US$50/diver/year, yielding an average value for WTP of US$27.40 (excluding the 8% who were not willing to pay a fee).

Clearly the average willingness-to-pay exceeded the relatively modest US$10 fee instituted in 1992. The difference between what people would be willing to pay for a good or service and what they actually pay is known as consumers' surplus. At the current rate of dive visitation (an estimated 18,700 divers in 1992) admission fees and estimated consumer surplus total US$512,000 per year, of which US$325,000 is the consumer surplus.

Table 8.2 Revenues and costs associated with the Bonaire Marine Park

Revenues	US$ million
Direct Revenue	
Diver fees (1992)	0.19
Indirect (private sector) Revenues (gross)	
Hotels (rooms/meals)	10.4
Dive operation (including retail sales)	4.8
Restaurants, souvenirs, car rentals, misc. services	4.7
Local air transport	3.3
Subtotal	23.2
Costs	US$ million
Costs of Protection	
Direct costs - Establishment, initial operation, rehabilitation	0.52
- Annual recurring costs	0.15
Indirect & opportunity costs	?

Source: Dixon et al., 1993

8.4 Decision making

Bonaire and its marine park are representative of the issues facing many marine protected areas in the Caribbean. The case of Bonaire illustrates the difficult trade-offs that exist in combining economic and ecological goals. Its marine ecology is rich, protected, but threatened. In late 2005 another long-held ambition became reality: Several employees of STINAPA, including the Director, the Managers, and the Chief Rangers, acquired Police-type ticketing and law enforcement powers.

On March 31, 2005, the 1991-legislation covering Marine Park usage fees was changed with the inauguration of the Nature Fee. With the introduction of this legislation all the users of the Bonaire National Marine Park, not solely the divers, pay a user’s fee. The most significant changes include:

- Marine Park tags also admit entrance to Washington/Slagbaai National Park.
- The price of Marine Park tags for SCUBA divers changed to US US$25.00 for a year pass or US$10 for a day pass.

- Swimmers, board sailers, and all other users of the Marine Park are now required to have to pay US$10 for a year pass.

Recently, it was decided that tag receipts go directly to STINAPA and are used entirely for the management of Bonaire's National Parks (STINAPA, 2008).

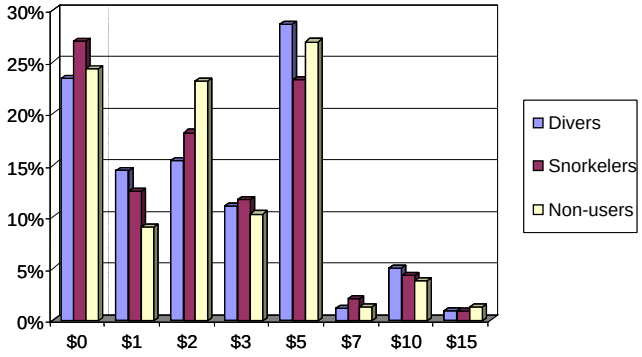
The model of sustainable financing as developed in Bonaire is referred to in the Caribbean, and even receives worldwide attention. Although it is hard to prove this, the Bonaire model is often regarded in policy discussions on marine funding as the classical example of how to develop a system of payments for environmental services for marine ecosystem systems.

Box 8. Marine Recreation Operators Join Forces with Conservationists in Hawaii

Hawaii's coastal waters are blessed with miles of exquisite coral reefs. More than 25% of the islands' marine life is found nowhere else on earth. Because government budgets for marine protection are not sufficient, particularly in Hawaii where government funding for marine management is among the lowest in the nation, private action and private money are essential in helping to ensure that the Hawaiian reefs are protected.

Recognising the need to support the state's work, dive and snorkel operators and local conservation organizations joined forces in 2005 to raise money for marine conservation on the Big Island and Maui. Through an innovative new program called the Reef Fund, dive and snorkel operators solicit voluntary donations from their clients to fund high priority marine protection programs on their islands, such as the repair and installation of mooring buoys, the protection of nesting and resting beaches for rare and endangered sea turtles and monk seals, and the establishment of local education and outreach programs to protect marine resources.

Originally, the private industry feared the negative impact for their business of requesting their customers to contribute to conservation. A 2003 survey done by Cesar and Van Beukering for TNC and the State Division of Aquatic Resources, however, indicated that 80% of those surveyed were willing to pay at least US$5 per snorkel/dive day for marine resource protection programs if the funds went to a private institution or non-profit and were not managed by a government agency (Beukering and Cesar, 2004; Beukering et al., 2004).



Distribution of WTP per activity for conservation program

While the majority of other fee-based marine protection funds around the world are mandated by the local or national governments, Hawaii's fund is voluntary. On Maui, the Reef Fund is coordinated by the local non-profit Hawaii Wildlife Fund. On the Big Island, the fund is managed by the Waimea-based non-profit Malama Kai. Donations collected by marine recreation operators are pooled into a collective fund on each island, and managed by the non-profit which is advised by a committee of operators, conservationists, scientists, and other stakeholders. The advisory committees decide how the funds will be spent on their islands.

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9. Payments for Environmental Services in Costa Rica

Messages

- Payment for ecosystem services (PES) has played a major role in changing Costa Rican destructive and rapid deforestation into sustainable management, with tangible and convincing results.
- PES facilitates market processes between individual landowners and the world carbon market.
- PES can ease the existing inequity in distribution of costs and benefits, when benefits of ecosystem services accrue to the global community, while the opportunity cost of not converting a forest lies with local landowners.
- Through the explicit quantification of the societal demand and supply for ecosystem services, economic valuation can play an important role in the emergence of PES.

9.1 Introduction to the case

The Costa Rica Payments for Environmental Services (PES)[5] program was initiated in 1997, becoming one of the first country-wide PES programs in the world, and the first to adopt the terminology of environmental services and PES. Since its inception, it has become a point of reference for environmental authorities and practitioners around the world, as well as becoming one of the pillars of Costa Rica's image as a "green" country that is a model for sustainable development.

The program was fostered by the 1996 changes in the Forest Law that created the legal framework to pay landowners for the provision of four types of ecosystem services (1) carbon sequestration; (2) watershed protection; (3) scenic beauty; and (4) maintenance of biodiversity. Originally, Costa Rica's government expected a large influx of funds through the sell of carbon sequestration and biodiversity prospecting by pharmaceutical companies, but neither materialized and, while there are still high expectations for the former, the latter has been almost abandoned. Nevertheless, the Costa Rican government pressed ahead, earmarking for PES a 3.5% tax on fuels and putting in place the program management agency, the Fondo Nacional de Financiamiento Forestal (FONAFIFO) (FAO, 2007).

Since its inception in 1997, a large area of privately owned land participated in the project. As of October 2005, approximately 250,000 ha where under contract: 95% of them for protection of natural forests and 4 % for reforestation activities. By 2005, public and private water users were paying some 0.5 million dollars a year for watershed conservation through forest protection (FAO, 2007).

[5] Pagos por Servicios Ambientales (PSA) in Spanish

9.2 Context of the case study: the planning process

In the last two decades, Costa Rica transformed from one of the most rapidly deforesting countries in the world to one of the foremost pioneers in reforestation, forest management, and forest protection. The predominant vision of development and economic growth in Costa Rica has been linked until recently with agro-export production, which has affected legal and institutional frameworks, economic policies, and land use decisions (De Camino et al., 2000).

In 1950, forests covered more than one-half of Costa Rica; by 1995, forest cover had declined to twenty-five percent of the national territory. Costa Rica had one of the highest deforestation rates in the world in the 1980s (Ortiz and Kellenberg, 2002). In the past years, however, the deforestation rate has fallen dramatically due to a remarkable set of institutional innovations in Costa Rican forestry in the mid 1990's (Figure 9.1) (Chomitz et al., 1998).

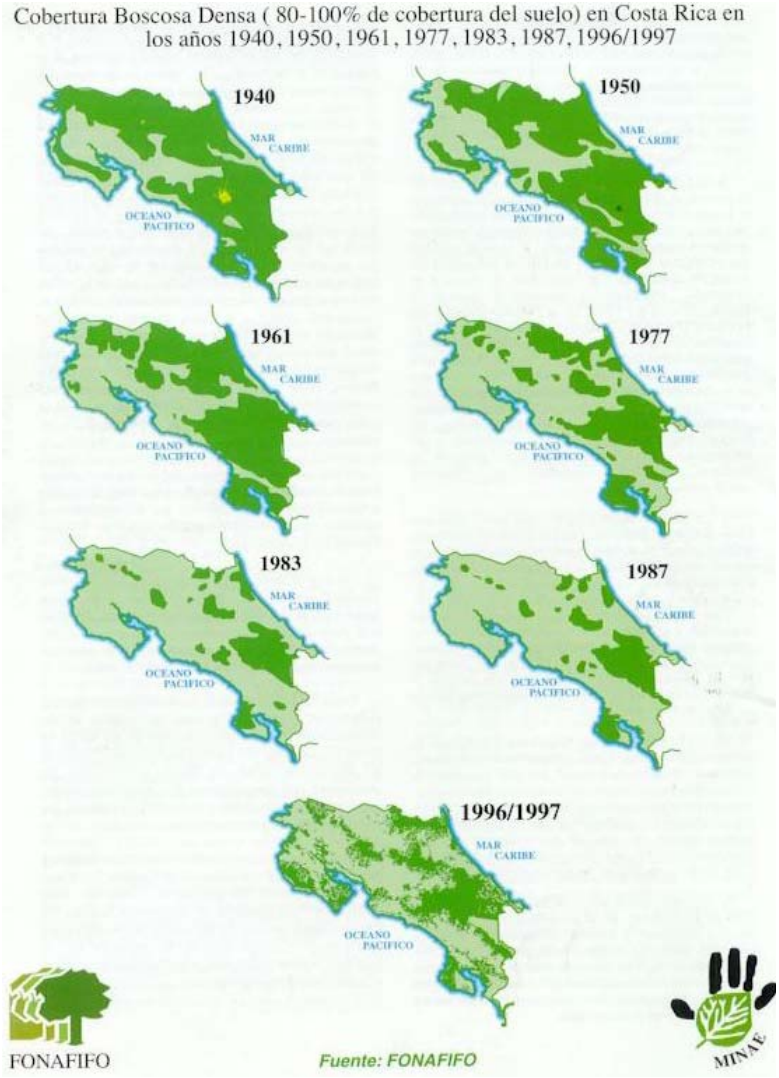

Figure 9.1 Forest cover changes in Costa Rica from 1940 to 1996/1997 (Ortiz&Kellenberg, 2002)

Box 9. Drinking water for New York City from restoration of the Catskill Watershed

In New York City, where the quality of drinking water had fallen below standards required by the U.S. Environmental Protection Agency (EPA), authorities opted to restore the polluted Catskill Watershed that had previously provided the city with the ecosystem service of water purification. Once the input of sewage and pesticides to the watershed area was reduced, natural abiotic processes such as soil adsorption and filtration of chemicals, together with biotic recycling via root systems and soil microorganisms, improved water quality to levels that met government standards. The cost of this investment in natural capital was estimated between $1-1.5 billion, which contrasted dramatically with the estimated $6-8 billion cost of constructing a water filtration plant plus the $300 million annual running costs.

Chichilnisky, G. and G. Heal. 1998. Economic returns from the biosphere. Nature 391: 629-630.

Intent of Costa Rica's PES program

The PES program was established in Costa Rica in 1997. This program evolved in two phases. The *first phase* (1997–2000) coincided with a significant drop in the national rate of deforestation (1997–2000), relative to the 1986–1997 time period and the high rates of forest clearing that occurred from the 1960s to the early 1980s. Recently, there has been a net increase in forest cover, mostly due to land abandonment. The *second phase* of the PES program relates to the implementation of the Ecomarkets project (2001–today) and involves a comprehensive micro-targeting scheme and the provision of new ecosystem services (e.g., drinking water) that were not part of the first phase.

Three laws form the framework within which Costa Rica established the PES program. The 1995 Environment Law 7554 mandates a "balanced and ecologically driven environment" for all. The 1996 Forestry Law 7575 mandates "rational use" of all natural resources and prohibits landcover change in forests. Finally, the 1998 Biodiversity Law promotes the conservation and "rational use" of biodiversity resources.

Payments in the first phase were designed to address relevant forest conservation failures from a legal and institutional standpoint. The PES program compensated forest landowners for value created by either planted or natural forest on their land and recognized the four services (i.e. carbon sequestration, watershed protection, scenic beauty and biodiversity). The program did not attempt to measure all four services on a given parcel at once. An identically valued bundle of these services was assumed to be provided by each hectare of enrolled parcel. In the first phase enrollment was not based on parcel size, and the policy was "first come, first served." Factors such as farm size, human capital, and household economic level influenced participation in the program, and large landowners were disproportionately represented among participants at the national and regional levels.

The PES program has to compete with other land-use returns. Average returns from PES varied from US$22 to US$42/ha/year before fencing, tree planting, and certification costs. The main competing land use is cattle ranching, which shows returns from US$8

to US$125, depending on location, land type, and ranching practices. One measure of cattle-ranching returns is the cost of renting 1 ha of pasture. In Cordillera Central, in the heart of Costa Rica, pasture rental ranges from US$20 to US$30/ha/year (Sánchez-Azofeifa et al., 2007).

Implementation of PES

As shown Table 9.1, three types of contracts were part of the first phase of the PES program in Costa Rica:

- *Forest conservation contracts* required landowners to protect existing (primary or secondary) forest for 5 years, with no land-cover change allowed. The forest management contracts paid US$210/ha in equal parts over a period of five years;
- *Sustainable forest management contracts* (eliminated briefly in 2000) compensated landowners who prepared a "sustainable logging plan" to conduct low-intensity logging while keeping forest services intact. Contracts paid US$327 per ha and were for 15 years, although payments arrived during the first 5 years.
- *Reforestation contracts* bound owners to plant trees on agricultural or other abandoned land and to maintain that plantation for 15 years. Contracts were for 15 years. Contracts paid US$537 per ha with most of the payment in the first two years.

Table 9.1 Distribution of payments per contract type

Contract type	Total Payment (US$)*	Distribution by year				
		1	2	3	4	5
Forest Conservation Easements (C)	210	20%	20%	20%	20%	20%
Sustainable Forest Management	327	50%	20%	10%	10%	10%
Reforestation	537	50%	20%	15%	10%	5%

US$1 = 346 colones

Source: Ortiz & Kellenberg, 2002.

Any PES contract creates a legal easement that remains with the property if it is sold. Owners transfer rights to the greenhouse-gas-mitigation potential of the parcel to the national government. Costa Rica can then sell these abatement units on any international market. Under the PES program rules, no individual can register <2 ha or >300 ha/year, although indigenous groups may register up to 600 ha/year. There is no area limit for coalitions that act through local nongovernmental organizations. Such organizations can function as intermediaries between smallholders and authorities to increase participation by those who might not enroll. FONAFIFO, a public forestry-financing agency created under Forestry Law 7575 in 1996, administers the PES program. The inspection responsibilities within the program's implementation, however, rest with the Sistema Nacional de Areas de Conservacion (SINAC) and with the Ministerio del Ambiente y Energ´ıa (MINAE).

Funding sources for PES scheme

The primary funding source for the original PES program was a 15% consumer tax on fossil fuels established under the 1996 Forestry Law. Its Article 69 stated that FONAFIFO was to receive one-third of the revenue. The Ministry of Finance, however, rarely delivered that amount, and in 2001 the legislature repealed Article 69 and adopted the Ley de Simplificación y Eficiencia Tributaria, which assigns 3.5% of the tax revenue

directly to the PES program. This provided less money in theory, but increased actual transfers from the Ministry of Finance. As of 2003, such tax revenues provided an average of US$6.4 million per year to the PES program.

Funding to the PES program also comes from voluntary contracts with private hydroelectric producers, who reimburse FONAFIFO for payments given to individuals such as upstream landowners in watersheds. These private agreements have generated only about US$100,000 to finance about 2,400 ha of PES contracts. When fully implemented, however, these agreements are expected to provide about US$600,000 annually and to cover close to 18,000 ha.

Carbon-abatement trading was expected to provide significant funding through sales of certified tradable offsets. However, no significant market for carbon abatement has emerged. The only sale has been to Norway, which consisted of US$2 million in 1997 for 200 million tons of carbon sequestration.

Funding was also provided by a World Bank loan and a Global Environmental Facility (GEF) grant through a program called *Ecomercados* (a term used to define the second phase of the PES program after the year 2000). The World Bank/GEF provided a loan for US$8 million to support PES contracts. US$5 million of this total amount was used for conservation contracts along the proposed sites that will eventually form part of the Mesoamerican Biological Corridor. The other US$3 million was used to increase human, administrative, and monitoring capacity in the various institutions associated with the program, including FONAFIFO, SINAC, and MINAE (Sánchez-Azofeifa et al., 2007).

Total Distribution of PES Contracts

Around 300,000 ha of primary, secondary, or planted forest received funding in the first phase of the PES program through 2000. The mean project size was approximately 102 ha. The largest project was 4025 ha. The stated size limits were not fully enforced; 202 projects were over the 300-ha maximum and 60 contained less than the 2-ha minimum. From 1997 to 2000, the number of participants entering the program decreased, probably because funds were not delivered as expected. Payments for conservation alone were larger than the sum of the payments made for reforestation and forest management), but conservation contracts had the lowest payments per unit area. Reforestation and management contracts generally held steady over the years, whereas conservation payments fell (e.g., >$20 million in 1997; almost US$12 million in 1999; and <$4 million in 2001) (Sánchez-Azofeifa et al., 2007).

9.3 Ecosystem services & valuation

In 1993, the World Bank prepared the Forest Sector Review for Costa Rica. The review was the first attempt by the Bank to calculate the total economic value of Costa Rican forests. Table 9.2 shows the economic values of various forest activities according to the Bank's study. Twenty-eight percent of the value corresponds to market values (especially of wood) and 72 percent to non-market values. In the most pessimistic (from

the Costa Rican perspective) distribution of benefits, 66 percent of the environmental services of forests are enjoyed by the global community and only 34 percent by Costa Rica. The cumulative annual rent is US$208 million, of which US$137 million is enjoyed by the global community without compensation for Costa Rican farmers, and US$71 million is received by Costa Rica. Although the study has several weaknesses, such as the inclusion of primary forests only and the exaggerated value of carbon sequestration, the study highlight some important points: the value of environmental services is high, the global community receives the major benefits of these services, and owners of the resources that provide these services are not compensated for their full value (De Camino et al., 2000).

Table 9.2 Total Economic Values of Costa Rican Forests according to the World Bank, 1993 (De Camino et al., 2000)

Product or service	Total value (US$M)	Value per ha (US$)	Value/ha/year (dollars at an 8% discount rate)	Base
Carbon sequestration	1,098	845	68	1.3 mil ha
Sustainable logging	403	620	50	650,000 ha
Existence and option value	383	295	24	1.3 mil ha
Ecotourism	272	209	16	1.3 mil ha
Hydroelectric power	36	207	17	174,227 ha
Pharmaceutical	3	2.3	0.2	1.3 mil ha
Urban and rural water	59	47	3.8	1.3 mil ha
Total	2,254	2,225	179	
Total market	403	620	50	28%
Total non-market	1,851	1,605	128	72%
Total Costa Rica	664	1,001	81	34%
Total Costa Rica	261	381	31	17%
Total World	1,612	1,224	98	66%

Source: World Bank 1993. Table A 4.1.

In 1994, the World Bank issued another study of the value of primary forest in Costa Rica (see Table 9.3). The study arrives at a rent of US$102 to US$214 ha/year without considering the value of wood, and US$170 to US$282 ha/year by considering the value of wood. Although the values assigned by each study differ, both studies support the importance of payment for environmental services (De Camino et al., 2000).

Table 9.3 Environmental Values of Primary Forests (De Camino et al., 2000)

Types of benefits	Average annual dollar value (per ha)
Hydrological benefits	
Urban water supply	2.3–4.6
Loss of hydroelectric productivity	10.0–20.0
Protection of agricultural lands	0.25–2.0
Flood control	4.0–9.0
Subtotal	16.55–35.6
Carbon sequestration	60.0–120.0
Ecotourism (recreation or non-consumptive values)	12.56–25.12
Future pharmaceuticals (optional value)	0.15
Transfer of fund (existing and optional values)	12.8–32.0
Total	102.2–213.7
Net present value (8%)	1,277.5–2,671.3

Source: Kishor and Constantino 1994.

In 1996, MINAE commissioned the Costa Rican Tropical Science Center to conduct a study to obtain a scientific basis for assigning a value to environmental services. The center recommended payments for all four environmental services recognized under the PES program. The study distinguished between primary and secondary forests, departing from the assumption that secondary forests provide fewer environmental services than natural forests (Table 9.4). However, the study did not reveal the criteria that are used to distinguish between primary and secondary forests, or how compensation should be calculated for reforestation, forest management, forest conservation, or agro forestry systems.

On February 26, 1997, MINAE specified PES amounts. The World Bank and CCT studies suggested fixing a quantity per hectare and year or a single payment for one full rotation or cutting cycle. Instead, MINAE fixed a payment for environmental services for a period of five years and as a percentage of the costs of establishing and managing different kinds of forests. This amount is intended as a lump-sum compensation for all environmental services. This decision was made to avoid disrupting forest management.

Table 9.4 Findings of the TSC Study on Recommended Compensatory Payments in US$/yr/ha (De Camino et al., 2000)

Environmental service type	Primary forest	Secondary forest
Carbon sequestration	38	29.3
Water conservation	5	2.5
Biodiversity	10	7.5
Natural beauty	5	2.5
Total	58	41.8

Source: Carranza et al. 1996.

Despite these attempts to estimate the economic value of ecosystem services provided by the Costa Rican forests, both the Forestry Law (1996) and Biodiversity Law (1998) do not define the type of financial instrument nor the monetary amount that should be paid. Therefore, it is essential that FONAFIFO has solid scientific information as input in the negotiations of voluntary agreements, which form an important contribution to the payment mechanism.

One example of scientific support is the study by Reyes et al. (2002). Based on replacement and maintenance cost, they estimated a range of values for the ecological services provided by forests in several watersheds. These values range from US$100 /ha per year (Peñas Blancas watershed) to US$176 /ha per year (Pejibaye watershed). This implies that if forest cover is preferred in relation to the provision of hydrological services and is to be guaranteed in the long term, the landowners would have to receive at least US$100 /ha per year in terms of additional income in order to protect forest cover or commit themselves to reforestation activities.

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10. Water transfer in Spain

Messages

- When it is obvious that significant impacts on ecosystem services can be expected from a plan, ignoring such impacts may lead to opposition and ultimately the cancellation of the plan. **Not** studying (the impacts on) ecosystem services and their respective ecological, social and economic values thus can have serious repercussions.
- The Ebro delta combines multiple ecosystem services. One important service is its role in maintaining internationally important biological diversity. This has resulted in a protected status of parts of the delta. Ignoring this important aspect has contributed greatly to the failure of the water transfer plan to get approval.

10.1 Introduction to the case

The Spanish National Hydrological Plan (SNHP) was passed into law by the Spanish Parliament in July 2001. The SNHP identifies an elaborate programme of infrastructure development and management to assure constant water supply all over Spain. This plan, with a projected capital cost of €4.2 billion, consists of two main parts: (1) A new water transfer of 1,050 cubic hectometres (hm^3) per year from the basin of the Ebro river to other river basins in the north, south-east, and south of Spain; as well as (2) a block of 889 public water works affecting other Spanish river basins.

The chief objective of the SNHP is the transfer of water from the Ebro Basin to four other river basins in the east of Spain. This project is split into two large transfer projects from the Lower Ebro: the Northern Transfer, which would involve transferring 189 hm^3 to the metropolitan area of Barcelona for urban uses; and the Southern Transfer, which proposes to transfer 861 hm^3 to the Levante region and south-east Spain. Almost 70% of this transfer would be used for agricultural purposes, with the remaining 30% being for urban uses (WWF, 2006).

- These water transfers would lead to serious impacts on the river Ebro, which is of high economic and environmental importance for several reasons: The Ebro river basin counts close to 3 million inhabitants, with almost 50,000 living in the Ebro Delta. It has been estimated that economic activities associated with the ecosystems of the Ebro delta produce an annual turnover of €120 million from fisheries, aquaculture, agriculture and tourism (Day et al., 2006).
- Designated as a Natura 2000 zone and Ramsar site, the Ebro Delta is the third most important wetland in Spain with a significant importance at a European level. Water transfer would lead to the deterioration of the Ebro Delta ecosystem. The area is the second most important SPA (Special Protection Area) in Spain after the Doñana National Park.
- New dams will also need to be constructed in the high Pyrenees Mountains to regulate the water flow of the Ebro, which will lead to additional serious environmental and social impacts (WWF, 2006).

Figure 10.1 Location of the Ebro Delta in Spain (IUCN, 2004)

10.2 Context of the case study: the planning process

The SNHP approved by Congress in 2001 set out the government vision on how it intends to regulate, manage and plan the water resources and all their related uses within the Spain. As one step leading to the approval of the SNHP, in 1999, the Water Law (1985) was modified to adapt it to the purposes and needs of the SNHP. The Plan claimed to comply with the requirements of the European Water Framework Directive in terms of sustainable water use, environmental protection, reduction of pollution through efficient water planning, use of economic analyses and instruments, approval and action programs and cost recovery principles. However, extensive analyses indicated that the Plan was not compatible with the Water Directive, mainly in economic and environmental terms (see for example Albiac et al., 2006; Albiac et al., 2003; Biswas and Tortajada, 2003; Embid, 2003; Garrido, 2003; Getches, 2003; Hanemann, 2003; Howitt, 2003).

Aragón and Cataluña, two regions in the basin from which water was to be transferred, strongly opposed the Plan. Aragón argued that the National Hydrological Plan was conventional supply-oriented and could not be justified on economic, environmental nor on social grounds. Furthermore, the water transfer was considered to be unnecessary if proper demand management practices were implemented in the water-importing regions. In terms of sustainability, numerous analyses indicated that the environmental and the economic principles were mostly ignored. The Plan was also questioned because of its lack of assessment of social issues. The Plan merely stated that the transfer would not have any impacts on the economic activities of the donor basin, nor would it have any negative consequences on population distribution in the regions within the donor basin.

From an environmental viewpoint, studies carried out on the downstream areas from the diversion point concluded that the current ecological problems of the Ebro Delta and

estuary would further deteriorate by the implementation of the Plan *(for example, see Ibáñez and Prat, 2003; Arrojo Agudo, 2001)*. One of the main criticisms was that the National Hydrological Plan was approved by the national government even before a comprehensive environmental impact assessment was carried out. The Plan neither considered any of the impacts that such a large water transfer would have on the Ebro Delta in terms of biodiversity, wetlands, ecological flow, and expected changes in land use, and in social and economic activities such as fisheries, rice production, etc.

In economic terms, it was considered that the cost-benefit estimates in the Plan and its strategic environmental assessment were inaccurate or lacking completely (Hanemann, 2003). One example was the revenues per cubic meter of water exported which was expected to compensate the negative environmental impacts in the Ebro River basin because of the transfer. This revenue of € 0.03/m^3 of water exported, however, was not based on economic analyses, but was more of an administrative charge. The compensation was insufficient to mitigate the expected adverse impacts of the water transfer in the exporting region.

10.3 Assessment context

Because funding from the European Commission was necessary for the construction of the infrastructure considered within the Plan, the Government of Aragon and several environmental groups complained formally to the European Commission. There was a hearing before the European Parliament, and later on, a Seminar in October 2003 where the Plan and its impacts were discussed in detail. This Seminar was organized by the European Union with the aim to promote dialogue between the Governments of Spain and that of Aragon and the environmental groups. In the light of the discussions and the results of the different technical studies, and after considering that the Plan did not address properly economic and environmental concerns, there were several reports within the European Commission, which did not recommend the financial support for the implementation of the National Hydrological Plan. However, before the European Commission could take a final decision, the 2004 elections in Spain resulted in the change of the ruling political party and the cancellation of the 2001 National Hydrological Plan (Tortajada, 2006).

Later on, the Law 11/2005 of 22 June was enacted. Through this law, Spain's newly elected socialist government launched a new water policy named the Programa AGUA, Actuaciones para la Gestión y la Utilización del Agua, 'actions for the management and the use of water'.

The AGUA program targets Mediterranean Spain as a priority case for action. The law, Actuaciones en el Litoral Mediterraneo RDL 2/2004, forecasts an additional 1,063hm^3 of water and is estimated to cost €3.8 billion. Ten provinces are included (from Girona in the northeast to Malaga in the southwest) and these provinces are within the catchment area of five hydrographic zones. Twenty-one desalination facilities are planned for six provinces on the Spanish Mediterranean coast to supplement their water needs.

Controversially, AGUA challenges the geographical ideology of the river basin: whereas the National Hydrological Plan sought to balance basin deficits in the Mediterranean region by transferring water from distant basins, AGUA's vision extends the geographical boundaries of the river basin itself beyond its coastal limits to tap the

marine waters and littoral saline aquifers of the Mediterranean coast. Spain has over 1,500 km of coastline and numerous coastal aquifers with brackish groundwater, which can be desalinated. Furthermore, unlike the Ebro transfer, supplies of desalinated water can be predicted independently of climate changes and drought. In theory at least, the opportunities to supply desalinated water to recipient basins are limitless. Sustaining a basin's freshwater needs is simply a matter of financial investment to pay for the facilities' construction and running costs. Conceptually, therefore, resources are traded—as long as the 'value-added' to water (through goods and services produced) exceeds the cost of freshwater provision, the system can be considered economically sustainable. The Spanish government believes these balances can be achieved because the revenues from the service (including tourism) and agriculture sectors offset the financial cost of desalinating water (Downward & Taylor, 2007).

10.4 Ecosystem services & valuation

The Ebro Delta is one of the most important wetland areas in the western Mediterranean and is valuable both economically and ecologically. It is one of the most important bird habitats in the Mediterranean, and the second most important special protection area for birds (SPA) in Spain. Part of the delta (about 8000 ha) was designated as a natural park in 1986. The international importance of the natural values of the Ebro Delta has been widely recognized. In 1984, the delta was declared an area of special interest for conservation of halophytic vegetation by the Council of Europe. It has also been recognized as an area of European importance for conservation of aquatic vegetation. In 1993, it was included in the list of Ramsar areas and is part of the Natura 2000 network. Wetland area has been steadily reduced from approximately 250 km^2 in 1900 to 80 km^2 in 1990 due to conversion to agriculture and other uses.

A total of 330 species of birds have been observed in the delta, of which 81 breed regularly and another 28 do so occasionally. A total of 55 species are included in Annex I of the Birds Directive of the EU. Among breeding species, 50 are aquatic, with 40,000 nesting pairs and a mean population of 180,000 birds in winter. The Ebro Delta has international importance for breeding for at least 24 migratory species and 13 wintering species. With 55 species observed in the delta plain, the fish fauna is also very rich. It is remarkable that there are six endemic species of the western Mediterranean coast of the Iberian Peninsula. In the lower river, there is also a globally threatened freshwater mussel, containing the last viable world population. There are 18 habitats included in the 92/43/EEC Directive for the Conservation of Natural Habitats and Wild Flora and Fauna, from which two are of priority conservation and eight are locally endangered.

Agriculture, fisheries, aquaculture and tourism are economic activities that are dependent on the delta, with a total annual economic value of about € 120 million. Agriculture accounts for a gross economic benefit of about € 60 million, tourism about € 30 million, fisheries about € 20 million and aquaculture about € 10 million. Rice agriculture is the main human activity of the delta (60% of its surface), and rice fields play a crucial role in its economy and ecology. Total production of rice is about 120,000 metric tons per

year, the third most important of the European Union. An extensive irrigation system delivers fresh water from the Ebro River to the rice fields. In addition to the grain harvest, rice fields play significant ecological roles for overwintering of migratory birds, preventing saline intrusion, and in biogeochemical transformations such as de-nitrification.

Fish landings at ports influenced by Ebro River runoff are among the largest of the western Mediterranean, with an average of about 6,000 metric tons per year. Aquaculture is an increasing economic activity, with a high production of mussels and oysters in Fangar and Alfacs bays of about 3,000 metric tons per year. Tourism has increased substantially since creation of the natural park, and currently the number of visitors is estimated to be more than half a million people per year (Day et al., 2006).

The elements of the SNHP that include water transfers from the Ebro have caused great controversy, especially because of the different perspectives and uncertainty in defining the environmental and socio-economic impacts in the donor and receiving basins (Alcácer-Santos). The SNHP uses various economic arguments in support of a water management based on supply, via the construction of reservoirs and water transfers. It quickly rules out other alternatives such as demand management and water conservation, leaving them in the shade. A study carried out by the University of Zaragoza for WWF shows that the real costs of the SNHP were highly underestimated, in fact the SNHP made a negative contribution to economy of € 3.5 billion (Arrojo et al., 2002).

10.5 Decision making

In this case study, it was not so much the presence of economic valuation studies, but the lack of proper estimates of the real costs and benefits, that influenced decision making with regard to the plan. The analytical approaches used to formulate such a complex Plan were generally considered to be inadequate. Critics agreed on the fact that additional studies were needed for a proper economic evaluation of the impacts of the water transfer. These included economic analysis of the long-run elasticity of demand for water for urban and industrial uses in the project area; a marketing study to measure the marginal willingness of the farmers to pay for the water to ensure that the planned sale of imported water was financially feasible; and an economic analysis which implicitly identified the marginal losses of the farmers on their net income for those years when they faced uncertainty of support, taking into account the alternatives available to them, and the frequency with which these years would occur. A study was also necessary to estimate both the existing cost of water supply, and the anticipated future cost when the farmers received the water.

It was generally believed that, if the principles of cost recovery were to be implemented along with the water transfer, water prices for the urban and industrial consumers would have increased substantially. This in turn would have reduced the present and future total water requirements to a significant extent. Cost recovery for the agricultural sector would have also meant that agricultural water rates would have increased substantially, which would have reduced water requirements significantly because marginal and uneconomic agricultural production would have disappeared. Transferred water would not have been economically attractive for many farmers because its cost would have been higher than the marginal value of water in agriculture, and crop profitability would have been insufficient to pay for the transferred water.

The main rational for the water transfer project was that the coastal areas of the south required additional water from the north, essentially from the Ebro River. However, this need was questionable because of some fundamental reasons. First, forecasts of water demands for the future were likely to be significantly less if demand management practices like full cost recovery, proper levels of water tariffs, more efficient water management in the urban, industrial and agricultural sectors, treatment and reuse of wastewaters, etc., were considered. Second, consideration of cost-effective options already available, especially when the cost of transferred water exceeded € 0.45/m^3, was ignored. This includes desalination of seawater and saline groundwater along the coastal areas, which could be provided to the users more economically when the cost per cubic metre of imported water exceeded € 0.45/m3. Furthermore, the desalination option could provide water in about 2-4 years, while the water transfer would not have delivered water to the imported region for at least 10 years, if not more.

From the EU perspective, this plan was also unlikely to be accepted and funded. The National Hydrological Plan did not comply with "principles and articles established in the following Community texts: 1) Treaty of the European Community in the content and numbering arising from the 1997 Treaty of Amsterdam; 2) European Parliament and Council Directive 2000/60/EC of 23rd October 2000, establishing a Community framework of action in the field of water policy; 3) Council Directive 79/409/EEC, of 2nd April 1979, regarding the conservation of wild birds; and 4) Council Directive 92/43/EEC, of 21st May 1992, regarding the conservation of natural habitats and wild fauna and flora" (DGA, 2001, p.13).

An full fledged SEA at plan level could have avoided the total tearing down of the plan. A proper integrated assessment of economic, social and environmental consequences, including the analysis of alternatives based on water demand management would have shown in an early stage the non-viability of the plan in its original form.

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11. Compensation payments by Exxon Valdes

Main messages

- Economic valuation of ecosystem services provides acceptable clues for legal procedures and fines.
- The ecosystem service of maintenance of biodiversity can be monetised as a bequest value by using a stated preference methodology. The valuation similarly provided result accepted in legal procedures.
- This case set an example for liability claims for damage inflicted upon biodiversity.

11.1 Introduction to the case

Around midnight, on March 24, 1989, the *Exxon Valdez* ran aground on Bligh Reef near the coast of Alaska. At that time, the oil tanker was carrying 53,094,510 gallons or 1,264,155 barrels of oil. Approximately 11 million gallons -- the equivalent of 257,000 barrels or 38,800 metric tonnes -- were spilled. The amount of spilled oil is roughly equivalent to 125 Olympic-sized swimming pools.

More than four summers and US$2.1 billion (Exxon’s account) were spent before the effort was called off. Various methods were used to remove oil from the beaches. Not all beaches were cleaned; some beaches remain oiled today. At its peak the cleanup effort included approximately 10,000 workers, 1,000 boats and roughly 100 aircraft known as Exxon’s "army, navy and air force." However, many believe that wave action from winter storms did more to clean the beaches than all of the human effort involved. The spill region contains more than 9,000 miles of shoreline.

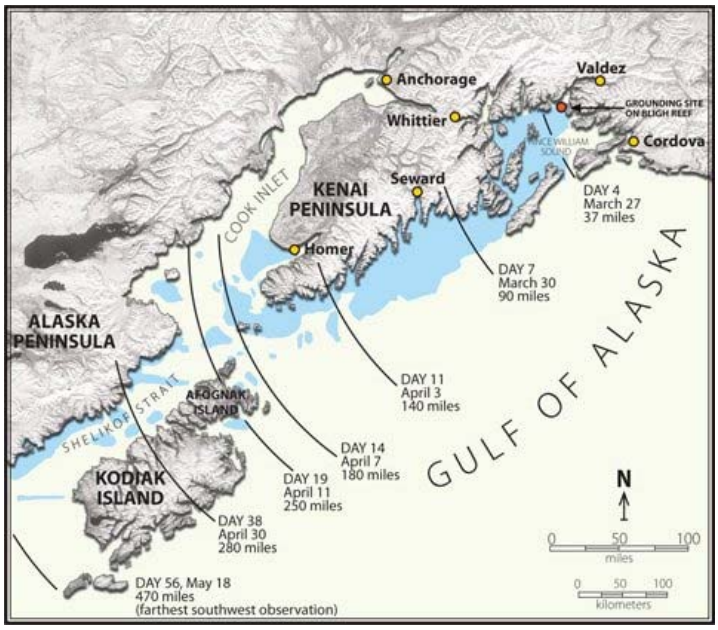

Figure 11.1 Area affected by the Exxon Valdez Oil Spill (EVOSTC, 2008)

The *Exxon Valdez* oil spill (EVOS), though still one of the largest ever in the U.S., has dropped from the top 50 internationally. However, it is widely considered the number one spill worldwide in terms of damage to the environment. The timing of the spill, the remote and spectacular location, the thousands of miles of rugged and wild shoreline, and the abundance of wildlife in the region combined to make it an environmental disaster well beyond the scope of other spills. Partly because it is also the most publicized and studied environmental tragedies in history, the disaster can be considered to be extremely influential in changing policies. For example, much has been accomplished over the years to prevent another *Exxon Valdez*-type accident.

11.2 Assessment context

Following the EVOS, the State of Alaska and the United States acted as trustees to protect and assess damage to the environment. Immediately after the EVOS, the Trustees began a series of studies - the Natural Resource Damage Assessment - to determine the effects of the oil spill on the environment, both its resources and services (e.g., marine and terrestrial mammals, birds, fish and shellfish, archaeological resources, and subsistence). These documents describe the studies necessary to determine the extent and magnitude of injury to natural resources of Prince William Sound and the adjacent Gulf of Alaska, including several economic valuation studies.

The studies to assess injury were designed to support: 1) the development of restoration plans to promote the long-term recovery of natural resources, and 2) the determination of damages to be claimed for the loss of services of the natural resources. These documents were the start of a process of research and consultations, which eventually resulted in a settlement agreement and the development and implementation of a restoration plan for the entire affected region. Figure 11.2 provides an overview of this process and the timing of economic valuation studies within the EVOS proceedings.

11.3 Ecosystem services & valuation

The various impact studies contributed to the establishment of a draft Restoration Plan in 1993. The draft Restoration Plan was analysed in the final Environmental Impact Statement (FEIS), comparing the potential environmental impacts of the draft Restoration Plan, as the Proposed Action 5, and four other alternatives.

The alternatives included:

6. No action, normal agency management would occur, but no restoration actions would be funded from by the Trustees;
7. Habitat Protection, habitat acquisition and protection actions would be the only restoration actions pursued;
8. Limited Restoration, a mix of habitat protection, monitoring and research, and general restoration actions would be implemented for the most severely damaged resources and services;
9. Restoration, habitat protection, monitoring and research, and general restoration actions would be implemented for all damaged resources and services;
10. Proposed Action (Draft Restoration Plan) uses all three restoration categories to restore damaged resources and services, but places greater emphasis on monitoring and research than any other alternative. While emphasizing habitat protection; general restoration actions would be used primarily for resources that were still not recovering.

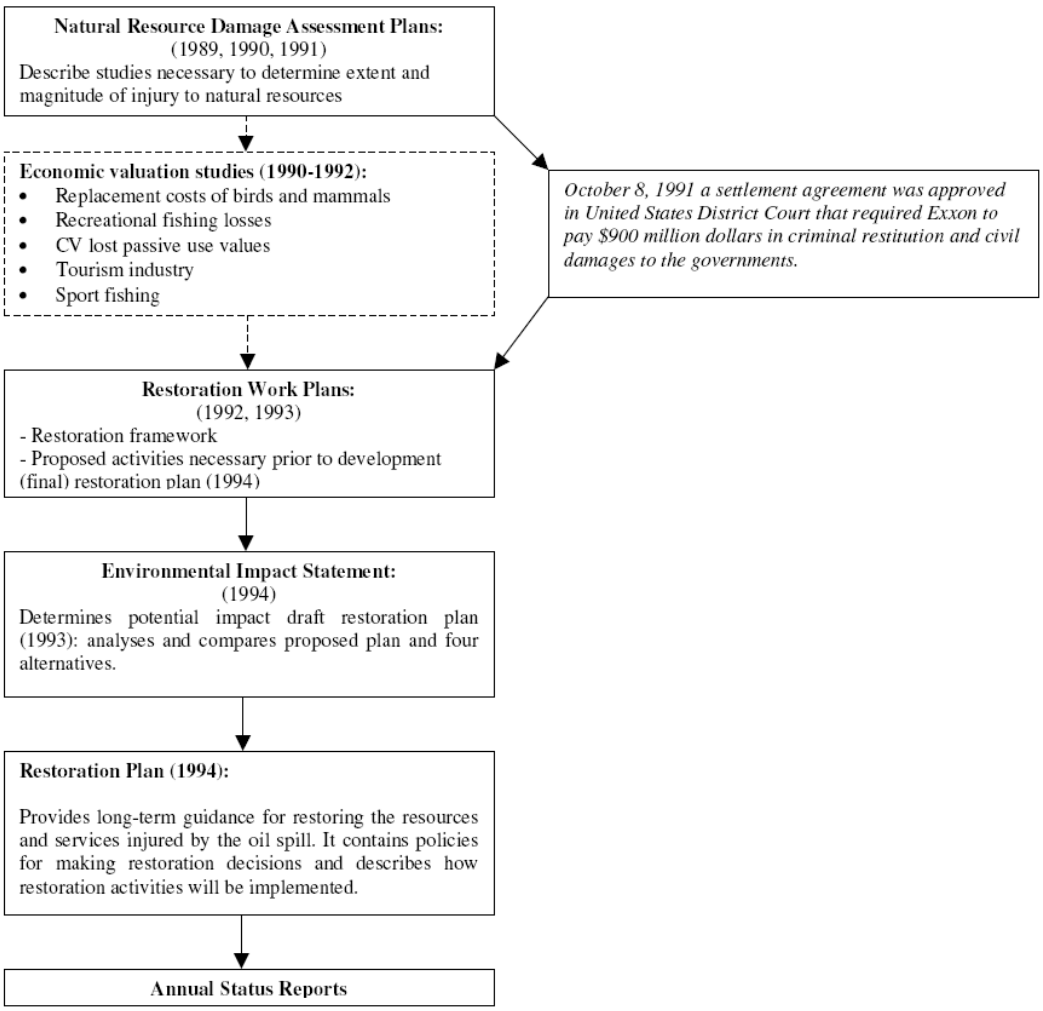

Figure 11.2 Planning process

11.4 Economic valuation

Following the research and planning process, several federal studies were proposed to assess the economic value of injury to natural resources associated with the EVOS. These would cover eight major areas: (1) commercial fishing, (2) public land values, (3) recreation, (4) subsistence, (5) intrinsic values, (6) research programs, (7) archaeological resources and (8) petroleum price impacts.

Ultimately, four ecosystem services were actually valued in economic terms:

- Replacement costs of birds and mammals (Brown, 1992)
- Recreational and sports fishing losses (Carson and Haneman, 1992; Mills, 1992)
- Tourism industry (McDowell Group, 1992)
- Contingent valuation (CV) lost passive use values (Carson et al., 1992)

Replacement costs of birds and mammals

The study estimates values based on the costs of relocation, replacement and rehabilitation for some of the shorebirds, seabirds and the marine and terrestrial

mammals that may have suffered injury or were destroyed in the oil spill. A likely range of costs is estimated and a best estimate is selected (see Table 11.1).

Table 11.1 Range of estimates for replacement costs of mammals and birds (in 1989 US dollars)

	Lowest	Highest
Marine mammals	700 (Harbour seal)	300,000 (Killer Whale)
Terrestrial mammals	125 – 250 (White tailed Deer)	300-500 (Brown Bear)
Seabirds and eagles	167 (Gull)	22,000 (Eagle)

Box 10. Administrative penalties for damage to coral reefs in Hawaii

Throughout the years, the U.S. has enacted several laws that enable trustees to recover damages for injuries to resources under certain circumstances. Funds recovered via Natural Resource Damage Assessments (NRDAs) are commonly used to pay for restoration of the injured resources. The original procedure of NRDAs was that trustees assess the damage, determine the amount of physical restoration that is necessary, and seek the cost of restoration from the responsible party.

Economic valuation is not traditionally used in standard NRDA. It is the cost of the restoration that matters to the trustees, not the value of the resources injured. However, this approach to damage assessment is gradually changing. More and more, trustees have pursued both NRDA damages and civil penalties for the same incident. For example, supported by economic valuation studies, the Florida Keys National Marine Sanctuary introduced a schedule of escalating fines for injury to living coral based on the area of impact.

A similar process of integrating economic valuation in setting penalties is ongoing in Hawaii. Hawaii's coral reef ecosystems provide a wide range of services to coastal populations, such as fisheries, tourism, biodiversity, and natural protection. These same coral reefs are under constant pressure damaging activities such as anchoring, ship grounding and coastal development. Penalizing such damage, not only discourages potential violators from exercising pressure on the reef, but also provides the wardens with means for better management.

Because of the absence of a workable system of penalties for coral reef damage in Hawaii many violators were not punished for doing damage to the reef, despite the fact that the damage to the reef was well documented and the violator identified. It was hard to determine a reasonable penalty because the way the present law is written. Recently, the bill H.B.3176 was proposed to allow the Department of Land and Natural Resources (DLNR) the authority to impose a fine for large-scale reef damage (State of Hawaii, 2008). The fine of up to US$5,000 per square meter is consistent with laws in other states and with the value of the reef. H.B.3176 addresses the urgent needs to have natural resource laws that are complete, clear and enforceable, and providing appropriate opportunities for administrative enforcement.

In setting the level of the penalties, ample use was made of an economic valuation study for coral reefs in Hawaii (Cesar and van Beukering, 2004). Without even attempting to measure their intrinsic value, this study shows that coral reefs, if properly managed, contribute enormously to the welfare of Hawai'i through a variety of quantifiable benefits. As shown in the Table below,

the net benefits are estimated at US$360 million a year for Hawaii's economy, and the overall asset value of the state of Hawaii's 1,660 km^2 (410,000 acres) of potential reef area in the main Hawaiian Islands is estimated at nearly US$10 billion. Converted to value per square meter, the economic value can be as high as US$2,600.

Total economic value of the Hawaiian coral reefs (Main Hawaiian Islands)

		Hawaii - overall
Recreational value	*Million$/year*	304.16
Amenity value	*Million$/year*	40.05
Biodiversity value	*Million$/year*	17.00
Fishery value	*Million$/year*	2.50
Education spill-over value	*Million$/year*	-
Total annual benefits	*Million$/year*	363.71
Net Present Value* @ 3%	*Million$*	9,722

* For a 50-year period

Cesar, H.S.J. & P.J.H. van Beukering (2004) Economic valuation of the coral reefs of Hawaii, *Pacific Science*, 58(2), 231-242.

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Recreational and sports fishing losses

Those planning economic studies to assess damages from lost recreational uses identified sport fishing as the recreational activity with the most potential for rigorous evaluation of the spill's impact. The study indicated the impacts on sport fishing industry through the analysis of annual survey results that has been conducted since 1977 by the Sport Fish Division of the Alaska Department of Fish and Game among anglers who sport fished in Alaska. During a five-year period from 1984 to1988, the estimated number of anglers who fished the area where oil was spilled in 1989 increased continuously. However, these increasing trends changed after the EVOS. The results of the study indicate that in the oil spill area, the estimated number of anglers decreased 13% from 120,160 in 1988 to 104,739 in 1989, the number of household trips decreased 15% from 270,956 to 230,520, the number of days fished decreased 6% from 312,521 to 294,598, and the number of fish harvested decreased 10% from 352.630 to 318,981.

Another study determined a range of monetary values for recreational fish losses after the oil spill (Carson and Haneman, 1992). A lower bound estimate was found by considering the reduction in fishing days between 1988 and 1989 in the immediate spill area (i.e. 17,923 days), ignoring whether households participated in the oil spill clean-up, and valuing lost days at an average value of US$204 per day. This calculation yields a lower bound estimate of US$3.6 million dollars. An upper bound was be found by considering the lost days for 1989 (i.e. 127,527) and 1990 (i.e. 40,669) in the South central area based on a prediction from a simple trend regression equation using the pre-1989 data coupled with a higher value of US$300 per day. This calculation yields an upper bound estimate of US$50.5 million dollars.

Tourism industry

Two research techniques were utilized. The first reviewed all existing data which were accessible and which might indicate impacts of the oil spill on the 1989 visitor season. The second technique included executive interviews of two major groups: tourist-affected businesses and relevant government agencies and organizations.

Overall, the EVOS had major effects on Alaskan tourism industry. Some examples of the identified impacts include:

- The negative effects of the spill directly felt by visitors were as follows: visitor spending decreased with 8% in South-central Alaska and 35% Southwest Alaska from previous summer spending, the two major affected areas. The net result was a loss of US$19 million in visitor spending.
- A potential loss of 9,400 visitors was determined for the summer of 1989, representing US$5.5 million in in-state expenditures.

Contingent Valuation of lost passive use values

The CV study was designed to measure the loss of passive use values[6] arising from damage to natural resources caused by the oil spill. Respondents were told that if no action is taken over the next 10 years another oil spill would almost certainly cause damages to Prince William Sound comparable to those of the Exxon Valdez spill. Respondents were then asked their willingness to pay for a realistic program that would prevent with certainty the damages, which would be caused by such a spill. The median household willingness to pay for the spill prevention plan was found to be US$31. Multiplying this number by an adjusted number of U.S. households resulted in a damage estimate of US$2.8 billion.

11.5 Decision making

On October 8 1991, Exxon agreed to pay the United States and the State of Alaska US$900 million over ten years to restore the damaged resources by the spill, and the reduced or lost services (human uses) they provide. Exxon was fined US$150 million, the largest fine ever imposed for an environmental crime. The court forgave US$125 million of that fine in recognition of Exxon's cooperation in cleaning up the spill and paying certain private claims.

The various impact studies made an important contribution to the settlement and the adaptation of the Restoration Plan and related policies. In 1989, 72 studies were being carried out in 10 categories of natural resources and related services. Research has been continuing on the effects of residual oil in the ecosystem and on the natural recovery process ever since. The Trustee Council adopted the Restoration Plan for the civil settlement funds in 1994 after an extensive public process. More than 2,000 people participated in the meetings or sent in written comments.

[6] These passive use values encompass option values, existence values, and other non-use values.

A major lesson of this disaster was that the spill prevention and response capability in Prince William Sound was fundamentally inadequate. Debate continues over whether a spill the size of the Exxon Valdez disaster can be contained and removed once it's on the water. But there is little doubt that today the ability of industry and government to respond is considerably strengthened from what it was in 1989 (EVOSTC, 2008).

The Exxon Valdez case was also crucial for the further development and acceptance of economic valuation in environmental policy making. After the Exxon Valdez oil spill, contingent valuation studies gained new prominence in the natural resource damage assessment process. It was in this context that NOAA convened a blue-ribbon panel, chaired by two Nobel laureates (i.e. Kenneth Arrow and Robert Solow), to explore whether or not contingent valuation studies were reliable enough to measure total value (direct plus passive use) for the natural resource damage assessment process. To some extent, the panel's recommendations shaped the development of the method, use of the results of stated preference studies by Federal agencies, and the direction of research in the area since 1992.

The NOAA panel concluded that stated preference studies could provide estimates reliable enough to be the starting point of a judicial process of damage assessment, including lost passive use values (58 Federal Register 460, January 15, 1993). Moreover, the panel gave several specific and fairly stringent recommendations on how stated preference studies should be designed and administered to ensure reliability and validity (Arrow et al. 1993).

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Annex I: Concepts

Ecosystem services provide a means to "translate" the role of the biophysical environment in sustaining humanity, and provide insight into the relations between human society and the biophysical environment. In order to better understand these relations, the world can be split up in three different but intensely interacting subsystems: the biophysical subsystem, the societal subsystem and the resources management subsystem, the latter being a combination of institutions, technology, knowledge and human capacity. Figure AnI.1 illustrates the way in which these three settings interact. The core element is the characterisation and classification of ecosystem services provided by the biophysical environment and the assessment of their value for sustaining human livelihoods.

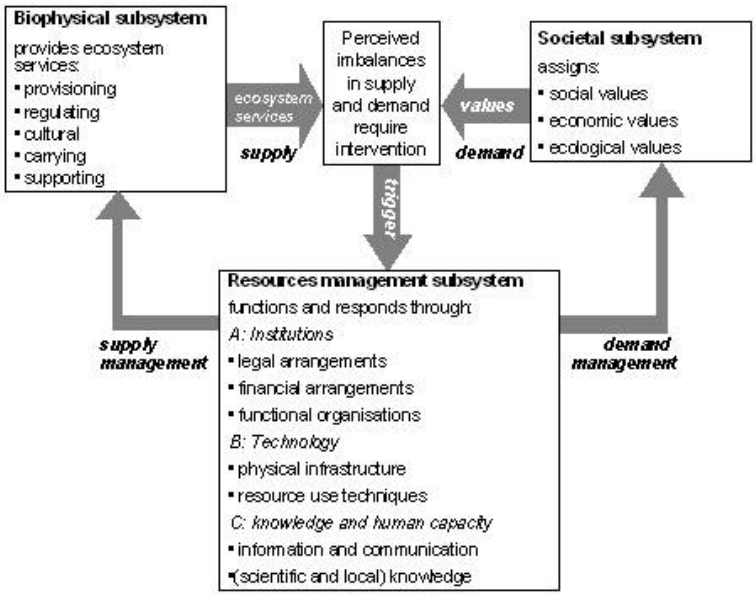

Figure I.1: linkages and interactions of three subsystems[7]

Human society utilises products and services that are provided by the biophysical environment. Society constitutes the demand side, and the biophysical environment constitutes the supply side (supply is not used in the economic sense here; it simply signifies the provision of ecosystem goods and services). The demand for ecosystem services may surpass the available supply, leading to a present or expected future problem (e.g. overexploitation of fish stocks or degradation of soils). Reversely, the potential supply of ecosystem services can be larger than the actual demand; in this situation one can speak of an opportunity for sustainable development (e.g. sustainable exploitation of forests and groundwater aquifers, tourism development). Perceived imbalances thus include both threats *and* opportunities for human development. Simply

[7] Slootweg & Mollinga (in press). Chapter 4: The impact assessment framework. In: Slootweg, Rajvanshi, Matur and Kolhoff (in prep): Biodiversity in Environmental Assessment. Ecology, Biodiversity and Conservation Series. Cambridge University Press

stated, sustainability deals with the equilibrium in supply and demand, now and in the future!

Imbalances in the supply of and demand for ecosystem services trigger the resources management system to act by managing either the supply of ecosystem services (e.g. through hydraulic engineering, agriculture, forestry, compensation payments, etc.) or the demand from society (e.g. through tax incentives, setting of quota, trade negotiations, regulations, etc.). The resources management subsystem is the initiator of policies, plans, programmes and projects that are subject of environmental assessment at project or at strategic level.

Box Annex AI.1: Ecosystem services

- **Provisioning services**: harvestable products obtained from ecosystems. A distinction is made between natural and joint production, i.e. products harvested from nature with minimal human effort, or produce obtained with human inputs such as fertilizers, pesticides or intense resource management. There is no clear-cut differentiation between natural and joint production as many degrees of human intervention occur.
- **Regulating services**: benefits obtained from the regulation of ecosystem processes. Examples are chemical transformation, dilution, sequestration or processing of waste, the dampening of harmful influences from other components such as flood retention, coastal protection or protection against UV by the ozone layer.
- **Cultural services**. These are nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences.
- **Carrying services**. Ecosystems provide space, a substrate, or backdrop for human activities. This represents a group of services not recognised independently by the MA, but yet an important aspect of the ecosystem services concept. It is best illustrated by river navigation. Navigation needs water as a substrate; if water depth is not sufficient a ship will not be able to proceed. Yet, a ship does, in principle, neither influence the quantity nor quality of water.
- **Supporting services** are those services that are necessary for the production of all other ecosystem services. They differ from all the other services in that their impacts on people are either indirect or occur over a very long time. For example, soil formation processes usually play on a time scale which humans cannot oversee; yet they are closely linked to the provision service of food production. As these service support the other groups of services, supporting service are usually not taken into account in valuation studies to avoid double counting.

Source: Millennium Ecosystem Assessment (2004), modified by Slootweg & Mollinga (in press)[8]

Understanding human-induced changes in biodiversity and its impacts on humankind, requires understanding of the **goods and services** provided by biodiversity as important contributors to human well-being. As shown in Figure AI.2, the Millennium Ecosystem

[8] Slootweg, R. & P. P. Mollinga (in press). The impact assessment framework. In: Slootweg, Rajvanshi, Matur and Kolhoff. Biodiversity in Environmental Assessment. Ecology, Biodiversity and Conservation Series. Cambridge University Press.

Assessment[9] provided an elaborate conceptual framework using the common denominator "**ecosystem services**" for the goods and services provided by biodiversity. The MA defines ecosystem services as "the benefits that people obtain from ecosystems".

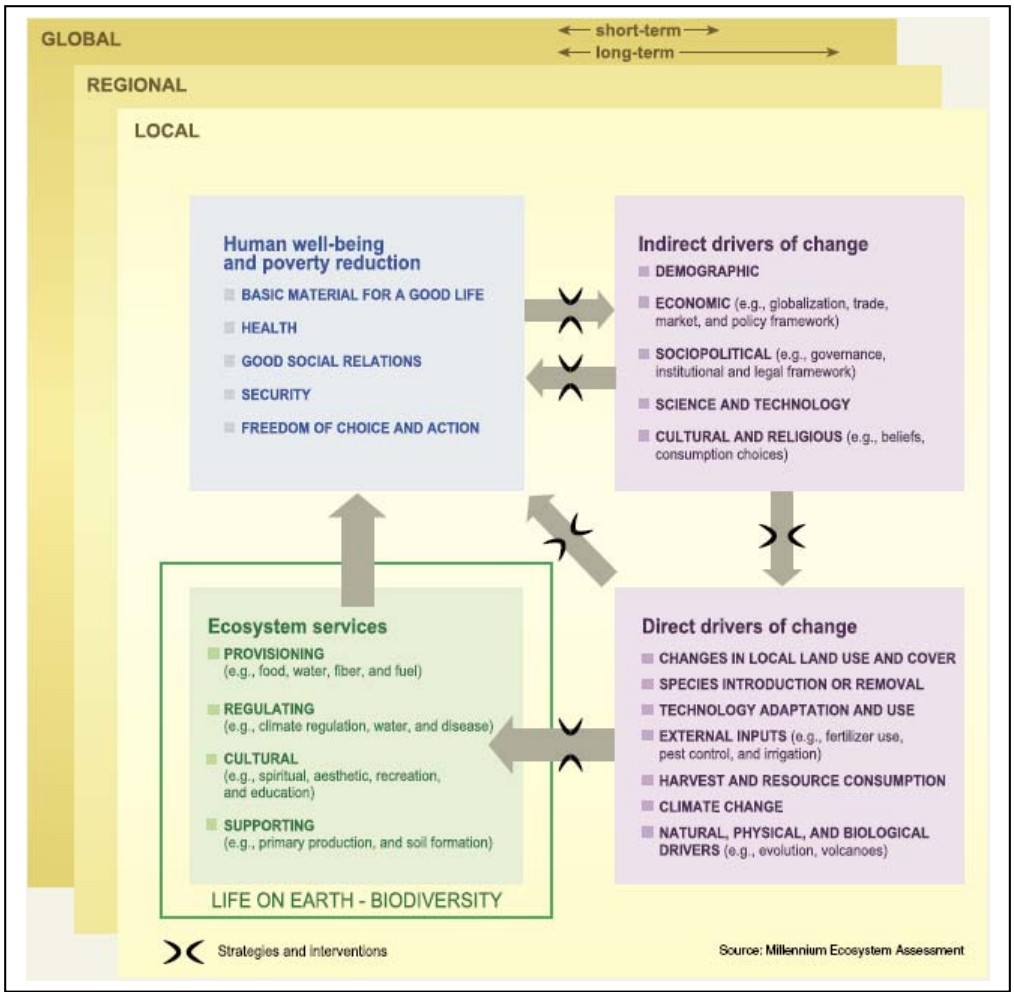

Figure I.2. MA Conceptual Framework. Changes in drivers that indirectly affect ecosystem services, (upper right corner), can lead to changes in drivers directly affecting ecosystem services, (lower right corner). These result in changes to ecosystem services (lower left corner), thereby affecting human well-being.

[9] Millennium Ecosystem Assessment (2003). Ecosystems and Human Well-being: A Framework for Assessment. Island Press. http://www.millenniumassessment.org/en/products.aspx

Annex II: Linking ecosystem services with SEA entry points

The OECD-DAC SEA Guidance recognises twelve different entry points to SEA (see Box AII.1). The CBD Guidance on Biodiversity in SEA recognises three different SEA aspects that trigger the need to pay special attention to biodiversity. By combining the 12 entry points with the three biodiversity triggers, a simple and straightforward framework can be created to identify linkages between a policy, plan or programme (PPP) and ecosystem services (see Table II.2).

Box II.1: Key entry points for SEA in Development Cooperation

(A) For SEA led by partner country governments

1. National overarching strategies, programmes and plans
2. National policy reforms and budget support programmes
3. National sectoral policies, plans or programmes
4. Infrastructure investments plans and programmes
5. National and sub-national spatial development plans and programmes
6. Trans-national plans and programmes

(B) For SEA undertaken in relation to donor agencies' own processes

7. Donors' Country assistance strategies and plans
8. Donors' partnership agreements with other agencies
9. Donors' sector-specific policies
10. Donor-backed public private infrastructure support facilities and programmes

(C) For SEA in other, related circumstances

11. Independent review commissions
12. Major private sector-led projects and plans

Source: OECD DAC (2006)

What triggers the need for a PPP to pay special attention to ecosystem services? This question has been treated in detail in the CBD SEA Guidance, by defining three "biodiversity triggers". If any or a combination of these triggers can be recognised in a PPP there is a definite link with ecosystem services:

- The area influenced by the PPP provides important and valued ecosystem services. This trigger can be recognised in PPPs applying to a geographically defined area, such as inventories of regional development potential (for example the South African case on the Umhlathuze strategic catchment assessment or the Aral Sea wetland restoration strategy)
- The PPP produces direct drivers of change, known to influence ecosystem services. This trigger can be recognised in PPPs with relatively well-defined interventions (for example the Wadden Sea gas exploitation case, the Wareham flood control case, or the Egypt and Ebro water diversion cases). Ecosystem services known to be sensitive for these drivers of change can be mapped creating an overview of potentially affected ecosystem services.
- The PPP leads to indirect drivers of changes, known to influence direct drivers of change. Ecosystem services will be affected if the PPP affects the way in which a so-

ciety (i) occupies areas of land and water (usually leads to a general change in provision of ecosystem services), (ii) consumes products derived from ecosystem services (e.g. forestry, fisheries, biomass for energy), or (iii) exploits ecosystem services (e.g. water resources, soil productivity, genetic resources). Trade policies, poverty reduction programmes, or tax measures are examples of PPPs characterised by this trigger (for example the payment of ecosystem services case from Costa Rica).

Table II.2: Key entry points for SEA from an ecosystem services perspective (this table appears simultaneously in the OECD-DAC Guidance Note on Ecosystem Service, at the time of writing still in preparation).

Key entry points from an ecosystem services perspective for SEAs led by partner country governments.		
Lead Authorities	**Focus Area**	**Ecosystem services perspective**
National Government and Cross-Sector Ministries (*e.g.* Departments of Finance/Planning)	- National overarching strategies, programmes and plans. - National policy reforms and budget support programmes	May affect ecosystem services predominantly through indirect drivers of change. Ecosystem services underpin development, but may also be affected, intentionally or unintentionally, by development policies. Sustaining ecosystem services may require specific investments in management and monitoring through national and local budgets. National plans (such as a PRS) should consider/map ecosystem services dependency. National programmes should consider their impacts on ecosystem services and how this may affect other development goals.
Sector or Line Ministries (*e.g.* Mining, Health or Agriculture)	National sectoral policies, plans or programmes, *e.g.* energy or health sector reform	May affect ecosystem services through direct drivers of change where it concerns physical interventions, or through indirect drivers where a policy may affect the way in which society consumes, depends on, or makes use of ecosystem services (see fig 1 for examples). Ecosystem services underpin development, but may also be affected, intentionally or unintentionally, by PPPs. Sector PPPs should consider how their impact on ecosystem services may affect goals of other sectors.
Transport, Energy, Water, Sanitation Ministries	Infrastructure investments plans and programmes	Infrastructure investment affects ecosystems through direct drivers of change, and may thus impact on ecosystem services in the area under influence of these drivers (e.g. downstream in a watershed, or in a zone of influence along linear infrastructure). The planning process eventually results in a choice of location(s) or alternatives, thus providing a detailed view on affected ecosystem services at these locations, and potentially affected beneficiaries of these services.
Sub National, Regional and Local Governments	National and sub-national spatial development plans and programmes	Spatial planning affects geographically defined areas. An assessment of ecosystem services in this defined area, including their social, economic and ecological importance, can inform the planning process on development opportunities and constraints. It can also provide an overview of sensitive areas to specific drivers of change.
International/ Transboundary Agencies	Trans-national plans and programmes	All of the above may apply. The cross-boundary character of many ecosystems and their services (watersheds, groundwater aquifers, climate regulation, etc.) makes the ecosystem services approach particularly useful for transboundary plans. Attention needs to be paid to differences in legal regulations, institutional arrangements and monitoring systems with respect to ecosystems and their services.
Key entry points from an ecosystem services perspective for SEAs in relation to donor agencies' own processes		

Lead Authorities	Focus Area	Ecosystem services perspective
International (multilateral and bilateral) Development Agencies	Donors' Country assistance strategies and plans	Focus on: the role of ecosystem services in supporting human well-being in the country; ecosystem services the poor depend on for well-being and livelihoods (with their participation); existing drivers of change and expected future trends; and decide with stakeholders what measures to take as a result of the analysis above.
	Donors' partnership agreements with other agencies	Create procedural guarantees so that ecosystem services and their stakeholders will be taken into account in planning and execution.
	Donors' sector-specific policies (*e.g.* water and sanitation, agricultural development)	See above. E.g. check existing in-country EIA/SEA regulations, other relevant regulations, and capacity of the sectors to determine whether they make provision for considering linkages between the policy and ecosystem services.
	Donor-backed public private infrastructure support facilities and programmes	See above.

Key entry points from an ecosystem services perspective for SEAs in other, related circumstances

Lead Authorities	Focus Area	Ecosystem services perspective
Independent Review Commissions	Independent review commissions (*e.g.* Extractive Industries Sector Review, World Commission on Dams)	It is important to include experts on ecosystem services as well as representatives with local ecosystem knowledge and perspectives in the review commission. The experts should be familiar with the MA conceptual framework and the institutional requirements to implement an ecosystem services based approach that addresses how a PPP depends on and affects ecosystem services.
Private sector	Major private sector-led projects and plans	Companies currently primarily assess their environmental impacts in terms of pollution, resource consumption and possible interference with protected biodiversity, thus overlooking their impacts on ecosystem services. Likewise corporate environmental management systems typically focus on risks and do not identify opportunities to provide new products or services to mitigate impacts on ecosystem services.

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