THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY

TEEB for National and International Policy Makers

Part I: **The need for action**

Ch1 The global biodiversity crisis and related policy challenge

Ch2 Framework and guiding principles for the policy response

Part II: **Measuring what we manage: information tools for decision-makers**

Ch3 Strengthening indicators and accounting systems for natural capital

Ch4 Integrating ecosystem and biodiversity values into policy assessment

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Ch10 Responding to the value of nature

Chapter 7: Addressing losses through regulation and pricing

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Chapter 7

Addressing losses through regulation and pricing

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Key Messages of Chapter 7

Policies to date have not succeeded in curbing ongoing losses or degradation of biodiversity and ecosystem services, e.g. the loss of forests, fisheries and the pollution of air, marine and water resources. For the reasons outlined earlier in this report, the costs of these losses are still hidden or distorted. Polluters and resource users rarely meet the costs of the real damage caused by their activities and sometimes pay nothing at all.

Rewarding benefits and reforming subsidies (Chapters 5 and 6) are important components of policy reform but in isolation they will never be enough to halt continuing losses. A coherent strategy to make the full costs of loss visible and payable should form the backbone of new biodiversity policies.

Basic principles for halting ongoing losses

Policy design should be based on two key principles: the polluter pays principle and the full cost recovery principle. Many tools for this purpose already exist and more are coming on stream, but their potential is far from fully exploited. Such instruments encourage private and public actors to incorporate biodiversity values in their decisions and investments and can stimulate economic efficiency and technical innovation. They contribute to social and distributional equity and can increase the credibility and acceptability of public policies in force.

Regulating to avoid damage: environmental standards

Environmental regulation has long been and will remain central to addressing pressures on biodiversity and ecosystems. The use of prohibitions, standards and technical conditions has a proven track record and has delivered major benefits. A well-defined and comprehensive regulatory framework should be the baseline for policies to avoid damage and a precondition for introducing compensation mechanisms and market-based instruments.

Regulatory frameworks should support attribution of environmental liability to provide further orientation for the private sector and promote more efficient approaches both to prevention and remediation of damage by responsible parties.

Setting more accurate prices by the use of market-based instruments

A systematic proactive approach is needed to send accurate price signals about the true value of ecosystem services. Incentives can be adjusted by using opportunities to apply standards or introduce taxes, charges, fees, fines, compensation mechanisms and/or tradable permits. This should be part of a wider fiscal reform in favour of biodiversity (see also Chapters 5, 6 and 9).

Designing smart policy mixes

Combining policies provides the opportunity to adequately address different ecosystem services and different actors. Effective policy mixes need to take account of institutional background, capacity, traditions, affordability and the characteristics of the resource or service in question.

It is crucial to communicate the benefits of introducing regulation and market-based instruments to overcome political/social opposition. Flexible policy mixing can:

- stimulate greater efficiency through price signals and least cost solutions to environmental problems;
- through compensation tools, provide for no net loss in policies or even create net-gain solutions;
- generate additional public revenues that, if earmarked, can support pro-biodiversity measures.

Monitoring, enforcement and criminal prosecution

Effective enforcement is critical to give policies teeth and demonstrate the gravity of environmental crimes. Adequate funding for technical equipment and trained staff is essential to show policy makers' commitment to tackling biodiversity and ecosystem losses.

7 Addressing losses through regulation and pricing

"If we were running a business with the biosphere as our major asset, we would not allow it to depreciate. We would ensure that all necessary repairs and maintenance were carried out on a regular basis."

Prof. Alan Malcolm, Chief Scientific Advisor, Institute of Biology,
IUPAC -- THE INTERNATIONAL UNION of Pure and Applied Chemistry
http://www.naturalcapitalinitiative.org.uk/34-quotes/

Chapter 7 focuses on ways to increase accountability for the cost of damage to biodiversity and ecosystem services in order to curb further losses. **7.1 sets out key concepts** to underpin all policies, aligned with the polluter pays principle. **7.2** describes the role of **environmental regulation** and shows how economic information can be used to inform and target regulatory standards. **7.3** analyses **compensation schemes** designed to ensure no net loss or a net gain of biodiversity and ecosystem services. **7.4** discusses the scope and limitations of **market-based instruments** in delivering additional conservation gains and encouraging innovative approaches. **7.5** addresses the critical need to improve **enforcement** and international cooperation in the area of **environmental crime**. **7.6** concludes the chapter with design indicators for a **smart policy mix.**

7.1 BASIC PRINCIPLES FOR HALTING ONGOING LOSSES

"We should not limit our attention to protected areas. If we do we will be left with a patchwork quilt: pockets of nature in a desert of destruction."

José Manuel Durão Barroso
President of the European Commission 'Biodiversity Protection – Beyond 2010' conference in Athens, 27 April 2009

As highlighted throughout this report, policies to date have not managed to halt loss or degradation of ecosystems and biodiversity. We need **instruments that reflect and incorporate the cost of such losses** to turn this situation around. Many promising tools are available and can be more widely shared but their potential is not yet fully exploited.

Chapters 5 and 6 showed how payments for ecosystem services and reformed subsidies can help build up natural capital and create positive incentives for biodiversity action. However, their contribution will be undercut if economic activities continue to lead to releases of pollutants and ecosystem degradation. Measures explicitly designed to avoid ongoing losses are therefore a core component of the policy mix.

Decision-makers and resource users will only take such losses into account if confronted with the real costs involved. This report has already stressed the factors that conceal such costs: lack of information, lack of appropriate incentives, incomplete property rights, relatively few markets or regulation. We face a situation of market failure because most markets do not signal the true value of biodiversity and ecosystem services or show what their losses cost us.

This chapter focuses on a range of policy tools to incorporate such costs, showing their respective advantages and disadvantages and providing guidance for improved instrument design.

Strengthening instruments to make costs visible can have several advantages for policy makers:

- **using values transparently** can justify environmental regulation and help overcome political resistance (see Chapter 2). Showing what and how much society is losing can strengthen the hand of policy makers arguing for improved policies;
- confronting those who cause damage with the associated costs **can stimulate efforts to take preventive action, thus boosting efficiency** (e.g. by less water-intensive production, less fertiliser use, greater use of bio-degradable products, switching to low-carbon energy sources etc.);
- **making the polluter pay is more equitable:** it is quite simply not fair that a few benefit from resource use while society has to pay for the resulting damage (see Box 7.1). This also supports good governance and increases the credibility of the regulatory system by giving a clear signal that those causing damage are also responsible for addressing it;
- applying the **full cost recovery principle** to the user/polluter/emitter can set appropriate incentives and reduce burdens on public budgets (see Box 7.1);
- some instruments (e.g. taxes, fees and charges, auctioned licences) can **generate revenues for conservation** (see also e.g. PES/REDD in Chapter 5, Protected Areas in Chapter 8, investment in natural capital in Chapter 9).

Box 7.1: Fundamental principles for incorporating costs of biodiversity loss

Together with equity and social considerations, three closely-related principles should guide the choice and design of policy instruments:

The **polluter pays principle** (PPP) is anchored in the 1992 Rio Declaration on Environment and Development (UNEP 2009a) and embedded in a growing number of national environmental policies (e.g. most OECD countries and EU Member States). It requires environmental costs to be 'internalised' and reflected in the price of goods and services. To this end, the polluter has to take measures to prevent or reduce pollution and in some cases pay taxes or charges for pollution and compensate for pollution impacts. For ecosystem degradation, this means that the polluter should pay directly for clean up and restoration costs or pay a fine that would help offset damage costs.

The **user/beneficiary pays principle** is a variant of the PPP. Where an action provides a benefit e.g. use of natural resources, recipients should pay for the cost of providing that benefit. This could be used to argue that e.g. users of a clean beach should contribute towards beach cleaning expenses.

The **full cost recovery principle** provides that the full costs of environmental services should be recovered from the entity benefiting from the service. There is a growing trend internationally for this principle to be applied directly and explicitly to energy, electricity and water pricing which means that full costs are passed on to consumers.

Source: Adapted from ten Brink et al. 2009

7.2 REGULATING TO AVOID DAMAGE: ENVIRONMENTAL STANDARDS

"It is bad policy to regulate everything... where things may better regulate themselves and can be better promoted by private exertions; but it is no less bad policy to let those things alone which can only be promoted by interfering social power."

Friedrich List
German Economist (1789-1846)

7.2.1 IMPORTANCE OF A STRONG REGULATORY BASELINE

Regulation has long been – and still is – the most widely used instrument for environmental protection. It is used to **establish protection objectives, reduce pollution and hazardous events and trigger urgent environmental improvements**.

A clearly defined regulatory framework provides **orientation for the private sector**. Regulation needs to be conducive to business, compatible with commercial activities and set a level playing field to encourage capacity building, local training and compliance with best professional standards (see TEEB D3 Report for Business forthcoming).

A **strong system of regulation and governance is also essential** for the establishment of market-based policies such as trading schemes, biodiversity offsets and banking (see 7.4). Regulation is the reference point upon which market-based instruments can build and needs to be underpinned by adequate monitoring and enforcement arrangements (see 7.5).

Environmental regulation sets rules and standards across a range of areas (see Box 7.2).

Box 7.2: Scope and flexibility of environmental regulation

As in many other fields of law, the regulatory toolkit includes a battery of prohibitions, restrictions, mandatory requirements, standards and procedures that directly authorise or limit certain actions or impacts. The term **'command-and-control'** is often used as a generic term for regulatory instruments promulgated by a (government) authority (c.f. non-enforceable self-regulation and social norms).

There are three basic types of regulatory instruments for biodiversity and ecosystem services:
- **regulation of emissions:** usually involves emissions standards, ambient quality standards and technical standards (e.g. Best Available Techniques (BAT)); performance standards (e.g. air quality management); or management prescriptions for good practice (e.g. in agriculture);
- **regulation of products** set restrictions on the use of products (e.g. illegally logged timber, activities damaging to endangered species etc.) or establishes production standards (certification, best practice codes, etc.);
- **spatial planning** involves regulation of land uses that have direct implications for ecosystem services or habitats. Planning decisions in most countries are devolved to local or regional planning boards (see TEEB D2). Designation and establishment of protected areas is a specific regulatory tool based on spatial planning (see Chapter 8).

Source: André Künzelmann, UFZ

A tight regulatory framework defining the scope and extent of resource use is a precondition for halting losses. Because biodiversity has a public good character (see Chapter 4), it is the **responsibility of politicians** to define relevant targets and set up an adequate framework to ensure such targets are met.

We often underestimate the contribution that sectoral regulations can make to safeguarding biodiversity. In agriculture, for example, regulating fertiliser use can reduce nutrient run-off into soils and water, eutrophication in river systems, lakes and coastal areas and algae build-up on beaches. Regulations of this type thus support multiple ecosystem services and benefits (aesthetic, tourism and cultural values, reduced health impacts, provisioning and regulating services) and improve carbon storage in the soil (see examples in Table 7.1).

Table 7.1: Examples of sectoral regulations that can benefit ecosystem services

Regulated activity	Type of regulation	Affected ecosystem service	Regulated activity	Type of regulation	Affected ecosystem service
Water use	Drinking water Water / groundwater extraction Waste water treatment Water body condition Water pollution and quality	Fresh water Food Water purification Water regulation Natural hazard regulation Recreation and ecotourism Aesthetic values Water cycling Nutrient cycle	Agriculture	Required minimum practices Best practices Fertilizers Regulation on transgenic crops	Food Fiber Climate regulation Erosion control Pest control Disease regulation Recreation and ecotourism Soil formation Nutrient cycling
Air pollution	Ambient air quality standards Emission standards Off-gas treatment Fuel efficiency standards Lead ban motorfuels Exhaust emission standards	Food Fresh water Air quality regulation Climate regulation Natural hazard regulation Recreation and ecotourism	Forestry	Afforestation / Reforestation Best practices Timber harvest regulation Forest product licensing Hunting licensing Abstraction of non-timber-forest-products	Food Fiber Biochemicals Climate regulation Erosion control Natural hazard regulation Water regulation Aesthetic values Recreation and ecotourism Inspiration Water cycling Nutrient cycle
Land use	Spatial planning / zoning Mineral extraction Soil protection and contamination	Food Fiber Fresh water Biochemicals Water regulation Climate regulation Natural hazard regulation Erosion control Air quality regulation Aesthetic values Cultural Diversity Recreation and ecotourism Soil formation Water cycling Nutrient cycle	Fisheries	Catch licensing Nursery protetcion Mesh size	Food Genetic resources Climate regulation Recreation and ecotourism Nutrient cycle
			Nature Protection	Protected areas Protected Species Act Habitat Directive Birds Directive	Fresh water Genetic resources Biochemicals Natural hazard regulation Aesthetic values Inspiration Educational value Spritual and religious values

Key: Provisioning Services; Cultural Services; Regulating Services; Supporting Services

Regulation has already provided a catalyst for significant environmental improvements by reducing the release of pollutants that threaten ecosystem status and functions. Management of air quality, water and soils all rely heavily on this type of regulation (see Box 7.3). Chemicals regulation addresses risks associated with producing, distributing and using certain products or their compounds.

Where hazards to human health or the environment are potentially high, strong interventions are called for. In practice, strict regulation is often reactive and adopted in response to a catastrophe (e.g. US Oil Pollution Act 1990 adopted in response to the Exxon Valdez oil spill, see Chapter 4).

Regulation is not in itself expensive for public budgets but carries administrative costs in terms of monitoring and enforcement (see 7.5). Costs of implementation and compliance fall primarily on private resource users who must finance abatement or equivalent measures to reach the required standard. Regulation can also require monitoring activities (e.g. waste water effluent or river water quality downstream), at cost to the emitting source. This is consistent with the polluter pays principle.

Decision-makers and administrators already have far-reaching experience with regulation. Where institutional capacity for implementing regulations is already set up, it is often easier to expand regulation than to set up market-based approaches. Emission limits (e.g. for power stations emissions to air, quality of effluent discharge from industrial plant) can be tightened over time as it becomes clear that there is an environmental or health need. BAT standards lay down detailed prescriptions on type of technology, requirements of a particular technical solution, monitoring etc. Where such standards are available, it may be easiest to adapt them to local conditions, offering opportunities for learning and applying regulatory experience from other countries.

As noted, **regulation forms the baseline and catalyst for additional complementary measures**. Emissions trading instruments, for example, emerged against a background of air quality regulatory standards in the USA (Hansjürgens 2000). The first generation of instruments in the 1970s (i.e. netting, offset, bubble and banking policy) were based on credits that could be created if abatement went beyond a certain standard. Only additional emissions 'saved' by over-compliance could be used for compensation or trading. Similar rules apply for biodiversity offsets and/or banking (see 7.3).

Box 7.3: Regulatory success stories: tackling air pollution and promoting sustainable forestry

Germany: Forest damage from 'acid rain'– mainly caused by SO_2 emissions from energy-producing combustion plants (*Waldsterben*) – created enormous pressure on politicians in the early 1980s. Germany therefore set a tight SO_2-emission standard at 400 mg/m^3 that all plants had to comply with by 1993. Following the enactment of the standard, the electricity sector embarked upon a major reduction program that led to sharp decline in SO_2-emissions (see table).

Year	1980	1982	1985	1988	1989	1990	1992	1995
SO_2-emissions (mg/m^3)	2154	2160	1847	582	270	290	250	154

Sweden: the decline of forests during the 1980s and 1990s led to the Swedish Forestry Act being updated in 1994. The new Act specifies that forests "shall be managed in such a way as to provide a valuable, sustainable yield and at the same time preserve biodiversity". It provides for new standards to be established after (i) felling (ii) if forest land is unused and (iii) the forest condition is clearly unsatisfactory and sets quotas for maximum annual allowable cut to promote an even age distribution of forest stands. Recent statistics prove that the regulation has had positive results, especially the numbers of old or deciduous trees recovered in the past 20 years (increase of 10 to 90%, depending on diameter).

Sources: Wätzold 2004; Swedish Forestry Act; Swedish Forestry Statistics; The Work Done by the Swedish Forestry Organisation in Order to put the Environmental Goal on an Equal Footing with the Production Goal 1999

7.2.2 RULES FOR ENVIRONMENTAL LIABILITY

Environmental liability is an overarching term – covering prevention and remedial action – for the process by which responsibility for the cost of damage is explicitly assigned to those who cause that damage. Liability rules are based on the polluter pays principle and provide economic incentives to developers/users to incorporate the risk of a potential hazard and the value of remediation.

Environmental liability regimes operate by reference to regulatory frameworks that set standards for resource use. The basic rule is that those who damage the environment beyond a defined limit have to pay for necessary clean-up and/or restoration. Depending on the regime, they may also have to provide for the continued losses of ecosystem services pending restoration (or in perpetuity if restoration is not possible).

Earlier systems had an essentially pollution-based focus but several laws now address broader environmental damage in recognition of its public good character. Box 7.4 outlines the two main types of liability.

Liability rules require resource users to pay for the impacts of potentially hazardous activities. **The potential polluter therefore balances risks and costs** and decides what measures are appropriate to avoid a certain risk. Options include abatement (e.g. through better filters), recycling, less hazardous production techniques, rigorous risk management procedures and standards (e.g. international environmental management ISO standards and the European EMAS) and insuring against potential claims if insurance is available. **Liability rules provide economic incentives to reduce risk and can directly stimulate technical improvements.**

Box 7.4: Scope of environmental liability rules

Legal regimes provide for two main variations:

- **strict liability** does not require proof of culpability (i.e. *fault or negligence*) for damage. This is usually deemed more appropriate for inherently risky activities that present specific hazards e.g. the International Convention on Civil Liability for Oil Pollution Damage, nuclear accidents and, in some countries, damage caused by genetically modified organisms. Tightly-limited exceptions may be provided in the relevant legislation and may include e.g. cases where the operator proves that the activity/emission was expressly authorised by the competent authority and carried out to the required technical standard without fault;

- **fault-based liability** depends on the operator being proven to be *negligent* or at *fault*. This is usually the standard retained for other occupational activities that cause damage to the environment and its components.

Regulatory instruments can combine these approaches to cater for the different levels of risk presented by different types of activity. A prominent example of this **dual approach** is the EU Environmental Liability Directive (2004). This instrument focuses on damage to EU-protected habitats and species, EU water resources and land contamination that presents hazards to human health. It excludes matters regulated under international liability regimes as well as interests covered by traditional liability regimes (personal injury and damage to goods and property) which vary between countries.

Liability regimes may also confer rights on civil society, including environmental NGOs, to request competent authorities to take action and to apply to the courts for review of administrative action or inaction. This can provide an important mechanism for transparency and accountability (see 7.5).

Economic information can help introduce and implement liability rules by reducing uncertainties with respect to expected costs of hazardous risks and assisting resource users in defining abatement strategies. It can also help insurance companies not only to determine financial risks and product premiums but also to develop new products.

Liability regimes face some major constraints. **Problems often arise when the operator responsible for damage caused by accidents cannot be traced.** This results in 'orphan liability' cases or sites affected by the accident. Other problems relate to damage generated by repetitive actions and negligence that lead to significant cumulative damage (e.g. diffuse pollution). In such cases, transaction costs for assessing natural resource damage can be substantial. The same is true for the task of apportioning responsibility between individual polluters: conventional liability rules may not apply if e.g. the individual polluter's share of the damage is not enough to trigger liability. In such cases, it often makes sense for the state to provide directly for the restoration of the damage (see Chapter 9).

7.2.3 USING ECONOMIC ANALYSIS IN STANDARD SETTING

Economic valuation of ecosystem services can help to build up and extend a regulatory framework for biodiversity conservation. It can support arguments in favour of policies to avoid net losses and, by informing better regulatory standards, increase their credibility and acceptance.

Cost-benefit considerations were often not included, or only implicitly, when regulatory instruments were initially designed. This balancing act was rarely required because early regulations focused on preventing hazardous situations i.e. urgent concerns of human life and health. This is still the case for some environmental fields with respect to well-known hazards, e.g. carcinogenic substances, ambient air quality standards for particulates.

The urgency of including costs and benefits in decision-making has increased in recent years for several reasons:

- **many countries have an unseen potential for regulation.** Where institutions are weak and administrative capacities underdeveloped, identifying and valuing ecosystem services can feed information on development constraints and opportunities into national and local planning process. This can help raise awareness of the need for better regulation (see Box 7.5);

- many countries now apply the precautionary principle in relevant policy fields even where environmental risks are not hazardous to human life. **Balancing costs and benefits is even more important for precautionary policies than for prevention of known hazards** i.e. to provide justification for possible regulation. Stricter controls are often only accepted by stakeholders and the general public if it is clearly shown that the benefits outweigh the costs.

Box 7.5: Feeding catchment assessment data into the regulatory process, South Africa

A biodiversity hot spot area in the municipality of uMhlathuze was confronted with the classic 'development versus conservation' dilemma – with the local municipality mostly in favour of development as a result of the poor socio-economic climate. uMhlathuze opted to undertake a Strategic Catchment Assessment to highlight the ecosystem services that the environment provided free of charge to the municipality. The assessment estimated the value of environmental services provided by the catchment, e.g. nutrient cycling, waste management and water regulation, at nearly US$ 200 million per annum. Politicians known to be 'biodiversity averse' reacted positively once they realised the economic value of the ecosystem services provided and identified management actions to ensure the sustainable use of biodiversity resources and sensitive ecosystems.

Source: Slootweg and van Beukering 2008

7.3 COMPENSATING FOR LOSSES: OFFSETS AND BIODIVERSITY BANKS

7.3.1 WHY DO WE NEED COMPENSATION INSTRUMENTS?

Developments linked to economic growth often lead to habitat loss and degradation, pollution, disturbance and over-exploitation. These impacts can often be avoided or substantially reduced through measures at the design stage (see Chapter 4) and during ope-and adaptive management).

Even with avoidance and other measures, it is **in-evi-table that some developments will result in significant residual impacts. Compensating for such impacts is essential** to avoid ongoing cumu-lative losses of bio-diversity and ecosystem services. Offsets and biodiversity banks are the main instru-ments for this purpose. They are suited for use in habitats that can be restored within a reasonable time-frame and/or may benefit from additional protection (see Box 7.6). Offsets can play a key role in delivering 'no net loss' policies (Bean et al. 2008). They are implicitly required as part of an overall policy package where biodiversity policy targets aim to halt the loss of biodiversity (such as in the EU).

Box 7.6: Biodiversity compensation mechanisms

Biodiversity offsets: "measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate prevention and mitigation measures have been implemented. The goal of biodiversity offsets is to achieve no net loss, or preferably a net gain, of biodiversity on the ground with respect to species composition, habitat structure and ecosystem services, including livelihood aspects".

Biodiversity banking: a market system, based on biodiversity offsets, for the supply of biodiversity credits and demand for those credits to offset damage to biodiversity (debits). Credits can be produced in advance of, and without ex-ante links to, the debits they compensate for, and stored over time. Such banks include habitat banks and species banks, and are often known as conservation banks.

Biodiversity banking resembles carbon trading to some extent but is more complex because
(i) there is no such thing as a unit of biodiversity as there is for carbon;
(ii) the location of biodiversity damage and/or compensation matter can present constraints; and
(iii) while there are policy instruments and regulations supporting carbon trading, regulations controlling biodiversity loss are weak and therefore demand for biodiversity trading is low.

Source of definitions: BBOP 2009

Offsets and habitat banking work by triggering actions that provide measurable benefits for biodiversity (credits) comparable to the damage (debits). This equivalence can involve the same kind of habitat or species (like-for-like) or different kinds of habitats and species of equal or higher importance or value.

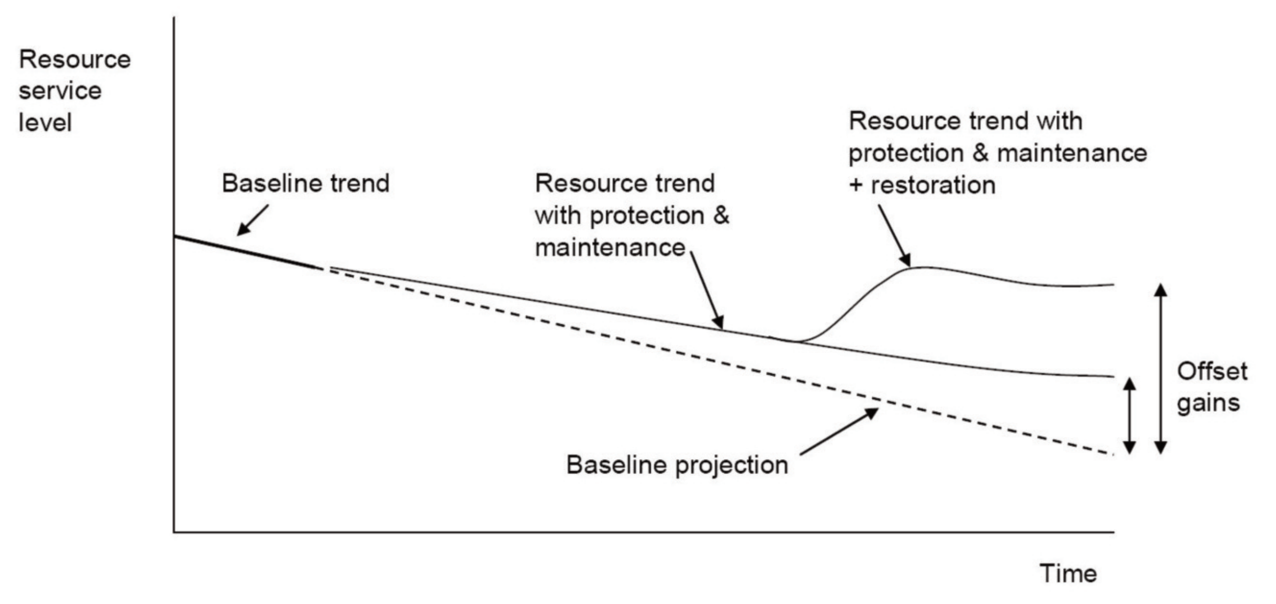
Offsets can focus on protecting habitats at risk of loss or degradation (i.e. risk aversion offsets) or restoring previously damaged or destroyed habitats. The example in Figure 7.1 shows how a habitat can be subject to ongoing measurable losses due to cumulative impacts, which can be extrapolated to an anticipated baseline rate of loss. If a development project protects a larger proportion of equivalent habitat than it destroys, it can provide an 'offset benefit' by reducing the rate of loss in comparison to the baseline. Restoration may provide an additional more tangible benefit, leading to a no net loss situation.

Biodiversity banks create a market-based instrument by turning offsets into assets (credits) that can be traded (see definition in Box 7.5 above). Offsets on their own involve actions that arise from (but do not always occur in) a sequential logic: planning of a project or activity; identification of likely residual damage; biodiversity offset for residual damage. Banking allows these actions to take place without prior connection – and thus in any order. The biodiversity credit can be made before the scale of the debit has been assessed and be stored until it is needed to compensate for a project causing damage.

Banking gives rise to credits that were not created in response to specific (occurred, happening or planned) debits and are thus influenced by past and future conditions (e.g. demand for compensation). Biodiversity banking therefore offers features of supply and demand over time, including speculation and discounting of values.

Biodiversity banks have the **potential to be efficient market-based mechanisms. They have been developed by businesses and public-private partnerships** that have managed to mobilise private funds. Banks and trusts are keen to invest and support this type of activity, especially when markets that allow for credit trading are also created. The financial sector has seen the opportunities for further business creation and development of another 'green' investment product that can be targeted to this niche market. However, many banking and offset schemes are expensive and can entail high up-front and long-term investment. The involvement of public or financial stakeholders is sometimes needed to provide support for complicated and large scale projects.

Figure 7.1: Illustration of potential offset gains (credits) secured by protecting and restoring a threatened biodiversity component (risk aversion)



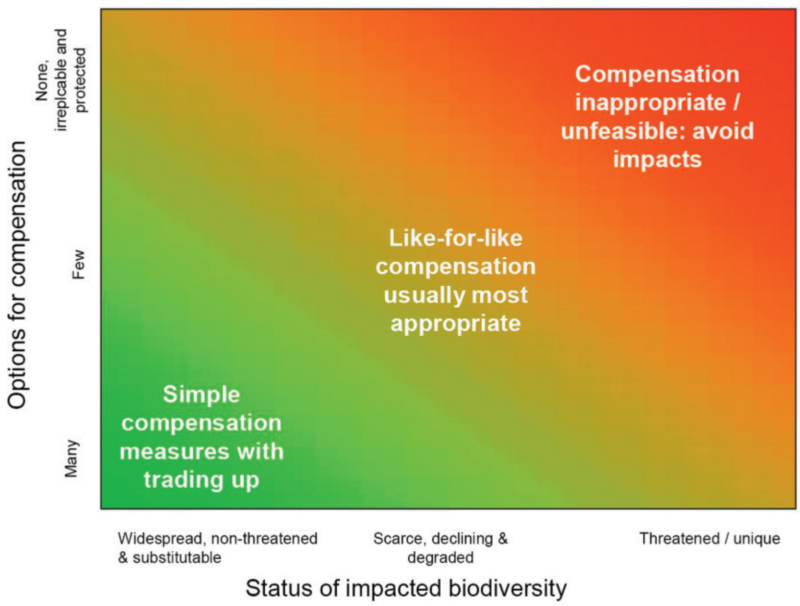
Source: own representation, Graham Tucker

The following drivers create demand for compensation mechanisms:

- **clear policy requirements for no net loss or a net gain of biodiversity;**
- **legislation that requires compensation** for residual impacts to achieve no net loss or a net gain of biodiversity (e.g. as for Natura 2000 sites under the EU Habitats Directive). Such measures are normally strictly regulated and must be project-specific offsets that are like-for-like, usually within or close to the project development site;
- **planning and impact assessment procedures** (like the EIA and SEA Directives in Europe) that create a requirement for offsets by identifying significant residual adverse effects through application of the mitigation hierarchy. Impact assessments are much more effective when implemented within a clear policy framework requiring no net loss or a net gain: this places the onus on proponents of developments to demonstrate how such a result will be achieved;
- **commercial considerations** (e.g. management of business risks and liabilities; access to investments; accreditation requirements; public relations; corporate social responsibility goals that encourage 'voluntary' compensation measures). For example, the mining company Rio Tinto uses offsets to compensate for unavoidable residual impacts and thereby meet its "aim to have a net positive impact on biodiversity" (Rio Tinto 2004).

However, it is important to note **that many biodiversity components and ecosystem services are unique and irreplaceable and cannot be effectively compensated through offsets**. Compensation measures are best suited to addressing moderate residual impacts on biodiversity components that are replaceable and can be conserved or restored using known techniques within a reasonable timeframe (see Figure 7.2). They are also appropriate for impacts which seem minor in isolation but are significant on a cumulative basis. For impacts on widespread biodiversity, trading up (through activities to promote more important biodiversity) is likely to be acceptable in most cases. However, where impacts are of relatively small magnitude, project-specific compensation can have prohibitive transaction costs. In such cases, it may be possible to develop simple generic schemes (e.g. possibly through standard in-lieu payments to trusts that distribute funds to biodiversity banks or other biodiversity projects).

Figure 7.2: Appropriateness of compensation in relation to the importance of impacted biodiversity and availability of reliable compensation options



Source: adapted from BBOP 2009

POTENTIAL BENEFITS OF OFFSETS AND BIODIVERSITY BANKING

Well-designed **biodiversity offsets and banks can provide additional benefits beyond the achievement of no net loss** from individual developments. Net biodiversity gains are most feasible in regions where past impacts have resulted in landscapes dominated by artificial or cultural habitats with relatively low biodiversity and where remaining areas of semi-natural or natural habitats are small, fragmented and degraded. In such cases, offsets can:

- balance development and conservation, while delivering more conservation efforts than the 'status quo';
- introduce additional finance for conservation and mainstream biodiversity into business and regional planning;
- reverse some past losses of restorable threatened habitats and increase the size of remaining small habitat patches, thereby increasing the viability of species populations and resilience to pressures such as climate change;
- reduce habitat fragmentation by re-creating habitats in appropriate locations that restore connectivity;
- secure more reliable biodiversity outcomes than mitigation measures, especially if biodiversity banks are established in advance;
- prove more cost-effective than avoidance and mitigation measures, especially where banks benefit from economies of scale and competitive market forces. Cost reductions may increase the likelihood that measures are implemented beyond strict legal requirements;
- provide a mechanism that enables the cumulative impacts of low-level impacts to be addressed in a cost-effective and practical manner.

CONSTRAINTS AND POTENTIAL RISKS OF OFFSETS AND BIODIVERSITY BANKING

Significant constraints on offsets and banks need to be considered to avoid risks to biodiversity if compensation measures are inappropriately applied. Probably the most fundamental constraint is that such measures must provide long-term added value (i.e. not just benefits that would have occurred without new actions). Measures must also be based on outcomes going beyond those under existing/foreseen policy and legislative requirements.

In some situations (see Figure 7.1) significant benefits may be obtained by stopping ongoing degradation and avoiding losses from e.g. agricultural improvement, deforestation, wetland drainage and pollution. This can be done through by entering into agreements with individuals (e.g. contracts or covenants) who give up the right to convert habitat in return for payment or other benefits. However, offsets of this kind can only deliver benefits where there are significant areas of remaining habitat that meet three conditions:

- worth maintaining;
- unprotected and likely to remain so in the future (to ensure additionality);
- subject to significant and predictable levels of loss or degradation.

In practice, options for risk aversion compensation may therefore be limited in areas with already high levels of protection for important habitats. Furthermore, even when protection of one area of habitat is successful, this can simply lead to the threat being displaced to another area, resulting in no impact on the overall rate of loss (often referred to as 'leakage').

Given these constraints, **many offsets and biodiversity banks focus instead on habitat restoration or re-creation** (see Chapter 9). This requires proposed offsets to provide a high level of certainty that their intended conservation outcomes will be achieved (or at least that they are high compared to alternative mitigation measures). In practice, the creation or restoration of many habitats is extremely difficult, particularly natural and ancient habitats that have developed over thousands of years.

Another important principle is that **reliability of compensation outcomes should increase in relation to the importance of the habitat/species affected** (Figure 7.2). Stringent avoidance and mitigation measures should be taken to avoid residual impacts on very rare or otherwise valuable habitats, where these are considered more reliable than restoration or other offset measures.

In this respect, biodiversity banks have a distinct advantage if they store credits (restored or enhanced habitats) in advance of possible impacts: this reduces uncertainty and concerns over the feasibility and likely quality of compensation, even if some long-term uncertainty remains. However, the commercial risks and long timescales involved in creating many habitat banks are likely to restrict their establishment and the supply of credits.

This summary again highlights the need for a strong regulatory baseline to establish policies for biodiversity offsets and banking systems. Without this, there are significant risks that project proponents will use offsets to avoid other more costly measures and project delays. Proponents have a financial incentive to underestimate potential impacts, overestimate the reliability and benefits of offsets (or other mitigation measures if these have lower costs) and avoid implementation of agreed measures. It is therefore critical to develop offset and habitat banking systems alongside appropriate regulation and adequate administrative capacities. A robust regulatory framework makes it possible to ensure that biodiversity impacts by programmes or projects are properly assessed and that appropriate compensation measures are properly implemented, monitored and managed for at least as long as the period of residual impacts; which often means in perpetuity.

7.3.2 WAYS TO MAXIMISE BIODIVERSITY BENEFITS AND MINIMISE RISKS

The potential benefits and risks of offsets and biodiversity banking have been widely recognised (e.g. Bean et al. 2008; Carroll et al. 2007; ten Kate et al. 2004). The Biodiversity and Business Offsets Programme (BBOP) has developed a set of design principles in consultation with stakeholders (see most recent version in Box 7.7).

Source: Jutta Luft, UFZ

Box 7.7: BBOP Principles on Biodiversity Offsets

1. ***No net loss:*** A biodiversity offset should be designed and implemented to achieve in situ measurable conservation outcomes that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity.

2. ***Additional conservation outcomes:*** A biodiversity offset should achieve conservation outcomes above and beyond results that would have occurred if the offset had not taken place. Offset design and implementation should avoid displacing activities harmful to biodiversity to other locations.

3. ***Adherence to the mitigation hierarchy:*** A biodiversity offset is a commitment to compensate for significant residual adverse impacts on biodiversity identified after appropriate avoidance, minimisation and on-site rehabilitation measures have been taken according to the mitigation hierarchy.

4. ***Limits to what can be offset:*** There are situations where residual impacts cannot be fully compensated for by a biodiversity offset because of the irreplaceability or vulnerability of the biodiversity affected.

5. ***Landscape Context:*** A biodiversity offset should be designed and implemented in a landscape context to achieve the expected measurable conservation outcomes taking into account available information on the full range of biological, social and cultural values of biodiversity and supporting an ecosystem approach.

6. ***Stakeholder participation:*** In areas affected by the project and by the biodiversity offset, the effective participation of stakeholders should be ensured in decision-making about biodiversity offsets, including their evaluation, selection, design, implementation and monitoring.

7. ***Equity:*** A biodiversity offset should be designed and implemented in an equitable manner, which means the sharing among stakeholders of the rights and responsibilities, risks and rewards associated with a project and offset in a fair and balanced way, respecting legal and customary arrangements. Special consideration should be given to respecting both internationally and nationally recognised rights of indigenous peoples and local communities.

8. ***Long-term outcomes:*** The design and implementation of a biodiversity offset should be based on an adaptive management approach, incorporating monitoring and evaluation, with the objective of securing outcomes that last at least as long as the project's impacts and preferably in perpetuity.

9. ***Transparency:*** The design and implementation of a biodiversity offset, and communication of its results to the public, should be undertaken in a transparent and timely manner.

10. ***Science and traditional knowledge:*** The design and implementation of a biodiversity offset should be a documented process informed by sound science, including an appropriate consideration of traditional knowledge.

Source: BBOP 2008

These principles are generally applicable to all compensation measures, but care needs to be given to their interpretation and application. In particular, Principle 3 is often misinterpreted. A key objective of its mitigation hierarchy is to reduce the risk of biodiversity loss from developers taking easy least-cost actions, i.e. using offsets and biodiversity banking as a 'licence to trash'. On the other hand, authorities insisting on extremely expensive mitigation measures (e.g. tunnels or viaducts) may not obtain good value for money. It is also clearly inappropriate to expect project proponents to take preventive measures for low-level impacts if much greater benefits could be obtained by simple compensation measures that trade up to provide higher biodiversity benefits.

The term 'appropriate' is therefore central to the mitigation hierarchy principle. The specific aim should be to **compare the conservation benefits of the potential mitigation and compensation measures to identify the combination that delivers the highest reliable benefit**. The question of reliability must be considered in accordance with the precautionary principle. Uncertainty can affect all types of mitigation and compensation measures depending on the circumstances: some mitigation measures may be more reliable than compensation measures or vice versa. The weight given to the reliability of measures should increase with the importance and irreplaceability of the habitats and species that may be impacted. For biodiversity of high conservation importance, measures should therefore focus on avoidance actions (assuming they are most likely to be reliable) rather than risky compensation options.

An advantage of established biodiversity banks, noted above, is to reduce uncertainty over the amount and quality of compensation that will be realised, given that credits already exist and can be measured directly in terms of their ecological value and ecosystem benefits. However, it is still important to assess the ongoing value of the benefits (e.g. in relation to climate change or other external pressures) as well as their additionality.

7.3.3 EXPERIENCE OF COMPENSATION TO DATE

There is growing evidence that, **when appropriately designed and effectively regulated, offsets and biodiversity banks can be efficient market-based instruments** (MBI) that help businesses compensate for the residual unavoidable harm from development projects.

Over 30 countries now require some form of compensation for damage to biodiversity or have established programmes requiring offsets. Countries with legal requirements for offsets include Brazil, South Africa, Australia and the United States, which probably has the most advanced example of a biodiversity mitigation market (Bean et al. 2008; Carroll et al 2007). Box 7.8 provides examples of practice to date in two countries.

Box 7.8: Biodiversity compensation and offsets in Australia and the United States

Australia's habitat banking system is known as BioBanking. It provides that where land use conversion and associated biodiversity loss are inevitable, alternative sites can be restored or put in conservation. This acts as an incentive measure to encourage biodiversity conservation on private land and provide compensation for biodiversity loss at other locations. No economic data are available yet as the programme is still in an early stage.

United States: More than 400 wetland banks have been established, creating a market for wetland mitigation worth more than $3 billion/year. There are also more than 70 species banks which can trade between $100 million and $370 million in species credits each year.

Source: Bayon 2008; DECC 200

The EU has strict legal requirements for compensation measures for 'unavoidable impacts' on protected areas of European importance (i.e. Natura 2000 sites). Some EU Member States (e.g. France and Germany) have additional legislation and policies requiring or enabling offsets and habitat banking. Further information on offsets, including references and best practice guidance, is available at the BBOP website (http://bbop.forest-trends.org/).

7.4 SETTING MORE ACCURATE PRICES: MARKET-BASED INSTRUMENTS

'Taxes are the price of a civilized society'

Franklin D. Roosevelt upon introducing the first US income tax in the 1940s.

'Maybe environmental tax reform is the price of a sustainable society?'

Jacqueline McGlade (EEA) speech at the 8th Global Conference on Environmental Taxation (Munich, 18 October 2007).

Source: André Künzelmann, UFZ

7.4.1 CHANGING INCENTIVES IN DECISION-MAKING

Market-based instruments (MBI) can be designed to change the economic incentives available to private actors when deciding upon resource use and contribute to more effective and efficient management of biodiversity and ecosystem services.

MBI (e.g. taxes, charges, fees and fines, commercial licences as well as tradable permits and quotas) send economic signals to private actors. They can be adjusted to discourage activities harmful to biodiversity and ecosystem services by increasing the tax or charge on the use of certain services or by requiring users to purchase tradable permits. Targeted increases of this kind can provide a catalyst to develop more environmentally-friendly alternatives.

In principle, the same is true for direct environmental regulation (see 7.2 above). However, MBIs give private actors more choice (i.e. whether to pay the higher price or find an alternative) depending on what is more cost-efficient for them.

MBIs work in two ways: by controlling prices or controlling quantities.

Taxes, fees and charges are price-based instruments which determine a price that has to be paid when an ecosystem is used, e.g. charges for water abstraction or sewage fees, entry prices for a national park, a carbon tax, deposit–refund systems or waste fees (see Box 7.9 and also Box 7.11 below).

Box 7.9: Use of volume-based waste fees to reduce waste generation in Korea

In 1995, Korea introduced a Volume-Based Waste Fee (VBWF) where residents pay for solid waste services by purchasing standard waste bags. In principle, the full cost of collection, transport and treatment should be included in the VBWF bag price. However, to avoid negative side effects of a sudden increase in waste treatment costs (e.g. illegal dumping), each municipality sets a different rate depending upon its financial circumstances and treatment costs. Disposal of waste without using VBWF bags or illegally burning waste is subject to a 1 million won (US$ 1,000) negligence fine.

The VBWF programme has had far-reaching effects. From 1994–2004, it led to a 14 % reduction in the quantity of municipal solid waste generated (corresponding to a 20% decline in waste generation per capita) and an increase of 15% in the quota of recycled waste (up to 49%).

Categories	1994	1996	1998	2000	2002	2004
Total waste generation (tons / day)	58,118	49,925	44,583	46,438	49,902	50,007
- thereof recycled	8,927	13,085	15,566	19,167	21,949	24,588
- thereof land filled	47,116	34,116	25,074	21,831	20,724	18,195
Per capita (kg / day)	1.30	1.10	0.96	0,98	1.04	1.03

Source: Korean Ministry of Environment 2006

Tradable permits schemes are quantity-based instruments that restrict the absolute extent for using a resource. They create an artificial market for a resource by:

- determining the number of rights to use a resource (e.g. tons of timber to be cut per year);
- allocating the rights (e.g. to cut one tonne of timber) to the users (e.g. logging companies or local landholders) via auction or free of charge; and
- facilitating trading of rights between potential users (e.g. between different logging companies or the sale of logging rights from local landholders to commercial loggers).

The permit price is set by supply and demand. The best-known example of permit trading is to control air pollution (e.g. CO_2 or SO_2) but the concept has been successfully adapted to a range of resources and goods e.g. to manage fish stocks (see Box 7.10), regulate water abstraction (see Box 7.12) or limit urban sprawl and preserve open space (see Box 7.14). Further applications are being discussed, notably forest carbon trading (see Chapter 5 for the REDD-Plus mechanism), water quality trading or habitat trading (see Hansjürgens et al. forthcoming).

Box 7.10: Experience with Tradable Fishery Quotas in New Zealand

New Zealand's fishing industry has grown exceptionally fast in the last century: by 2004 the seafood sector was the fifth largest export earner occupying over 10,000 workers. To ensure sustainable management of fish stocks, the government has introduced a system of tradable fishing quotas under the Fisheries Act 1986. Every year the Fisheries Ministry sets a new Total Allowable Catch (TAC), based on biological assessment of the stock, which is handed out as 'individual tradable quotas' to fishing companies. Companies are free to decide whether to use their quota (catch fish) or to sell or buy remaining quotas depending on their profits per catch.

The results are so far quite positive: most fish stocks have been rebuilt and the country's fishing grounds are some of the very few to achieve the conservation target of less than 10% stock collapse.

Sources: Ministry of Fisheries NZ 2005; Yandle and Dewees 2008; Worm et al. 2009

Market-based instruments can be designed to address very different environmental concerns (see examples in Table 7.2). Depending on the ecosystem or ecosystem service, there are **different entry points for pricing resource use**. Prices can either be levied on:

- input goods (e.g. water charges, stumpage fees, fuel taxes or land conversion fees);
- processes and associated emissions (emission trading for pollutants like SO_2, NO_X or CO_2); or
- output (e.g. mineral oil tax; waste fees; waste water charges or pollution taxes; fertiliser or pesticide taxes).

Economics suggests that prices work better if they are directly based on emissions or close complements because this makes abatement measures more effective in terms of mitigating such emissions or harmful products (Hansjürgens 1992).

The term 'MBI' is sometimes used for other instruments that may improve market conditions, including market friction reduction policies (e.g. liability rules, see 7.2), information programmes like labelling (Chapter 5) or subsidies (Chapter 6).

Table 7.2: Examples of different uses of MBIs to protect biodiversity and ecosystems

Name	Country	Object	Purpose	Mechanics	Success	Further Information
Landfill Tax Credit Scheme	UK	Terrestrial ecosystems	Re-pricing	Tax scheme and funding	£1 billion of contributions paid from landfill operators to environmental projects	Entrust (2009): How the LCF works, URL: http://www.entrust.org.uk/home/lcf/how-it-works
Acid Rain Programme	USA	Air-quality management	Re-pricing	Tradable permits for the emission of sulphur	Reduction of SO_2 by 52% compared to 1990	US EPA (2009): Emission, Compliance, and Market Data, URL http://www.epa.gov/airmarkets/progress/ARP_1.html
Garbage Collection Fee	Japan	Waste reduction	Re-pricing	Garbage fee (e.g. in Tokyo 0,43 US$ per 10 litre)	Significant reduction of garbage in the participating cities	http://www.unescap.org/drpad/vc/conference/ex_jp_14_jgc.htm
Reforestation Charge	Liberia	Forest protection	Re-pricing	Charges on felled trees (5 US$ per m³ reforestation charge)	Helps to prevent the unsustainable use of forests	FAO (2009): Description of the forest revenue system, URL: http://www.fao.org/docrep/007/ad494e/AD494E06.htm
Tradable Hunting Permit	Mexico	Protection of big horned sheep	Re-pricing	Hunting quotas for the big-horned sheep in every community	Hunting for animals does not endanger the existence of the whole population	Biller (2003)
Nitrogen Oxide Charge	Sweden	Air-quality management	Re-pricing	Charge of SEK 40 (3.9€) per emitted kilogram Nitrogen Oxide	Emission of Nitrogen Oxide reduced from just over 300 tonnes (1990) to 200 tonnes in 2003	Naturvardsverket (2006)
Taxes on pesticides	Sweden	Groundwater management	Re-pricing	Tax of 20 SEK/kg (in 2002) on pesticides	65 % reduction in the use of pesticides	Sjöberg, P. (2007)
Tradable permits on water pollution Hunter River	Australia	Catchment	Re-pricing	Each mine is allowed to discharge a percentage of the total allowable salt load, which is calculated in relation to conductivity levels	Exceeding of permitted quotas decreased from 33% to 4% after implementation	Kraemer et al. (2003)
Environmental Taxes and Water Taxes	Colombia	Catchment	Re-pricing	Pollution and water use is taxed	The level of BOD (the amount of oxygen required to biologically decompose organic matter in the water) dropped by two third in 4 years	Kraemer et al. (2003)
Guabas River Water User Association	Colombia	Watershed management	Re-pricing / Revenue-raising	Water users downstream pay fees (per litre of water received) into a fund for watershed management activities	Revenues (about US$ 600,000 annually) used for projects to protect and regenerate degraded forests, reforest with native species, and for community organization	Landell-Mills (2002) ; Echavarría (2002)
Fees for Mountain Gorilla Tracking	Uganda	Forest habitat protection	Revenue-raising	Visitors have to pay a US$500 permit to go Gorilla Tracking	Population of gorillas is slowly increasing also due to the improved management (e.g. more guards).	Uganda Wildlife Authority (2009): Gorilla permit booking, URL: http:// www.uwa.or.ug/gorilla.html; Zeppel (2007)
Water Conservation Fund	Ecuador	Biosphere Park management / financing	Revenue-raising	Own Financing of watershed reservoir	Over $301,000 were spent on water management projects in 2005, securing the important functions of the Reservoir	The Nature Conservancy (2007)
Entrance fees for the Galapagos Islands	Ecuador	Protected Area management / financing	Revenue-raising	Entrance fee for the Protected Area: 6$ for Ecuadorians / 100$ for other tourists	Revenues (> US$3 million annually) help to improve the management of the National Park	Vanasselt (2000)

7.4.2 WHAT CAN MARKET-BASED INSTRUMENTS CONTRIBUTE?

Market-based instruments (MBI) to price resource use have **particular strengths in four areas:** They can, if set at sufficient rates, make the polluter pay more explicitly than regulation and put the full cost recovery principle into effect. Experience shows that environmental goals may be reached more efficiently with potential for cost savings – however, actual cost savings depend on instrument design and implementation as well as the ecosystem service in question. Lastly, pricing instruments can generate public revenues that can be used to finance biodiversity-friendly policies.

IMPLEMENTATION OF THE POLLUTER/USER PAYS PRINCIPLE

Direct regulation and the use of MBIs are both in accordance with the polluter pays principle but **only market-based instruments make the values attached to resource use explicitly visible**. MBIs confront actors with at least part of the environmental and social costs their actions cause (i.e. costs that were previously externalised and thus not considered in private decision-making) and lead to explicit payments. Tax bills or permit prices are more transparent and more easily mainstreamed into private accounts than investments in technical adaptations to comply with environmental regulations.

Boxes 7.11-7.13 present successful examples of using different MBIs for specific goals.

Box 7.11: Contribution of product taxation to reducing biodiversity loss

Product taxes are important drivers of ecosystem change. **Fertiliser taxes or taxes on excess nutrients** provide an incentive to increase efficiency in fertiliser use for crops and thereby reduce negative externalities. Application of various schemes saw decreases in product use (and subsequent reduction of levels in soil and water) of 20-30% in the Netherlands, 11-22% in Finland, 15-20% in Sweden and 15% in Austria. (Ecotec 2001).

In 2002, Ireland introduced a **tax on plastic bags**; customers now pay 33 cents per bag at checkout. Plastic bag consumption dropped by 80% from 1.2 billion to 230 million bags in the first year, generating tax revenues (US$ 9.6 million) earmarked for a green fund. The tax also halted a major import as only 21% of plastic bags were manufactured in Ireland (New York Times, 2 Feb 2008).

Papua New Guinea has significant foreign receipts through exporting crocodile skins, mainly to Japan. To promote sustainable resource use, **taxes levied on exports** provide an important source of funding for control and monitoring operations by the Department of Conservation (Hunt, 1997).

The Eritrean government implemented a series of **fiscal reforms in the energy sector**, including subsidies to kerosene, promotion of energy-efficient fuel-wood stoves and dismantling of duties on imported solar technology. The goal was to encourage people to consume less fuelwood, thus addressing deforestation and forest degradation problems in the country (UNDP 2001).

Box 7.12: Experience of water use rights in reducing water consumption in China

China's first water use rights system with tradable water use quotas was launched early in 2002 (Zhangye City, Ganzhou District, Gansu Province) as part of a national water saving project. Water use in the pilot area was readjusted based on local ecological and social conditions: high-efficiency water users were given preference for distribution of use rights, and per capita water use was determined based on proximity to water resources. Water use rights certificates were distributed to counties and irrigation districts, and subsequently to townships, villages and households.

In Minle County, each irrigation district distributed water rights certificates to households based on land area and a water resource deployment scheme which was checked, ratified and strictly enforced. Water used for irrigation was reduced to 1,500–1,800 m3/ha/year, significantly lower than the previous year.

Source: Forest Trend 2009

DESIGNING MBIS FOR FULL COST RECOVERY

Market-based instruments have the potential to **make the polluter/user carry the full cost** of pollution/resource use, provided that charge/tax rates are set high enough or the number of permits is adequately restricted. This is a key difference with regulatory approaches which require compliance to a set standard and leave resource use up to this limit free of charge i.e. there is no incentive to reduce pollution below the standard. Under MBIs like taxes, the tax is imposed on all emissions (e.g. every tonne of carbon, every litre of discharged water) and thus increases incentives to reduce resource use. However, tax rates, fees or charges will only reflect the true economic value of the resource in question if the MBIs are explicitly designed and set at an adequate level to secure full cost recovery (see Box 7.13).

Source: André Künzelmann, UFZ

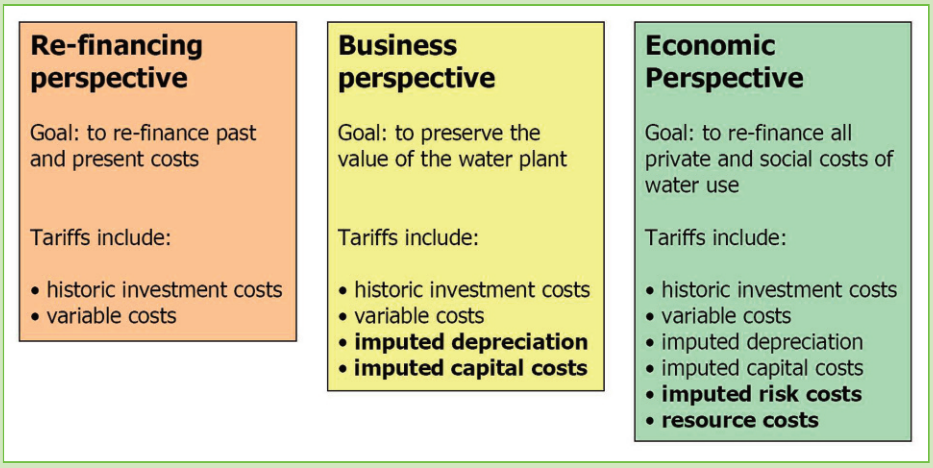
Scuba diver at the top of '1000 Steps' beach and dive site on Bonaire.

Box 7.13: Full cost recovery as a tool to reduce overexploitation: examples from water pricing

In some countries water charges have historically been - and in some cases still are - very low. This reflects the view that provision of basic services like water is a duty of government, with access considered a right. In such cases, end-users often pay less than the full costs. This has led to resource overexploitation, wastage, groundwater depletion, pollution, soil salinisation and biodiversity loss.

Adequate pricing of water to end-users can improve price signals and encourage increased efficiency in water use (OECD 2006), leading to reduced investment needs for infrastructure (both water supply and downstream waste water treatment) and lower overall costs. Both effects can reduce environmental pressures significantly.

Under a full cost recovery approach, users should pay for the full cost of water abstraction, supply infrastructure, preservation of the water plant's value and all private and social costs associated with the provision of water (see figure below).



Many **EU Member States** (e.g. Netherlands, UK) have moved towards full cost recovery for water, involving significant changes in water pricing for most newer Member States. In the Czech Republic, for instance, water pricing gradually increased from €0.02/m3 before 1990 to €0.71/m3 in 2004. Between 1990 and 1999, water withdrawals decreased by 88% (agriculture), 47% (industry) and 34% (public water mains). All houses were provided with metering: consumption of drinking water decreased by about 40%, from 171 litres per day/capita in 1989 to 103 litres in 2002 (UNDP, 2003). In 2003 it was about 10% below the EU average (Naumann 2003). It should be emphasised that there was no sudden imposition of full cost recovery: implementation was gradual in order to avoid social impacts and take affordability issues into account.

Sources: Naumann 2003; UNDP 2003; Hansjürgens 2004; OECD 2006; IEEP et al. 2007

In **Mexico**, annual water withdrawal represents just 43% of the average total renewable water per year, but availability varies by region and water scarcity has increased in most regions over the last ten years. A water pricing system with two different tariffs was therefore introduced. The first tariff involves a fixed price per cubic metre used, which varies between water supply zones. The second uses an increasing block-rate structure to take account of different forms of water use and previously-unmet infrastructure costs. Prior to this programme, water prices covered only about 20% of operation, maintenance and replacement costs. Water tariffs now cover more than 80% of these costs, contributing to a more sustainable use of water by irrigation, industrial and municipal water use.

Source: Dinar 2000; Guerrero and Howe 2000

POTENTIAL COST SAVINGS THROUGH MBIS

Incorporating costs and using market forces has the potential to make MBIs **more cost effective than standard setting by direct regulation**. Where this is the case, it arguably offers the opportunity for more ambitious conservation goals to be set and reached (using a given budget) or that substantial cost savings can be achieved.

In the area of land development, a well-known example for achieving conservation goals without public expenditure concerns the local Tradable Development Rights programmes implemented across the USA (see Box 7.14). Similar programmes are run in New Zealand, Italy and France (OECD 1999a).

Other areas of environmental protection also provide evidence of potential cost savings that could be realised. A study of MBI use for biodiversity over 20 years in the USA showed that cost savings exist in practice (US EPA 2001). In terms of projections, evidence is mainly available for the use of tradable emission rights to regulate air pollutants. Studies based on econometric estimates and survey methods found savings of 43-55% compared to use of a uniform standard to regulate the rate of a facility's emissions (Burtraw and Szambelan forthcoming). The European Emissions Trading Scheme is expected to cut the cost of meeting Kyoto targets for EU Member States. Potential cost savings of a global emissions trading scheme compared to a protocol without trade have been estimated as significant: 84% at world level and 56% for the EU (Gusbin et al. 1999). However, any assessment of cost effectiveness is of course specific to the instrument, problem and context. Some MBIs have been set at very low rates and cannot subsequently be scaled up, due to public opposition or lack of political will (see 7.4.3).

Box 7.14: Tradable Development Rights to control urban sprawl and preserve open space: the case of Montgomery County (Maryland, USA)

The rural and mainly agricultural northern part of this county has cultural and environmental significance beyond its base economic importance. It enhances the quality of life for residents and visitors in the densely-developed Washington DC/Baltimore corridor by providing opportunities for access to locally-grown produce and recreation. A combination of low building density and adapted farming and forestry practices have protected the natural air and water filtration abilities of the ecologically diverse landscape.

In 1981, to prevent urban sprawl and preserve contiguous blocks of open space in this fast-growing county, a tradable development rights scheme (TDR) was introduced. Rights are handed out to landowners in a 'sending zone' in the rural north in exchange for them downsizing the authorised development density of their land. TDR can be bought by developers in 'receiving zones' who face high development pressure and want to exceed the authorised development density of such zones.

The Montgomery County TDR scheme is considered one of the most successful in the USA. By 2008 it had preserved over 50,000 acre of prime agricultural land and open space by transferring more than 8,000 development rights, accounting for 75% of all preserved agricultural land in the county (Pruetz and Standridge 2009). Because the programme is fully private, the savings in public expenditure for the amount of land preserved is estimated at nearly $70 million (Walls and McConnel 2007).

Sources: Walls and McConnel 2007; Pruetz and Standridge 2009

GENERATION OF PUBLIC REVENUE THROUGH MBIS

Public revenues can be generated not only by pricing instruments but also through tradable permit schemes where the State auctions the rights. Such revenues can constitute quite substantial parts of a public budget: estimates for the Seychelles show that biodiversity-related taxes, levies and permits made up one third of total public revenues in 1997 (Emerton et al. 1997). Revenues generated can increase the effectiveness of biodiversity-related instruments by providing extra funds for protective measures e.g. payments for environmental services or incentives like tax relief or endowments to enhance pro-biodiversity practices by land owners (see Chapter 5).

Examples can be found in many countries that earmark environmental taxes for biodiversity policies or use taxes to set up funds (see Box 7.15).

MBI-generated revenues can also play a key role in helping countries to meet their Millennium Development Goal commitments. Governments can consider using taxes to finance their social and physical infrastructure, provide a stable and predictable fiscal environment to promote growth and share the costs and benefits of development more fairly. Fiscal policy and administration also shape the environment in which economic activity and investment take place. Consultation on taxation between governments, citizens and other stakeholders can contribute to improved efficiency, accountability and governance.

Box 7.15: Creating synergies: using MBI revenues to finance biodiversity policies

Examples of pricing systems to generate revenues to restore/manage biodiversity are available from around the world:

- Australia introduced a water extraction levy for the Murray River basin and earmarked the revenues for wetland restoration and salt interception schemes (Ashiabor 2004);
- Mexico increased gasoline tax by 5.5% in October 2007. 12.5% of proceeds will go to support investments in the environment sector, including protected area management (Gutman and Davidson 2007);
- entrance fees to national parks are important revenue sources for countries with limited public money for nature conservation e.g. fees to the Biebrza National Park in Poland (OECD 1999b);
- charging special fees for specific activities in protected areas is also common e.g. diving fees in marine reserves in the Philippines (Arin and Kramer 2002). Tourists are interested in preserving sites they come to visit: the increase in fees paid is only a small fraction of their trip's total cost;
- in the USA, duck hunters are required to purchase Federal Duck Stamps. 98% of revenue generated by stamp sales goes directly to the purchase/lease of wetlands, targeting vital breeding habitats within the National Wildlife Refuge system. The system raises around $50 million/year (http://www.fws.gov/duckstamps/; see also Dunbar w/o).

Sources: OECD 1999b; Arin and Kramer 2002; Ashiabor 2004; Gutman and Davidson 2007; Dunbar (w/o)

7.4.3 LIMITATIONS OF MARKET-BASED INSTRUMENTS

Despite the potential described above, **use of resource pricing tools to safeguard biodiversity and ecosystem services is underdeveloped in most countries**. Although there are many market-based approaches globally, the share of environmental taxes as a percentage of total tax receipts is small and even decreasing in some countries (see Figure 7.3). Fully-implemented levies on harmful products are rare. The level of tax receipts from environmental taxes was about 6.4% of GDP in the EU in 2006; it has been recognised that this could usefully be significantly increased (Bassi et al. 2009), but also that political resistance is still substantial.

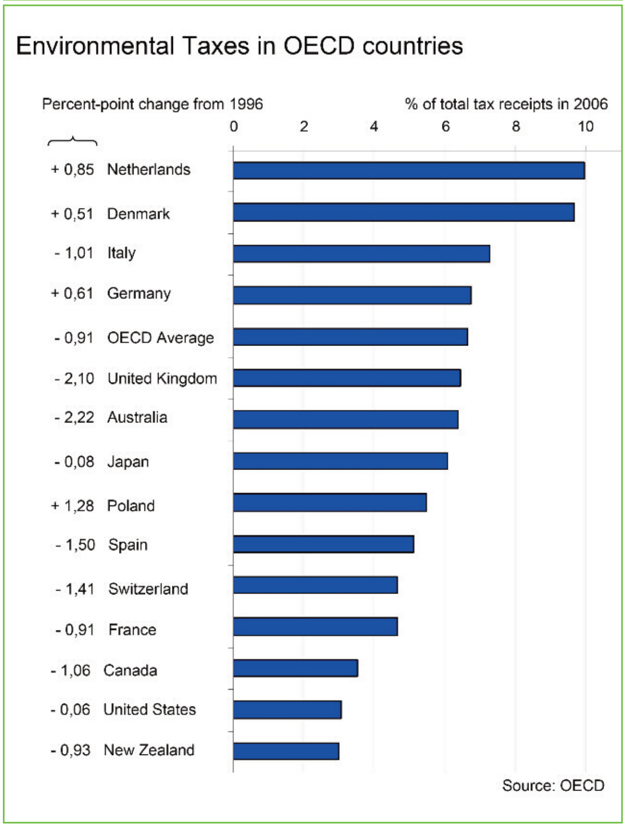
At pan-European level, a comparative study by the Council of Europe of tax systems specifically targeting biodiversity suggests that tax incentives are under-developed as a mechanism and do not make a targeted contribution to strengthening ecological networks: they are generally fragmented and **poorly integrated into biodiversity policy toolkits** (Shine 2005).

Market-based instruments are not appropriate in every situation and for every ecosystem. By leaving actors free to choose between reducing resource use or paying the price, they cannot reliably secure site-specific conservation goals to safeguard threatened ecosystems or species. Moreover, since inflation may erode the dissuasive effect of taxes, fees or charges over time, rates have to be continuously reviewed and adapted. When setting up permit trading schemes, determining the 'safe load' (i.e. number of permits to be issued) requires a detailed analysis of the ecosystem at stake. Experience suggests that incentive-based solutions rely on trying one thing, failing and then trying another (Bayon 2004). For these reasons, MBI should only be applied where trial-and-error is appropriate i.e. where failures do not lead to severe and unacceptable damages.

The **introduction of MBIs is often associated with high political costs**. In many countries raising taxes is likely to raise more political resistance from affected interest groups than complex technical requirements set by environmental standards. Administrative requirements are also quite high, especially for operating permit markets. There may be also ethical and equity issues at stake. Some see a charge, a tax or a quota as a paid right to pollute or to degrade the environment which may be ethically questionable. Such instruments can be perceived as unfair as the rich can more easily pay than the poor.

Policy makers and public agencies therefore play a vital role in creating the legal framework necessary for MBI to operate effectively. This means that tradable permit markets for use of ecosystem services are difficult – if not impossible – to implement in countries with weak institutions and regulatory regimes. The aim should not to develop MBI as a substitute for direct regulation, but to create smart policy mixes that provide more flexibility for targeted actors to achieve environmental goals (see 7.6). Such policy mixes can minimise abatement costs to pave the way for more ambitious conservation goals.

Figure 7.3: Environmental taxes as a percentage of total tax receipts in 2005



Source: http://media.economist.com/images/columns/2008w14/Environment.jpg

7.4.4 ROLE OF ECONOMIC INFORMATION IN INSTRUMENT DESIGN

Economic values can feed into the design of market based instruments e.g. to set the rates or number of permits necessary to address the loss of ecosystems and biodiversity.

Understanding the costs of loss can **trigger new pricing instruments**. Valuation provides facts and evidence of ongoing damage and sheds light on negative effects of current consumption patterns. These cost calculations can greatly help policy makers to establish instruments to make the user pay, as they justify the need for price-based approaches and support awareness raising.

Such information can also **facilitate the design of price instruments** for capturing the values of public goods. To implement full cost recovery approaches to cover associated environmental costs, the full costs obviously need to be known. Economic assessments will thus need to play an increasingly important role in e.g. future water pricing policies.

Economic information can **be used directly to determine the tax rate or price** e.g. for fees, charges and trading rules to enable markets for tradable permits to run properly. A good example can be found in India, where the Supreme Court used the results of an economic valuation study to set mandatory compensation payments for conversion of forested land to other uses (see Box 7.16: this case study is also cited in Chapter 4).

Box 7.16: Using economic valuation to determine compensation rates in India

In 2006 the Indian Supreme Court set compensation rates for conversion of different types of forested land to non-forest use, with much higher damage assessment multiples (5x for sanctuaries, 10x for national parks) for any conversion of such biodiversity-rich protected areas. It drew on an economic valuation study of Indian forests by the Green Indian States Trust (GIST 2006) which estimated the value for six different classes of forests (see table below) of timber, fuelwood, non-timber forest products and ecotourism, bio-prospecting, ecological services of forests and non-use values for the conservation of some charismatic species, such as Royal Bengal tiger or the Asian lion. Converters pay compensation to an afforestation fund to improve national forest cover. In 2009 the Supreme Court directed Rs. 10 billion (~ US$ 215 million) to be released from the fund every year towards afforestation, wildlife conservation and creating rural jobs (Thaindian News, 10 July 2009).

Eco-Value Class	Forest Type	Very Dense Forest	Dense Forest	Open Forest
I	Tropical Wet Ever- and Semi Evergreen; Tropical Moist Deciduous	22,370	20,100	15,700
II	Littoral and Swamp	22,370	20,100	15,700
III	Tropical Dry Deciduous	19,000	17,200	13,400
IV	Tropical Thorn and Tropical Dry Evergreen	13,400	12,100	9,400
V	Sub-Tropical Broad Leaved Hill, Sub-Tropical Pine and Sub-Tropical Dry Evergreen	20,100	18,100	14,100
VI	Montane Wet Temperate, Himalayan Moist and Dry Temperate, Sub Alpine, Moist and Dry Alpine Scrub	21,300	19,200	15,000

All values per ha, transformed to US$ and rounded.

Sources: GIST 2006; Thaindian News 10 July 2009

Non-market valuation studies can help **set an adequate price level for entrance fees**. Visitors' willingness to pay may be higher than first thought by protected area administrators. One study provided support for sustainably financing the Bonaire National Marine Park in the Caribbean (see Box 7.17). Another study – focused on the Polish Baltic Sea – showed that a substantial number of coastal users were willing to support the idea of a tax to protect the Baltic Sea from eutrophication (Zylicz et al. 1995).

Box 7.17: Analysing willingness-to-pay to adjust fee structures in the Antilles

The National Parks Foundation is a non-governmental non-profit foundation commissioned by the island government to manage the Bonaire National Marine Park (BNMP), one of the world's premier diving sites. The Foundation gets its income from park admission fees, users of commercial and private moorings, donations and grants, including a government grant for the Education Coordinator's salary. A successful visitor and user fee system, introduced in the early 1990s, was amended in the light of economic valuation studies and now provides more than 90% of self-generated revenues for BNMP. A contingent valuation survey (Dixon et al. 1993) showed that the willingness-to-pay of scuba divers for annual BNMP tags clearly exceeded the relatively modest US$ 10 fee instituted in 1992. This led to a price increase in BNMP dive tags to US $ 25 in 2005: in addition, all users now have to pay entrance fees.

Source: Dixon et al. 1993; Slootweg and van Beukering et al. 2008; Stinapa Bonaire 2009

To summarise, available experience suggests that MBI – if properly designed, implemented, monitored and enforced for compliance – are powerful tools to manage and protect ecosystem goods and services. **As environmental pricing regimes and permit markets develop, it is important to learn lessons from their implementation**. In particular, it is necessary to study whether, and under what institutional and regulatory conditions, existing markets for one resource could be applied more widely within and between countries. Being able to show that it works in a neighbouring country is sometimes the best argument for launching the instrument at home.

Source: Janderk

Scuba diver at the top of '1000 Steps' beach and dive site on Bonaire.

7.5 MONITORING, ENFORCEMENT AND CRIMINAL PROSECUTION

Building awareness across society and political commitment at all levels is a fundamental step towards improving environmental performance and compliance.

In parallel, monitoring, enforcement and criminal prosecution of non-compliant behaviour are essential for any environmental policy to become effective. Environmental crimes often yield high profits for perpetrators, while risks of detection are too low and punishment is not severe enough to deter illegal practices. Change will require adequate funding for monitoring activities, international cooperation on law enforcement and the provision of viable and legal alternatives for certain groups.

7.5.1 ENVIRONMENTAL CRIME: A LOCAL AND GLOBAL PROBLEM

Individuals and businesses will more likely comply with an environmental standard, fulfil a compensation re-quirement or pay a tax if the incentives are right, including a meaningful risk that any illegal behaviour will be detected and appropriately punished. Where government efforts to track down crimes and enforce the law are perceived as weak, this will be taken by some as a tacit acceptance that regulatory requirements do not need to be respected. Good governance and credibility are therefore critical to law enforcement.

Box 7.18 outlines the range of activities and sectors concerned by environmental crime.

Box 7.18: What are environmental crimes?

Environmental crimes include any actions – or failure to act - that breach environmental legislation. They can range from relatively minor offences to serious offences that cause significant harm or risk to the environment and human health. The best-known categories include the illegal emission or discharge of substances into air, water or soil, illegal trade in ozone-depleting substances, illegal shipment or dumping of wastes, illegal trade in wildlife, illegal logging and illegal fisheries but there are many others, including illegal building, land conversion and water extraction.

The impacts of environmental crime can be felt from very local through to global level. Offences with a trade-related or pollution dimension are particularly likely to have a cross-border aspect which can widen the number of impacted people. Not paying attention to this dimension can have implications for a country's trading status and the ability of its businesses to develop new opportunities. Several initiatives to improve international governance and collaboration on monitoring and enforcement are therefore under way.

Many drivers need to be considered, from poverty (i.e. lack of alternatives) to corruption and organised crime. The economics of wildlife crime, for example, show that trade of illegally harvested biodiversity is extremely profitable, generating billions of dollars. The same magnitude of profits can be made by polluters who defy environmental standards and permit conditions. There is a huge need to change people's attitude towards environmental crimes.

POLLUTION AND OTHER DAMAGING ACTIVITIES

Serious pollution-related offences include the handling, transport, trading, possession and disposal of hazardous waste or resources in breach of national and/or international law. They have a clear and direct impact on human health, biodiversity and provision of ecosystem services due to the hazardous nature of the substances in question and can have **knock-on transboundary or wider impacts**. Illegal actions can thus have **far-reaching consequences going beyond the damage caused by the initial act**, often over a considerable period of time. Moreover, businesses that violate applicable laws have an unfair economic advantage over law-abiding ones.

We easily overlook what seem to be minor offences but these too have a significant cumulative impact on biodiversity, cause disturbance to species or lead to ecosystem degradation. Examples include the destruction of breeding places or nests; ongoing pollution of water resources through excessive discharges of chemicals, dangerous substances and wastes; and non-compliance with conditions laid down by administrative permits (see Box 7.19).

As noted in 7.2, regulatory frameworks set rules and standards to avoid or minimise the risk of damage. These, along with best practices adopted in different sectors, are **widely incorporated into environmental management procedures implemented by reputable operators around the world**. Whilst accidents can always happen, negligent practices and/or failure to comply with applicable rules and standards foreseeably increase the likelihood of damage to the environment and/or human interests. The main sectors concerned include the oil storage and transport sector, oil distilleries, chemical manufacturing and storage, the waste treatment and water services sectors, as well as agriculture.

Environmental liability rules, coming on stream in some parts of the world, provide a mechanism for relating the harmful activity to the polluter (where identified) and securing restoration and compensation (see 7.2). Environmental criminal law goes a step further by defining what constitutes illegal conduct, whether it is deliberate and setting penalties (monetary, imprisonment or both). However, its enforcement is always cumbersome as relevant activities are often widespread and surveillance on the spot cannot reliably take place. Corruption in certain countries further adds to the problem. Too often monitoring comes into play only after the damage has occurred and its effects on the ecosystem are apparent. Such monitoring rarely makes it possible to trace a polluting incident back to the polluter with the degree of certitude required for penal actions.

Box 7.19: Wider impacts of pollution and dumping

Oceans are fast becoming a garbage dump. In Australia, surveys near cities indicate **up to 80% of marine litter originating from land-based sources** (sea-based sources are in the lead in more remote areas). Cigarette products, paper and plastic bags headed the Top 10 List of Marine Debris items for 1989-2007. Plastic, especially plastic bags and polyethylene terephthalate (PET) bottles, is the most pervasive type of marine litter around the world, accounting for over 80% of all litter collected in several regional seas assessed.

One key step is to review the level of fines for ocean dumping to increase the level of deterrent where necessary. In the USA, for example, the cruise ship Regal Princess was fined $ 500,000 in 1993 for dumping 20 bags of garbage at sea (UNEP 2009b).

Dumping of mining waste: The Panguna copper mine in Papua New Guinea dumped 130,000 tons per day of tailings into the Kawerogn/Jaba river system (a total of 600 million tons). The damage spread over 30 kilometres from the source and all life disappeared from the river due to the metal and leach acids. The conflict over the mine also inflamed a civil war which lead to its eventual closure (Young 1992). Although this particular case has been dealt with, mining remains one of the most polluting and controversial activities with potentially severe effects on biodiversity and ecosystem services.

Sources: UNEP 2009, ten Brink et al., Young 1992

ILLEGAL USE OF RESOURCES AND WILDLIFE CRIME

Offences related to natural resource use and wildlife can take many forms and take place at many levels. Most countries have long regulated direct taking, trade and other activities affecting valued resources, species and their derivatives where these could collectively lead to over-exploitation or irreversible damage. These rules and associated permit requirements (e.g. to prevent over-collection of wild plants and poaching of animals) are very familiar to environmental administrations, even if detection of offences and subsequent enforcement present major logistical difficulties.

Box 7.20: The economics behind environmental crimes

A whole economy is associated with illegal poaching and hunting. Related profits can be substantial and easily exceed the financial penalties imposed were the crime to be detected. By way of example:

- Cambodian farmers can reap 250 times their monthly salary through the sale of one dead tiger;
- in Papua Province, Indonesia, a shipload of illegal timber yields profits of roughly $92,000, while the penalty is only US $6.47: the rewards are over 14,000 times greater than the risks;
- in Brazil, illegal loggers in the Atlantic Forest can make $75 per tree they harvest but face a deterrent of only US$6.44;
- in Mexico's Selva Maya Forest, poachers obtain a net average of $191.57 per trip but face a deterrent of only $5.66;
- in the Philippines, illegal dynamite and cyanide fishing in the Calamianes Islands earn fishermen an average of $70.57 per trip. The value of the deterrent is only $0.09.

Smuggling wildlife, including many endangered species, is the third largest and most profitable illegal cross-border activity after arms and drugs. Due to increasing demand for animal parts, tigers and other big animal populations (elephants, rhinos) have declined drastically since 1950. Growing demand from Asia for ivory is driving the black market where it now sells for $750 per kilogram, up from $100 in 1989 and $200 in 2004.

Source: Akella and Cannon 2004

We should not neglect the fact that some illegal activity is generated by poverty in developing countries. For example, **illegal hunting** can be triggered by increasing demand for bush-meat from indigenous people through to global buyers. Poorer people are selling bush-meat to collectors and restaurants, meat suppliers and poachers as a means of survival.

As noted throughout this report, many rural and indigenous populations depend on ecosystem goods and services for their livelihoods, cultural identity and even survival. Access to common resources and harvesting is a de facto right. Conflicts of interest are often inevitable and foreseeable where regulatory restrictions or bans are extended to resources used by such groups.

The guiding principles for policy makers set out in Chapter 2 are particularly relevant when negotiating new controls in this field. More broadly, where environmental crime exists, it needs to be addressed through the provision of income-producing alternatives and education. Linking conservation strategies with poverty alleviation is an absolute must for developing countries.

Global illegal trade in wildlife species has grown into a multibillion-dollar business. Species most at risk are plants of edible, medicinal or decorative use, emblematic animal species for their skins and trophies and exotic species (e.g. reptiles, amphibians, fish/corals and birds) collected as pets, ornamentals and for their eggs or venom. Existing black markets, as problematic as they are, mirror the values underlying biodiversity and specific ecosystem services (see Box 7.20).

International treaties may help to protect endangered and threatened species but enforcement is difficult and penalties lack teeth. The 1973 CITES treaty (Convention on International Trade in Endangered Species) protects 900 species from being commercially traded and restricts international trade for 29,000 species that may become threatened. However, a major constraint on global implementation is that even though over 170 countries are party to CITES, implementation and enforcement are inadequate at national level.

7.5.2 NEW APPROACHES NEEDED TO TACKLE CRIME

The economic values of biodiversity and wildlife driving illegal activities can shed light on possible policy responses. Public spending for improved monitoring and detection may be a worthwhile investment as well as providing viable alternatives of livelihoods for local people. Being a global problem, international collaboration to fight environmental crimes is an essential step towards greater efficiency and effectiveness.

Better enforcement of existing regulations is key to stopping illegal activities. Poor enforcement often results in more breaches of legislation affecting all the threats identified above (pollution, dumping, illegal wildlife trade, etc). Stronger enforcement can be assisted by high-tech tools that facilitate crime detection and identifying the source (detection of illegal logging activities, DNA tests on poached animals, pollution alerts and monitoring, satellite tracking of fishing vessels). However, detection is not an enforcement measure and more needs to be done to strengthen implementation. A study by Akella and Cannon (2004) suggests that strengthening crime detection in isolation has often been ineffective; it is more promising to **address the entire enforcement chain - detection, arrest, prosecution, conviction and penalties - in an integrated way**.

Applying meaningful penalties and sanctions is critical to address all types of environmental crimes: only if penalties are high enough will they deter people and businesses from undertaking illegal activities. In EU Member States, environmental offences are subject to similar penalties as traditional crimes (fines, prison, community sentences) but in practice, fines are by far the most common sanction and it is extremely rare to see prison sentences imposed. However, there is now a general trend towards more severe sentencing and a recent study has revealed that the number of prosecutions for environmental crimes is increasing (Huglo Lepage and Partners 2003, 2007).

A promising avenue for further progress is the **participation of citizens** in monitoring and management activities. Environmental NGOs are often in a good position to monitor conditions on the ground, investigate breaches of legislation and raise the alarm about environmental crimes at national or global level. Several do this very effectively in cases of e.g. forest destruction, dumping from minefields or marine pollution. Other NGOs provide technical support for tracing, detecting and investigating wildlife trade crimes.

There are now good examples of how citizens can engage actively in protecting wildlife and reporting bad practices, which can also help with improving prosecution rates (see Box 7.21).

Box 7.21: Investigating bats crime in the United Kingdom

All UK bats and their roosts are protected by law. The Bat Conservation Trust's Investigations Project was established in 2001 as a two-year project in collaboration with the Royal Society for the Protection of Birds to monitor bat-related crime. 144 incidents were reported to the Investigations Project but it was acknowledged that this was likely to be just the tip of the iceberg. Building development and maintenance accounted for 67% of incidents. In addition, 87% of all incidents involved destruction or obstruction of a roost threatening the bat population of an area. The work of the BCT led to the criminal prosecution and penalisation of several offenders (recent fines include £3,500 for destruction of 2 roosts by a developer).

Source: Bat Conservation Trust 2009

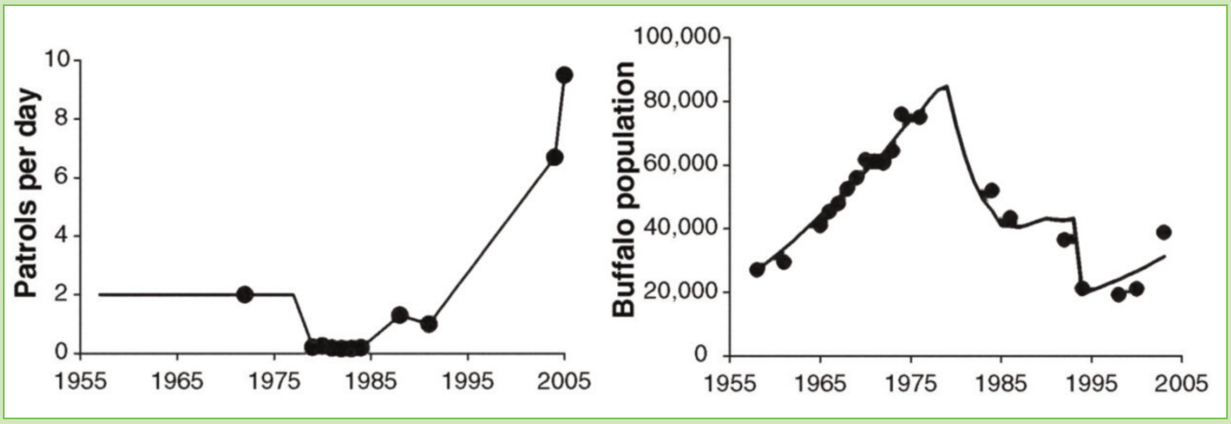
As part of a coherent approach to address drivers of illegal activities, creating income alternatives and reforming unjust laws will help to improve compliance.

To prevent illegal poaching, a starting point is to educate local people about the hunting rules in force and at the same time **provide viable alternatives for jobs and livelihoods**. Experience with ex-poachers in Thailand suggests that they now make more money taking eco-tourists into the forest (and protecting bird populations against poachers) than they did by poaching hornbills themselves (Wildlife Extra 2009; Thaipro 2003).

Demand for illegal wildlife products needs to be halted. For this to happen, we urgently need to change people's perceptions about wildlife products and help consumers to understand the scale of the catastrophe in terms of population declines (see TEEB D4 for Consumers/Citizens for more details). Trade bans and efforts to control borders and customs are frequently suggested tools. However, these are controversial: it has been argued that proactive management of trade in endangered wildlife makes more sense than last-minute bans that can inadvertently stimulate (Rivalan et al. 2007).

Box 7.22: Enforcement at Serengeti National Park

Scientists from the University of Washington have shown that in the Serengeti, which has a 50-year-record of arrests and patrols, a precipitous decline in enforcement in 1977 resulted in a large increase in poaching and decline of many species. Conversely, expanded budgets and anti-poaching patrols since the mid-1980s have significantly reduced poaching and allowed populations of buffalo, elephants and rhinoceros to rebuild. After the improved patrols in the Serengeti proved effective Tanzania initiated a community conservation program in 2000. Outside of established reserves, using tourism or hunting expeditions to generate economic benefits for local communities is the cornerstone to enlisting their help in protecting wildlife.



Source: Wildlife Extra 2008; Hilborn et al. 2006

Sustainable use of wildlife has also been recognised as a possible solution (see Box 7.22). Safari hunting could offer a significant and durable source of financing to offset some of the costs of maintaining Africa's wild lands and protected areas. However, some scientists have called for a better quantitative assessment of whether trophy hunting is both ecologically sustainable and economically competitive over the long term relative to other land uses (Wilkie et al 1999).

In today's global economy, there is more than ever a **need for an international strategy** to deal with environmental crime. Continued cooperation under international treaties to harmonise environmental standards and monitoring requirements is indispensable, together with mutually supportive collaboration on criminal prosecution. The INTERPOL Working Groups on Pollution Crime and on Wildlife Crime (Interpol 2009) provide an excellent example of what can be done.

7.6 MAKING IT HAPPEN – POLICY MIXES TO GET RESULTS

Policies that make the polluter take the full cost of loss into account are a key element of responses to the biodiversity challenge. Policy mixes are crucial for this purpose – they can combine the advantages of different instruments and deliver positive synergies, if properly designed and if institutional and cultural factors are not neglected.

Policies to avoid ongoing losses form the backbone of the policy response. Minimising emissions from point sources (e.g. factories) and diffuse sources (e.g. pesticides) and tackling resource over-use are essential to halt losses and maintain ecosystem services and functions.

Policy makers already have a useful toolkit at their disposal. Pollution control, resource use minimisation and land use management can best be achieved on the basis of a strong regulatory framework. Regulation, especially setting standards, has achieved great successes: many environmental problems that were pressing in the past (e.g. contamination of water bodies, high concentrations of pollutants in the atmosphere) have been significantly reduced through this type of instrument. There is considerable scope for further use of regulation to address environmental problems directly. However, a **strong regulatory framework can also provide more:** it is a **basic precondition for introducing other instruments** such as offset requirements, biodiversity banking or ecologically-focused taxes.

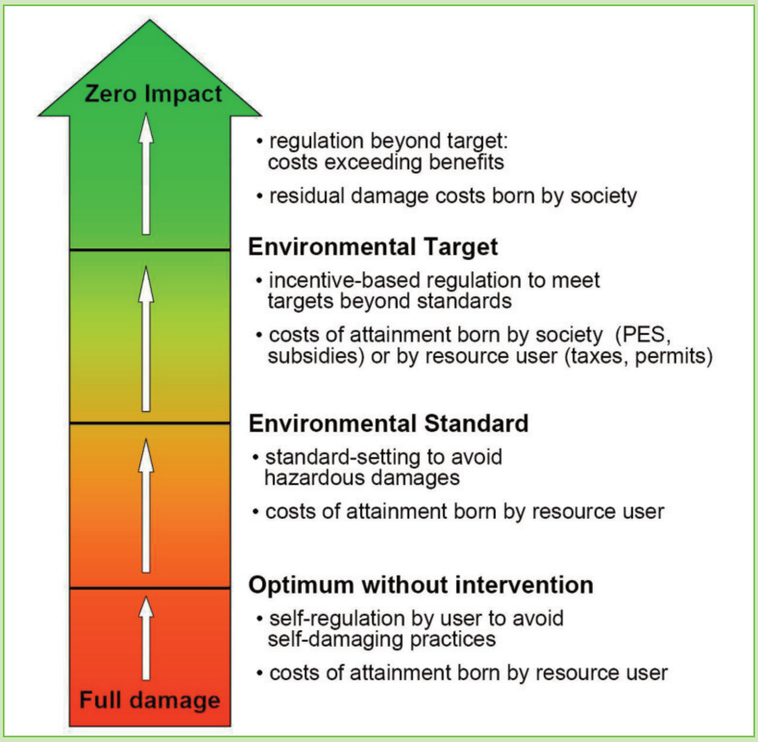
No single policy instrument is enough to tackle the wide range of activities, sources and sectors affecting biodiversity and ecosystem services provision. Market-based instruments are crucial to keep the costs of action low as they encourage actors to develop and implement the cheapest abatement options. The real challenge is to create **smart policy mixes combining the advantages of regulation and flexible market-based instruments** to reach the full potential of the polluter pays and full cost recovery principles (see Figure 7.4).

Policy mixes offer opportunities to address various ecosystem services and various actors at the same time. The optimal policy mix will depend on the state of the resource or ecosystem in question and the number and variety of actors affected. By way of example:

- in the field of hazard prevention, strong environmental regulation is important (e.g. banning highly toxic substances that may be released into the environment);
- for sustainable management of renewable resources, market-based solutions such as permit trading or introducing taxes merit serious consideration;
- even for a single resource, a combined approach is often suitable e.g. in fisheries policies, no-take zones such as marine protected areas might be appropriate to provide undisturbed spawning grounds while fish catch might best be managed through individual tradable quotas.

Market-based instruments can deliver significant social benefits as they stimulate consideration of different abatement costs among resource users and development of **least-cost solutions**. However, these appro-aches are insensitive to distributional concerns and often neglect the needs of the poor and vulnerable. Governments around the world already use a significant share of their revenues to equalise incomes and regulate market activity to ensure wider access to goods and services by such groups. For this reason, smart policy mixes need to go beyond simple cost recovery mechanisms to include appropriate **distributional measures**.

Figure 7.4: Stylised policy mix to address environmental impact



Environmental policy based solely on regulation involves the cost of compliance with a set standard. These costs are already borne by polluters but resource use below the chosen standard is free of charge which means that the associated environmental damage has to be borne by society. Neither the polluter pays principle nor the principle of full cost recovery are applied to their full extent.

If a market-based instrument (e.g. a tax) is introduced covering the entire resource use, this policy mix (of regulation and market-based instrument) leads to a stronger attribution of costs to the polluter. This strengthens incentives for change in the polluter's behaviour.

Reaching a situation of zero impact is economically not desirable in most cases as it often implies that the costs of environmental protection exceed its benefits (i.e. damages prevented). From an economic perspective this is an inefficient point where environmental policy is 'over-shooting'.

Policy design also needs to consider the **institutional preconditions necessary for implementation** (see also Chapter 2). Setting up an emission trading market may be much more ambitious than requesting a minimum standard for filtering emissions at every smokestack. Tax regimes or charging systems (e.g. to reduce water consumption) will only become effective if payments can actually be enforced. Offsets (e.g. for environmental impacts caused by urban development) will only be able to secure no net loss if their effectiveness is monitored over the long term.

Information on the economic costs of biodiversity loss and degradation of ecosystem services can be helpful to support policy makers wishing to propose a new instrument, reform an existing one or build capacity to better implement an existing instrument that is not yet reaching its potential. Economic insights can also help with **instrument choice** (i.e. which combination is more likely to create cost-effective solutions) and in **policy implementation** (e.g. high damage costs suggest high penalties). Building on local knowledge and cultural and institutional contexts can further extend the range of innovative policy mixes (see TEEB D2: Report for Local Policy Makers and Administrators).

Every country is different and what works in one country will not automatically work in another. On the other hand, **learning from success stories and experience elsewhere provides opportunities to adjust and adapt policy tools to national conditions**. A range of approaches combining regulatory and market based solutions should be actively promoted in tandem with the recommendations and guidance in Chapters 5, 6, 8 and 9. The creativity of national and international policy makers is needed in designing smart policy responses to tackle the tremendous biodiversity challenge that confronts us and the generations to come.

Chapter 7 has shown the critical need to strengthen and target a **smart policy mix of instruments** aligned, as far as possible, with the **polluter pays** and **full cost recovery** principles. A strong regulatory framework and good governance is the baseline from which more innovative and ambitious compensation and market-based mechanisms can be developed. Improved application of liability and enforcement regimes is essential to make existing and new policies deliver effective and equitable results.

Chapter 8 discusses the **potential of protected areas** to add value to biodiversity and ecosystem services with associated gains for local and wider communities.

REFERENCES

Akella, A. S. and Cannon, J. B. (2004) Strengthening the Weakest Links: Strategies for Improving the Enforcement of Environmental Laws Globally. Centre for Conservation and Government at Conservation International. URL: http://www.oecd.org/dataoecd/18/37/33947741.pdf (last access Sep 24, 2009).

Arin, T. and Kramer, R. A. (2002) Divers' Willingness to Pay to Visit Marine Sanctuaries: An Exploratory Study. Ocean and Coastal Management 45: 171-183.

Ashiabor, H. (2004) Taxation and the fostering of biodiversity conservation in Australia. Bulletin for International Fiscal Documentation 58(7): 315-325.

Barroso, J. M. D. (2009) Biodiversity: Giving Proper Value to a Priceless Asset. speech at 'Biodiversity Protection – Beyond 2010' conference in Athens, 27 April 2009. URL: http://www.eu-un.europa.eu/articles/en/article_8673_en.htm (last access Sep, 14, 2009).

Bassi, S.; ten Brink, P.; Pallemaerts, M. and von Homeyer, I. (2009) Feasibility of implementing a radical ETR and its acceptance. Report under task C of the 'Study on Tax Reform in Europe over the Next Decades: Implication for the Environment, for Eco-Innovation and for Household Distribution' for the European Environment Agency. Forthcoming 2009. Brussels.

Bat Conservation Trust (2009) Bats – the real stars of the night. URL: http://www.bats.org.uk/ (last access Oct 16, 2009).

Bayon, R. (2008) Banking on Biodiversity. Chapter 9 in 2008 State of the Environment Report - Innovations for a Sustainable Economy. The Worldwatch Institute: 123-137.

Bayon, R. (2004) Making environmental markets work: Lessons from early experience with sulphur, carbon, wetlands, and other related markets. Forest Trend, Washington D.C.

BBOP – Business and Biodiversity Offsets Programme (2008) Principles on Biodiversity Offsets Supported by the BBOP Advisory Committee. URL: http://bbop.forest-trends.org/guidelines/principles.pdf (last access Oct 16, 2009).

BBOP – Business and Biodiversity Offsets Programme (2009) Biodiversity Offsets. URL: http://bbop.forest-trends.org/offsets.php (last access Sep, 14, 2009).

Bean, M.; Kihslinger, R. and Wilkinson, J. (2008) Design of US habitat banking systems to support the conservation of wildlife habitat and at-risk species. The Environmental Law Institute, Washington D.C.

Burtraw, D. and Szambelan, S. (forthcoming) US Emissions Trading Markets for SO_2 and NOx. In: Hansjürgens, B.; Antes, R. and Sterk, M. (Eds.): Permit Trading in Different Applications. Routledge Publisher, in print.

Carroll, N.; Fox, J. and Bayon, R. (2007) Conservation and biodiversity banking: a guide to setting up and running biodiversity credit trading systems. Earthscan, London.

Department of Environment and Climate Change of the Government of New South Wales (2009) BioBanking. URL: http://www.environment.nsw.gov.au/biobanking/ (last access Oct 16, 2009).

Dinar, A. (2000) The political economy of water pricing reforms. A World Bank Publication, Oxford University Press.

Dixon, J. A.; Fallon Scura, L. and van't Hof, T. (1993) Meeting ecological and economic goals: marine parks in the Caribbean. Ambio 22: 117–125.

Dunbar, S. G. (w/o) Lecture 9 - Paying for Biodiversity. URL: http://resweb.llu.edu/rford/courses/BIOL549/docs/Lecture9PayingForBiodiversity.pdf (last access Aug 19, 2009).

Ecotec (2001) Study on the Economic and Environmental Implications of the Use of Environmental Taxes and Charges in the European Union and its Member States. URL: http://ec.europa.eu/environment/enveco/taxation/pdf/ch1t4_overview.pdf (last access Aug 19, 2009).

Emerton, L. (1997) Seychelles Biodiversity: Economic Assessment. URL: http://www.cbd.int/doc/external/countries/seychelles-eco-assessment-1997-en.pdf (last access Aug 19, 2008).

ENCORA (2008) Overview of oil spills events from 1970 to 2000. URL http://www.coastalwiki.org/coastalwiki/Overview_of_oil_spills_events_from_1970_to_2000 (last access Oct 16, 2009).

Forest Trend (2009) Markets for Ecosystem Services in China: An Exploration of China's 'Eco-compensation' and Other Market-Based Environmental Policies. URL: http://www.forest-trends.org/documents/files/doc_2317.pdf (last access Aug 19, 2009).

GIST – Green India States Trust (2006) The Value of Timber, Carbon, Fuelwood, and Non-Timber Forest Products in India's Forests. URL: http://www.gistindia.org/pdfs/GAISPMonograph.pdf (last access Aug 19, 2009).

Guerrero, H. and Howe. C (2000) Water pricing in Mexico: principles and reality. URL: http://www.soc.uoc.gr/calendar/2000EAERE/papers/PDF/D1-Howe.pdf (last access Oct 16, 2009).

Gusbin, D.; Klaassen, G. and Kouvaritakis, K. (1999) Costs of a ceiling on Kyoto flexibility and Presentation at the IAEA Workshop - The Clean Development Mechanism and Nuclear Power. URL: http://r0.unctad.org/ghg/background.htm (last access Aug 19, 2009).

Gutman, P. and Davidson, S. (2007) A review of innovative international financial mechanism for biodiversity conservation with a special focus on the international financing of developing countries' protected areas. URL: http://www.cbd.int/doc/meetings/pa/wgpa-02/information/wgpa-02-inf-08-en.doc (last access Aug 19, 2009).

Hansjürgens, B. (1992) Umweltabgaben im Steuersystem. Zu den Möglichkeiten einer Einfügung von Umweltabgaben in das Steuer- und Abgabensystem der Bundesrepublik Deutschland. Nomos, Baden-Baden.

Hansjürgens, B. (2000) Effizienzsteigerungen in der Umweltpolitik durch Policy-Mix – Umweltordnungsrecht und handelbare Umweltnutzungsrechte. in: Gawel, E. und Lübbe-Wolff, G. (Eds.): Effizientes Umweltordnungsrecht. Nomos, Baden-Baden: 251-275.

Hansjürgens, B. (2004) Cost Recovery and Water Pricing. Presentation at Wageningen University, May 26, 2004.

Hansjürgens, B. Antes, R. and M. Sterk (Eds.) (forthcoming) Permit Trading in Different Applications. Routledge Publisher, in print.

Huglo Lepage & Partners Counsel (2003) Criminal Penalties in EU Member States' environmental law - Final Report, 15-09-03. Study Contract:ENV.B.4-3040/2002/343499/MRA/A. Available at: http://ec.europa.eu/environment/legal/crime/pdf/criminal_penalties2.pdf (last access Aug 19, 2009).

Huglo Lepage & Partners (2007) Study on environmental crime in the 27 Member States. Contract JLS/D3/2006/05. URL: http://ec.europa.eu/environment/legal/crime/pdf/report_environmental_crime.pdf (last access Aug 19, 2009).

Hunt C. (1997) Economic Instruments for Environmental and Natural Resources Conservation and Management in the South Pacific. Working paper in Ecological Economics No 9706. Centre for Resource and Environmental Studies, Australian National University, Canberra. URL: http://een.anu.edu.au/download_files/eep9706.pdf (last access Oct 16, 2009).

IEEP et al (2007) Reforming environmentally harmful subsidies. Final report to the European Commission's DG Environment, March 2007.

Interpol (2009) Environmental crime. URL: http://www.interpol.int/Public/EnvironmentalCrime/Default.asp (last access Aug 19, 2009).

ITOPF – The International Tanker Owners Pollution Federation Limited (2009) Statistics. URL: http://www.itopf.com/information-services/data-and-statistics/statistics/ (last access Oct 16, 2009).

Korean Ministry of Environment (2009) Website of the Ministry. URL: http://eng.me.go.kr/docs/sub2/policy_view.html?idx=50&class=13&topmenu=B&cat=240 (last access Aug 19, 2009).

Korean Ministry of Environment (2006) Volume-based Waste Fee System in Korea. URL: http://eng.me.go.kr/docs/publication/filedown.html?filename=VBWF(06).pdf&mcode=B (last access Aug 19, 2009).

McGlade, J. (2007) speech of the morning plenary session on 18 October 2007 at the 8th Global Conference on Environmental Taxation, Munich, Germany, 18–20 October 2007. URL: http://www.eea.europa.eu/pressroom/speeches/eco-innovation-and-climate-change-the-role-of-fiscal-instruments (last access Oct 16, 2009).

Millennium Ecosystem Assessment (2005) Ecosystems and Huamn Well-being: Global Assessment Reports. URL: http://millenniumassessment.org/en/Global.aspx (last access Oct 16, 2009).

Ministry of Fisheries New Zealand (2005) Characteristics of the fishing sectors. URL: http://www.fish.govt.nz/en-nz/Publications/Ministerial+Briefings/Ministerial+Briefing+05/Annex+1+-+Fisheries+Management+in+New+Zealand/Characteristics+of+the+fishing+sectors.htm (last access Aug 19, 2009).

Naumann, M. (2003) Current Status of Water Sector in the Czech Republic. Working Paper.

New York Times, Feb 02, 2008: Motivated by a Tax, Irish Spurn Plastic Bags. URL: http://www.nytimes.com/2008/02/02/world/europe/02bags.html (last access Oct 16, 2009).

OECD – Organisation for Economic Co-operation and Development (1999a) Implementing domestic tradable permits for environmental protection. OECD, Paris.

OECD – Organisation for Economic Co-operation and Development (1999b) Handbook of Incentive Measures for Biodiversity: Design and Implementation. OECD, Paris.

OECD – Organisation for Economic Co-operation and Development (2006) Improving Water Management: Recent OECD Experience. Policy Brief February 2006. URL: http://www.oecd.org/dataoecd/31/41/36216565.pdf (last access Oct 16, 2009).

Pruetz, R. and Standridge, N. (2009) What makes Transfer of Development Rights work? Success factors from esearch and practice. Journal of the American Planning Association 75 (1): 78-87.

Rio Tinto (2004) Rio Tinto's biodiversity strategy. URL: http://www.riotinto.com/documents/CorpPub_Biodiversity Strategy.pdf (last access Sep 14, 2009).

Rivalan, P.; Delmas, V.; Angulo, E.; Bull, L.S.; Hall, R. J.; Courchamp, F.; Rosser, A.M. and Leader-Williams, N. (2007) Can bans stimulate wildlife trade? Nature 447: 529-530.

Shine, C. (2005) Using tax incentives to conserve and enhance biodiversity in Europe. Council of Europe, Nature and Environment. N 143.

Slootweg, R. and van Beukering, P. (2008) Valuation of ecosystem services and strategic environmental assessment: lessons from influential cases. Netherlands Commission for Environmental Assessment. URL: http://www.indiaenvironmentportal.org.in/files/cs-impact-nl-sea-valuation-en.pdf (last access Oct 16, 2009).

Stinapa Bonaire - Stichting Nationale Park Foundation Bonaire (2009) Stinapa Bonaire. URL: http://www.stinapa.org/ (last access Oct 16, 2009).

Swedish Forestry Act. URL: http://www.svo.se/episerver4/templates/SNormalPage.aspx?id=12677 (last access Oct 16, 2009).

Swedish Forestry Statistics. URL: http://www.svo.se/minskog/Templates/EPFileListing.asp?id=16685 (last access Oct 16, 2009).

TEEB D0 – Ecological and Economic Foundations. Draft chapters for comment available. URL: www.teebweb.org.

TEEB D2 – TEEB for Local Policy Makers and Administrators (forthcoming). URL: www.teebweb.org.

TEEB D3 – TEEB for Business (forthcoming). URL: www.teebweb.org.

TEEB D4 – TEEB for Citizens (forthcoming). URL: www.teebweb.org.

ten Brink, P.; Lutchman, I.; Bassi, S.; Speck, S.; Sheavly, S.; Register, K. and Woolaway, C. (2009) Guidelines on the Use of Market-based Instruments to Address the Problem of Marine Litter. Institute for European Environmental Policy (IEEP), Brussels, Belgium, and Sheavly Consultants, Virginia Beach, Virginia, USA.

ten Kate, K.; Bishop, J. and Bayon, R. (2004) Biodiversity offsets: views, experience, and the business case. IUCN and Insight Investment, Gland, Switzerland and Cambridge, UK.

Thaindian News July 10, 2009 Apex court provides funds for afforestation, wildlife conservation. URL: http://www.thaindian.com/newsportal/enviornment/apex-court-provides-funds-for-afforestation-wildlife-conservation_100216356.html (last access Aug 19, 2009).

Thaipro (2003) Thai poachers become animal protectors. URL: http://www.wildlifeextra.com/go/news/thailand-hornbills783.html#cr (last access Sep 24, 2009).

The Work Done by the Swedish Forestry Organisation in order to put the Environmental Goal on an Equal Footing with the Production Goal (1999). URL: http://eurosai.nik.gov.pl/en/site/px_Swedish_Forestry_Sweden.pdf (last access Oct 16, 2009).

UNDP – United Nations Development Programme (2001) The Use of Economic Measures in National Biodiversity Strategies and Action Plans: A Review of Experiences, Lessons Learned and Ways Forward. URL: http://www.undp.org/biodiversity/biodiversitycd/use%20of%20economic%20measures%20in%20NBSAPs.pdf (last access Sep 9, 2009).

UNDP – United Nations Development Programme (2003) A Case Study on Commitments-Related Best Practice or lessons learned. In: Water in the Czech Republic. URL: http://waterwiki.net/index.php/A_Case_Study_on_Commitments-Related_Best_Practice_or_Lessons_Learned_in_Water_in_the_Czech_Republic (last access Sep 9, 2009).

UNEP – United Nations Environmental Programme (2009a) Rio Declaration on Environment and Development. URL: http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=78&ArticleID=1163&l=en, (last access Sep 9, 2009).

UNEP – United Nations Environmental Programme (2009b) Marine Litter: A Global Challenge. URL: http://www.unep.org/pdf/UNEP_Marine_Litter-A_Global_Challenge.pdf (last access Oct 16, 2009).

UN FAO – Food and Agriculture Organization of the United Nations (2001) Global Forest Resource Assessment 2000. URL: ftp://ftp.fao.org/docrep/fao/003/Y1997E/FRA%202000%20Main%20report.pdf (last access Oct 16, 2009).

UN FAO – Food and Agriculture Organization of the United Nations (2006) Global Forest Resource Assessment 2005. URL: ftp://ftp.fao.org/docrep/fao/008/A0400E/A0400E00.pdf (last access Oct 16, 2009).

US EPA - US Environmental Protection Agency (2001) EPA's acid rain program: Results of phase I, EPA 430-F01-022. Washington D.C.

Yandle, T. and Dewees, C. M. (2008) Consolidation in an Individual Transferable Quota Regime: Lessons from New Zealand 1986–1999. Environmental Management 41 (6): 915–928.

Walls, M. and McConnel, V. (2007) Transfer of Development Rights in US Communities: Evaluating program design, implementation, and outcomes. RFF, Washington D.C. URL: http://www.rff.org/rff/News/Features/upload/30347_1.pdf (last access Aug 19, 2009).

Wätzold, F. (2004) SO_2 Emissions in Germany: Regulations to Fight Waldsterben. in: Harrington, W., Morgenstern, D., Sterner, T. (Eds.): Choosing Environmental Policy: Comparing Instruments and Outcomes in the United States and Europe. RFF-Press, Washington D.C.: 23-40.

Worm, B. et al. (2009) Rebuilding Global Fisheries. Science 325: 578-585.

Wildlife Extra (2009) Hornbill Conservation in Thailand - Poacher to Gamekeeper. URL: http://www.wildlifeextra.com/go/news/thailand-hornbills783.html#cr (last access Sep 24, 2009).

Wilkie, D. S. and Carpenter, J. (1999) The potential role of safari hunting as a source of revenue for protected areas in the Congo Basin. Oryx 33(4): 340-345.

Wilkinson, C. R. (ed.) (2004) Status of the coral reefs of the world - 2004. Volumes 1 and 2. Australian institute for marine Sciences, Townsville, Australia.

Young, J.E. (1992) Mining the earth. Worldwatch Paper 109, Worldwatch Institute, Washington D.C.

Zylicz, T.; Bateman, I.; Georgiou, S.; Markowska, A.; Dziegielewska, D.; Turner, K.; Graham, A. and Langford, I. (1995) Contingent valuation of eutrophication in the Baltic Sea region. CSERGE Working Paper GEC 95-03. URL: http://www.uea.ac.uk/env/cserge/pub/wp/gec/gec_1995_03.pdf (last access Sep, 19, 2009).