Handbook of Market Creation for Biodiversity

ISSUES IN IMPLEMENTATION

OECD

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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Foreword

Since shortly after the signing of the various biodiversity-related agreements that emerged from the Rio de Janeiro Earth Summit in 1992, the OECD has been undertaking policy analysis for biodiversity in support of the goals of these agreements. Beginning with its initial focus on using economic incentives to promote the sustainable use and conservation of biodiversity-related resources, the Working Group on Economic Aspects of Biodiversity (WGEAB), and its predecessor (the Expert Group on Economic Aspects of Biodiversity), have developed a series of contributions to policy-making that are grounded in economic analysis. Earlier work by the group includes the publication of Handbooks that dealt with both incentive measures and valuation.

The Handbook of Market Creation for Biodiversity is the latest contribution to that effort. It contains a synthesis of market approaches to biodiversity aimed at making biodiversity protection as compatible as possible with economic development. Like the earlier work, it is oriented to policy-makers and other interested parties who are working to set up the framework and context within which biodiversity-friendly markets will operate. To that end, it provides considerable discussion of the underpinning of market institutions and their role in facilitating sustainable use of biodiversity. It also provides some practical advice and many examples and case studies on implementation, so that the work is not purely an abstract treatment of the subject.

Given that the language of markets and their operation is essentially the language of economics, the work presented here is steeped in economic analysis. The objective, however, is to present this material in a manner that is accessible to the full range of individuals and professions who are involved in developing biodiversity policy. While a firm analytical foundation provides only part of the necessary underpinning for good policy development, it is, nonetheless, essential that some of its lessons be internalised. From that foundation can be developed the measures that deal with special cases caused by peculiarities in human behaviour and custom.

Under the WGEAB's guidance, this book was drafted with contributions from Dr. Philip Bagnoli (OECD Secretariat), Professor Timothy Swanson

(University College London), and Professor Andreas Kontoleon (Cambridge University). Financial assistance from the Governments of France and Denmark are also gratefully acknowledged.

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Executive Summary

This Handbook provides a conceptual guide, with practical examples, to creating markets for the sustainable use and conservation of biodiversity. It outlines many of the issues that policy-makers and practitioners should take into consideration when developing agendas for making biodiversity-related policy more compatible with economic development. Market creation is effective because it is often the most direct approach to solving the problem of biodiversity decline. Market creation may take many different forms: markets in land, markets in uses of land, markets in specific flows of biodiversity, markets in things associated with biodiversity.

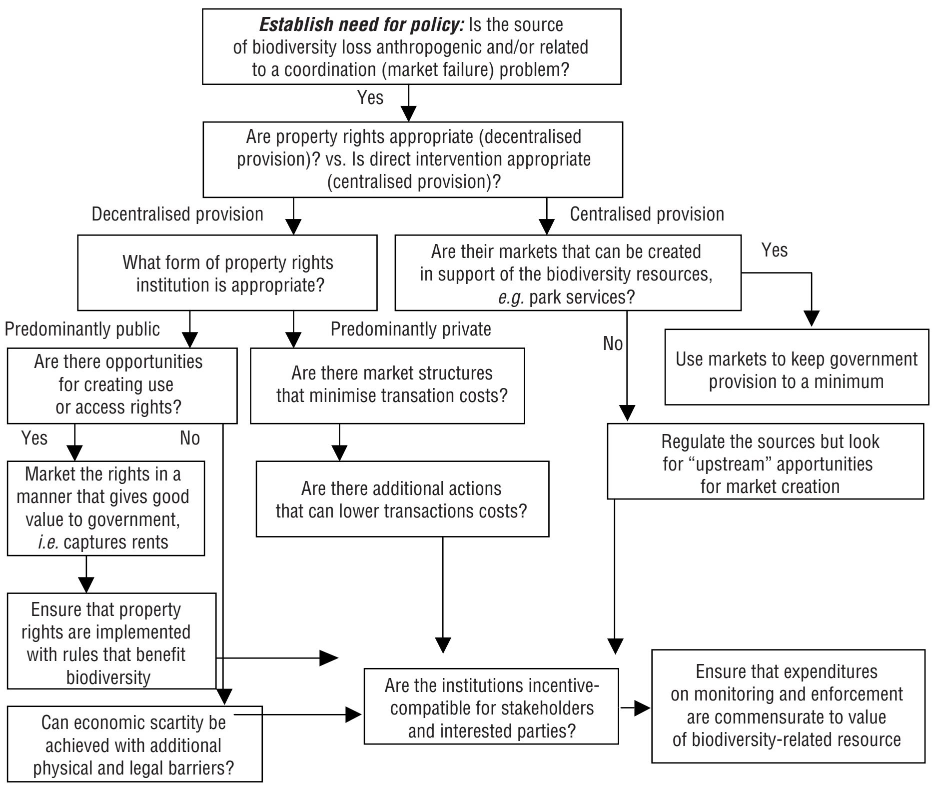
The problems that cause valuable biodiversity-related goods and services to go unprovided have been detailed previously in other work (e.g. OECD, 2002; OECD, 2003). A brief review is provided in the early chapters of this Handbook to give context to the discussion. These problems are associated with various types of *market failures,* which are often caused by the existence of externalities, and imperfect information, as well as, the "public" nature of some goods and services. The latter, public good, source of market failure has its origins in the *non-excludability* or *non-rivalry* of some goods or services. The implication of these problems is that there are goods and services that are not easily marketable.

Understanding the reason why biodiversity is not readily marketable is an important and difficult first step in addressing market failure. It will, however, make it possible for public intervention to establish the conditions under which the good is supplied by the market itself, rather than by the public sector. This may be viewed as both a more direct approach to the provision of the valued good or service, and one that can involve lower levels of government expenditure in the long-run. However, public intervention may have to be more involved in supplying the biodiversity-related good when the source of the marketability problem is particularly strong.

With the large number of sources of pressure and potential solutions, there will be numerous ways of fixing the problem that is causing biodiversity loss. Only one, however, will generally minimise the associated cost. The ability of the policy analyst to sort through the problems and solutions will be the determining factor in how close the policy comes to achieving the best solution. Since results that are costly in one policy area can negatively influence an overall policy agenda by depleting government resources and even causing a "discouragement effect", achieving the best outcome with each implementation of policy is imperative.

The Figure below provides the conceptual outline that underpins this Handbook. It does so in the form of a ready-guide to some of the important questions and approaches that are part of the solution to market failures which are impacting biodiversity. Underlying this schematic is an economic foundation that suggests that when market activity is undertaken with a *full* accounting of the costs and benefits of using resources, those markets will result in resource uses that achieve the best outcome.

Figure 1. **Schematic conceptual outline**



What elements of biodiversity are being lost: are the causes of biodiversity loss human-induced or natural?

Extinctions caused by humans are an important source of biodiversity loss (see Gibbs, 2001, for a non-technical review). However, changes on geological, climatic and even local scales have also occurred in the past that have led to significant changes in the composition of species (MacDougall, 1998).

Identifying the underlying source of biodiversity loss is, therefore, important because the goal of policy is not purely to prohibit further loss – the goal is to ensure a sustainable use and level of conservation that benefits everyone. To that end, biodiversity policy must achieve a balance between gains in well-being (that includes the use and conservation of biodiversity) and losses in biodiversity.

How far can property rights go in fixing the problem?

Addressing the perceived loss also requires a clear understanding of how it is occurring from a policy perspective. A public good requires intervention because, either someone's use (direct or indirect) of a good or service does not diminish it for others (non-rivalry), or others cannot be excluded from using it (non-excludability). In either case, marketability is weak because the provider can not be certain of recovering any costs that might be incurred in developing the good or service – even when those costs may be small.

Dealing with these sources of pressure on biodiversity will lead to decisions regarding provision of biodiversity-related resources: should they be provided in a centralised or de-centralised manner. When de-centralised provision works best, it will be a matter of establishing the correct regime of property rights. This is not to say that it is a simple question of turning things over to the private sector. Property rights come in many forms, and engage complicated legal and institutional dimensions. Often they require direct support or intervention by the government. Once the appropriate form of property right has been developed, there will also be considerable additional effort needed to ensure that supporting functions by government and other participants are forthcoming.

When centralised provision is expected to work best, the involvement of government will be greater but there will still be opportunities for engaging markets. Since governments have numerous demands on their resources, finding the means to create self-sustaining services, even when centrally provided, will be an important objective. Creating secondary industries, or even support for them, can help achieve that goal. Examples include providing support for activities such as guided tour operators or accommodation that is privately provided (but is made to contribute to the maintenance of the biodiversity-related resource).

Who are the stakeholders? How are they likely to be impacted?

The process of developing (biodiversity) policy sometimes impinges on pre-existing implicit or explicit rights. In general, this is done for the benefit of a larger group – it is often said that the costs of conserving biodiversity are local, while the benefits are global. Such policy is clearly redistributive, since one group is benefiting at another's expense: a local group loses while the global community gains. Market forces, however, will not ensure that the benefits accruing to the larger global community are shared with those directly impacted by policy. The implicit (or sometimes explicit) redistribution thus has some obvious ethical implications that need to be addressed. Perhaps more importantly, the redistribution has the potential to create obstacles which can ultimately undermine the market creation if the affected individuals experience significant impacts.

Monitoring and enforcement

Monitoring the success of a policy after it has been implemented is an integral part of a biodiversity strategy. Corrections that may be needed can only be implemented if there is a subsequent review to uncover unforeseen problems. In ensuring that objectives have been met, goals have to be quantifiable in one form or another. Results-oriented goals specify quantified targets that need to be met, whereas process-oriented goals state that certain criteria should be met for how the system will work. In general, results-oriented goals are more compatible with economic instruments since they are more likely to specify outcomes that can be easily associated with an economic incentive – and leave the details of how to get there to knowledgeable individuals. Monitoring of results-based goals is similarly more easily accomplished, because observing outcomes is easier than observing processes. In either case, however, monitoring usually requires the commitment of sufficient resources to ensure a good probability of knowing what is occurring. In other words, monitoring effort should be used economically.

Enforcement must also be undertaken to ensure that incentive compatibility is maintained. It should not, however, extend beyond the value of the resource. Since enforcement is always undertaken to dissuade individuals from undertaking undesirable activity, the right level of enforcement is where the incremental expenditure on enforcement is just equal to incremental benefit derived from it.

Creating markets

Creating markets for biodiversity is part of a public policy shift that taps into the same entrepreneurial pool of talent that has produced many amenities of modern life. It attempts to harness the creative power of entrepreneurs and direct it toward enhancing the quality of the environment. While it is recognised that regulatory policies (sometimes referred to as command-and-control) have a place in the policy-maker's toolkit, the need to introduce market creation for biodiversity is compelling. During the past 20 years many economic sectors were reformed to be more market-oriented and the gains are thought to be significant (OECD, 2001). Moreover, it reduces the demand for financial resources from governments faced with other public policy issues, such as heath care and pensions.

In *Harnessing Markets for Biodiversity: Toward Conservation and Sustainable Use* (OECD, 2003), an exploration was undertaken of the wide range of areas where markets have been developed and the degree of success they have enjoyed. That work lays the foundation for this Handbook, by providing clear illustrations of the principles that are developed and explored here. This Handbook is written to provide a guide for participants in policy development (including policy-makers, their advisors, and public-policy advocates). It is, however, also intended to be accessible to non-specialists who are interested in understanding how market-based approaches to biodiversity can improve conservation and sustainable use.

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Chapter 1

Introduction

There now exists a wide range of experiences with instruments for the conservation and sustainable use of biodiversity. As a result, policy-makers and their advisors have a broad appreciation of the flexibility and effectiveness of various instruments, both market and non-market. Of particular interest, more recently, have been examples of successful market creation that have moved biodiversity firmly into the context of economic growth and development. Entrepreneurial activity has been harnessed in a number of cases to make market outcomes consistent with social objectives. Unfortunately, a certain level of randomness still accompanies most efforts at market creation. While acknowledging that entrepreneurial endeavours are always fraught with risk, there are some principles that can be used to minimise those risks. A careful look at the (economic) lessons from the successes (and failures) can provide guidance to policy-makers in both OECD member and non-member countries who are attempting to create markets for biodiversity. This introductory chapter discusses the background in which those lessons will be applied.

The concept of biodiversity management came to be seen as important with the realisation that fixing many of the existing environmental problems would not necessarily bring long-term environmental sustainability. Getting the right policies for clean water, clean air, species extinction, and other concerns, would undoubtedly lead to an improved quality of life for many individuals: these are life-and-death issues even within OECD member countries. Such policies, however, would still leave important gaps in the environmental policy framework concerning the enduring sustainability of the underlying ecosystem. This problem becomes clearer in the context of continued economic growth. Fixing today's urgent problems would not necessarily ensure that future economic growth is compatible with the long-term environmental quality and amenities that many people want. The reason for this is that while many problems exist at the level of individual issues – with identifiable sources and outcomes – the aggregate impact of human activity on the environment is greater than the sum of each individual problem. The word "biodiversity", for example, is intended to reflect the notion that variety itself is important. The loss of any one component of biodiversity is not only a loss of the direct function that that component provides, but also a loss that could have implications for the integrity of the ecosystem as a whole. Analogously, one could say that biodiversity represents the characteristic of an ecosystem that makes the whole greater than the sum of the parts, *i.e.* an ecosystem is more than just the sum of the individual species that inhabit it.

The concept of biodiversity, therefore, is intended to help people think beyond the local environmental level, and grasp a broader (global) ecosystem perspective. This all-encompassing view, however, runs into some difficulties from the perspective of public policy. For economic policy-making, it is the notion of *scarcity* that underlies economic value. The problem for biodiversity is that it is inherently not scarce since it has many components (also, as will be described later, market systems have some inherent problems in dealing with biodiversity). The interconnectedness of biodiversity is what makes it a challenge to get its value right in the market place.

To see this, consider that we are seldom able to isolate the impact of the loss of a single species or ecosystem and to identify all its repercussions. Only in limited cases does biodiversity, by itself, manifest scarcity in a manner that gives it economic value. Giving (economic) value to biodiversity requires, in a sense, that we value the synergy that exists between species in order to properly account for their relative scarcity. That is, we need to more thoroughly understand the contribution that each species makes to the ecological, and even economic, system. This is a challenging task. To make this more concrete, consider the values listed in Box 1.1 that some regard as being the most solidly attributable to biodiversity.

Box 1.1. **Some biodiversity benefits**

Economic

Land is more productive (over time) when biodiversity is maintained.

It is a reservoir of potentially beneficial compounds and material that are, as yet, undiscovered.

Protection against evolving pathogens

Genetic diversity will prevent the development of super-pathogens that can be catastrophic for food sources, etc.

Ecosystem services

Biodiversity contributes many functions to the economy that are currently not priced but would be costly to replace.

Aesthetic

Diversity has value in-and-of-itself.

Source: Ehrlich and Ehrlich (1992).

All of these benefits are very difficult to measure, even in the best of circumstances. The interconnections that each represents are complex and generally poorly understood. It will therefore be difficult to ensure that the use of biodiversity reflects its scarcity in terms of the full contribution it makes in each of these areas. Moreover, there are some characteristics of biodiversity-related resources – referred to as public goods – that compound the problem by making them difficult to market even when they can be, even partially, measured. Again, the scarcity that generates economic value will be difficult to achieve. Markets that are compatible with biodiversity will not, in general, appear autonomously, but will have to be nurtured by government policy.

The motivation for using markets to achieve biodiversity-related goals originates in the success that markets have had in other areas of public policy. The use of market-based incentives to *induce* changes in behaviour – in a cost-effective manner – has met with considerable success in numerous industries. OECD (2001) outlines some of those success and provides a discussion. Other non-market approaches for ensuring that biodiversity is properly valued in economic uses could certainly work – regulatory approaches, for example. Indeed, in some cases regulatory instruments can turn out to be less costly than market-based instruments.[1] Market creation, however, carries the potential for more flexibly keeping the costs of attaining public policy objectives to a minimum (in terms of economic disruption, as well as public outlays).

As earlier OECD work shows, there is much scope for greater use of market mechanisms in many areas of public policy – and even for reforming some past policies to make them more market-oriented. In many circumstances, taking a market-creation approach is more of an evolutionary step rather than a radical change. Consider, for example, other industries where increases in the use of markets occurred through deregulation. Often there was not a complete removal of the regulatory framework, but a scaling back to the point where policy-makers believed that markets could operate autonomously. Some (or even many) regulations were retained to provide assurances to market participants. The airline industry, for example, was deregulated in some countries, but has still been subjected to safety standards so that travellers know they are flying in safe airplanes.

Making markets work is most readily apparent as an option for those resources that are already widely traded in some marketplaces (*e.g.* elephant ivory, eco-tourism services), (Swanson and Luxmoore, 1996). It is also a potential option for those resources that are in use as commodities although not necessarily in trade (*e.g.* plant genetic resources, medicinal plants), (Swanson, 1995). Finally, there are other uses that might be traded when bundled with other goods or services that are tradable (*e.g.* watershed services), (Heal, 1999; 2000).

In many other cases, market creation is feasible but requires that the policy-maker consider the imperfections that may be inhibiting the accurate valuation and ready exchange of the biodiversity resource in the market. These imperfections may be addressed through specific reforms or more general institution-building. Specific reforms may be devised to address the specific nature of the market imperfection (*e.g.* information failure, externality or excludability problems). General institution-building may take the form of attempts to generate well-defined property rights in a complex good or service (*e.g.* tradable quotas in fisheries or intellectual property rights in informational services). The overall objective is to create the underlying institutional framework that enables a well-managed exchange between those who supply and those who demand the biodiversity-related resource.

In *Harnessing Markets for Biodiversity: Toward Conservation and Sustainable Use* (OECD, 2003), an exploration was undertaken of the wide range of areas where markets have been developed and the degree of success they have enjoyed. That work lays the foundation for this Handbook, by providing clear illustrations of the principles that are developed and explored here. This Handbook is written to provide a guide for participants in policy development (including policy-makers, their advisors, and public-policy advocates). It is, however, also intended to be accessible to non-specialists who are interested in understanding how market-based approaches to biodiversity can improve conservation and sustainable use.

The commitment to pursuing market creation for biodiversity as a policy tool has been recognised in the Convention on Biological Diversity (CBD) in its founding articles, as well as in subsequent decisions by the Conference of the Parties (COP). One of the objectives of this Handbook, therefore, is to help countries implement their commitments under the CBD in a manner that all its signatories have accepted. Article 11 of the CBD, for example, calls on Parties to:

> "as far as possible and as appropriate, adopt economically and socially sound measures that act as incentives for the conservation and sustainable use of components of biological diversity."

Previous OECD work (*e.g.* OECD, 1999) has sought to explore some of the channels through which markets work (*i.e.* incentives) so that policy-makers would be better equipped to make choices. Academic researchers have also generally been paying more attention to specific issues that concern market creation. In some cases, this has focused directly on biodiversity (*e.g.* Chichilnisky and Heal, 2000; Heal, 2000; Swanson, 1999). Nonetheless, actually creating and using markets for biodiversity conservation and sustainable use is still in its early stages. There exist scattered examples of market creation, and attempts have been made to disseminate the lessons from those experiences (*e.g.* OECD, 2003). This Handbook, attempts to address the gap between the promise and the use of markets by synthesising some of that work.

What is biodiversity?

To many people, biodiversity is synonymous with "life on earth". Implicitly or explicitly, biodiversity is taken to refer to the number, variety and variability of living organisms. It embraces two somewhat different concepts. One is a measure of *how many* different living things there are, the other is a measure of just *how different* they are.

More formally, the Convention on Biological Diversity refers to "biological diversity" as "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems".

As an analytical issue, biodiversity has come to be considered at three hierarchical levels – genes, species and ecosystems. All of these levels are of interest to researchers and they are each important parts of the overall view of biodiversity. In practice, however, species diversity is central to the evaluation of diversity, and is a constant point of reference in analyses of biodiversity.

An alternative view of biodiversity is to consider it from a measurement perspective. This involves three parts: scale, the component aspect, and the viewpoint aspect. The **scale** can be subdivided further into: species richness within a local ecosystem; change in species richness as one moves from one ecosystem to another across a landscape; and species richness at a regional or geographical level. The latter is a more global concept and a measure that is much more dependent on global shocks than on local ones (*e.g.* forest fires). The **component** aspect identifies what constitutes a minimum viable population for species survival – for species to reproduce, a minimum density is required. Finally, the **viewpoint** aspect refers to the many sources of value of a species, ranging from the practical, through to the moral and the aesthetic. Viewpoints are necessarily subjective, so a theoretical/legal framework is needed to ensure the widest possible consideration of views. OECD work on biodiversity has mainly concentrated on the *viewpoints* perspective. That is, economic and development frameworks have been the central concern in an effort to make economic development consistent with biodiversity conservation and sustainable use.

From a formal economic perspective, one can also think of biodiversity-related resources as assets that generate streams of income flows, but where the assets have some capacity to renew themselves. This then leads to an overall analytical framework that seeks to allow society to decide how much biodiversity it wants to use for its own purposes, versus how much it wants to leave. While this Handbook does not deal with issues relating to the overall social choice, it does discuss market creation in terms analogous to the portfolio approach to the management of biological assets. The issues are, therefore, how best to ensure that only sustainable quantities of biodiversity are used, and how to make the best use of those quantities.

The remainder of this Handbook is organised to present, and then draw out, some of the issues that are relevant for public policy when the goal is to encourage market creation for biodiversity. The next chapter discusses the conceptual framework and lays the intellectual foundation for the chapters that follow. Chapter 3 then provides some insight into this framework by focusing on property rights – that chapter can actually be seen as an overview of the entire Handbook. Chapter 4 to 6 then provide the core of the policy-relevant discussion that underpins market creation. The general progression of those three chapters is to begin with the role that valuation has in market

Box 1.2. **Biodiversity loss?**

Although there is general agreement that biodiversity is being lost, there are some who disagree. The main proponents of this contrary view point out that since it is not known how many species exist (just over a million have been documented whereas anywhere from 3 to 100 million are thought to exist), it is not easy to estimate how many are being lost. There has always been a "background rate" of extinction, making it difficult to know whether humans have added to that number in a significant way. At times, they also argue that any elevated rate of extinctions will be dominated by species that compete directly with humans, *i.e.* the large predators and herbivores. This latter view implies that extinction is limited and not widespread.

The response to this scepticism can be given at two levels. One is to note that scientific estimates of the background rate of extinction have improved over the years in response to objections raised by the critics. The end result is that they still point to a rate of extinction that is higher than in the past (a non-technical summary is given in Gibbs, 2001). At a scientific level, therefore, while there may be some residual debate, the majority opinion suggests biodiversity is being lost (for completeness, it should be mentioned that a few scientists have begun to warn of a human-induced mass extinction similar to some that appear in the fossil record). The arguments of those who view biodiversity loss with some scepticism are not only being addressed, but also used to refine the estimates of species extinction.

The second level at which the sceptics can be addressed is more anthropocentric, and therefore more related to public policy. The loss of biodiversity is something that many people care about (*i.e.* they have a preference for biodiversity). Moreover, many feel that there is a moral call on humans to act as custodians of the planet's richness in life, rather than as its exploiters. This is made more important when we consider that future generations will have an even higher relative preference for that diversity – given expected increases in income and its association with leisure and environmental amenities. From the perspective of public policy, these preferences must be allowed to manifest themselves in economic outcomes. Using markets, where impacts on biodiversity have been incorporated into the price of goods being traded, has the potential to ensure that collective preferences prevail in the use or conservation of biodiversity-related resources.

creation (Chapter 4) and then discuss the role of government in using various incentive measures to create and nurture markets (Chapter 5). Chapter 6 concludes the core chapters by outlining the essential supportive role that is provided by non-government actors and some steps that government can take to encourage their involvement. Chapter 7 then discusses some issues in getting the mix of policies and measures to the level where outcomes are achieved most efficiently. The final chapter (8) gives the Handbook a "field guide" characteristic by outlining a step-by-step approach to implementing policy.

Note

1. For example, when dealing with a "pure" public good, or even when there are multiple and dispersed small sources of a pollutant and the marginal abatement cost between sources is similar.

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Chapter 2

Conceptual Framework: an Economic Approach

Market creation is largely concerned with putting in place the frameworks that guide self-interested behaviour on the part of stakeholders toward socially (environmentally) beneficial outcomes. The essential element of a market is that prices are determined by the collective supply and collective demand of individuals willing to exchange goods and services. For biodiversity, this definition requires some refinement. Biodiversity-related goods and services often have characteristics that are public, i.e. *they do not exhibit complete* rivalry *and* excludability *in the marketplace. The various tools that governments have at their disposal can, however, mitigate some of these characteristics and thus make goods and services derived from biodiversity private. To use those tools effectively and efficiently requires making use of a well-developed framework for thinking through the various issues. An* economic framework *is best suited to dealing with the complexity of making efficient use of resources when there are competing interests. Fortuitously for biodiversity-related market development, some of the details of that framework have recently been explored. Designing markets for facilitating public sales and private exchanges has become a rapidly developing theoretical and empirical field in a number of economic sectors – many of their lessons are applicable to biodiversity.*

The underlying perspective of an economic approach to biodiversity policy is to focus on the needs of people; that is, it is anthropogenic in orientation. This is somewhat different from other policy approaches to biodiversity which may focus on nature without emphasing the well-being of people. Two questions that underlie this economic approach are:

- Is there an anthropogenic source to a problem?
- Is there a *market failure* that is preventing the problem from being internalised into economic activity?

The first question leads to the second, so that a human-induced problem that is not being internalised is considered to be policy relevant.[1] The second question is based on a foundation that people's collective preferences will be reflected in economic activity under the right (fairly general) circumstances. In democratic societies, collective preferences are the main guides for determining social policy/outcomes.[2] These two questions therefore, provide the underpinning for undertaking public policy – they ensure that collective action (public policy) will lead to a collective improvement in well-being. An affirmative answer to the second question then leads to a much broader discussion of how the problem will be dealt with. In this Handbook, the focus is on identifying the circumstances where markets are likely to fail, and on discussing how creating markets might contribute to a solution.

While an anthropogenic approach may seem to be rather restrictive, it is in fact very broad. Focusing on the needs of individuals through an economic system implies building institutions that are responsive to their demands. Since many individuals care a great deal about their natural environment, important (beneficial) repercussions for biodiversity would result just by making the link between economy and biodiversity more explicit in economic choices. As pointed out in OECD (2002), people put different values on different facets of their environment. The typology given there is: 1) instrumental or functional value; 2) aesthetic value; and 3) moral value (or goodness). While the first of these values is most directly related to economic outcomes, the latter two are still part of people's preferences. An overall biodiversity-oriented policy process must be designed to systematically incorporate all these values into the use of biodiversity-related resources. Institutions will therefore need to be put in place that either directly mandate outcomes (*e.g.* regulations), or facilitate the manifestation of those values in economic outcomes through incentives and market creation. Given the under-utilisation of markets, and their capacity to efficiently allocate resources according to preferences, this Handbook focuses on the latter solution. Nonetheless, in a complete policy-mix setting, attention needs to be given to all potential policy mechanisms. Especially since aesthetic value is difficult to capture in the market (though it can often be done); moral values pose even greater problems.

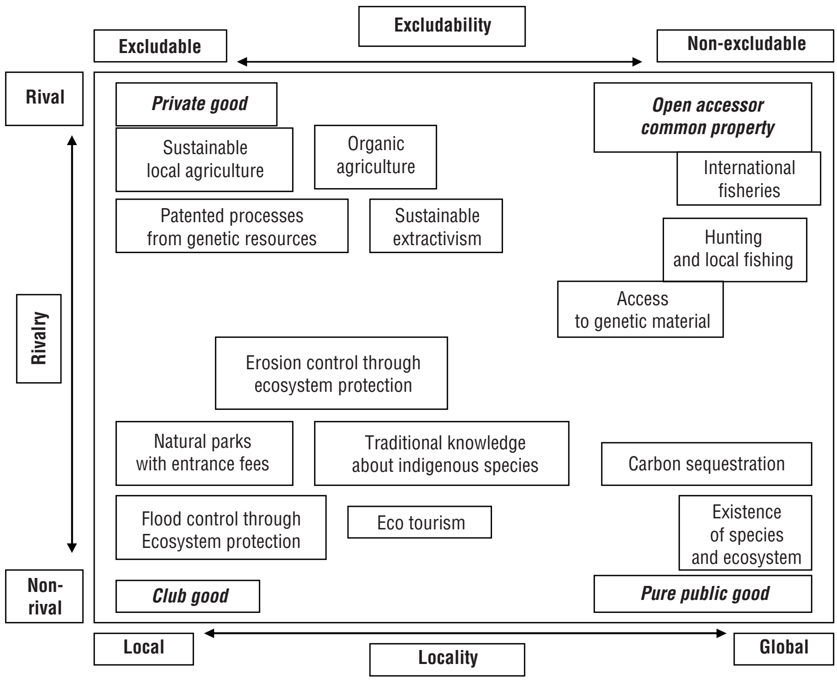
Ensuring that values are incorporated into market transactions is complicated by the fact that those goods and services often have characteristics that are public. A good is public to varying degrees, depending on the extent to which it exhibits *rivalry* and *excludability* characteristics. When a good (or service) is non-rivalrous, its essential feature is that one person's use of it does not affect another person's use. Both users can be equally satisfied simultaneously – by the same good. This means that the supply of the good cannot be controlled, so the willingness to produce it decreases. When a good is non-excludable, it implies that there is no means of preventing people from using it (or enjoying it). Again, this creates a problem of controlling supply which leads to its under-provision. These characteristics are said to lead to market failure because markets, by themselves, are unable to provide the amount that would be socially optimal. Under-provision of non-rivalrous and/or non-excludable goods occurs because the price does not reflect a market-clearing demand and supply for the good – economic scarcity is difficult to achieve with a public good. Since economic value is defined by economic scarcity, public goods are difficult to value in a market economy. A government that is acting on behalf of the greater good of society should intervene in the market to help ensure that these problems are overcome.

To make this discussion more concrete, consider the diagram below that was developed in OECD (2003).

As the figure illustrates, in many cases there are some characteristics of biodiversity that make it public. Some aspect of it might be non-rival, such as flood control, while others might be non-excludable, such as international fisheries. Rarely, however, is it the case that biodiversity is a purely public good that can only be provided by government. As a result, policy is called for in one context or another to improve outcomes. Fortunately, many options are available to achieve this: market creation is only one, although an important, solution.

A traditional approach to addressing market failures related to biodiversity as a public good has been for the public sector to provide the good or the service itself. In the context of biodiversity's goods and services, this has been pursued most often through the establishment of various forms of land use restrictions and planning. The most explicit such policy measure is the establishment of restrictions that create a "protected area". More than 10% of

Figure 2.1. **Markets in environmental flows**



Source: OECD (2003).

the earth's surface has now received some sort of protected status. The parks and protected areas of the world now afford some flows of biodiversity's goods and services in almost every state. These parks can be funded in part via fees based on excludability, and about 50% of countries do so. In general, however, parks and protected areas require significant amounts of funding in addition to their designation as protected areas, and so require substantial levels of commitment by the society concerned. For example, the developed countries' average spending on protected areas has been in the region of USD 2058/sq. km. (James, 1999). Hence, the governmental provision of biodiversity via protected areas and parks is something that requires both the conservation of the land and an ongoing commitment to management spending. This is an option for some lands and some countries, but it is not necessarily the only effective approach to biodiversity conservation. More lands and biodiversity may be protected if other approaches are practiced in addition.

Some amount of biodiversity's goods and services might be provided via much less restrictive land use controls and planning than absolute protection, establishing a division of the use rights of the land concerned between private and public uses. A property right in land is usually conceived to be a "bundle of rights" in most countries, and the state has the authority to divide these uses between the public and the private ("land holding") sectors. Most states pursue some forms of zoning or land use planning policies for these purposes. Some states divide the rights to the use of all land between the private and public sectors. For example, in some Scandinavian countries there are constitutional rights to the public use of all private lands. In the UK there is a national system of footpaths protecting public uses of private lands, and recently this has been extended to a general "right to roam". Increasingly there are encumbrances placed upon private lands for the purposes of the provision of public goods such as wetlands and biodiversity. Limits are placed on these approaches due to the requirement in many states that private property is not over-regulated, or that its taking be compensated. In the US now, prohibitions on private wetland development are being relaxed by allowing development if other wetlands are substituted. Such forms of regulation of land use enable private uses of land, while simultaneously allowing the most important land uses to be conserved.

Another approach to addressing these market failures is for the policy-maker to create or to establish *incentive mechanisms* for the provision of the valued good or service. Such incentive mechanisms often provide for a monetary or non-monetary inducement. This might take the form, for example, of incentive payments for land set-asides or tax benefits for conservation expenditures. Of course, these mechanisms are also costly to the public sector. They are considered in more detail in Chapter 5, below.

Addressing market failures can also proceed by attempting to address the failures themselves. A first step in this approach is to consider the essential nature of the good or service concerned, and the reason that it is not readily marketable. The policy-maker then attempts to generate policies that enable that market and/or to correct the market failure. Then it may be possible for public intervention to establish the fundamental conditions under which the good is supplied by the market itself, rather than by the public sector. This may be viewed as both a more direct approach to the provision of the valued good or service, and one that can potentially involve less substantial government expenditures in the long run.

Market creation is, therefore, effective because it is the most direct approach to solving the problem of biodiversity decline, and potentially the least expensive. In many cases, market creation requires only that the policy-maker consider the imperfections that may be inhibiting the accurate valuation and ready exchange of the biodiversity resource in the market. These imperfections may be addressed through specific reforms or more general institution-building. Specific reforms may be devised to address the specific nature of the market imperfection (*e.g.* information failure, externality or excludability problems). General institution building may take the form of attempts to generate well-defined property rights in a complex good or service (*e.g.* tradable quotas in fisheries or intellectual property rights in informational services). The overall objective is to create the underlying institutional framework that enables a well-managed exchange between those who supply and those who demand the diverse resource.

Market creation is largely concerned with putting in place the frameworks that guide self-interested behaviour on the part of stakeholders toward environmentally beneficial outcomes. For example, the simple removal of barriers to trade and the assignment of well-defined property rights can be a powerful tool in the conservation and sustainable use of biodiversity. This is because they can lead to the creation of markets where environmental goods and services are treated as coming from sources that need to be maintained over the long term – natural assets from which benefits are derived. Markets, by definition, can be either virtual or real places where transactions occur between buyers and sellers. The essential element of a market is that prices be determined by the collective supply and collective demand of individuals willing to exchange goods and services. For biodiversity, this definition requires some refinement, given the characteristic of biodiversity-related goods. Two short examples illustrate markets for biodiversity.

One of the best illustrative examples of a market for biodiversity is found in the use of private lands for eco-tourism. Given that it creates a *demand* for natural areas in near pristine form, it does the most direct job of promoting biodiversity conservation and sustainable use. The "market creation" in this context is in the *supplying* of tourism services – the land is made available for recreational activities that do minimal damage. A market is simply a device whereby exchanges occur at prices that are mutually agreeable. The tourism services in this case are provided to those individuals willing to pay for the service of experiencing natural sites. The income that is generated from providing tourism services conveys a monetary value to that region which will promote its conversation; other (more damaging) uses will thus be rendered less profitable.

The benefit of markets is that they ensure that collective preferences are reflected in use decisions, *i.e.* by giving everyone an opportunity to influence the price at which trades occur. This is seen most clearly in cases where private organisations are active in auctions for timber rights. Those groups often purchase the timber rights, but do not exercise their right to extract the wood. Since they generally represent a broader segment of society whose preferences for natural sites would not otherwise be monetised, their ability to participate in the auction allows the price of those rights to be more reflective of collective preferences. Putting in place the right framework that permits such outcomes can ensure that prices bring about the most in social well-being.

Earlier work by the OECD has established the range of values of biodiversity and the range of methods available for signalling these values, (OECD 2002). These methods for demonstrating the values of biodiversity can be costly and, even if the value indicated is substantial, the problem of implementing the outcome indicated by that value remains. The existence of value does not in itself ensure the existence of the valued resource – market creation must be a specific objective of policy.

Types of markets

Market creation may take many different forms: markets in land, markets in uses of land, markets in specific flows of biodiversity, markets in things associated with biodiversity. Markets work best for the part of biodiversity that can be appropriated for private gain. This is particularly true for activities such as commercially valuable fish-stocks, the tradable meat, skins or other attributes of certain animals, commercially valuable timber and non-timber forest products, eco-tourism, organic agriculture, some eco-services, some park services, among others. The assignment of well-defined property rights (discussed below in more detail), has resulted in considerable success in managing commercial fish stocks through individual transferable quotas. By limiting the amount of quota available, the government creates an economic scarcity that reflects the long-term damage that would result from further depletion of the resource. That is, by choosing the quota to, among other things, incorporate biodiversity concerns, the price of a unit of quota will also reflect the marginal damage to biodiversity. This latter point is particularly important since the market value of the quota can only reflect those factors explicitly considered in setting the quota. Any factor not included, will not be part of the market's determination of long-term sustainability for the resource.

Some markets result in direct transactions of products taken from biodiversity-related resources – *e.g.* a particular forest product. Other markets involve some level of service that is directly or indirectly provided by biodiversity – such as the services of a watershed. Still others involve markets that enable various activities to occur; for example, establishing a markets for property rights that encourage creative flexibility in the use of resources (while helping to ensure that biodiversity-related goals are met). The goal in each case is to have market transactions either reflect the value of biodiversity benefits, or the cost of biodiversity loss.

What makes markets "work"?

Any policy that attempts to achieve goals in biodiversity conservation and sustainable use must induce changes in behaviour. The important question concerns how that change in behaviour is going to be achieved. Since the policy-maker's options range from moral suasion to legal requirement, there is a wide scope for alternatives to achieve the government's objectives. When an action is required by regulation, there is often an explicit *fixed* cost (negative incentive) for not doing so. Other, less forceful, means also exist which can induce change through a realignment of the incentives that firms and individuals face. When a policy changes the prices prevailing in the market place, it is said to be "market-based" because it leaves to market participants the decision of *how* to respond; *i.e.* according to their tastes and means. Rational firms and consumers will seek the least disruptive response and, coincidentally, the one that is least costly to the economy. Since governments do not know exactly how each market participant might respond beforehand, it is unlikely *in most circumstances* that government can achieve the same outcome through other means at the same cost. In this sense, markets are said to be *efficient* at achieving social goals.

Market creation requires establishing the conditions whereby it is mutually beneficial for parties to complete an exchange. When markets do not form autonomously, either: tradable goods and services do not provide sufficient utility to potential parties; or, they provide utility, but the marketable aspects are limited; or, the transaction costs of trading overwhelm its benefits. The later category, transaction costs, includes a very wide array of impediments that must be dealt with. For example, attempting to market biodiversity requires rules and regulations that support incentive measures in much the same way that most economic sectors have specialised regulatory frameworks that make trading as efficient as possible. Some of the most regulated markets are those that deal with very large volumes/values of trades, such as the financial services industry or the agricultural sector. It is arguably the case that the more advanced an industry is, the more extensive will be the rules and regulations that guide it. Even without positing a causal relationship (in either direction), it is clear that there is an important supporting role between them.

Market creation is generally thought to be advantageous over direct government regulation of outcomes because less information is required by government to achieve the objective. That is, for regulation to be efficient, the government must have considerable information about the internal processes of those being regulated – at the extreme government must have the same information. This information advantage inherent in market instruments, however, can be overcome by the simple costs of using a market, *i.e.* the need to transact. A market requires participants to engage in buying and selling (or at least to be aware of prices and be prepared to transact). Markets work well where participants can easily find each other (*e.g.* people can easily trade quota for a fisheries). However, when participants are few and geographically dispersed, using a market risks either creating high overhead costs, or not having a market at all. In some cases, a simple regulatory requirement may, in fact, be the most efficient solution.

Addressing the legal/institutional foundations for making markets work

Unfettered markets that are allowed to operate with only the self-imposed discipline of "buyer beware" can impose significant transaction costs on both buyers and sellers. Such markets require the expenditure of resources to determine, among other things, whether the goods are "as promised" by the seller and whether payment will actually be made by the buyer. Those transactions costs, of course, can determine whether the market is viable over the long-run: a trade can only occur when both the buyer and the seller receive sufficient benefit that an exchange will result in a gain for both. When the transaction cost results in too low a selling price for the producer or too high a purchase price for the consumer, the market will not materialise.

The legal framework in which markets operate affects those transaction costs by allocating responsibilities and liabilities. It effectively allocates property rights by defining who can be held accountable. It thus has a large impact on outcomes through its regulatory impact. Legislation on endangered species, for example, may allocate certain responsibilities to landowners on whose property the endangered species is found.

Alternatively, the legal framework may define who will bear the transaction cost of providing information. By removing transaction costs from buyers (*e.g.* requiring sellers to conform to standards) or removing them from sellers (*e.g.* providing remedies for non-payment), the framework influences the gains to individuals from trading. As such, the legal framework can determine the viability of markets. The legal framework carries with it information that has economic value, and which market participants can more or less take for granted since it will be the state that will undertake enforcement. That is, buyers and sellers can trade with the knowledge that the judiciary branch of government can be used to settle disputes that may arise.

The institutional setting of markets can be very broad, covering many legal jurisdictions within a country, as well as across countries. It will, therefore, be important to distinguish between them, and to outline clearly when national or international domains of market creation are being addressed. On the national scale, markets are fully under the control of domestic governments – who can create and modify rules as necessary. On the international side, however, considerable constraints are imposed on market creation by the need to conform to various treaties, as well as (sometimes) foreign regulations. For example, most countries have standards that are imposed on imported agricultural products which are relevant to biodiversity-related organic foods and products. Such standards can act as non-tariff barriers which limit the market for biodiversity-friendly goods and services.

Business law (anti-trust, patent, IPR, etc.)

Certain basic rules concerning markets are put in place because they address problems that are pervasive across economies. Patent laws and regulations governing intellectual property rights, for example, address problems concerning the motivation of entrepreneurial researchers to pursue innovations. Since most innovations are easily duplicated, patent laws, or other such protection, help to raise the rate at which innovations occur by ensuring that innovators can obtain monopoly profits for a fixed period of time. For biodiversity, these issues are most applicable in relation to genetic resources.

Anti-trust frameworks have importance for a wide range of areas related to biodiversity markets. Where property rights are to be established and either distributed or auctioned, the potential for strategic behaviour is high. The auctioning of forestry rights in OECD countries, for example, would carry considerable risk of collusive behaviour if anti-trust laws were not established and enforced. The results of collusive behaviour could be to either distort the subsequent market for property rights, or to leave the government with less revenue than it could otherwise obtain (Klemperer, 2002).

Establishing the conditions for creative use of markets is also an important role that must be purposefully engaged by policy-makers. Since the social policy objective is always to ensure that the maximum *net* benefit is achieved, the rules under which markets will operate should not unduly preclude biodiversity-related activity or resource use that has the potential to create benefits. That is, market rules should specify what outcomes are undesirable and ensure that such outcomes are not allowed to occur but otherwise allow the widest possible latitude to market activity. To see how entrepreneurs and local officials can operate creatively within flexible regulations, consider the auctioning of timber rights in forested areas. In cases where the rights are very specific and indicate some detail in the harvesting of timber, the rights may force those who acquire them to cut down the trees. On the other hand, more flexible specification of the rights may *allow* the taking of wood but not *required* it. In fact, many examples now exist of groups buying timber rights, but then not exercising those rights. For this example, the specification of rules concerning undesirable outcomes might include rules (linked to the rights) to keep environmental damage to a minimum – such as damage to river beds, etc.

Rules/laws governing exchange (market design)

As was just discussed, establishing various aspects of the legal foundation for creating markets for biodiversity is important for creating the *conditions* for good outcomes. The actual (more practical) rules, however, under which exchanges will occur are also of considerable importance. Such rules range from what exactly will be auctioned (it may be a very limited set of use rights, for example), to the manner in which the sale will occur, *i.e.* market design. In recent years, market design has received a great deal of attention from policy-makers – particularly as OECD countries turned to the use of markets in areas that were previously regulated.

One area where market design has been applied with particular vigour has been in the auctioning of spectrum for communication technologies. Those experiences provide many lessons for the broader field of market design, which have been adapted to other areas where resources need to be allocated on an intermittent basis (Roth, 2002). It is safe to say that market design has now gone from a novel curiosity of economic analysis to a rapidly developing theoretical and empirical field. Moreover, experiences during the 1990s illustrate the extent to which small changes in the rules under which markets operate can produce radically different results (Milgrom, 2004, provides many examples).

The rules of the market in an auction are the determining factors in two areas of particular interest to this Handbook. First, they help government to ensure that the rents being collected by private participants in the market are minimised. That is, a well-designed auction can induce bidders to reveal their reserve price. Second, the rules will allocate risk between seller (the government) and bidder and automatically have that risk reflected in the price of transactions (*i.e.* the value of the bid). An auction can do this even while minimising the amount of technical information that the policy-maker is required to have to achieve policy objectives. By contrast, non-market measures generally require more information to be obtained by policymakers to achieve the same outcome – because the measures are often specifying *how* to achieve the objective. This point is most easily illustrated using an example from Australia that involves the auctioning of payments to achieve biodiversity outcomes. The government created markets for improvements in agricultural biodiversity. It did so by creating a series of rules that allocated payments based on proposals that were "bid" by farmers. That is, farmers offered to undertake a commitment that would improve or help conserve biodiversity and they attached a cost to their offer. The bids were evaluated by knowledgeable individuals (according to a pre-defined set of criteria) in a competitive process and the winners were allowed to implement the improvements in exchange for the payment. The rules were important in minimising the price that government paid and in not requiring a great deal of knowledge by the government concerning the farmer's internal costs of providing the service. They were shown to have been much more successful than earlier schemes that attempted similar outcomes with command-and-control measures (see Stoneham, Chaudhri, Ha, and Strappazzon, 2003, for details).

This example illustrates a link between the efficiency of markets in providing biodiversity-friendly outcomes and the design of the market. Such experiences, along with the many that exist in other areas where auctions have been applied, provide a useful intellectual background for advising policy-makers on biodiversity-related issues.

Addressing market imperfections for biodiversity

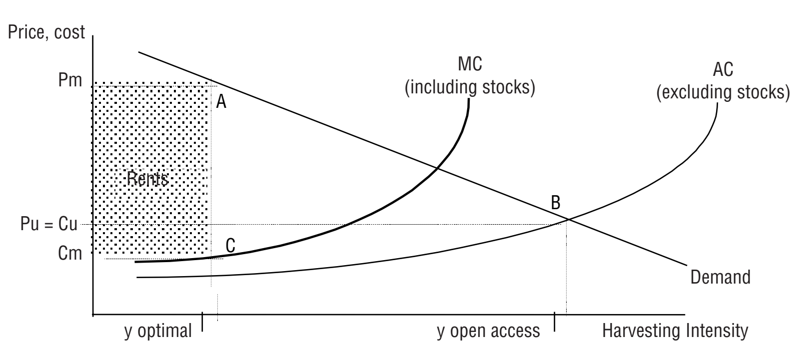
Access/rent creation

When biodiversity's goods or services are associated with some form of publicly accessible resource (*e.g.* habitat), then it becomes difficult to control the exclusivity of access required for perfect marketability. It may be possible to control access to some extent, but the existence of some unmanaged access generates an imperfection that requires management.

In the context of biodiversity, this problem is represented by the fact that the management of resources often requires the joint restriction of output. If the flow of the resource is jointly managed on public property (*e.g.* a fishery in public seas), then the harvesters must combine efforts to restrict their joint output in order to generate the rental value of the resource. In the absence of joint management, the resource will be harvested and sold until the effective value of the resource is driven down to zero (*i.e.* its price covers only the costs of the labour and capital put into the harvesting process). This is the outcome resulting from open access management.

Optimal pricing of flows of goods and services from biodiversity can be complicated by the fact that joint output restriction is required to generate a

Figure 2.2. **Harvest levels and rent creation**



value to the resource flow. In a perfect market, the good or service would have its own price and market management would not be required; however, this is not the case for many facets of biodiversity. For example, the harvest of a jointly managed resource (such as a fishery) does not include a charge for each fish harvested. The harvesters will respond to the unpriced resource by harvesting until rents are exhausted (*i.e.* point B above). Joint management would result in restricted harvesting (point C) to generate a higher price and a rental value to the resource. In essence, the problem of managed access requires the coordination of suppliers of the resource, when the property rights in the habitat are not perfectly well-defined.

Externalities

The concept of externality refers to the fact that there is never a precise fit between the flows from the resource and the specified property right. There may be additional flows of biodiversity services flowing from the resource than those transferred with the associated property right, or there may be flows from other resources attached to that property right. In essence, externality is the concept indicating that an imprecise bundling of goods and services is usually associated with most property rights. For example, an owner of a wetland may receive a bundle of goods and services from that wetland (*e.g.* timber, thatch) but there may be a much larger set of goods and services that flow to others (*e.g.* habitat for migratory species used and valued by many others). The imprecise fit between property right and the flow of services implies that any exchange within the market will be imprecisely valued and implemented as well.

Externalities may occur at many different scales. They may be relatively local, as in the case of a neighbour benefiting from another's particular use of a river. They may be more regional, as in the case of an entire set of communities benefits from upstream uses of that river. Or, they may be global, as when individuals value the existence of a species that continues to exist on a particular body of water. The difficulties or costs imposed by externalities are dependent to some extent on the number of persons affected by the externality, and the distance involved. It might be possible for externalities to generate very low costs in markets, if the individuals who experience the externality are closely associated. This enables them to structure the transaction in such a manner as to take the externalities into account. If the externalities are experienced at a large scale, in terms of space and numbers of individuals, then the transaction costs of restructuring the exchange (to take these externalities into consideration) may render market transactions infeasible. Then the transaction may yield little social value if it goes ahead, and many potential exchanges of social value will not occur.

Box 2.1. **Examples of biodiversity externalities**

Local	*Regional*	*Global*
Watershed values	**Migratory species**	**Existence values**

The market exchange of property rights in resources is socially valuable to the extent that the property rights capture the majority of the value from the resource. When significant externalities exist, and it is not possible to internalize these externalities within the scope of the transaction, then market creation creates very inexact incentives for resource investment.

Information asymmetry

Another problem that detracts from the effectiveness of market exchange is the absence of perfect information flows between those supplying and those demanding the resource. If it is not possible to convey clear and credible information about the resource, then the potential for welfare-improving exchange will be incomplete. In fact, the inability to convey credible information will to some extent result in the consumer's perception that the worst-case is the most-likely; this is known as the lemons effect (Akerlof, 1974). It results from the observation that the inability to assess the actual quality of a good or service implies that cost-incurring investments in quality will go uncompensated, and so will not occur. The lemons effect implies that there will be no supply of higher quality goods, if there is any additional cost associated with their supply and if it is not possible to credibly convey the existence of quality.

This is a problem in the context of biodiversity resources, since so many of these resources produce undifferentiated goods and services. It is the quality of the production process then that differentiates whether the good is associated with biodiversity externalities or not. For example, a piece of timber that is derived from a cut and burn operation is unlikely to afford significant biodiversity flows, while an identical piece of timber derived from a single tree might leave the forest, and biodiversity flows, untouched. In the market for timber, there is no capacity to distinguish the nature of the production process used to produce the timber or the impact of that process on the flow of biodiversity goods and services.

Applications to biodiversity

Rent creation

The problem of rent creation may be discussed in the context of the problem of park pricing. In most parks, tourism is not charged a price by reference to each use, but only by reference to entry. Where there are competing tour operators, this may create incentives for overexploitation of the biodiversity resource. Management of the resource then accords with restrictions on the use of the resource by the tour operators, thereby increasing the price charged per tour and enhancing the rents derived from the resources.

This may be illustrated by reference to competing developments of the coral reefs in the Red Sea, at Hurghada and Sharm al Sheikh respectively, (Medio, 1995; Bulte, Fernandez and Swanson, forthcoming). Hurghada made use of its coral reef resource in an unrestricted fashion, where the government allowed unmanaged development of the shores along the reef. The other, Sharm, made use of its coral reef in a managed fashion, where the government restricted development density along the reef (tourism and fishing) and implemented a monitoring programme for compliance. The contrasting results were dramatic. In Hurghada, development density is nearly three times greater and the reef suffers from over-exploitation (three times as many visitors and twice as many boats), reckless exploitation (unnecessary damage from construction of hotels and unmanaged tours) and pollution (poor visibility). In Sharm, the restricted number of operators has rendered it possible for them to recognise their interdependence in their joint use of the reef, and thus they have invested in its

Table 2.1. **Some key parameters at Sharm el Sheikh and Hurghada**

	Sharm	Hurghada
Government Intervention		
Urban planning	Yes	No
Monitoring programme	Yes	No
Public awareness programme	Yes	No
Fishing regulations	Yes	No
Development density indicators		
Hotels	40	127
Dive centres	27	85
Boats	220	400
Investment for conservation		
Dive sites	37	30
Fixed moorings	108	65
Diver briefing (% dive centres)	65	3-5
Conservation benefits		
Sewage pollution	No	Yes
Infilling	Jan.-40	64/75
Underwater visibility (m)	15-30	1-2
Anchor damage	Neglig.	Signif.
Rents from conservation		
Avg. price of package	USD 45	USD 27

Source: Most data from RAS MOHAMMED NATIONAL PARK (SHARM) and Fawzi (1995).

conservation. The hoteliers in Sharm provide more mooring sites and diver briefings to spread the repercussions and reduce unnecessary damage. They have also invested in sewage controls and visibility is ten to twenty times greater than at Hurghada. Importantly, all of these investments earn a return. Hoteliers at Sharm are able to charge a fee double that applicable at Hurghada. It is this price differential between the controlled and the uncontrolled resource use that is the *rent* flowing from the resource. It is only through governmental restriction of use of the resource (and monitoring to ensure compliance with the restriction) that rents are created, and hence incentives to invest in the reef are induced.

Park pricing policies demonstrate the importance of joint management in the context of biodiversity resources. Where there are multiple users with unrestricted access to the resource, they will compete away the value of the resource and overexploit it in the process. Government policies that aim to use markets must restrict access via either property right mechanisms or other restrictions on use. These restrictions serve the same purpose as well-defined property rights: they generate incentives to invest in the resource.

Externalities

The problem of externalities may be illustrated by reference to joint wildlife management on private properties. When wildlife moves across property boundaries, there are externalities between neighbouring property owners. These externalities imply that, even if the private property owner has rights in the wildlife while resident on its property, investments in that resource generate flows to others. These unappropriated benefits (externalities) reduce the incentives to invest in the wildlife.

This problem has been addressed in some countries by means of so-called land conservancy programmes. In South Africa, the state has developed policies that encourage neighbouring property owners to cooperate and collaborate in programs of wildlife investment and joint marketing. With governmental facilitation the neighbouring property owners are able to see a joint return from joint management, and so the externalities from wandering wildlife are internalized. The southern African conservancy movement was sourced initially in the legislation passed in 1967 by the South West African (now Namibian) assembly (Ordinance 31). Ordinance 31 stated that the Division of Nature Conservation and Tourism was to "give the owner and occupier of a farm full ownership of all game, other than specially protected game, while such game is lawfully upon such farm and while such farm is enclosed with a sufficient fence". The ordinance also made provision for that person to lease his rights (Joubert, 1983). It was this "privatisation" approach to wildlife that generated an entirely different management system for the wild animals in what is now Namibia.

Box 2.2. **Private property rights and the African conservancy movement**

The Southern African Conservancy programme was initiated by vesting private property rights in wildlife in the landowners. Once private property rights in game species were in place, the individual landowner had the capacity to capture the use values of wildlife on his land. The immediate problem facing these individuals was that in many cases the individual landholdings were insufficient to support the range of the wildlife species. Much of the Namibian territory is extremely arid and wildlife must range across large territories in order to browse successfully and to locate water supplies. Although individual ranches are usually very large (c. 5-10 000 ha), the range of many of the wildlife species in these arid districts is often even larger. The solution to such problems has come with the establishment of a contractual relationship between neighbouring landowners providing for the join management of the wildlife species that range across their lands. In such agreements, between ten and twenty landowners join together to establish a common outside boundary around a more substantial land area, and principles for the joint management and use of the wildlife.

The joint management actions taken by the Khomas Hochland conservancy thus far (since its initiation in September 1992) have included:

- the reduction of the cattle stocking levels on the conservancy lands;
- the opening of waterholes to game during the dry season;
- the removal of the two wire strands from the interior fences;
- the erection of game proof fences on some of the exterior boundary;
- the stocking of new wildlife species (hartebeest);
- the development of common marketing organisation (brochure, agent).

The key to this programme is the values that these species generate, and the benefit sharing system that has been implemented. Each hunter must pay a trophy fee for any animal bagged on the conservancy property as well as for lodging and a licensed guide. The hunter is recruited from Europe or the US and his lodging fee is kept by the landowner who recruits and lodges him. However, once the hunter is within the conservancy, the individual conservancy member is welcome to hunt on any of the conservancy property. The landowner on whose property the game is bagged is entitled to a specified share of the trophy fee, and the conservancy itself receives a further 5 per cent of this specified fee; the recruiter conservancy member is entitled to the residual of the trophy fee as well as the lodging fee.

Box 2.2. **Private property rights and the African conservancy movement** *(cont.)*

This benefit sharing arrangement allows for the various landholders to share in the benefits of game ownership, even if they do not themselves engage in recruiting and lodging trophy hunters. All that is required is that they participate in the joint management actions that enable the use of their land by game species. In addition, the levy collected by the conservancy itself is being used to fund jointly beneficial management activities, including restocking of game species and the construction of exterior game-proof fences. Therefore, as a direct result of the financial incentives arising from the privatisation of wildlife within Namibia, private landowners are in the process of removing fences erected earlier this century and restocking species that were eradicated in the process of these earlier conversions. In addition, it is clear that these are only the first steps down the road towards wildlife-based land uses. The conservancy continues to look for members (hoping to expand to the boundary of a game reserve in the proximity) and it is in the process of importing other wildlife (giraffe, impala) in the hopes of developing the ecotourism-based values of its lands as well.

What has been the impact of wildlife privatisation within Namibia? There is now a solid history of experience with the new policy, since it has been in place for nearly three decades. First the wildlife numbers appear to have increased by some 70% over the 20 year period between 1972 and 1992. Second, and similarly, the biomass of game appears to have increased by some 84%. There appears to have also been an increase of some 44% in the diversity of species.

Therefore, the impact of privatization and externality internalisation in Namibia provides solid evidence for the incentives that this programme has created for the conservation of wildlife. Wildlife populations have increased dramatically (albeit cyclically) over this period, as has general diversity. In many areas, species are being returned to habitats in which they were systematically eradicated under government policies in place only a few decades before. In addition, economic incentives are allocating land uses in a manner very different than did the previous administrations. It is apparent from these studies and many others that mixed land uses are not only possible but also profitable. In Namibia the existing conservancies are all using wildlife only in combination with domesticated species, rather than one at the exclusion of the other. Landowners are transforming Namibian habitats by the removal of fences and the reintroduction of game, solely in response to the financial incentives created by privatisation.

Source: Barnes and de Jaeger (1998).

The southern African conservancy movement demonstrates the importance of property rights and contracts in the internalisation of the externalities from supplying biodiversity. Neighbouring landowners have little interest to invest in the factors necessary to supply jointly held biodiversity. Such investments would simply flow as externalities to the adjoining landowners. Without property rights and contracts, there would be no incentives to maintain any wildlife on these lands. The introduction of property rights and contracts enables these landowners to introduce joint management regimes that allow them to benefit jointly in shared investment schemes. Then the minimal investments required for the continued existence of wildlife (fence removal, waterholes) are enabled.

Information asymmetry

The problem of information asymmetry may be illustrated by reference to the management of the international trade in wildlife species. This trade emanates from various sources, some from sustainable use and many others from unsustainable ones. In the past the international management of trade has not distinguished between the form of use, but has regulated the trade solely by reference to the global status of the species population, (Swanson, 2001). If the species was found to be endangered, then the trade was banned irrespective of the nature of the source of the products. If the species was not endangered, the trade was allowed irrespective of the source of the products.

More recently, the CITES agreement has been evolving to enable the trade in species depending on the nature of the source. Some sources are able to qualify as sustainable on the basis of so-called ranching exemptions (whereby the species is removed from the wild and sold in sustainable quantities) or on the basis of quotas established by the parties to the agreement. Either approach is devised to enable sustainable use of endangered species to continue, if there are indications of sustainable use and investment.

The important role of CITES in the market is to establish credible information on the process used to harvest and maintain the resource. Without a credible certification of the production process, the market cannot distinguish between those which are sustainable and those that are not.

The role of certification in markets for biodiversity is to provide information to consumers regarding the nature of the production process providing the consumer goods. Without a credible source of information, consumers remain unable to separate between goods with regard to the production processes from which they derive. Since the goods and services of biodiversity are so often bundled with other goods and services (*e.g.* the timber flowing from a forest), it is important to provide the mechanism for signalling which flows represent supplies of biodiversity and which do not.

Box 2.3. **Certification of products in international trade**

The vicuna population of south America has been listed on Appendix I of the Convention on International Trade in Endangered Species (CITES) since the inception of that international agreement, effectively disallowing the trade in the products from this species. Nevertheless, the species continued in decline due to poaching and local use. In 1986, the trademark "***Vicuñandes***" was registered and some populations in Perú were downlisted to Appendix II in CITES to allow export of cloth made with fibre from live animals. In the Conference of the Parties (Fort Lauderdale, 1994) this was taken further and all Peruvian populations were downlisted to Appendix II. The downlisting was conditional on the trade in fibre from live vicuñas.

In Perú in 1991, legal reforms altered the status of the *vicuñas* in communal lands, returning them to the local communities in usufruct and custody, thus enabling their use under state regulation. Communal *Vicuña* Committees have been created since then as a means to protect, negotiate and regulate the use of the vicuña, complementing state protection. The National *Vicuña* Breeders' Society (NBS), encompassing all regional associations, is the legal body representing the communities. Since *Vicuña* fiber is difficult to process given its fineness and relatively short staple length, the management authorities sought to create a joint venture with the industry. In order to get better prices, the NBS put out for tender the processing of the stock of fibre accumulated until 1993. A total of 2 000 tonnes of fibre and 200 metres of cloth from early trials were offered. The tender was for a two-year participation agreement, requiring the applicant to guarantee a direct processing line to the final consumer. The resulting agreement was very advantageous, and several funds for development and conservation were secured. The International *Vicuña* Consortium, the winning Italo-Peruvian venture, gained in exchange exclusive use for two years of the trademark and marketing of existing stocks of fibre.

Source: Bulte, Fernandez and Swanson (forthcoming).

Monitoring and enforcement

Essential to the establishment of well-functioning markets is the assurance that rules, regulations, and laws will be enforced. Only when coupled with sufficient monitoring that ensures that compliance will occur can market activity lead to net social gains from trading. For example, where *enforceable* property rights to biodiversity-related resources are created, the resources become private goods. Enforcement means that the goods are less likely to be subjected to short-term unsustainable use since theirs owners will treat them as part of their portfolio of durable (*i.e.* income-generating, long-term) assets. That is, market failures arising out of problems with non-excludability or non-rivalry will be addressed.

The caveat, of course, is that property rights must in fact be enforceable – from a technical as well as an economic perspective. This should be part of the consideration given to various policy options at the outset – not as an afterthought. As with any good foundation for public policy, "incentive compatibility" must be a hallmark of the underlying institutions.

While in most cases enforcement requires strong oversight, in some cases this may not be necessary. For entities (such as large business interests) that have a very public presence in many parts of the world, a long-term view of their own self-interest would lead them toward behaviour that was not perceived to be questionable. Enforcement is less likely to be an important issue for this type of entity as it might be for others who do not take a long-term view.[3]

Enforcement may sometimes not be economically desirable. When it is too costly, the social or private value of the property in question may be lower than the cost of monitoring and apprehension. Optimality in the enforcement of property rights would call for the incremental expenditure on enforcement to be equal to the incremental forgone revenue from non-enforcement. For many property rights, this condition may not be attainable, so enforcement will not be optimal – the value of the property right may be too low. The temptation in such cases may be to establish property rights that are clear and well-known – in the expectation that they may be in-and-of-themselves persuasive moral deterrents. That temptation, however, has to be weighed against the potential adverse impacts on society of establishing policies that can not be enforced, and therefore that may lead to increased non-compliance in other areas.

Caveats and dilemmas

The positive potential of markets to provide benefits for biodiversity has thus far been the main focus of the discussion. Given the public aspects of biodiversity, however, the potential for problems to arise needs to be acknowledged and taken into consideration. The example of the Tagua tree in Ecuador provides an illustration. This plant produces a very hard seed that has been called vegetable ivory – useful for making buttons. Creating markets for biodiversity involves promoting the use of the Tagua seed so there is an incentive to maintain the tree. Consider alternative uses of the forest where the tree is found. It may, for example, have value as a potential source of timber, or even for use in farming activity. Alternative uses of the land will give the land different potential values. So, for example, the value of timber products will convey a certain value to the land based on the amount of wood per km^2 that can be produced. Similarly, the value of the land in farming activity will be determined by the amount of farm products that can be produced (over a discounted period of time). When the seeds from the tree are sufficiently valuable, alternative uses of the forest will not be viable in the market.

When the seed is too valuable, however, the promotion of the Tagua seed for use in buttons may lead to an undesirable impact on biodiversity. If the Tagua seed becomes the focus of intensive demand such that the environment in which it lives is substantially altered, market creation may actually do more harm than good for biodiversity. Creating markets for biodiversity requires care to ensure that commercialisation of the product does not destroy the source of biodiversity. Market creation must therefore be part of a well thought out process to encourage sustainable use.

There are many who feel that using markets for biodiversity is a wrong approach because markets are the primary source of damage to biodiversity in the first place. They argue that it is likely that encouraging markets will not only lead to further damage, but may even accelerate the problem. This is, of course, a concern that is shared by broad cross-sections of people engaged in biodiversity-related activity. Allowing unfettered markets to operate can result in social loss by allowing the sale of goods or services that a society might not want to permit. That is, allowing individuals to engage in biodiversity-using activity that is profitable to them may not always be in everyone else's best interest, and may lead to reductions in general well-being. To the extent that biodiversity is something that we all care about, advocates of markets for biodiversity automatically have a burden to prove that the public aspect of biodiversity is being accounted for.

Markets for timber and agricultural production accounts for the bulk of land that is altered from its natural state in many countries. Underpinning this Handbook, therefore, is the belief that markets can be *harnessed* to achieve biodiversity goals. That is, markets on their own lead to improvements in material well-being. The fact that a very large proportion of the world's population lives on less than one US dollar per day suggests that many parts of world need well-functioning markets to provide basic goods and services. When markets can be guided to encourage the production of those goods and services in ways that are compatible with biodiversity conservation and sustainable use, improvements in well-being will not come at the expense of biodiversity. Moreover, since budgetary and other pressures in many countries have left little scope for direct expenditure by governments, markets remain one of a few options left for affecting significant change.

While market creation can have a large positive influence in achieving biodiversity goals, it should not be viewed either as the sole solution for biodiversity loss, nor as a substitute for an articulated policy. Rather, it should be viewed as a tool to complement other policies and assist society at large. It has the potential to achieve biodiversity conservation and sustainable use objectives in a more efficient manner than other government policies, but only when used with due care for the context in which the market will operate.

Conclusion – supporting institutions for markets in biodiversity

It is generally believed that biodiversity will not be supplied in adequate quantities by the market, as it currently operates, on account of incomplete and imperfect markets. One approach to this problem is for the public sector to supply biodiversity via direct intervention, *e.g.* by the establishment of parks and protected areas. Another approach is to establish incentive mechanisms (payment schemes, tax incentives) that render it financially beneficial to conserve biodiversity. Both of these approaches are indirect, and require direct and continuing government expenditures.

A more direct approach is to attempt to address the problem of incomplete and imperfect markets. Biodiversity has many values: use, system, existence, option. Some of these values are very difficult to market. Many others are already in trade, or are able to be bundled with other goods already in trade. If this is feasible, then the "market creation" approach has the advantage of providing biodiversity via private rather than public expenditures.

In market creation, the role of the policy-maker is to generate the supporting institutions that enable these markets to generate support for biodiversity. The creation of markets may take many different forms. Markets may be generated in access to lands (*e.g.* park pricing), or in particular rights or uses of those lands (*e.g.* logging rights). Markets might also be generated in the biodiversity goods and services themselves (*e.g.* quotas in a fish species), or in related goods and services (*e.g.* watershed services). The choice of market to be created depends on its potential for generating biodiversity conservation in a given context.

It is equally important to aid the continued performance of these markets, as well as their creation. Flows of value from the use of goods and services deriving from the biodiversity resource do not necessarily generate incentives for conservation. This requires both well-defined property rights (*i.e.* property rights that suit the particular resource) and reasonably efficient markets (*i.e.* markets without serious imperfections). Since biodiversity's goods and services are unlikely to fit the market model perfectly, it is important for policy-makers to support them after their creation if they are to be effective.

Market imperfections that plague these markets include: access/rent creation, externalities, and information asymmetry. Access restrictions may require public assistance, if the resource's boundaries or uses are not easily defined. Externalities may persist if the resource is not easily confined within specified boundaries. Information asymmetries are important if the market is to exist for goods or services that remain distant when traded. None of these problems prevent market creation, but all of these problems may persist after market creation and render the market much less effective.

It is important to recognize that markets are not always capable of conserving all of the values of biodiversity. Where it is feasible to use markets, they should be used when they are the most cost-effective means of both realizing values and implementing incentives for conservation. Where markets are infeasible or not cost-effective, the policy-maker must consider other policy options.

Notes

1. This may not always be the case, since natural phenomenon may also lead to impacts that are not fully internalised into market activity, and are thus valid public policy issues.
2. Given the protection afforded minority opinions in national constitutions.
3. Firms that are constrained from taking a very long-term view are generally those that are unable to fully borrow against future income.

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Chapter 3

Supporting Institutions – Property Rights

The property rights regime applied to resources is usually a policy choice – its use is dependent upon circumstances. In a market creation context, however, property rights are a fundamental underpinning of successful outcomes. A property rights regimes, provides restricted access so that its "owner" is assured that today's investments will generate tomorrow's returns. A successful property rights institution, therefore, guarantees exclusive access to future flows of goods and services from a resource – thus providing the incentive for long-term, even inter-generational, planning. Many of the resources we have come to know as biodiversity are thought of as non-excludable, but need not be so. For example, the international agreement on the Law of the Sea provides that fisheries within 200 miles of a state's coastline fall within that state's exclusive economic zone, and then it is a choice by the state to provide for the institutions that are used for harvesting those resources. The state must choose the nature of the management regime that is to be used to determine how/if the resources will be used. Specifying the nature of the property rights regime, however, engages a consideration of numerous factors: from where the burden of risk fall, to how enforceable the regime will be. Exploring some of the characteristics of property rights regimes will help in choosing appropriate measures.

This chapter sets out some fundamental issues regarding the use of property rights and markets for the provision of biodiversity's goods and services. These issues underline the reasons why market creation is important, the various approaches to market creation, and the tools that make market creation effective.

There are goods and services flowing from the biodiversity resource that may not be readily amenable to management through markets. For example, there are existence values given to many species by individuals who are unlikely ever to encounter the specific resource. A concrete example would be the monetary value given to the existence of the Blue Whale by individuals surveyed on the issue (Pearce and Moran, 1998). Given that the nature of this demand is unable to be commodified (unless the individual intends to view or visit the resource at some point in the future), the policy option of market creation is unlikely to be feasible in this application. In these cases the policy-maker must consider other more traditional approaches to biodiversity conservation, such as parks and protected areas or other restrictions on use.

A market-creation approach to addressing market failures is to attempt to address the failures themselves. This approach starts by considering the essential nature of the good or service concerned, and the reason that it is not readily marketable. Then the policy-maker attempts to generate policies that enable that market and/or to correct the market failure. Then it may be possible for public intervention to establish the fundamental conditions under which the good is supplied by the market itself, rather than by the public sector. This may be viewed as both a more direct approach to the provision of the valued good or service, and one that can potentially involve less substantial government expenditures in the long run. It is this approach that is the subject of this chapter.

Creating markets – choosing appropriate property right institutions

The objective of market creation is to generate private incentives for investment in the supply of resources that are the subject of market exchange. Preconditions to the vesting of such incentives are the establishment of some property rights institution and the establishment of some method of exchange. Exchange must be feasible in order for those investing in the supply of the resource to receive value from their investments. Property rights

Box 3.1. **The origins of the public ownership of wildlife**

Almost every legal system dating back to the formation of Roman law has recognised the competing claims to wildlife, terming it *res nullius* ("unownable"). Given this indeterminate relationship between wildlife and the individual, wildlife was implicitly rendered one of the very first wards of the state. The state was made the guardian of wildlife, charged with the regulation of the peoples' taking of any wild species. It fulfilled this role by acting as the arbiter of the many competing claims upon wildlife resources, and as the enforcer of these allocations. There was little doubt that these functions were exclusively within the domain of the state, and so the state's monopoly in the area of wildlife regulation became enshrined. In England, where the state was manifested in the form of the monarchy and its representatives, wildlife became "the property of the sovereign". The competing claims upon the wildlife resource often took the form of a contest between the local community and a more distant elite. The sheriff and game keepers worked together to prevent local communities from "poaching" all of the wildlife before those claiming title through the king could prosecute their claims. The contest was between different interest groups over the wildlife resource, and the state was arbitrating between these groups.

In colonial America, wildlife remained within the received common law framework as *res nullius*: one of the earliest American cases confirmed that wildlife could not be considered the property of the individual land-owner. One of the first acts of the newly established states often was to establish the state as the regulator of wildlife. Even prior to independence from Britain, the first hunting regulations were adopted in Rhode Island as early as 1646, and had spread to most of the other colonies by 1720. Shortly after statehood, Iowa (in 1878) introduced the first set of regulations governing the quantity of game that could be taken by an individual (Edwards, 1995). In these instances the state had assumed the role of manager of the wide range of uses made of the remaining wildlife, even on privately held lands.

These perspectives on wildlife management were transferred to many other parts of the world. In Africa, for example, wildlife was seen as a reservoir of disease and grazing competition. It was often eradicated as part of the agricultural development policy of these regions (Cumming, 1990). For colonial Africa the London Agreement of 1933 formally translated the western tradition in wildlife management to this continent. The state assumed the role of wildlife guardian. This role was to be executed through the establishment of game reserves and national parks set aside for the sole purpose of wildlife uses and preservation. Large areas of the colonial world (*e.g.* 10 per cent of southern and eastern Africa) were placed within such

Box 3.1. **The origins of the public ownership of wildlife** *(cont.)*

a "protected area" preservation framework. In many of these newly designated protected areas the local peoples were forcibly removed from the designated zones and anti-poaching police patrols were instituted to protect the wildlife from any use by the remaining communities (Marks, 1987).

Source: Edwards (1995).

must be available in order for that value to translate into incentives for investment. In this part, we investigate the feasibility of the establishment of property right institutions, and following this we investigate the feasibility of establishing a market in the resource.

The role of property rights is to provide restricted access to a resource, so that the designated property owner is assured that today's investments will generate tomorrow's returns to that owner. The key to the success of a property right institution is therefore the guarantee of exclusive access to future flows of goods and services from a resource that is owned. The expectation of exclusive access in the future generates the incentives for investment today.

The perception that exists of biodiversity as a public good is an artefact of many centuries of legal and social custom and belief. Many legal regimes have for centuries treated biodiversity and wildlife resources as un-owned until captured. International fisheries (that are not subject to international agreement) were termed by Roman law as *res nullius* (owned by no-one). Many non-timber forest products in many countries are available to anyone engaging in harvesting activities. (All of these resources are subject to a management regime that is known as open access, in which each harvester competes with all others in an open competition to maximize its catch.)

It is important to recognize that the property rights regime applied to resources is usually a policy choice. Many of the resources we have come to know as biodiversity are thought of as non-excludable, but need not be so. For example, the international agreement on the Law of the Sea provides that fisheries within 200 miles of a state's coastline fall within that state's exclusive economic zone, and then it is a choice by the state to provide for the institutions that are used for harvesting those resources. The same is true for forested lands within a state's boundaries; the state may elect to allow open access, or it may provide for some form of restricted access. The state must choose the nature of the management regime that is to be used to determine the harvesting of many biodiversity resources.

Box 3.2. **The African Elephant and the choice of management regime**

In the 1980s the Ivory Trade Review Group documented a 50% decline in the population of the African elephant across its 34 range states, from 1.3 m to approximately 600 000. This decline occurred in parallel with a rise in the trade in ivory, and was blamed on a combination of rising ivory prices and readily available weaponry, and a ban on the ivory trade was proclaimed. On closer inspection it became apparent that the rise in ivory prices had very different impacts on the elephant populations in different states. In just four range states a total of more than 550 000 elephants had been lost during the decade. In four others, a significant increase in the population of elephants had occurred. The remaining range states had lost less than 100 000 elephants during the course of the decade. The primary difference between the states with population declines and those with population increases was the form of management applied to the species. In those states with substantial population increases (*e.g.* Zimbabwe) the elephant population was subject to a significant campaign for investment and market creation. In those states with substantial population declines the elephant population was subject to open access and little or no investment.

Source: Barbier, Burgess, Pearce and Swanson (1990).

Choosing the appropriate property right regime – dividing rights between public and private sectors

Once it is accepted that the use of property rights is a choice in the context of biodiversity, the state must then make several decisions concerning the appropriate property rights institution for use in a given situation. As mentioned, property rights institutions are not uniform or monolithic in nature, but rather refer to a bundle of rights and responsibilities that may be attached to a designated resource and its habitat. The state may pick and choose in order to develop that set of rights that works best for dividing rights and uses between the private sector and the public sector. The primary benefit to be obtained from placing rights within the private sector will be the private flows of investments into the resources so vested, and thus the potential for conservation of those resources into the future. The state's decision concerning the division of rights in resources and habitats concerns the management of this trade-off between the primary benefits from private and public holdings.

There are many different dimensions in which property rights might be defined. First, there is the difference between the right to use (*usufruct*) as distinct from the right of ownership.[1] The *right of use* confers the right to enjoy a designated flow of benefits over a specified period of time. This designated flow might consist of only a single use (such as the right to light or air over a designated parcel of land) or it might consist of all possible uses (such as an unrestricted leasehold). The duration of such rights may extend from a single day to a full lifetime (a *life estate*), and they may be designated to be transferable or nonassignable. For example, such partial interests in land are often created by private agreements (such as leases or easements)

Distinguished from the right of use is the full right of ownership (the *fee simple* in common law). The right of ownership includes all of the rights of use as well as the residual and reversionary rights in the land. The residual rights refer to whatever remains after prior conveyances of specific uses. The reversionary right refers to the right to receive all use rights at the end of their term of duration. The right of ownership enables the owner to divide and allocate the rights in the land in the manner perceived to be optimal by that person. Thus the owner of land may separate out and convey various rights of use to various designated entities, retaining whatever residual and reversionary rights that remain. The owner may also convey the fee interest (the rights to residual ownership) to another entity, subject to the previously conveyed use interests. For example, it is possible for an owner to convey the rights to construct buildings on the land to one individual, the rights to the view across the land to another individual, and still convey to a third whatever residual interests that remain.

A state with control over lands may also separate out between the rights of use and the rights of ownership in the land, and it might keep some uses in the public domain while placing others in the private. Most states also recognise the sovereign right to provide for public uses over privately owned lands, through planning controls or zoning regulations. Increasingly, many states are placing limits on private landholders' rights of development that are potentially in conflict with other public policies, such as biodiversity conservation and species protection. For example, in the US, the development of private lands in watersheds is increasingly restricted by reason of laws created to mitigate development-related impacts upon salmon habitat.

Given that the state has the potential to control both ownership and use benefits in the lands under its jurisdiction, there are at least four conceptually distinct forms of management it might use in advancing the purposes of biodiversity conservation. First, it may treat the land[2] in which the resource is situated as public, as well as the resource's benefits; this is the equivalent of *open access* management. Second, it may treat the land in which the resource is situated as public, but designate private property in the use benefits of the resource itself. There are many different forms this approach to management might take, such as a franchise or a tradable quota regime. Third, it may treat the area in which the resource is situated as private, together with the use benefits of the resource; this is the equivalent of private property ownership. Fourth, it may also confer private rights in the area, while placing some sort of encumbrance on the owner to provide a flow of use benefits for a public purpose. Any one of these approaches may be seen as the best way forward for managing some particular form of resource (See Box 3.2).

The state might choose to operate under any of these four basic forms of property right institutions, depending on the nature of the resource concerned and the goals to be achieved. The primary advantage of conferring private property rights is the identification of a particular individual/entity with the future stream of benefits from the resource or land. This close identification of future prospects focuses the owner's attention on managing the resource, and avoiding overexploitation or under-investment, but can reduce or restrict public access to the use benefits. The primary advantage of retaining rights within the public sector is ensuring the availability of benefits to all. This has the advantage of informing and engaging wider sections of the public in the cause of the resource, but it retains within the public sector the responsibility for management and investment in the resource.

Applying the correct property right institution given the nature of the resource

There is no property right institution that is appropriate to all situations. If the objective is managing biodiversity appropriately, the appropriate choice of institution will depend on how closely the biodiversity is related to the property concerned and how much conflict exists between the resident biodiversity and the other potential uses of the property.

If the biodiversity resource is closely associated with a particular area of land and it is likely to be the first-best use of the land, then it may be possible to regulate access to the resource simply by means of conferring private property rights in the land and the resource (Type I resources in Table 3.1). This is the case when the flow of benefits from biodiversity constitutes the vast majority of the flow of benefits from the land. Usually, markets for these sorts

Table 3.1. **Choice of fundamental institutions for managing the biodiversity resource and habitat**

		Ownership of Resource (Flow of Use Benefits)	
		Private	Public
Ownership of Land	Private	I) Traditional property rights in resource/land	III) Public rights to some uses of private lands (*e.g.* zoning/ encumbrances)
	Public	II) Property Rights in some uses of public lands (e.g. tradable permits)	IV) Public access to resource/land

of goods and services are readily marketable, as in the case of eco-tourism. In this case, the important issue is the management of the market, not its creation (see previous chapter on access/rent creation).

At the other extreme are those forms of biodiversity that are closely associated with a particular area of land but for which the first-best use is unlikely to be associated with the biodiversity. Then it may be necessary to keep the resources in the public sector (to prevent their conversion) but important to manage them for maximum benefits to the public.

Box 3.3. **Markets in biodiversity via managed access to habitat: Optimal park pricing**

Those who actually visit the lands on which the biodiversity is resident can enjoy some of the flows of goods and services deriving from biodiversity. These flows include the recreational services and viewing enjoyment of the diversity there. Since access to the land is excludable by nature, it is possible to market these flows from biodiversity by marketing access to the lands. This is the essence of "optimal park pricing" in eco-tourism services. Charging the correct price for access to the park enables the appropriation of the value of the associated goods and services. For example, it was demonstrated that the optimal price for access to Kenya's wildlife parks required an increase in the fee from approximately fifteen to seventy-five US dollars per day, (Brown, 1995). Similarly, tourists in China indicated that they were willing to pay access fees of one hundred dollars per day to view pandas in their own habitat (Kontoleon and Swanson, 2002). These are examples of markets that already exist, but require the application of *optimal pricing strategies* for maximum biodiversity benefit.

Restricted access to habitats might be used to generate marketability of many different forms of biodiversity's goods and services. For example, bio-prospecting might be managed by requiring payments of access fees to habitats, or by requiring a royalty agreement from any party prior to making access.

Sometimes a parcel of land is not being used solely for the purposes of providing biodiversity goods and services, but it may have a partial role in providing the same. In that case, it may be possible to develop markets in specific uses or rights to lands, rather than the entirety of the land. For example, it is possible for conservation organisations to make bids for the logging rights or mining rights to specific tracts land, while keeping these rights for purposes of biodiversity conservation instead. It is also possible to practice such purchases of partial interests for conservation purposes more directly. In the US, for example, there is now a widespread practice of creating "conservation easements" and vesting them with Land Trusts (Box 3.4). Although it is far more complicated to transfer property interests across international boundaries, it has also been argued that this practice might be extended to international markets for uses such as "burning rights" or "transferred development rights" (Schneider, 1990).

Box 3.4. **Markets in biodiversity via divisible rights in habitats: Easements and Trusts**

Real estate markets are increasingly used to purchase conservation easements and development rights in potential wildlife habitats. For example, in the US, land trusts operate to take perpetual conservation easements in designated properties. Other groups (*e.g.* the Northwest Ecosystem Alliance) are active in the markets for logging rights. This recognition that specific uses might be acquired, rather than the whole of the bundle, has been an important aid to conservation.

A conservation easement represents a privately negotiated encumbrance on a designated property, which runs with the land in perpetuity. The easement may be defined so that it disallows certain specified uses of the property (*e.g.* further building or development) or so that it provides for only certain specified uses (*e.g.* agricultural or touristic). The easement is then conveyed to a Land Trust, for the benefit of all current and future members of the Trust (and such membership may be defined very broadly to include the public interest). This easement then runs with the title to the property forever, and means that future purchasers of the property do not take any of the interests vested with the Land Trust.

In the US, the number of acres receiving protection from Land Trusts increased from 1.9 million to 6.2 million between 1990 and 2000. Conservation easements were used to protect 2.6 million acres of this habitat in perpetuity.

Source: Land Trust Alliance (Washington, DC.).

If the resource is associated with the land but forms only one potential use of the property, then it might be possible to afford private rights in that use while retaining the remainder of the estate in the public sector. This could be the case, for example, if the land were to have use as a public park but also afford opportunities for concessionaires (for provision of private tours on the public lands). Then the state might afford a franchise or other limited private property right in the beneficial use, without affecting the publicly held nature of the lands.

If the resource is not readily associated with a particular area of land or water (*i.e.* it is entirely fugacious), then it might still be possible to create a private property right in the resource separate from the one managing its habitat. These are resources for which it is possible to manage the harvesting or exploitation rate (Type II resources in Table 3.1). For example, a tradable quota system in a fishery creates a right to a flow from the resource separate from the right of access to the body of water.

Box 3.5. **Markets in biodiversity via managed access to resources: Tradable quota systems**

Many fisheries are regulated via tradable quota systems. These operate by means of the creation of an aggregate quota for the fishery, and then the allocation of this quota to individual harvesters. Such individual quotas are best made transferable, in order to enable individuals to pool their resources to harvest them most efficiently. Such individual tradable quotas (ITQs) exist in New Zealand, US, Australia, The Netherlands and Iceland. To generate a market in the biodiversity, it would be best if both the quotas were auctioned and tradable. In a non-marine context, Mexico has created an ITQ system for the taking of big-horned sheep on open lands. Since the access to these lands is unregulated, it is then necessary to manage the exploitation of the resource itself.

The idea is to substitute the marketability of a permit or quota entitlement for the underlying biodiversity good or service. For example, such permits are sometimes used to generate exclusivity in accessing medicinal plants, in order to generate the "benefit sharing" required under the terms of the Convention on Biological Diversity.

If the resource is not easily commodified, then it might be necessary to bundle the resource with one (with which it is associated) that is more readily traded. For example, biodiversity might be believed to be associated with non-deforestation in some regions. Then it may be possible to trade rights in deforestation, in which a certain amount of the biodiversity good or service is included (Heal, 2000). This may often be the case in the context of watershed maintenance or forest conservation, in which a set of complex goods is implied within any transaction.

There are some forms of goods and services flowing from biodiversity resources that are non-excludable by their very nature. For example, one of the innate characteristics of diversity is information. The continuing availability of a greater diversity of resources by definition increases the likelihood of future useful information becoming available (as in the case of

Box 3.6. **Markets in biodiversity via bundling: Creating surrogate markets**

It is important to recognize the multi-faceted and complex character of biodiversity's many flows of goods and services. Some of these flows may not be readily marketed, but marketing other goods or services whose existence is related to them might preserve them. In this manner, the biodiversity goods and services are included in the same "bundle". For example, in many contexts the continued existence of forest habitat may be closely related to both the continued flow of biodiversity services and also the continued flow of watershed services (flood control, water purification). Then the development of a market in watershed services may be capable of contributing to the preservation of biodiversity in the same watershed.

Source: Heal (2002).

screening medicinal plants). Information by its nature is highly diffusive and non-exclusive. The fundamental paradox of information, as described by Kenneth Arrow, states that it is impossible for a prospective purchaser to value information without its prior exchange, rendering the market exchange of information infeasible. When goods or services are informational by nature, it is often the case that some complicated form of bundling must occur in order to generate property rights in the good or service. The policy of intellectual property rights allows an exclusive marketing right in certain specified products, as a means of compensating an innovator for investments in the production of new information. It is this exclusive right in a range of marketed products that confers some value upon the innovation. In general, vesting exclusive marketing rights in certain products can afford additional value to investments that are associated with that good (*e.g.* brand name and trademark protection).

Applying the correct property right – private and communal

The legal instrument that creates the property right will induce changes in behaviour by generating markets for profitable exchanges. The manner in which the instrument achieves that result, however, is subject to a great deal of flexibility which the policy-maker can use to achieve particular objectives. Transferable development rights (TDR), for example, have been used to allow a prescribed level of development activity to occur with maximum benefit within a given area. In the case of preserving wetlands, they have been used to create credits that allow development to occur in one area, and having it compensated by the re-establishment of wetlands in another area (Gardner, 2003). In other contexts, individual transferable quotas (ITQs) for fishing particular species can be adjusted annually to reflect fluctuations in stocks. The implied risk to the holder of the ITQs becomes factored into the price at which the ITQs will trade in the market – thus reducing the political vulnerability of government to fluctuating stocks.

Some determining factors in how private property rights work can be summarized by a number of key characteristics which define the nature of the incentive they will provide – for the use or non-use of biodiversity.

Table 3.2. **Characteristics of property rights (permits)**

	No offsets	Offsets
Non-tradable	• BushTender (Australia) • Conservation Reserve Program (USA)	• South Creek Bubble Licensing Scheme (Australia)
Tradable	• Hunter River Salinity Trading Scheme (Australia) • Regional Clean Air Incentives Market (USA)	• Wetland banking (USA) • Native vegetation offsets proposal (Australia) • Carbon sequestration credits

Source: Murtough, Aretino and Matysek (2002).

Tradability of the rights (vertical axis) ensures that the costs of achieving the objective are the same everywhere. In competitive markets, this implies that costs will be at the lowest level possible. Offsets (sometimes referred to as "banking") imply that an activity in one location is equivalent to a similar activity in another location. The ability to have offsets creates geographic and/or temporal flexibility that ensures that objectives are met at least cost across time and location. That is, when the dispersion of an activity is not important, then offsets allow overall biodiversity to be maintained while allowing property right holders to maximize private gains.

As each example shown in the box illustrates, the potential for improved outcomes in biodiversity management is large – even with reduced flexibility. The case of property rights which are non-tradable, and where offsets are not allowed, can still deliver high-value gains in biodiversity – as shown by the examples of the Australia's BushTender and the US Conservation Reserve Program.

Governments can also use alternatives to individually-held property rights that can take advantage of group activities. Assigning individual property rights often ensures that a particular resource is managed to achieve longer-term benefits. Indeed, when all public aspects of the biodiversity-related resource are accounted for, the resource will be managed to provide benefits indefinitely. In many circumstances, however, assigning property rights to a single individual may not be practical, and/or it may not achieve the desired outcome. For example, when traditional practice has led to a resource being managed collectively, assigning the property right to a single individual may not improve its management – it may even undermine the resource by

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creating inequities and hostility amongst community members. If the result is that monitoring and enforcement become necessary where previously they were not, the introduction can create a net social loss.

Collective (or communal) property rights can be seen as an intermediary solution where the public-good characteristic of a biodiversity-related resource has a strong local component. In a continuum between goods that are globally public (and require broad government intervention) and those that are fully private (*i.e.* are fully marketable), there are those that may have some characteristic of both. In that case, the concept of a "club" good (see OECD, 2003) may provide the best analytical underpinning. Clubs may, or may not, operate best under collective ownership – it will depend on factors like the relative transaction cost of collective management versus individual access fees.

The limits of the market creation approach

As the flows of the goods and services from biodiversity become more diffusive and less easily commodified (as with information), the cost of using property right institutions increases correspondingly. It remains feasible to consider the use of property right institutions, but the cost of using property right institutions in this context makes other policies relatively more attractive.

Once a property right institution is selected as the preferred policy option, the other policy-related task concerns the minimization of those market imperfections that make market exchange more costly or ineffective. The various forms of market imperfection can be categorised as: open access/ rent creation; externalities; information; and contract enforcement. These categories do not exhaust all possible market imperfections, but they are the most serious areas in which biodiversity resources are involved.

Notes

1. The terms used in this section refer to the concepts as they are known in Anglo-American common law, but most of the same concepts exist within civil law jurisdictions.
2. For purposes of simplicity, the chapter refers to all territory under the state's jurisdiction as "land", but the term should be considered to extend as well to marine areas under the state's jurisdiction.

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Chapter 4

Economic Value of Biodiversity

The economic value of biodiversity is measured in the numerous benefits that are derived from it: both tangible and intangible. These range from the things that are produced and sold, which are derived both directly and indirectly from biodiversity, to the non-marketed things that contribute to both our well-being and to the economy. These benefits can be demonstrated to already be significant in the areas where they are measured in market activities. By illustrating those benefits, a case is made that market failures lead to potentially substantial loss. Moreover, by demonstrating the measurable, but not yet quantified, benefits of biodiversity, a compelling case can be made for policy intervention. This chapter provides a sampling of the many values that biodiversity has for people. Since many of those values are not marketed, and thus not directly measured, valuation has an important role to play in demonstrating the benefits of biodiversity. It has, in the past, provided vital information for many facets of environmental decision-making. For example, valuation has contributed to cost-benefit analysis, environmental damage assessment in courts, implementing regulatory measures, etc. In these cases, valuation provided estimates of the full social (economic) value of environmental resources. By providing such estimates, valuation helps to ensure that market transactions are occurring with the "right" prices. That is, it can bring about tradeoffs between damage to biodiversity-related resources and other goods and services that people want at the rate that reflects collective preferences – not just the preferences of those deriving under-priced benefits from direct consumption of biodiversity.

A useful abstraction for policy purposes is to view biological resources as *assets* that provide a series of *flows* that benefit people (Swanson, 1994). These include flows that are directly consumed, such as commodities and services related to environmental resources as well as flows that are indirectly consumed such as ecosystem services. For simplicity, even intangible benefits such as an existence value of a species or ecosystem can be thought of as a flow of services. The intensity with which individuals prefer a particular biological asset (and the flows it provides) over another (biological or not) provides the measure of its *economic value*.[1]

A concept that will be used in these discussions is a measure known as the *total economic value* (TEV) of a biological asset. It is defined as the sum of all service flows that the asset generates (Freeman, 1993) both now and in the future – appropriately discounted. Activities, or policies, that lead to an increase in the level of these flows are considered welfare enhancing (*i.e.* they entail a benefit) while activities or policies that lead to their decrease are welfare decreasing (*i.e.* they entail a damage). In either case, a change in the level of resource flows leads to a change in the economic value of a biological resource.

The TEV is thus an abstract measure since it encompasses all the benefits derived from a particular resource (in our case, biodiversity-related resources). Often it is desirable in formulating government policy to make all, or some, of those measures more concrete by quantifying them. To achieve that objective, a common unit of account must be derived that allows comparisons to be made across diverse products and services, whether marketed or not. Using money (or a market-based) unit of measurement allows comparisons to be made in ways that can be easily explained to policy-makers. Moreover, since everyone is already familiar with money as a unit of account, expressing relative preferences in terms of relative money values is more likely (though not always) to give useful results to policy-makers. An alternative that is sometimes used is to measure relative values of consumer surplus – a very accurate, though difficult to obtain, measure of benefit. Which one is used depends on the nature of the environmental flow to be assessed.

For resource flows that are directly traded in markets (*e.g.* timber, food, tourism etc.), the value is evident in the price at which they trade in the market. As mentioned earlier, biological resources often generate flows of services that are not traded. When part of the benefits of a resource are traded, while others are not, market prices alone would underestimate their full value. In these cases, non-market valuation approaches have been developed in order to provide adequate monetary measures of value. These include *indirect* and *direct* non-market valuation approaches (Kontoleon, Macrory and Swanson, 2002, provide a more detailed classification and discussion of valuation techniques).

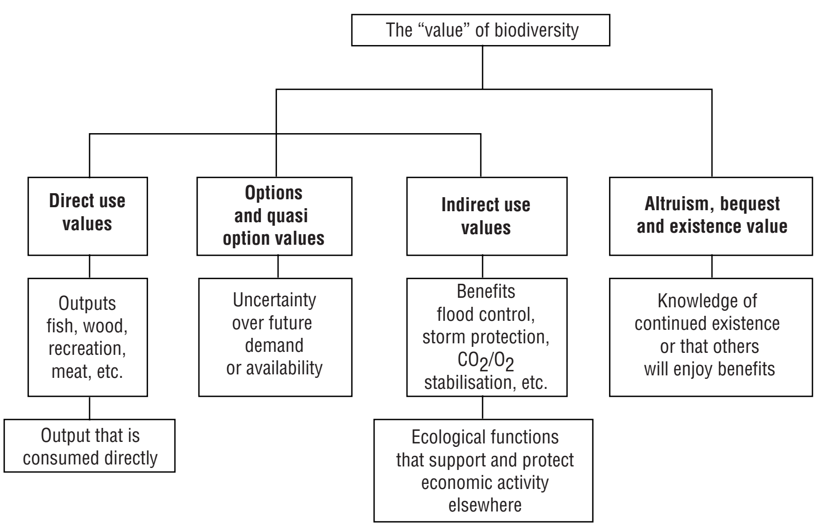
An extensive review of the issues pertaining to the concept of value, as well as to the process of valuation of biodiversity benefits, that are relevant for policy-makers were discussed in (OECD, 2001).[2] This chapter revisits those aspects of valuation that are particularly relevant to market creation. A discussion and survey of biodiversity values that complement and update that earlier work is also provided.

Values and valuation techniques

There exist a variety of taxonomies and classifications of environmental values. Freeman (1993) and Turner (1999) provide a review of some of the main approaches to classifying environmental values. A commonly used approach is that which first divides values into the two main categories of "use" and "non-use" and then proceeds with their decomposition into sub-categories of value.[3] Figure 4.1 presents an illustration of this classification approach – also adopted in OECD (1999; 2002).

Market creation for capturing direct-use values is often hindered by ill-defined property rights. Slash-and-burn agricultural practices are examples where poorly defined property rights do not allow for the incentives for the

Figure 4.1. **The different categories of value of different elements and functions of biodiversity**



creation of markets for certified timber products. Moreover, tradable permit right schemes can lead the creation of markets for direct use goods provided that transaction costs are not too high (OECD, 1999).

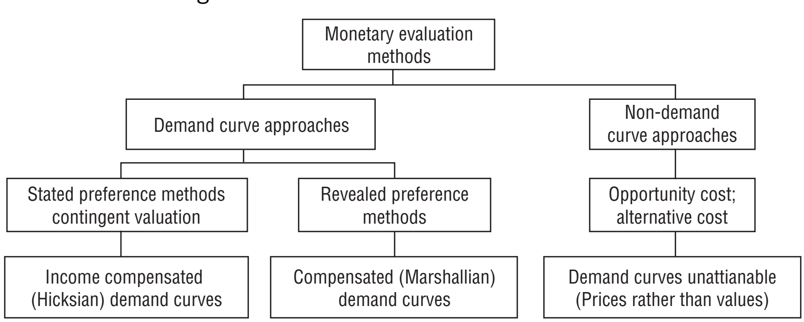
Estimates of option and quasi option values can be assessed using hedonic analysis and contingent valuation. Various cost-based approaches and stated preference studies have been used to assess indirect value but the nature and extent of this category of value remains illusive and uncertain. This is partly because our scientific knowledge of the complex relationships within and between ecosystems is incomplete. A challenge for valuation experts is to develop tools to more accurately assess such values.[4]

Methods for assessing environmental values can be split into formal valuation methods and environmental pricing techniques (see Figure 4.2). The former are used to assess welfare measures (*i.e.* consumer surplus) while the latter focus on market prices that are assumed to reflect economic scarcity. Valuation techniques for non-marketed resource flows from biodiversity are classified into revealed and stated preference techniques.

Revealed preference valuation techniques (including travel costs and hedonic pricing) rely on information from individual consumption/purchasing behaviour occurring in markets related to the resource in question (*i.e.* surrogate markets). The price differential of the good purchased in the surrogate market, once all other factors that affect choice apart from environmental quality have been controlled for, will reflect the purchaser's valuation of that particular level of environmental quality. These methods have the appeal of relying on actual/observed behaviour but are unable to estimate non-use values. Moreover, they are sensitive to the assumptions made on the relationship between the environmental good and the surrogate market good.[5]

Stated Preference techniques (including contingent valuation, choice experiments, and contingent ranking) are used in situations where both use and non-use values are to be estimated and/or when no surrogate market exists from which environmental (use) value can be deduced. These

Figure 4.2. **Price and valuation methods**



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techniques often use questionnaires to develop a hypothetical market through which they elicit values (both use and non-use) for the biodiversity service under investigation. Stated preference techniques do not suffer from the same technical limitations as revealed preference-based approaches, and can also be applied to non-use values. Nonetheless, the hypothetical nature of the market constructed in questionnaires and experimental settings has raised some questions regarding the validity of the estimates (Navrud, 2000).

Environmental pricing techniques that have been commonly used are divided into three categories. The first relies on the use of market prices of directly related goods and services as surrogate values for environmental amenities. The quality of the environmental good is treated as an input into the production of various goods and services (outputs). Changes in these environmental inputs may lead to changes in productivity or production costs which, in turn may lead to changes in prices and output levels which can be observed and quantified (Dixon *et al.,* 1988). These approaches have been referred to as "dose-response" techniques.[6] The second set of pricing techniques relies on data from *actual* costs of maintaining or preventing environmental degradation as a proxy for environmental value.[7] The third set of pricing methods is similar to above but relies on *potential* (as opposed to actual) costs as proxies for environmental value. These include methods as such "*shadow-project appraisal*".

Valuation and pricing techniques both rely on individual preferences (through hypothetical or surrogate markets or through price information). But, pricing techniques do not provide adequate measures of the change in well-being experienced by society from changes in services being provided by biodiversity-related resources.

The characteristic of many resources that underpins the use of non-market valuation techniques is the inability to obtain small discrete changes in the resource. Non-market valuation (as opposed to pricing techniques) is more suitable in assessing the impact on well-being from a change in the level of the provision of a particular service. In particular, the correct measure of value for *non-marginal* changes in the allocation of services is the change in consumer surplus[8] and not its market price. This change is given by the area under two demand curves or equivalently by people's willingness to pay for discrete changes in the level of the provision of an environmental flow. For *marginal* changes or for goods that are perfectly divisible, market prices work adequately as measures of welfare. When one uses market prices to measure the marginal value for a divisible market good, heterogeneity in preferences becomes irrelevant, and aggregation is trivial. At the margin, all consumers who face the same price have the same marginal value, regardless of their preferences, income or other commodity or individual attribute. All that policy-makers need to know about people's marginal value of the good is provided in the market price. There is no need for further knowledge about the actual demand curve. In addition, since all individuals have the same value at the margin, aggregation of marginal value across consumers is relatively simple. This is not so for non-divisible goods which exhibit non-marginal (discrete) changes. In this case knowledge of the demand curve is required in determining individual welfare changes and preference heterogeneity becomes important in obtaining aggregate welfare estimates.[9] These comments also underpin the criticisms that are often made of attempts to give aggregate monetary values to biodiversity or the environment.

Valuation and the process of market creation for biodiversity conservation

Attention is now focused more directly on how valuation plays an important part in the *process of creating markets* for biodiversity conservation. For interested readers, some views from detractors of valuation is provided in the Annex along with a more detailed discussion.

The success of creating markets for biodiversity conservation and sustainable use can be assessed on both its efficiency (in terms of costs) and effectiveness (in terms of biodiversity conserved). For success to be achieved on both these criteria the market creation process can be thought of in three stages: demonstration, appropriation and benefit sharing.

1. **Demonstration:** the identification and measurement of biodiversity values. It is required for the following reasons: the potential benefits from conserving a specific level of a particular resource may not always be evident. Further, even if potential biodiversity values are easily demonstrated, their magnitude is often not reflected in price data. Finally, the *relative* magnitude of the different values of a particular biodiversity resource is not always readily known.
2. **Capture (or appropriation)** the process of capturing some or all of the demonstrated and measured values pertaining to an environmental resource so as to provide incentives for its sustainable utilisation. This is achieved through the design and implementation of regulatory mechanisms and markets that allow for values to be expressed and channelled from those who receive a benefit from the conservation of a biological resource to those who bear the cost. For example, the creation of a market for certified sustainable timber would channel revenues to private forest-owners that would compensate them for foregone earnings from alternative (less rewarding) uses of their land. Likewise, various financial instruments such as the Global Environment Facility and Conservation International funnel funds for the provision of global benefits that stem from biodiversity that is conserved locally. These funds are manifestations of appropriated non-use and option

values and they often take the form of the purchase of development rights. Their aim is to raise the opportunity cost of land use conversion and thus increase the incentives for conservation (OECD, 2001). The capture phase in essence "internalises", in market systems, demonstrated biodiversity values so that those values affect biodiversity resource use decisions (Pearce, 2001). This internalisation is achieved by *correcting* markets when they are "incomplete" and/or *creating* markets when they are all-together missing.

3. **Benefit sharing:** the valuation and appropriation of biodiversity values are not sufficient conditions for providing incentives for biodiversity conservation. The implementation of appropriation mechanisms must be undertaken in such a manner that the captured biodiversity benefits are distributed to those who bear the costs of conservation. For example, there are numerous cases where ecotourism receipts have fled the local region or where no financial concessions or royalty payments have been made to communities that reside in or nearby protected nature reserves. In both cases, hardly any of the benefits from conservation (in the form of recreation and non-use values) are distributed to those who bear the cost of their provision.[10]

Illustrating value as part of a demonstration-capture and benefit sharing process of designing markets for biodiversity conservation can be an essential element of policy – even if, at an abstract level, it is not strictly necessary (see Annex). As Pearce (2001) notes, the current policy context in all countries leaves much scope for valuation to usefully contribute to policy formation.

Valuation can provide information about the *relative* magnitude of different values of a particular biodiversity resource. Using stated preference techniques the TEV of a biodiversity resource can be decomposed into its constituent parts.[11] This can allow policy agents and stakeholders to *prioritise* different types/forms of markets which is vital for setting optimal strategies for *capturing* and *sharing* biodiversity values. For example, Kontoleon and Swanson (2003) provide empirical evidence that wildlife species values are primarily associated with species *habitat* and not *stock size*. This kind of information is useful in focusing on types of markets that are suitable to capture these habitat related (as opposed to stock-species) values.

Moreover, the valuation process provides information not only about the total value of a resource but also about the shape and responsiveness of demand for goods and services related to the resource. This allows for optimal pricing of goods and services such as timber, tourism, and pharmaceuticals. This illustrates the role valuation has to play in *capturing* and *sharing* biodiversity values. For example, valuation allows us to estimate the demand curve for visiting a national park and consequently the price elasticity for entry into the reserve. This information can be used in order to estimate the optimal pricing policy for the reserve that maximises revenues or profits.[12]

Box 4.1. **Optimal park pricing**

In a study conducted by Swanson *et al*. (2001) the demand curve for the further development of eco-tourism in the existing Giant Panda Reserves of South East China was estimated. Based on this estimate, the price elasticity of demand as well as the revenue maximizing level of visitors – subject to carrying capacity of the reserve – were estimated. The study revealed that the entry fee to the current Panda Reserve could be increased by 242% (assuming existing rudimentary facilities) raising the daily price of entry from USD 7 to 24. The total revenues that could be generated from this increase would range between USD 1.6 to 2.1 million per year depending on the carrying capacity of the reserve and the length of the tourism season. The study further demonstrated that there is a "high value" segment of China's tourism market that revealed a strong demand for ecotourism options involving improved accommodation facilities (such as new mountain lodges) and more natural habitat-based panda viewing experiences (in situ "panda safaris"). Total annual revenues generated from the high value segment of the market were estimated to fall between USD 15 and 25 million.

Depending on the carrying capacity assumptions applied, estimated *total appropriable revenues* from the development of managed Panda ecotourism fall within the range of about USD 29 to 42 million per year. It is important to note that the lower bound estimate can be attained with very low levels of development and minimal impact in the core areas of the reserve (*i.e.* with only 30 people a day in the core area of the Reserve for six months a year).

Assuming that local communities receive the royalty currently authorised by the Chinese government of 4%, then local communities could receive between USD 1.2 and 1.7 million per annum. This should be contrasted to the current annual amount allocated to local communities residing in Panda reserves of USD 10 000 (all amounts in 2001 prices). The actual appropriation of even a modest percentage of these estimated values would dramatically alter the plight of the local peoples living near China's panda reserves, and their perception of the importance of the panda. This is the key to reversing the decline of these reserves and of the giant panda itself.

Further, valuation does not simply provide monetary measures of biological resources. Policy-makers can obtain considerable added information from the valuation *exercise* itself, especially when utilising stated preference methods. Policy-makers gain a better understanding of what individuals care about, what their motives are for conservation, and what their reaction would be to alternative instruments and management policies (Pearce, 2001). There are many practical ways in which this information can be utilised for designing market institutions and mechanisms for biodiversity conservation. In order to capture the maximum possible amount of TEV for a biological resource, policy-makers would require a *mixture* of incentive policies. Gaining a deeper understanding of the motives and preferences of various constituencies involved in conservation would aid in the determination of the optimal combination of incentive schemes that would minimise conflicts and maximise the appropriated value (see Swanson and Kontoleon, forthcoming).[13]

Box 4.2. **Valuation, consumer attitudes and market creation**

Non-market valuation can provide detailed information concerning the attitudes and preferences of citizens that can prove usefull for developing successful markets for biodiversity conservation. A valuation study commissioned by the CITES secretariat aimed at assessing the attitudes and preference of the various constituencies involved in reforming this important biodiversity and trade treaty. The central question was what form of markets and trade in products from endangered species could be developed so that the conflicts between the various constituencies involved (general public, conservation lobby groups, tourism sector, hunters and other stakeholders) could be minimised and effective conservation revenues earned maximised. The valuation study undertook a detail assessment of the attitudes, motives and preference of these interest groups focusing on the case of the African Black Rhinoceros. The study concluded that trade in certain goods and services linked to the Black Rhinoceros could be relaxed (*e.g.* horn harvesting) as long as recreational and other Rhino uses that involved grave animal cruelty (*e.g.* sport hunting) were disallowed (see Swanson and Kontoleon, forthcoming). Valuation work such as this is increasingly being used by policy-makers and stakeholders involved in facilitating market creation.

Economic values of biodiversity: facts and figures

There is a substantial empirical literature that has estimated the various categories of total economic value discussed above for nearly all forms of biological resources. The main emphasis has been laid on estimating *direct use* values of biological resources. A considerably smaller literature exists on the valuation of *non-use* and *indirect* values such as ecosystem services. Lastly, there is almost no literature on the valuation of biodiversity *per se* (as opposed to the valuation of *specific* biodiversity *resources*). This void indicates the main challenge for future valuation research.

Direct Consumptive use values

Biodiversity resources are used as inputs for the production and consumption of virtually all private consumptive goods. Most notably these resources include timber products, non-timber forest products, wildlife products, and fish products. Direct consumptive uses of biodiversity can take place either *ex situ* or *in situ* while their associated markets and can have both a local and global scope.

Valuation of direct uses can be readily determined using supply and/or demand side data from trade in private goods. However, obtaining accurate valuation estimates is often hindered by trade distortions while many of these goods in the developing world are traded in subsistence (non commercial) economies.

Direct uses of biodiversity are commonly sited as the primary source of biodiversity degradation. "Over-use" or use beyond "sustainable yields" are leading to extensive habitat conversion and species extinction. Achieving a sustainable level of "biodiversity consumption" is a complex issue due to the essential nature of these uses, institutional issues concerning their management (*e.g.* property rights) and populations pressures. The sub-sections below provide a review of selective direct consumptive biodiversity values. How these values relate to the creation of markets for the conservation of biodiversity resources are also discussed.

Domestic consumptive uses of biodiversity

Rural communities in the developing world make significant use of biological resources to satisfy a wide range of needs – food, housing, fuel, medicines. Much of this value is unaccounted for, as it represents the contribution of natural habitats to the subsistence of these societies. Despite the non-existence of measures of overall usage of biological resources, some indicators can be provided to indicate the extent of reliance.

Fuelwood. Fuelwood is by volume the single most important product that is produced in forests. About 85% of all timber (or 1.86 billion m^3 of wood) is used for fuelwood by being converted to charcoal (FAO, 2001). Approximately, half of this fuel-wood is derived form Asia, 28% from Africa, 10% South America, 8% from North and Central America, and 4% from Europe (Pearce, 2001). Clearly, fuel wood extraction and reliance is vital for the developing world.

Though hardly any fuel-wood is traded internationally, it is estimated that it is worth USD 4 000 per km^2 per year. The significance of this figure can be appreciated when compared to the *combined* value of *all* other non-timber forest products which is estimated to be at most USD 10 000 per km^2 per year (see SCBD, 2001).

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Non-timber forest products (NTFPs). This includes hunting wild animals for meat, clothing tools and medicines, live animals as productive assets, fish products for food, plants for food, tools, shelter, and medicines. These goods are mostly traded locally although international trade does exist in some cases. This makes monetary evaluation of these uses difficult. Further, the *social value* of biological resources consumed domestically can appear to be negligible when incorporated into policy decisions since the size of the population making uses of these resources is often relatively small. For this reason, Pearce (2001) suggests that we consider the value of NTFPs as a percentage of household income when making environmental policy decisions over the importance of these resources for local communities in developing countries. Table 4.1 below presents estimates of the value of NTFPs as a percentage of household income from several sites in the developing world.

The table makes clear that NTFPs are a vital component of the livelihood of rural communities. At the same time, there is ample evidence that extraction of many of these commodities far exceed sustainable yield levels. Whether such extraction levels are socially desirable depends on the how broadly we define the set of affected people. If we incorporate the preferences of people from the developed world that are currently relatively more affluent but also *future* individuals from the *developing* world that will also become relatively more affluent, then current extraction levels of NTFPs do not internalise their full "social" costs. The creation of markets provides one way for addressing this form of market failure. In the short term these markets should provide the vehicle for transferring values from the developed to the developing world. For example, markets that funnel international funds that subsidise the use of alternative means of fuel. Moreover, markets in certified "green" or specialty/differentiated "wild" products can be developed that will provide incentives for sustainable utilisation of the resource base (see Chapter 6). In the long run, as income levels rise and markets improve within developing countries, incentives for changing

Table 4.1. **NTFPs as a percentage of total household income**

Study	Site	NFTPs as a % of household income
Lynam *et al.* (1994)	Zimbabwe	
	Chivi	40-100
	Mangwende	Dec.-47
Houghton and Mendelsohn (1996)	Middle Hills, Nepal	Fodder, fuel, and timber can yield as much net revenue as agriculture
Kramer *et al.* (1996)	Mantandia, Madagascar	47
Bahuguna (2000)	Madhya Pradesh, Orissa and Gujurat, India	49
Cavendish (1999)	Zimbabwe	35

consumption and production patterns such that biodiversity is conserved will be further developed.

Global consumptive uses of biodiversity

International value of timber. "Conventional" (as opposed to "sustainable") logging refers to practices that pay little attention to maintaining long-run timber supply as well as other forest services.[14] The net present value of trade in timber from conventional logging is estimated between USD 30 000 and 440 000 per km^2 per year while that from sustainable logging lies between USD 20 000 and 260 000 per km^2 per year (SCBD, 2001). There is mounting empirical evidence that conventional logging practices tend to be more profitable than sustainable timber management (Pearce *et al.*, 2000; Bowles *et al.,* 1998; Rice *et al.,* 1997). However, there are voices of concern that this disparity in financial profitability reflects the fact that the true social value of forest has not been incorporated into forestry decision-making processes (*e.g.* see Pearce *et al.*, 2003). The value of forest-lands are often derived from its mere timber value. Yet, timber prices (even if determined competitively without distortions) do not reflect the true opportunity cost of these lands (*i.e.* their shadow price) since they do not include the values attached to forests for their *non-timber related services*.

Numerous valuation studies indicate that there maybe significant global values for forests that are not related to the actual use of timber products. These non-timber values (NTVs) are associated with the *means* of forest utilisation. Assessing the magnitude of these non-timber values (NTVs) is vital for exploring the potential for developing markets in *certified timber products*.

The premium that consumers would be willing to pay for timber products that are certified as being derived from sustainable forestry practices reflects a lower bound estimate of true non-timber values. The cost of certification in developing countries has been estimated to range between USD 20 and 170 per km^2 (Crossley *et al.*, 1998). Any willingness-to-pay (WTP) above these amounts would represent a "net premium" for sustainable timber products. Empirical evidence of the magnitude of this premium ranges between 5% and 15% (Pearce *et al.,* 2003). The total premium would be in excess of this bound after adding the actual costs of certification. Whether this premium *per se* is sufficient to induce conventional (non-sustainable) loggers to change their practices is ambiguous (*e.g.* Forsyth *et al.*, 1999; Ozanne and Vlosky, 1997; Cabarle, *et al.*, 1995; Barbier *et al.,* 1994). There is, however, evidence that timber logging firms that branch out to certified timber products benefit more indirectly by a substantial increase in their overall market share as well as their stock price (Pearce *et al.*, 2003).

International trade in non-timber biodiversity products. Non-timber biodiversity products that are traded for *direct consumption* include animal products (*e.g.* ornaments, hides), live animals (*e.g.* exotic birds and reptiles), and

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plant products for foods and herbs.[15] Collecting exact data for the volume and value of international trade in these products is hindered by the illegal nature of many of these transactions.[16] Numerous estimates are reported in the literature using alternative valuation techniques. It is estimated that trade – both legal and illegal – in wildlife and wildlife products (excluding timber and fish harvesting as well as medicinal plant exports) has grown from around USD 3 billion annually in the late 1980s to at least USD 10 billion in 2001. Estimates place illegal trade at USD 5 to 8 billion annually (TRAFFIC, 2000).[17] Translating such figures into per km^2 values is even more cumbersome. SCBD (2001) suggests that the total value of all non-timber biodiversity products ranges between USD 200-10 000 per km^2 per year. The higher values relate to easily accessible lands as well as to habitats that host species that can be traded internationally.

Though habitat destruction and fragmentation remain the most serious threats to biodiversity on a global scale, trade in wildlife and wildlife products also seriously harms many individual species. Despite institutional attempts to curtail the trade in non-timber biodiversity products (*e.g.* CITES) trade in such products remains strong. In fact in many cases trade restrictions have introduced perverse incentives that have accelerated the path towards extinction for several wildlife and plant species (see Bulte *et al.*, 2003). For example, in the international black market a gall bladder from a wild bear (used for medicinal purposes) is estimated to be worth USD 15 000 while a tiger is worth more than USD 5 000.[18]

Two policy implications can be drawn from these demonstrated values for the creation of markets that can reverse these adverse trends. First, as in the case of timber extraction, trade in wildlife and plant products data do not reflect the true social value of the resource from which they are derived. The total social economic value of these resources include non-consumptive uses (*e.g.* tourism, bioprospecting) as well as non-use values (existence value). The magnitude of these values as well as their potential for market creation is discussed below. For example, in Kenya it is estimated that a single elephant generates USD 1 million in tourist revenues throughout its lifetime whereas a single tusk taken from a live animal (*i.e.* not from stockpiles) cannot claim more USD 10 000 to 15 000. Developing markets in sustainable tourism that capture these values and allocate the benefits to those incurring the costs of elephant conservation would appear to be the evident policy prescription. Secondly, even if tastes for certain wildlife and plant products have been altered (*e.g.* the anti-fur campaign in western countries), preferences for numerous of these products still remains strong (demand for exotic bird species, ornaments, animal aphrodisiacs, etc.). Attempts to ban trade in goods that are in high demand generally leads to adverse consequences, and the case of wildlife and plant species has been no exception. For example, the 30 year experience with CITES' attempt to curtail international trade in wildlife species as a means of addressing threats to extinction has not been encouraging. Arguments are increasingly being voiced both within academic and policy circles for the easement of such restrictions and the development of regulated markets in wildlife consumptive products. Examples of such markets that are actually being developed are the sale of stockpiled elephant and rhino horns, sale of harvested rhino horns, sale of ivory and carcasses from the culling of "excess" elephants, recreational shooting safaris, and farming bears for extracting bile from their gall bladder. Two issues need to be noted in developing regulated markets in wildlife consumptive products: *a)* conservation can only be achieved if captured benefits are distributed to the local communities that incur the costs of conservation of stock sizes; *b)* some of the uses that are being traded in such markets would be in conflict with other uses or values expressed by other individuals. For example, individuals with strong non-use values may object to the development of markets that are exceptionally cruel to animals (*e.g.* farming bears for bile or shooting rhinos for sport). In these cases, such markets can be banned but then non-use values need to be captured so that: *i)* local communities receive incentives to curtail illegal poaching activities; *ii)* substitute goods – in the case of wildlife medicinal products – are developed; and *iii)* education and awareness promotion are undertaken in order to influence preferences for such goods. The role of valuation in estimating demand functions for these markets as well as probing into the nature of human preferences and attitudes is evident (see Swanson and Kontoleon, forthcoming).

Direct non-consumptive uses values

Non-consumptive uses of biodiversity are qualitatively different to their consumptive counterparts in that they do not involve direct extraction of biodiversity resources. Because of this they are also referred to as *non-extractive uses*. Non-consumptive uses may or may not involve utilisation of a resource beyond its sustainable yield or carrying capacity levels. For example, sampling plants from tropical forests for the quest of new medicinal compounds (bio-prospecting) entails a very mild ecological impact. The issue here is to assess the magnitude of the informational value contained in each km^2 of a specific forest in order to determine if investment in a particular bio-prospecting market is worthwhile. On the other hand, extensive numbers of nature tourists can undermine the ecological integrity of a recreational site. In this case, valuation has to assess the nature and magnitude of the demand for nature tourism *subject to the carrying capacity constraints* of the visitation site.

Ecotourism

Tourism is amongst the largest industries worldwide generating 7% of all employment, 5% of all income and 8% of all exports. The current value of international tourism exceeds USD 500 billion (WTO, 2004). Despite recent

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travel impediments (recession, fear of terrorism, SARS, etc.) the industry is expected to grow with a rate in excess of 7% till 2020.

Ecotourism, or nature tourism, is just one component of the tourism industry. At the global level it is estimated that between 4 and 35% of total tourism revenues are derived from "nature tourism". The huge disparity in these figures has to do with difficulties in assessing the size of the ecotourism industry. Defining the extent of the ecotourism industry is hindered by the lack of agreement on the definition and meaning of ecotourism (see for example Fennell, 1999; France, 1997; Lindberg, 1991, for different views). A source of confusion in this discussion over the delineation of ecotourism is that it seeks to find a single, all encompassing definition of the industry. Yet, ecotourism consists of a heterogeneous industry containing several different niche markets. The common thread across these sub-markets or segments is that they consist of "responsible travel to natural areas which conserves the environment and sustains the well-being of local people" (TIES, 2004). Irrespective of its exact share of the total tourism market, ecotourism is expected to outpace the general growth of "mass" tourism. Estimates place this growth rate between 10 and 25% over the next decade (WTO, 2004).

Going back to Figure 2.1, ecotourism services are highly excludable, rival and local in nature. The private good nature of ecotourism implies that property rights over the biodiversity resource base used as inputs for the production of the ecotourism "good" must be appropriately delineated if the market is to provide incentives for conserving biodiversity. For example, in Namibia the benefits from wildlife tourism have been substantially increased by giving local landowners the rights to the wildlife existing within their lands. This has led to further increases in the level of wildlife stocks (Krug, 2001).

There is an immense literature demonstrating the recreational value of biodiversity both the developed and developing world (*e.g.* SCBD, 2001). The recreational value (or consumer surplus) of visiting a forest in Europe and North America is estimated to range between USD 1-3 per visit. Aggregating these sums would yield significant values. For example, in Germany alone forest recreation values are estimated to be worth USD 2.4 billion per annum for casual and holiday users (Elsasser, 1999). The impact of ecotourism on local economies is even more acute in developing countries. For example, in Costa Rica and Kenya nature-based tourism contributes approximately one third of total foreign investment. To put this into perspective for the case of Kenya, ecotourism generates revenues equivalent to those derived from its main export crops, coffee and tea (Krug, 2001).

Efforts at market creation that lead to conservation through ecotourism have not been even across the developing world. For example in Africa we observe a disparity of impacts between the south and the north of the continent. In South Africa roughly 18% of habitat has been converted to tourism related parks. This development has provided not only with a more profitable use of large areas of land than conventional agriculture, but has also offered a more *stable* source of income. This has been an important element in the success of nature tourism in the African south. The northern African states have witnessed neither the same level of conservation impact nor the level of incomes observed in the south. This is partly due to the fact that northern states have on average less productive ecosystems, less infrastructure, and less political stability (Heal, 2000). Further, institutional reasons related to property rights structures are keeping the African north from exploiting the conservation and monetary benefits of ecotourism development. More specifically, the link between conservation and benefit sharing is much weaker in the North since a large proportion of ecotourism revenues are either channelled to the government or to the community as a whole (*e.g.* in the form of infrastructure). This form of benefit sharing does not provide sufficient incentives to individual landowners who perceive the benefits from ecotourism as essentially communal while those from other unsustainable activities (namely conventional agriculture) as accruing directly to themselves (Freese, 1999).

Box 4.3. **The South African Conservation Cooperation**

The Conservation Cooperation or ConsCrop originated as a private venture focusing on nature based tourism in South Africa in the late 1980s. The company established contracts with local farmers and ranchers to incorporate their land in the ConsCrop operation offering a per km^2 fee. Land owners are obligated to stock their land with endemic flora and fauna. Even non-endemic domestic animals such as dogs and sheep had to be removed. ConsCrop manages all aspects of the actual ecotourism business including building and maintaining infrastructure (*e.g.* buildings and roads), providing meals, offering tours etc. The annual per km^2 fee offered to participating farmers for restoring their lands to their initial ecological state ranges between USD 20 000 and 30 000. Comparison of these amounts with the annual yield of USD 25 000 per km^2 through ranching and USD 7 000 per km^2 through farming explains why the ConsCrop corporation has contributed to the restoration and conservation of several thousand km^2 of habitat.

Source: Heal (2000).

Beyond direct revenues from ecotourism in the form of hotel receipts, hiking tours, safaris etc. nature based tourism has a significant indirect impact on conservation by enhancing public awareness of the socio-economic

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reasons for biodiversity degradation. Several stated preference valuations studies have revealed that ecotourism holidays have provided a valuable educational experience to visitors on the importance of enhancing the well-being of the local people that preserve the biodiversity resource base associated with their recreational experience.[19] These survey-based studies suggest the "awareness enhancing" effect of ecotourism has a positive impact on visitor propensity to contribute (*e.g.* through donations) to conservation programmes. The exact influence of such a "trickle down" effect on conservation donations has still to be assessed using actual donation data.

Various issues related to the link between ecotourism and valuation must be addressed:

- First the extent of the ecotourism market (as well as its growth rate) must be more accurately estimated. This is a crucial piece of information in aiding decisions over the optimal amount of ecotourism investment that a society should incur. Accurately assessing the extent of the ecotourism market requires a far more discriminating statistical base than is currently available in the national-level figures given to the Word Tourism Organisation (WTO). While some activities can clearly be classified as ecotourism, much tourism defies such disaggregation. An additional problem in specifying the value of ecotourism is determining which receipts should be allocated to which type of tourism. The bulk of the receipts for tourist expenditures do not occur at tourist sites such as parks, museums and cultural festivals, but at hotels, restaurants and for travel costs. (Swanson and Fernandez, 1996).
- Secondly the nature (and not merely the extent) of the tourism market needs to be assessed. This includes an assessment of price elasticise of demand as well as other determinants of seasonality and market fluctuations that affect that industry. For example, based on valuation research on the nature of ecotourism demand in Kenya, park entry fees were raised by a factor of ten in the late 1990s and overall park revenues increased.
- Such analyses of ecotourism demand should acknowledge that ecotourism itself is characterised by sub-segments and niche markets. That is, analysis of the nature of the market should be undertaken at a disaggregated level (primarily at the market segment level) in order to account for the heterogeneity amongst consumers and suppliers. This analysis is absolutely fundamental for undertaking investment decisions that secure a stable stream of income to local communities. Only then will ecotourism provide a sustainable conservation policy option. Valuation has an important role to play in this analysis.

- Thirdly the link between ecotourism development and the preservation of diversity *per se* needs to be addressed. In many cases this link is clear. For example, in many resorts wildlife viewing is more attractive the more species there are to view. Also, in cases where the main recreational attraction is associated with animals high up in the food chain (*e.g.* lions) there are incentives for preserving the rest of the food chain as well (Heal, 2000). Yet, in many cases we observe that conservation that is linked to ecotourism often focuses on protecting habitats with low diversity value. For example, ecotourism related to exotic rare species or charismatic mega-fauna (such as mountain gorillas, Rhinos and Pandas) often contributes to the conservation of habitat with low levels of biological diversity (Swanson *et al.*, 2001; Kontoleon and Swanson, 2003). Information from valuation studies contributes towards developing ecotourism markets that focus on conserving biodiversity-rich habitats.
- Fourth, the carrying capacity levels of tourism needs to be incorporated into the design of ecotourism markets. This is related to the issue of optimal pricing of tourism (*i.e.* maximizing revenues subject to carrying capacity constraints). Accounting for the carrying capacity constraints is a crucial for the sustainability and of ecotourism investments. An instructive example of the importance of incorporating carrying capacity constraints into ecotourism development is drawn from the two main coral reef tourists resorts on the costs of the Red Sea. The resort that was more heavily regulated for density of hotels, numbers of divers and deposits of waste actually engendered far greater benefits for the local population in the long run (see Box 4.4). Valuation is vital in assessing ecotourism demand curves required to determine optimal pricing subject to carrying capacity constraints (see Swanson *et al.*, 2001).
- Finally, the issue of "benefit-drain" must be addressed: ecotourism values are often not distributed to the local communities affected by the industry but are channelled to stakeholders that have little association with the resource base (*e.g.* tour operating companies). Valuation is important for designing incentive compatible benefit sharing schemes.

Genetic information values

Another component of value of biodiversity that is most linked to its diversity is its informational value. Biodiversity is useful to important human industries because of the manner in which the existing set of life forms have been selected (within a living, contested system similar to our own), which provides us with an already-vetted library of successful strategies. The same forces which are at work against the human domain are also operating against all other extant life forms. Any organism which persists must do so because it

Box 4.4. **Carrying capacity constraints and sustainable ecotourism**

The importance of incorporating carrying capacity constraints into ecotourism development is illustrated from two tourist resorts using the same coral reef base in Red Sea. The first, Hurghada, has made use of its coral reef resource in an unrestricted fashion, where the government has allowed unmanaged development of the shores along the reef. The second, Sharm, has made use of its coral reef in a managed fashion, where the government has restricted development density along the reef (tourism and fishing) and implemented a monitoring program for compliance. The contrasting results have been dramatic. In Hurghada, development density is nearly three times greater and the reef suffers from over-exploitation (three times as many visitors and twice as many boats), reckless exploitation (unnecessary damage from construction of hotels and unmanaged tours) and pollution (poor visibility). In Sharm, the restricted number of operators has rendered it possible for them to recognize their interdependence in their joint use of the reef, and thus they have invested in its conservation. The hoteliers in Sharm provide more mooring sites and diver briefings to spread repercussions and reduce unnecessary damage. They have also invested in sewage controls and visibility is ten to twenty times greater than at Hurghada. Importantly, all of these investments earn a return. Hoteliers at Sharm are able to charge a fee double that applicable at Hurghada. It is this price differential between the controlled and the uncontrolled resource use that is the *rent* flowing from the resource. It is only through governmental restriction of use of the resource (and monitoring to ensure compliance with the restriction) that rents are created, and hence incentives to invest in the reef are induced.

Source: Swanson *et al.* (2001).

has evolved successful strategies which are successful in a contested environment, *i.e.* resistance. It is for the retention of these already successful strategies that human societies require biodiversity as an input into so called bio-industries. It is their informational content and its usefulness within the R&D process that is the primary value of biodiversity within these industries. There are two industries, agriculture and pharmaceuticals, where the object of the industrial R&D process is most closely linked to the biological-societal interface. (Swanson, 1997; Swanson and Fernandez, 1996; Swanson and Luxmoore, 1996; Swanson *et al.*, 1994). The extent to which development of markets in genetic information can provide incentives for biodiversity depends on the (per km^2) magnitude of these informational values. Valuation thus has a crucial role to play in determining the conservation potential of bio-industries.

Agriculture and genetic information values. A survey of plant breeding companies reported in Swanson (1997) revealed that plant breed co-operations heavily rely on wild species and landraces as sources of germplasm. Assessing the genetic information value for the agricultural industry is the subject of a rapidly increasing literature (see Pearce, 2001). A first method of valuation is to examine what plant breeding companies are willing to pay to conserve the wild sources of germplasm. A minimum bound of this WTP would be given by the magnitude of their R&D budgets allocated for discovering such resources. Alternative approaches would be to estimate the value of lost crop output that would emerge as the result of this material ceasing to exist, and another approach would be to assess the cost of developing alternative (*ex situ*) sources of germplasm. For example, a study assessing the value of landraces for rice breeding in India estimated that rice landraces acquired from India contributed 5.6%, or USD 75 million, to India's rice yields. Assuming that landraces have a uniform impact on rice yields in all other countries where rice is cultivated, the global value added to rice yields by use of landraces amounts to USD 400 million per year (Dutfield, 2000).[20] Similar studies corroborate such findings for the value of landraces associated with other crops (*e.g.* Swanson and Luxmoore, 1996; Brush, 1996).[21]

The source of this demonstrated value for the information contained in wild seed varieties or landraces rests in seed companies, the majority of which are located in the developed world. However, it is the developing world which hosts biodiversity rich lands. Despite the apparent potential for developing markets for capturing the informational value of landraces, there are several impediments that have deterred trade between the biodiversity-rich south and seed companies in the north. Dutfield (2000) identifies several reasons that undermine the bargaining position and benefit-sharing possibilities of biodiversity-rich developing countries:

- Apportioning the benefits from trade may be unfeasible. New crop varieties are often the result of selection and breeding by farmers in many parts of the world which implies that many countries and/or communities may claim intellectual property rights.
- A great deal of germplasm is held in ex situ collections in universities, botanic gardens and in the CGIAR banks. The germplasm in these collections has been carefully selected, is well classified and documented, and – under the provisions of the CBD – is freely available.
- Many large crop-breeding companies find using wild plant varieties cost inefficient (*e.g.* since it may be more difficult to adapt to specific conditions). As a result many companies tend to use varieties held in their own collections and those bred in public institutions. Advances in genetic engineering are expected to further reduce dependency on exotic and wild

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plant germplasm. Yet there are important exceptions to this tendency. For example, wild landraces are used when particular traits are sought, new breeding programmes are being started, and also in the breeding of certain crops (*e.g.* potatoes).

- Developing countries lack the scientific and technological capacity to develop local breeding enterprises that can capture the benefits from agro-biodiversity. This highlights the importance of scientific and technological capacity building for developing countries (see Chapter 5).
- Temperate countries are relatively well endowed in genetic diversity for specific important crops that have been cultivated in that part of the world for centuries. Hence, even tropical-developing countries are not self sufficient with respect crop germplasm. Hence, on balance a strong regulating regime controlling access to crop germplasm may in fact disproportionately harm developing countries.

The above reasons partly explain why only approximately 2.5% of germplasm used in the development of new crop varieties comes from landraces that are maintained in situ (Swanson and Luxmoore, 1996). Yet, this does not nullify the potential for developing markets that provide incentives for preserving in situ crop varieties. The stock of existing commercial varieties is the information base from which bio-industries develop new crop varieties that are resilient to evolving diseases and pests. Yet, it is wild species that remains the source of new diversity that is required to replenish and restock this information base. The exact magnitude of this "replenishing" property of biodiversity has yet to be assessed. Yet, the crucial and irreplaceable role it plays in securing long-run food supply suggests that is must be significant. Developing market instruments that will induce *in situ* conservation of genetic resources is an ongoing research agenda of major international organisations including FAO, IFPRI and IPGRI. Research has focussed on three aspects: *a)* development of an appropriate intellectual property system similar to that regulating, breeders' rights in the US and Europe; *b)* create a system of contracts between farmers and the users of crop genetic resources; and *c)* further technical and scientific capacity building between developing and developed countries (Brush, 1996).

Pharmaceuticals

There is a considerable empirical literature assessing the value of biodiversity as a source of new pharmaceutical products. Partly, this literature has been spawned from the observation that pharmaceutical companies have billion dollar sales of drugs derived from natural materials. It was thus realised that the value of these materials must also be significant. The value that biodiversity has as a source of new pharmaceuticals depends on the level of WTP that "bioprospectors" would be willing to offer to purchase a unit of habitat. The potential "price" determined in such bioprospecting markets depends on various demand and supply conditions (see Pearce, 2004):

- Current technological developments can sway things either way: on the one hand the use of synthetic and combinatorial chemistry as well as biotechnology using human genes may reduce reliance on natural organisms. On the other hand, advances in genetics may bring about the opposite effect.
- Technological change is increasing the ability to exploit further existing collections of seeds, reducing the need for access to new genetic resources.
- Search processes are becoming very selective, favouring particular areas with known prior information, and thus reducing the demand for access to new areas as a whole.
- Paralleling the demand for organic foods, there is a growing demand for "natural" products that require direct access to genetic material.
- Legal and institutional difficulties in securing access may well deter bioprospectors. This partly reflects the limited institutional structure in many host countries, bureaucracy and even corruption.
- The supply of genetic material is vast. At best, bioprospectors can be expected to "demand" only a tiny fraction of what is available, so that most natural areas will be very unlikely to benefit from bioprospecting.
- International patent law still discriminates against worldwide protection for natural materials.

A series of valuation studies emerged from the 1980s examining the potential demand of bio-prospecting. This multitude of valuation studies generated a rather polarised picture, with some studies finding very high and others very low bioprospecting values. Pearce *et al.* (1999) and Pearce (2001, 2004) review and assess this conflicting literature. Amongst the most reliable of these studies are those by Simpson *et al.* (1996) and Rausser and Small (2000). Both of these studies avoided the mistakes committed earlier that estimate either *average* values, or attribute *total* drug value to the genetic resource. Instead those studies correctly try to estimate the value of the contribution that the *marginal* species makes to the development of new pharmaceutical products.

The resulting figures from this work for WTP per hectare across a series of regions are shown in Table 4.2. Looking first at the results by study by Simpson *et al.* (1996) it appears that even the largest figure of USD 20 per hectare would not (in many cases) be sufficient to cover the opportunity cost of land conversion. Pearce (2004) highlights reasons for these low values as being *a)* that biodiversity is abundant, and hence one extra species has low economic value; *b)* that there is extensive "redundancy" in that, once a discovery is made, finding the compound again has no value. Each additional "lead" is likely to be non-useful or, if useful, redundant.

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Table 4.2. **Estimates of the pharmaceutical value of "hot spot" land areas (max WTP USD per hectare*)**

Area	Simpson *et al.* (1996) WTP of pharmaceutical companies per ha	Simpson and Craft (1996) "Social value" of genetic material per ha	Rausser and Small (2000) WTP of pharmaceutical companies per ha
	(1)	(2)	(3)
Western Ecuador	20.6	2 888	9 177
Southwestern Sri Lanka	16.8	2 357	7 463
New Caledonia	12.4	1 739	5 473
Madagascar	6.9	961	2 961
Western Ghats of India	4.8	668	2 026
Philippines	4.7	652	1 973
Atlantic Coast Brazil	4.4	619	1 867
Uplands of western Amazonia	2.6	363	1 043
Tanzania	2.1	290	811
Cape Floristic Province, S. Africa	1.7	233	632
Peninsular Malaysia	1.5	206	539
Southwestern Australia	1.2	171	435
Ivory Coast	1.1	160	394
Northern Borneo	1	138	332
Eastern Himalayas	1	137	332
Colombian Choco	0.8	106	231
Central Chile	0.7	104	231
California Floristic Province	0.2	29	0

* 1 hectare = 0.01 km^2.

Source: Simpson *et al.* (1996); Simpson and Craft (1996); Rausser and Small (2000). Reproduced from Pearce (2004).

Simpson and Craft (1996) revised these figures by relaxing the assumption that there is perfect substitutability between species. The results of these revised calculations are presented in column 3. Pearce (2004) notes that the revised estimates relate to "social surplus", *i.e.* the sum of profits and consumer surplus, and this is higher than the original estimate of the marginal value of a species. On the basis of these higher estimates, the authors conclude that "modest incentives might be sufficient to motivate conservation in some areas" (Simpson and Craft, 1996, p. 4). Hence the overall conclusion we reach from the Simpson *et al.* (1996) work is that *private* prospecting values are very small, whilst *social* values may or may not be significantly different.

Rausser and Small (2000) have challenged these findings, providing considerably more optimistic estimates (see column 2). Simpson *et al.* (1996) estimates assume pharmaceutical companies' search programme consist of randomly selecting from large numbers of samples with each sample having same probability of success. Instead in the Rausser and Small (2000) calculations assume that samples are selected on a structured basis according to various "clues" about their likely productivity. Clues are obtained from experience, knowledge of particular attributes, and even indigenous use of existing materials. Rausser and Small (2000) conclude that "the values associated with the highest quality sites – on the order of USD 9 000/hectare in our simulation – can be large enough to motivate conservation activities".

What does this literature tell us about promoting market creation in bioprospecting? Pearce (2001) comments that if *private* prospecting values are high, as Rausser-Small would suggest, then there appears to be no role for social policy, *i.e.* there is no need for a policy instrument to encourage prospecting. Still, policy might be focused on ensuring that prospectors pay what they are alleged to be willing to pay, rather than treating genetic material as a de facto open access resources. If private values are small, as suggested by Simpson *et al.* (1996), then we would not expect to see significant prospecting activity, nor would there be a rationale for encouraging it since the values to be captured would be small.

A stronger case for pro-active policies emerges when the social and private values diverge significantly. Such a divergence may be significant given the various spill-over/public good benefits that derive from the discovery of new drugs – if a life-saving drug costs USD 100, then clearly the value of that drug is much greater than its cost at the pharmacy. Still, adequate measures of the magnitude of the social values of pharmaceuticals are still not known. Perhaps the best that can be said is that the early, largely unqualified optimism for bioprospecting, cannot be sustained, at least until the assumptions regarding models and parameter values are better developed (Pearce, 2004).

Amenity values

Biodiversity resources provide a further direct source of non-consumptive values from the aesthetic and "quality of life" attributes they contain. Markets demonstrating and capturing such amenity values are well established in the form of real estate markets. Using data on prices and other property characteristics hedonic analysis techniques have been used to isolate the amenity value attached to dwellings that are in close proximity to an environmental site such as a forest. For example, a study by Tyrväinen and Miettinen (2000) found that Finland house prices with a view to a forest were 4.9% higher compared to prices for otherwise similar houses. House prices dropped by a further 6% when they were located one kilometre away from a forest. Similarly, Powe *et al.* (1997) found that in England re-planting one hectare of forest-land within 100 meters of a dwelling raises its price by an average of GBP 540. Such figures provide a lower bound estimate to the

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amenity value of an environmental site since they do not include the aesthetic values received by people passing by or visiting the site. This aesthetic value is a form of public good and has been assessed by contingent valuation and travel costs studies (*e.g.* Tyrvainen and Hannu, 1998; Lockwood and Tracy, 1995). Capturing these demonstrated amenity values provides local governments with the means (and incentives) to restore and maintain environmental sites. Market oriented means of appropriation include property taxes levied on the housing markets and levies on commercial enterprises that benefit from the existence of the environmental site.

Ecosystem functions and the indirect use value of biodiversity

The value of the ecosystem extends well beyond their role as habitat for particular species or as source of recreation but is also derived from a series of functions that are necessary for the preservation and maintenance of ecological and economic systems. Barbier *et al.* (1994) identifies four such ecosystem functions: *a)* regulatory functions that regulate climate, water and waste flows, and nutrients; *b)* production functions are associated with the beneficial outputs of ecosystems such as water and fuel; *c)* Carrier functions refer to the support functions underpinning industries such as recreation, fishing, agriculture; *d)* information functions relate to aesthetic, cultural, and scientific benefits.

Attempts to estimate the value of such indirect services has mostly relied on a few identified "production functions", however, the existing data is patchy in this respect. The public good nature of these services has motivated the use of contingent valuation methods. Moreover, the multidimensional character of ecosystem services has prompted the use of choice experiment approaches that are able to capture and assess the relative importance of different services stemming from the same resource. Two widely studied indirect use values are watershed services and carbon sequestration.

Watershed service values

Watershed protection functions include a series of services obtained from forest and grassland ecosystems. They include soil conservation (siltation and sedimentation control), water flow regulation, water supply, and nutrient outflow. Some findings from recent watershed valuation studies are summaried in Table 4.3 below. Though per hectare unit values may appear to be small, we should keep in mind that watershed services influence a very large catchment area and hence aggregate values could be very large (Pearce, 2001).

There are numerous examples of market institutions that attempt to internalise the values associated with watershed services. Pagiola (2002), Kerr (2002), Salzman and Ruhl (2002), and Echavarria (2002) provide detailed assessments of the success of different forms of markets instruments from

Table 4.3. **Valuation of watershed functions**

Author(s) and Study site	Type of watershed protection Function	Results.
Ammour *et al.* (2000). Guatemala forest	Prevention of soil erosion. Valued at cost of soil replacement and at costs of preventing soil loss. Prevention of nutrient loss. Valued at fertiliser prices.	Negligible. USD 12 ha/annum (hectare* per annum) out of USD 30 ha/annum for all NTFPs and environmental services.
Kumari (1996). Malaysian forest	Protection of irrigation water, valued at productivity of water in crops. Protection of domestic water supplies. Valued at treatment cost for improved quality.	USD 15/ha. USD 0/ha.
Ruitenbeek (1989). Korup, Cameroun	Flood protection only.	USD 3/ha.
Yaron (2001). Mt Cameroun,Cameroun	Flood protection, valued at value of avoidable crop and tree losses	USD 0-24/ha.
Bann (1998b). Turkey	Soil erosion valued by replacement. Cost of nutrients, flood damage.	USD 46/ha.
Adger *et al.* (1995) Mexico	Sedimentation effects on Infrastructure.	Negligible.

* 1 hectare = 0.01 km^2.

Source: Adapted from Pearce (2001).

cases studies in both the developed and developing world. Common issues related to capturing watershed service values via market instruments include identifying and quantifying water services, identifying key watershed services beneficiaries and means for charging for such services, developing sustainable (long-term) payment mechanisms, and addressing political economy and perverse incentive issues (Pagiola, 2002).

Pagiola (2002) details the experience with watershed conservation markets in Costa Rica that were established in late 1990s. The markets consist of a forum of exchange between the beneficiaries of watershed services and their providers, mainly farmers. The latter receive compensation together with enhanced tenure security rights for reconverting and maintaining forestlands for the purpose of providing watershed protection. The funds for the scheme are provided from an earmarked fossil fuel tax, from direct payments from beneficiaries (such as hydro-electric power plants and other water users) and from international grants reflecting the global nature of the services provided (*e.g.* a USD 8 million grant from the Global Environmental Facility and a USD 32.6 million loan from the World Bank). The current annual payment stream amounts to approx USD 0.6 million covering an area of

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Box 4.5. Capturing watershed services via wetland mitigation banking

Conserving vast areas of space for the provision of wetland functions is often met with great public dismay since the opportunity costs are often high and benefits are indirect. This is the case in many wetlands in developed countries that have significant opportunity costs (such as those in coastal and urban regions). As a response to mitigating public resistance to conventional conservation approaches, so called wetland mitigation banking schemes have been developed. The scheme consists a form of habitat trading programme and has been in use for over a decade in the US. It involves public and/or commercial entities creating or restoring a set of wetlands, that make-up a "wetland bank". Private developers must then purchase wetland "credits" from these banks in order to offset the damage they will cause to another comparable wetland. Purchase of such credits is a precondition for being granted their development permit. Hence, the logic behind such a market based instrument aims at ensuring wetland provision whilst minimising both economic and political cost. The scheme has flourished since its inception in the mid-1980s with over 70 commercial mitigation banks currently in operation in the US. Between 1993 and 2000 95 km^2 of wetlands were developed in exchange for 165 km^2 restored in mitigation form. Cost of credits range between USD 1.8 million per km^2 up to USD 24.7 million per km^2 epending on the opportunity costs of the resorted wetlands.

Despite the promise this scheme has shown, serious constraints have not allowed for the realisation of full gains from trade in wetland credits. More specifically, methods of assessing that equivalent types of wetlands are traded tend to be very crude, relying on basic metrics such as size (hectares) and habitat function. In their attempt to reduce the dire consequences from (highly probable) "unbalanced" wetland exchanges, regulators have instituted a series of constrains limiting free trade of wetland credits. This highlights the need for deriving an accurate and cost effective system of assessing wetland quality and type.

Source: Salzman and Ruhl (2002).

24 000 hectares. Though these figures are not negligible, they are considerably less than what Costa Rica annually receives from GEF payments for biodiversity conservation (USD 1.8-1.9 per year for million for five years) or payments for carbon sequestration services (USD 2 million between 1997-2002) (Pagiola, 2002). The general system of payments for other forms of

environmental services in Costa Rica has proven to be quite successful in terms of its conservation impact and its cost-effectiveness (with over 200 000 ha of reconverted forest in a span of about five years at a cost of about USD 50 million). Given the significant demonstrated values of watershed protection there is room for an increase in the volume of total payments and hectares covered for providing these types of services. Issues that need to be addressed include clarifying the link between forest cover and water services and the development of a targeted (as opposed to uniform) system of payments.

Carbon sequestration values

The importance of tropical forests in decelerating global warming has been given official recognition in the provisions of the 1997 Kyoto protocol that promote the creation of carbon storage markets. A recent survey of sustainable forest practices from 40 developing countries has shown that tropical forests can sequester between 5 and 40 tons of carbon per hectare per year depending on the altitude of the forest-land (see Dixon, 1997).

Recent reviews by Clarkson (2000) and Tol *et al.* (2000) suggest that the value of carbon sequestration in terms of prevented damages lies between USD 34 and 50. Yet, Pearce (2001) arques that in practical terms a better guide to the value of carbon can be found in the price paid for a ton of carbon (tC) in "carbon markets". Several hundred of such "carbon offset" markets have been under development since the late 1980s mostly on a voluntary basis and with no relation to global warming legislation. It is estimated that under a regime of unrestricted international trade, carbon credits will be able to command a price of about USD 10 per tC (Zhang, 2000). Using this more conservative estimate of the value of carbon storage Pearce (2001) estimates that closed primary and secondary forests that are *a)* under threat of conversion and *b)* capable of being the subject of deforestation avoidance agreements are worth up to USD 2000. Carbon markets are expected to develop further as trading parties gain more experience with such transactions and with eventual ratification of some form of global warming protocol that will include provisions for flexibility "implementation mechanisms".

Non-use biodiversity values

Results from several valuation studies suggest that non-use values (NUVs) may be the largest category of total economic value of biological resources. The implication of this finding is that conservation policies must focus on those measures that are able to capture these particular values (*e.g.* OECD, 2001;[22] Alexander, 2000). Obviously the validity of this reasoning lies on the accuracy of non-use value estimates. The pure public good nature of these values implies that accurate demand revelation is problematic. Since the very definition of non-use values is that they are values that "leave no behavioural trail" (Freeman, 1993), they cannot be econometrically identified using data for the demand of any environment-related good or service. This leaves researchers stated preference techniques as the only readily available method for assessing non-use values. Yet, stated preference estimates of NUVs leave considerable room for debate over the true magnitude of non-use values. For example estimates of global annual non-use values for tropical forests range from several hundred billions of dollars (*e.g.* Kramer and Mercer, 1997) to only a few billion (*e.g.* Pearce, 1996).

Disagreements over the level of non-use values mainly concern conceptual issues (*i.e.* what exactly are we measuring? Are these really economic values?), methodological issues (are valuation methods valid?), and aggregation issues (whose preferences over non-use benefits do we count?) (See Kontoleon *et al.,* 2002 for a review). Another thorny issues concerns the fact that non-use values are often found to be associated with certain charismatic species and not with diversity *per se* (Kontoleon and Swanson, 2003; Loomis and White, 1996). The link between appropriating non-use values and conservation of biodiversity has to be clarified.

Despite these problems the conservation potential from appropriating these values is considerable. Market based (as opposed to coercive) instruments for capturing values include donations to environmental organisations (*e.g.* WFF), debt-for-nature swaps, and international transfers (*e.g.* Global Environmental Facility).

Conclusion – assessment

- There is unequivocal evidence of the value of direct (consumptive and non-consumptive) use values related to forests, wildlife and marine resources is very large. Instituting markets for the sustainable extraction or provision of such goods and services is vital.
- There is scant evidence on the value of indirect ecosystem values. Existing attempts to estimate the value of indirect services have relied on a few identified "production functions". Amongst the most well documented values are those for forests as carbon depositories. It is estimated that these values may equal or even surpass those of commercial logging (SCBD, 2001).
- There is mounting evidence that there is an immense global public-good benefit for protecting biodiversity for its non-use values. Based on the current literature it would appear that creating markets for appropriating non-use values should constitute a priority for conservation policies. It is thus imperative that mechanisms such as resource transfers under conventional aid, transfers under the GEF, debt-for-nature swaps, etc. are strengthened and added to (see Pearce and Moran, 1996).

- The economic value of diversity as a store of genetic information for agriculture is well documented. This literature suggests that there is substantial value for conserving genetic diversity at the plantation level in order to provide two important benefits: *a)* plant improvements and derived yield increases; *b)* natural insurance against yield variability of homogenized systems. (See Swanson and Fernandez, 1996; Pearce and Moran, 1994.) Conserving genetic information valuable for agriculture requires instituting inventive mechanisms for the adoption of *in situ* agricultural practices.
- On the other hand the literature on the economic value of biodiversity as an input to the pharmaceutical industry is less clear with considerable disagreement on the magnitude of these values (see Simpson, 1997; Swanson and Luxmoore, 1996; Swanson and Fernandez, 1996). At the moment it appears that the value of natural ecosystems as store of pharmaceutical information is not sufficient to overcome the opportunity cost of conservation.
- It is not certain that valuation estimates that focus on individual ecosystem services or a particular species or biological resource also represent the value of biodiversity per se. While these preference based values for such services or resources may be attributed to diversity, we cannot be sure (see OECD, 2001). The link between estimates of value for biological resources and the value of diversity needs to be further clarified.

The review of economic values leads to the following implications:

- In many cases the valuation data seems to suggest that biodiversity values are insufficient to cover the opportunity cost of conservation.
- Yet, it is argued that this inference is invalid since various factors are distorting the true magnitude of biodiversity values. For example, the rate of return of non-sustainable land uses if often augmented due to perverse subsidies, distorted property rights etc. These distortions downplay the magnitude of biodiversity values providing disincentives for investment in conservation.
- Despite these distortions in estimates of biodiversity values, this survey clearly suggests that investment in conservation does pay off. In the next chapter we explore illustrations of how these values can be captured by means of creating markets in biodiversity related goods and services.

Notes

1. The economic conception of value as the relative trade-off between assets is anthropocentric in nature. One can conceive of non-anthropocentric forms of value such as pure intrinsic values that imply that a resource has value *in and of* itself. Yet,

such values are operationally meaningless and provide no input for making allocative decisions or for creating incentive mechanisms (see Pearce, 2000).

2. See in particular Chapter 2 by Pearce and Chapter 3 by Dixon and Pagiola. More detailed reviews of these issues can be found in Bateman *et al.* (2002), Haab and McConnell (2002), and Bateman and Willis (1999).

3. Disagreements over the location and definition of subcategories of values persist. See Turner 1999, Carson 1999 and Foster (1996) reviews of these debates. Disagreements involve how to define and classify option values as well as what are the sub-categories of non-use values. These conceptual disagreements are not merely of academic concern. Reaching theoretically consistent definitions of categories of value is a fundamental prerequisite for the process of measurement, appropriation and benefit sharing.

4. See OECD (2001) for a discussion of approaches for valuing ecological services. It is argued that even in cases when monetary measures of these values may be difficult to obtain, policy-makers can use approaches that at least attempt to manifest the trade-offs inherent in biodiversity conservation decisions (*e.g.* conjoint analysis).

5. See Freeman (1993) for a thorough discussion of the restrictive behavioural assumptions implied in revealed preference methods. Also, revealed preference valuation methods are inadequate when we wish to assess environmental quantity/quality changes outside the observed range of changes.

6. Three such techniques have been widely used: "changes-in-productivity" approaches where impacts on environmental quality are reflected in the changes in the productivity of the systems involved and these, in turn, are used to assign values. The physical changes in productivity (*e.g.* crop yield) are valued using market prices for inputs and outputs. "*Loss of earnings*" approaches measure the impacts on environmental quality from changes in human productivity. The value of lost earnings and of medical costs created from the degradation in the quality of some environmental resource (*e.g.* water poisoning) is used under such approaches as a proxy for environmental value. "*Opportunity cost*" approaches are based, as the term suggests, on the concept of opportunity costs: the value of using an environmental resource for a particular purpose is approximated with the value in forgone income from alternative uses of that resource. [see Dixon *et al.* (1988) and Freeman (1979) for a detailed exposition of such approaches].

7. This set includes "*cost-effectiveness*" analysis where a predetermined goal or objective regarding the quality of an environmental asset is set and then the most cost effective means of achieving it are chosen and "*preventive or mitigation expenditure*" approaches where the value of an environmental recourse is approximated by the cost of the preventive measures that people are willing to pay to avoid any damage to it or from the cost savings obtained from a reduction in maintenance cycles due to reduced damage rates.

8. Consumer surplus is the difference between what someone pays for a good or service and the maximum they were willing to pay.

9. See Kontoleon *et al.* (2003) for a more detailed discussion of non-market valuation and pricing techniques.

10. See Swanson *et al.* (2001) for a further discussion of the importance of benefit sharing in the implementation of appropriation mechanisms.

11. Such decomposition can be directly achieved using the contingent valuation methods or indirectly using choice experiments.

12. See Swanson *et al.* (2001) for an application of how valuation was used to determine the optimal pricing policy for China's Panda reserves.

13. The OECD has emphasises this point in the Recommendation on the use of economic instruments for biodiversity conservation, where it states that: "Markets will also need to be monitored and even guided to ensure they result in net benefits for society as a whole. For example, trading in (illegal) products from endangered species highlights the potential adverse consequences of markets that do not take account of public values and externalities".

14. There is considerable definition hair-splitting on the various types of conventional and sustainable forest management practices. See Pearce, 2001 for a discussion.

15. Non consumptive non-timber related values as well as values for forest systemic functions (*i.e.* indirect use values) are discussed below.

16. For example, the CITES convention limits and regulates trade in products from endangered species.

17. *http://www.traffic.org/.*

18. *http://www.elephantcountryweb.com/.*

19. See for example the studies by TIA&NGT (2002), Goodwin (2000), Goodwin and Francis (2003), Swanson *et al.* (2001), Navrud (1994), and Fredman and Emmelin (2001).

20. Note the economic value of plant genetic resources as inputs into commercial crop breeding programmes does not include their importance for subsistence farmers who rely on them for their everyday subsistence. Moreover, it does not include social, cultural and spiritual values of these genetic resources.

21. An indirect method of evaluation would be to examine the crop insurance premia paid by farmers since such payments reflect the value of reducing the reduced risk of crop failure that would come about if natural diversity was increased. Pearce (2001) notes that farmers prefer the insurance scheme to adopting more diverse output, because it is cheaper for them: diverse crops may not match demand so well, and tend to be lower productivity crops (and, of course, subsidy systems favour uniformity of output). Insurance payments will therefore be a maximum estimate of the economic value of crop diversity. For example, Such crop insurance schemes are limed to developed countries. WCMC (1992) estimate that total crop insurance premia in the USA in 1990 amounted to USD 0.82 billion.

22. Dixon and Pagiola (2001).

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ANNEX

Assessing monetary valuation techniques

Valuation provides vital information for many facets of environmental decision-making. For example, valuation can play a crucial role in cost-benefit analysis, environmental damage assessment in courts, and green national accounting. In these cases, valuation provides estimates of the full social economic value of environmental resources thus enabling more accurate project or policy appraisal, more precise environmental damage estimates and more accurate net national accounting figures. The importance of valuation has also been acknowledged for designing regulatory measures that aim at internalising environmental externalities. For example, valuation has been used for assessing the costs associated with transportation emissions. This information has then been utilised for the design of regulatory measures such as "green" fuel taxes (Pearce, 2001).

Nonetheless, numerous shortcomings and limitations of monetary valuation techniques have been discussed in other fora. In most instances those discussions reflect some confusion of the foundation and uses economic valuation. Beyond these misunderstandings, however, there are several real conceptual, methodological and technical shortcomings that plague non-market valuation methods. An extensive review of these issues is provided in Kontoleon *et al.* (2002).

For the purposes of this Handbook, two sets of issues should be noted: the first concerns the accuracy of environmental valuation estimates while the second the cost of undertaking original valuation studies.

Accuracy of environmental valuation estimates

Measurement issues concern two aspects of the problems concerning the accuracy of stated preference studies (such as contingent valuation, CV). One aspect is the *credibility* of the stated preferences, *i.e.* how well do the surveys create incentives for the truthful revelation of preferences? For example, if an individual wishes to skew the results of the exercise, does the methodology create incentives or mechanisms that will constrain this sort of behaviour? These are the problems of survey design that exist in all sorts of similar exercises (such as marketing studies). A National Oceanographic and Atmospheric Administration (NOAA) panel that included Nobel laureate economists found that properly constructed surveys could in fact produce incentives for truthful revelation, and that there existed additional methods by which the results of the survey might be checked. For example, individual bids are usually checked against the salient characteristics of the bidder (such as income level, interest in the issue, family status) to determine whether the bid is consistent the character of the bidder. Thus, the credibility of the results of a survey is a function of the quality of the survey design.

The other problem of accuracy concerns the margin of error surrounding the valuation. This variance will depend to some extent on the size of the sample and the nature of the good being valued, but it will necessarily remain fairly large and uncertain on account of the technique that is used. No doubt attaining a high degree of accuracy is desirable when using valuation for cost-benefit analyses or environmental damage assessment (*e.g.* Desvousges *et al.,* 1993; Johnson *et al.,* 2001). Yet, it is reasonable to argue that attaining a high level of accuracy is of a much lesser concern, when valuation is used for the purpose of market creation. As discussed, valuation studies facilitate the generation of biodiversity markets by inducing market creation as well as provide information that will allow for an optimal market creation strategy (*e.g.* minimizing market conflicts, maximizing net appropriable benefits, etc.). In other words, in the context of market creation valuation is not used to make an allocative decision *per se* and as such the uncertainty of estimated environmental values is less an issue.

The cost of environmental valuation studies

A further point of concern has to do with the costs required to undertake a "state-of-the-art" valuation study. Some have argued (*e.g.* Shavell, 1993) that in many cases the cost of undertaking the study may exceed the damage itself, and thus the conduct of a valuation may not itself pass a cost-benefit-analysis (CBA) test! This has led some academics and policy-makers to endorse the use of *benefit transfer* techniques. These refer to a series of methods that "estimate" the value of an environmental flow based on the estimates provided by other studies conducted on similar flow undertaken within another context, region, and/or time. No doubt these techniques provide large cost-savings. These savings, however, are not achieved without a price: "transferred" values contain a compounded degree of error. Nevertheless benefit transfer methods can be particularly useful in policy contexts, such as market creation, where assessing rough economic benefits is sufficient to make a judgement regarding the advisability of a policy or project.

There have been some recent advances that address the main shortcomings faced in benefit transfer methods. First, there has been important work in the development of a unified and commonly acceptable protocol for benefit transfer (see Brouwer, 1999). Secondly, there has been considerable progress in developing extensive valuation databases.[1]

Information from preference-based valuation methods can contribute importantly to policy-making since it has been shown in the past to have value in making decisions. What should really be at issue is how much weight is to be given to that information in various contexts where other information may, or may not, be available. To be sure, policy-makers should interpret and utilise the information provided by these techniques in light of their limitations. It is thus essential that valuation practitioners make public the procedures and methods used in their studies as well as openly acknowledge any obstacles that they may have encountered.[2]

Discussion

In this chapter it was argued that valuation plays a vital role throughout the demonstration, capture and benefit sharing process of market creation. However, several economists and policy-makers have argued that the discussion over economic values and valuation is generally *irrelevant* for the creation of incentives for biodiversity conservation. For example, Heal (1999) argues that: "Incentives are crucial for conservation: valuation is not necessary for establishing the correct incentives".

The implication from such views is that policy-makers can exclusively focus on designing and implementing incentive mechanisms to capture value without dealing with valuation *per se*. That is they can focus on the appropriation and benefit-sharing stages of market creation. Pearce (2001) concedes that this reasoning is technically correct and that incentives can indeed be stated without going through the valuation stage of the demonstration-appropriation-benefit sharing paradigm. He argues that this reasoning is similar to that behind the Baumol-Oates least-cost theorem for pollution changes, where policy-makers need not know the value (or cost) of pollution in order to adopt cost-minimising abatement incentives (Baumol and Oates, 1998).[3]

Nonetheless, many believe that in the current policy environment facing most countries, where government resources are scarce and must be prioritised, that valuation is vital. In the context of the demonstration-capture and benefit sharing process of designing markets for biodiversity conservation, it has a crucial role to play in showing that the non-marketed aspect of biodiversity are worth policy-maker's attention for its economic value. Pearce (2001) argues that the pressures to causing biodiversity loss are

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so large that the chances that policy-makers *will in fact* introduce incentives without *demonstrating* the economic value of biodiversity are much less than if we engage in valuation. Hence, valuation (by providing a measure of the full social value of a biological resource) provides an important inducement and legitimisation to establish incentives in the first place. There exists a significant number of valuation studies that were undertaken with the aim of demonstrating the potential benefits of market creation for biodiversity. For example, numerous studies have been undertaken to explore the potential benefits of developing bioprospecting markets (*e.g.* Simpson and Craft, 1996; Rausser and Small, 1998; Simpson, 1998; etc.), eco-tourism markets (Fredman and Emmelin, 2001; Krug, 2001; Swanson, 2001; Navrud, 1994) and sustainable forestry markets (*e.g* Pearce *et al.*, 2003). Such studies have played a vital role in demonstrating the value of biodiversity resources that are used as inputs for the provision of either private goods (*e.g.* ecotourism) or public goods (carbon sequestration).

Notes

1. For example the EVRI – Environmental Valuation Reference Inventory (at *http://www.evri.ca/*) and ENVALUE environmental valuation database (at http://*www.epa.nsw.gov.au/envalue/*).
2. This form of information exchange is one of the aims of the valuation data banks that are currently being developed as part of environmental policy capacity building initiatives (see Chapter 6).
3. For other arguments against the use of valuation in environmental decision-making see Pearce (1999).

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Chapter 5

Direct Role for Policy-makers: Incentives

Establishing the essential elements such as legal frameworks and property rights regimes is a central role for government, but often it is only the first step. In many areas of public policy there are continual refinements and improvements that need to be made in the policy apparatus. Incentives for biodiversity are an important element in internalising the value of biodiversity and getting people to alter their behaviour – by changing economic choices. By influencing the (implicit or explicit) price of various activities, incentives can create markets while correcting for the discrepancy between the private and public values of biodiversity-related goods and services. Creating markets through the use of incentive measures is easily accomplished but must be undertaken to correct market failure while minimizing public expenditures. Given the pressures on governments to deal with public policy issues such as pensions and health care, the use of markets to make biodiversity management a self-sustaining activity is a needed innovation.

Using incentives for market creation

The role of the policy-maker in creating markets for biodiversity extends beyond the establishment of legal frameworks and their enforcement. Achieving sustainable use of biodiversity also requires considerable effort in implementing direct actions that encourage and deepen markets and ensure their proper functioning.

Incentives are the primary tools that governments have to achieve that goal. They are used to address particular obstacles to getting markets started, or to enhance the efficiency of nascent or existing markets. The public good characteristic of biodiversity will mean that its goods and services are under-priced in the market – some aspect of the good is not endogenously captured in market activity. Incentive measures can cost-effectively mitigate that problem by either discouraging activities that use biodiversity, or encouraging activities that favour biodiversity. For example, a levy on biodiversity-related resources can increase their price by an amount equal to the public value of the biodiversity being used – thereby discouraging use. A payment for an ecosystem services can also increase its value (by its public value), thereby encouraging maintenance of biodiversity.

These two approaches define the main alternatives that policy-makers have at their disposal. The instruments that fall within each can be broadly categorised as: *Positive Incentives* and *Disincentives*. In general terms, incentives are measures that assume a degree of rationality in people's behaviour. In altering the choices they face, incentives encourage people to change their behaviour. Whenever an incentive is used, the explicit goal for public policy will be to alter the price of public goods by an amount equal to its public value. In this respect, incentives help to level the playing field between public and private goods.

Given their significance both within and outside the OECD, the removal of *Perverse Incentives* can be considered as a form of market creation, again by changing relative prices. The role of perverse incentives in biodiversity loss is particularly pernicious since they not only fail to internalise the public aspect of biodiversity, but even disadvantage the part of biodiversity-related services that could potentially be delivered by private interests. For this Handbook, the discussion is limited to the manageable (but still significant) subtopic of harmful subsidies within the theme of perverse incentives. The focus is on measures that government can undertake to help mitigate some of the impacts of perverse incentives through market creation.

Positive incentives

When the public value of a good or service exceeds its private value, a positive incentive can be justified on the grounds that the gain from the public expenditure exceeds its cost. If, for example, the holdings of a landowner include a particularly unique eco-system that many people value, a public payment commensurate with its public value is justified. The basis for such a payment would, of course, come from the government's ability to measure the public value of the eco-system (so that the payment did not exceed that value). As we will see, the manner in which those payments are made can encourage markets to form, and influence the amount of economic rent accruing to the landowner. To see this latter point, recall that a landowner in possession of an ecosystem would be willing to accept a payment, to maintain the ecosystem, that is just equal to any alternative uses of the land. The public value of the ecosystem, however, may exceed the value of the land in any of those uses. Since techniques exist to elicit the owner's *reserve price* to maintain the ecosystem, an important objective in market creation is to uncover that price so that rents collected by the payment recipients are minimised.

Direct payments for biodiversity services

Appleton (2002) discusses the use of positive incentives in encouraging the maintenance of the Catskills watershed in New York state. The authorities in New York city chose to encourage farmers, and other commercial enterprises, who were contributing to the degradation of water quality, to alter their activity. They did so by providing payments to those willing to participate in reducing their impact on the watershed. The payments made up for lost income so the farmer was willing to "supply" the environmental services being requested: a market was therefore created for those services. For the City, the total payments were well below the alternative cost of building new filtration capacity. It is also interesting to note the recognition of the farmer's (property) rights. The City could, for example, have attempted to have higher levels of government regulate farming practices so that activities that damaged the watershed were prohibited. The impact would have been felt by many of the farmers in the watershed and some may no longer have found farming viable. The people who ultimately use that water would have benefited at the expense of those farmers – a larger group benefits at the cost of a small group. In New York, the government paid farmers, thereby recognizing that the farmers held some of the rights related to the water and were entitled to be compensated.

Biodiversity in this watershed example was enhanced by maintaining the watershed at something closer to its natural state. It illustrates the direct creation of a market by a public authority that is willing to purchase services that have not traditionally been exchanged. Creating the *conditions* that encourage such payments, or that encourage exchanges in certain rights, are also market creation activities. Demonstrations of the utility of markets, such as in New York, along with the careful definition of property rights, all help to create the conditions for biodiversity-friendly markets to flourish.

Indirect payments for biodiversity services

In a number of countries, governments have begun to make indirect payments for biodiversity services by providing tax incentives for preservation and sustainable use. One of the more successful programs involves cases where land is restricted in economic use (*i.e.* an easement or land trust is given). The Nature Conservancy, for example, is active in a number of OECD countries and encourages development restrictions to be instituted in exchange for favourable tax treatment of the property. In fact, it operates as a charity in some countries, so that easements given to the organisation are tax deductible.

Payments for endangered species

A well-defined context where markets have also already worked is in the payment of "bounties" for rare or endangered species. This involves payments to individuals or firms to provide and maintain mating pairs of particular species. Such programs have been used for wolves – where landowners are paid USD 5 000 for mating pairs of wolves on their property (Defenders of Wildlife, Washington, DC). It has also been successful in creating a market for endangered species, such as red-cockaded woodpeckers where the value of a mating pair for use in mitigation banking can be very high (Environmental Defense, 1999; see also *www.environmentaldefense.org/article.cfm?ContentID=2664*).

Another example of payments for an endangered species is found in the Austrian Gene Conservation Program (AGCP). Breeders receive subsidies for avoiding inbreeding by planned mating and genotyping their animals. One result of this program has been the commercial development of the Austrian "Waldschaf" or "Forest Sheep" – the breed is ranked in Austria as highly endangered and receives subsidies under the AGCP. Although the meat of the lambs was always considered high quality, it was not enough to sustain the breed and it was in general decline. Interest in the breed was renewed when it was realised that changes in farming practices were leading to loses of ecosystems and biodiversity. Meadows and fields were being lost to farming and development and original meadow biodiversity was difficult to maintain

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in other areas without the help of an extensive grazing animal. The Forest Sheep turned out to be an ideal solution. Market creation was engaged by developing new markets for tweed made from the wool (Berger, 2003) and this has tipped the scales in favour of the sheep. It has also successfully sustained the biodiversity of the meadow ecosystems.

Box 5.1. **Direct and indirect payments for endangered species**

The role of private landowners in species conservation is essential in Texas, where numerous rare species can be found – seventy four species that were listed by the United States federal government as of the beginning of 2000 – and 79% of the land is privately-owned. To encourage landowners to undertake voluntary actions on behalf of imperiled species, the state has created the Landowner Incentive Program (LIP).* The Texas Parks and Wildlife Department (TPWD) administers the program.

LIP funds landowners who are willing to undertake actions on their land to benefit at least one rare species or its habitat. Such actions include restoring native vegetation, conducting prescribed burns (which aid species dependent upon habitat once maintained by wildfires), and habitat protection, *e.g.*, gating caves or constructing fences. Funds are dispersed after the landowner and TPWD sign a conservation agreement.

TPWD also offers landowners who manage their land for wildlife conservation purposes the opportunity to have it appraised for property tax purposes at its agricultural value. Since this is often much less than its fair market value, it provides an opportunity for reduced tax payments and is thus an implicit subsidy from the state.

* See *www.tpwd.state.tx.us/conserve/lip/lip.htm*.
Source: Environmental Defense.

Performance-based payments

Paying for biodiversity outcomes can also occur in a context where a government purchases public services from a source that is either privately or publicly held. While examples are more common of the former, the latter also exist. Government purchases of public services within a public park illustrate this case. The mechanism that is used for making those payments can have important implications for economic efficiency in achieving biodiversity outcomes. A simple "auctioning" of the right to receive a payment in exchange for biodiversity-related services can work as an effective device to ensure that the government gets the most value for its money. Examples along this line include Australia's BushTender (Box 5.2) and the United States government's Conservation Reserve Program.

Box 5.2. **BushTender Programme**

In Australia, governments have employed a range of mechanisms for biodiversity conservation on private land. For example, a pilot called BushTender was implemented on a trial basis in Victoria to examine the feasibility of employing a market-like mechanism (auction) to allocate public resources to private conservation effort.

The government auctioned what were effectively "biodiversity conservation contracts" in two regions of Victoria – the North East and North Central. These regions are characterized by areas defined as Plains Grassy Woodlands, Grassy Woodlands and Box-Ironbark Forests. Although the ecosystems characteristics of these areas once covered three hundred thousand km^2 of northern Victoria, 83% of those ecosystems has now been cleared and fragmented for agriculture, urban development, gold mining and firewood collection. Today less than 2% of Plains Grassy Woodlands, 7% of Grassy Woodlands and 50% of Box-Ironbark Forests remain in their original form.

The BushTender contracts began with an assessment of each of the sites that were being made available (*i.e.* bid). The biodiversity significance of each was assessed on the basis of two measures: the vegetation type; and, the contribution to biodiversity benefits that would accrue from promised landholder actions. The vegetation type was developed into a Biodiversity Significance Score by ecologists for each site, it would measure its conservation value. A Habitat Services Score was also developed to measure the amount of biodiversity improvement offered by the landholder. The combination of these two scores represented the farmers "offer".

The landowners would then bid their land to obtain compensation to maintain biodiversity. The government would decide if it wanted to pay the asked price for the scores the land received. For this trial, the government chose to accept all bids until it exhausted the allocated funds. Landholders, however, were only informed about part of their score. This meant that they had little ability to behave strategically and were forced to limit their bid to the opportunity cost of their actions. Creating information asymmetry and having landowners individually auction their parcels of land appears to have been successful in keeping the total cost to government much lower than alternatives, especially since the individually auctioned parcels of land allowed the price per unit of biodiversity to vary substantially according to the landowner's opportunity cost.

Source: Stoneham, Chaudhri, Ha and Strappazzon (2003).

Payments for specific outcomes

Payments for endangered species are examples of measures that make use of incentives to create markets that benefit biodiversity. Those measures, however, are very focused on a specific species within a well-defined, localised area. Alternative performance-based payments for biodiversity could feature payments for anything from targeted levels and types of vegetation in a given area, to enhancements in the composition and numbers of various animal species. A simple example of this, in the context of a species, is a payment that is offered which is contingent upon the maintenance of the geographical range of a species at a target level.

Somewhat more sophisticated measures are also possible that are more closely related to broader indicators of biodiversity. Many biodiversity indicators already exist with the potential for providing information of sufficient value that government policy could make use of them. Indicators in this context would provide the basis for markets to form around the payment that government, or even private organisations, would offer – in exchange for maintaining the indicator at a certain level. Payments for specific outcomes are *ex post* rewards that are given on the basis that a desirable outcome is achieved. By making the payment ex post and contingent on the outcome occurring, some element of risk is transferred to the recipient of the payment. Clearly, many other variations on this theme of offering payments based on a biodiversity indicator are possible and worth exploring. In particular, the links between various indicators and different forms of payments warrant further exploration to better understand the circumstances under which particular schemes would be most appropriate.

Auctions for payments

The United States Conservation Reserve Program (CRP) and Europe's Natura 2000 programs are examples of modes of direct payments for biodiversity (that create markets in a performance-based context). In the case of the CRP, the markets are somewhat more oriented to auctions, thereby gaining the allocative efficiency of allowing the high bidder to signal where social welfare may be highest. The CRP is an initiative of United States agricultural policy that initially sought to limit production, in an effort to support prices for agricultural products. The CRP has been increasing in importance, with successive reform of world trade. The Uruguay Round Trade Agreements, for example, established categories of support measures that were distinguished according to the degree to which they were likely to cause trade distortions. Support measures for farmers that were not tied to either inputs or outputs were deemed to be desirable, and governments were encouraged to de-couple existing support measures. This has led to substantial revisions to agricultural support in favour of environmental amenities which are not input- or output-linked. As the CRP has developed, the payments have become gradually more linked to specific levels of performance that the government is "purchasing". The measure used to gauge performance is an environmental benefits index (EBI) which is used to score services that are being offered. In fact, the EBI acts like a monetising biodiversity indicator.

The government offers payments to farmers on a performance basis (as measured by the EBI) and farmers "bid" certain agri-environmental outcomes for those payments. That is, an auction is held and farmers bid for the right to *receive* the payment. Under the right conditions, such an auction works to ensure that the government gets the most value for its money by maximising the EBI that is being achieved. The bids necessarily outline very specific actions that the farmer will undertake in exchange for the payment. Since the context is likely to be very different across farms, the EBI has to be well enough specified to capture significant elements of those differences. Other examples along this line include Australia's BushTender Programme.

A variation on the idea of auctioning payments that provide incentives for undertaking biodiversity-friendly actions is to auction bonds for the right to receive the payment. In this case, the link between the provider of the payment (most likely, but not necessarily a government) and the provider of the service is one step removed. Auctioning a bond is a promise to make a payment in the future. If the promise is linked to a specific outcome, then the bond is effectively a promise to pay the person (or entity) holding the bond for achieving that outcome. To see what this entails, consider a government that is interested in achieving a particular biodiversity outcome (*e.g.* establishing and protecting a particular ecosystem over a period of time). The government may not have very much information regarding the cost of achieving that goal. It may have, however, undertaken valuation studies and found that the value to its citizens of achieving that goal is roughly EUR 1 000 000. In that case, it can issue a bond with a promise to pay EUR 1 000 000 at a future date if the goals for the ecosystem are achieved. Once the bond is issued, the government need only be able to monitor outcomes over time to know whether payment should be made to the bondholder. Individuals and firms will bid for the bond on the basis of what they estimate it will cost to achieve the outcome. Firms that expect the cost to exceed the value of the bond will not bid. However, a firm that expects it to cost EUR 800 000 to achieve the goal will offer to pay up to EUR 200 000 for the bond. The bids themselves will reveal considerable information regarding cost, and give government the opportunity to observe market participants so as to adjust the value of future bonds. The main benefit of a bond of this type is that it minimises the information that government needs to know concerning how to achieve the outcome. It suffices to know the preferences of its citizens and how much they are willing to pay for outcomes. An open bidding process should also ensure that the government pays a reasonable price for achieving its goal – a competitive system will tend to remove excess profits. Nonetheless, since the bond will have to be re-issued, there is an opportunity to move future bond values closer to the firm's actual costs. A more general discussion of environmental performance bonds is given in Box 5.3.

Box 5.3. **Environmental Policy Bonds**

Environmental Policy Bonds are a financial instrument designed to include financial markets in the achievement of environmental goals. The bonds could be backed by either government or by the private sector. They would not bear interest and would be redeemable for a fixed sum only when an environmental objective has been achieved and sustained.

The bonds would initially be auctioned for whatever price they would fetch. Thereafter they would be freely tradable at all times until redemption. People would buy and sell the bonds just as they do normal bonds and shares. The price of Environmental Policy Bonds would be higher the closer the targeted objective is to being achieved. As the objective became less remote, the price of the bonds would rise. It is this increase in value that generates the incentive for bondholders not just to hold bonds, but to do something to help achieve whatever is the targeted objective.

If government backs the bonds, then the effect of a bond regime is to contract out the achievement of environmental goals to the private sector. Government would still specify the objective, and would still be the ultimate source of finance for their achievement.

However, private individuals or companies could also back Environmental Policy Bonds. Non-governmental organizations currently involved in environmental issues, could issue bonds redeemable when a particular objective that they favour has been achieved.

The market for Environmental Policy Bonds would generate valuable information about the total and marginal costs of achieving goals. Apart from their cost-effectiveness, they would also inextricably link rewards to outcomes – the bonds could be redeemed only when the specified objective has been achieved.

Source: Horesh (2000).

Though limited in use thus far, these types of payments hold some potential for the development of future programs.

Payments for ecosystem services

Biodiversity provides a large number of services that are not currently transacted in a market place, so they are not valued in an economic sense. Market creation in this area is therefore a case of ensuring that payment is made for services rendered. The policy issue in this case is for government to provide the market framework in which the services will be transacted. For typical economic goods the competitive market place will tend to drive prices for goods and services to the cost of the material input plus the value-added of labour and capital. For ecological services, none of these quantities is necessarily applicable. The question is then, how to price the ecological services (assuming alternative uses of the ecosystem have lower value)? An obvious criterion is to do so at the price necessary to maintain the resource. That is, whatever price engenders a level of demand that is consistent with long-term sustainable use, including providing funds for necessary interventions for maintenance.

There is, however, often a more complex set of circumstances that should be considered in policies for ecological services. Some of these issues can be seen by looking at watersheds that provide drought protection services to farmers – by allowing them to withstand periods of low rainfall. When the watershed involves an area that is provided or maintained through public funds, it not only conveys a public service to individuals who receive non-monetary benefits, but also conveys a private gain to downstream farmers. This gain is, in fact, measurable and therefore potentially subject to taxation (Pattanayak, 1997). To be clear, given that the benefits are accruing to the general public, the watershed should, at a certain level, be provided through public funds. However, the private benefits should also be a source of contributions to the operation and maintenance of the watershed.

To realise that potential, a full understanding of the services that are being provided by nature (including their valuation) is necessary in order to achieve internalisation into the market. To see how strong the inter-linkages can be, consider the example of silviculture. In most cases, silviculture is not competitive with traditional farming. However, it becomes profitable when the value of the wood is combined with payments for other services, such as soil conservation (Pattanayak, 1997). When the market price of goods reflects their marginal contribution to total economic value,[1] biodiversity conservation becomes consistent with improved economic outcomes. Establishing links between the services that nature provides and the economy is a goal that some have begun to work towards. Although it is in its early stages, examples such as Cork *et al.* (2001) exist where attempts are being made to rigorously develop the underpinnings for mechanisms for internalisation of biodiversity services.

Payments for environmental services also provide a means of direct funding of biodiversity, by having money flow directly to providers of services. In cases such as the purchase of certain land-use agreements in the US that are intended to maintain water quality (Heal, 2000), the biodiversity benefits are indirect but significant. By creating incentives to leave particular regions in conditions that are more conducive to biodiversity, the payments create markets which support long-term goals for biodiversity. Similar programs exist on a small scale in many parts of the world. For example, the Colombian Green Plan (CGP) seeks to provide incentives for the provision of watershed ecological services. This is achieved by making direct payments to farmers to undertake reforestation as well as ecological restoration of critical ecosystems, mangrove swamps and streams affected by forest fires. The schemes are financed from domestic sources. Between 1999-2002 a total of 1 000 km^2 were restored. Recipients of payments are obligated to maintain the ecological integrity of the land for a period of ten years (Beccera, 2001). Similar programmes have been developed in a number of countries for the protection of soil conservation (Pagiola, 1999).

Box 5.4. **Payments for environmental services in Costa Rica**

Since 1997, the government of Costa Rica has established a system of direct payments for environmental services. Under this system, land users receive direct payments for limiting their activities to specified land uses, including new plantations, sustainable logging, and conservation of natural forests. Funding is provided by the local government, the World Bank and the GEF. This funding scheme is compatible with the strong public good characteristics of the services provided by the programme.

Results

By mid-2000, over 2 000 km^2 of forest had been incorporated into the program at a cost of about USD 47 million. Average payments are USD 3 500-4 000 per km^2 conserved per year. At these compensation levels, the programme has been immensely oversubscribed which indicates that payments well exceed farmers' opportunity cost. The programme seems to be highly successful in attaining both its conservation and development goals. Some questions may need to be addressed in the future regarding economic efficiency – equating marginal costs with marginal benefits.

Prospects

The long-term effectiveness of these incentives will depend on the payments being continued. Since all participants in the Costa Rica programme are still receiving payments as part of their 5-year contract, it is too early to make conclusions about the long-term sustainability of the program.

Source: Pagiola and Platais (2001).

Negative incentives

Disincentives (or negative incentives) impose a cost on activities that impact on biodiversity, in an attempt to encourage alternative (less damaging) uses. The public policy justification for using disincentives is that biodiversity-related goods are under priced (given their public characteristic), so increasing the price of those goods and services that use biodiversity will help level the playing field. Castro (2001) highlights a case where a water tariff structure was used to both discourage low-value use of water and to help recuperation of areas where water filtration services were provided by nature. In this case, an increase in the water charge (a disincentive) was used to increase the cost of water by the amount of damage being done to the watershed. The charge itself made some watershed-degrading activities less attractive relative to those that are biodiversity-friendly. It also created revenues that allowed the government to purchase services related to watershed maintenance.

Fees, charges and environmental taxes

Disincentives can be integral parts of a market creation agenda when they are combined with other measures. The negative incentive allows a form of user-pay to be established where funds can be used to maintain a service. Trophy hunting and trophy fishing are classic examples of this phenomenon, though others exist. Market creation occurs because users are being made to "buy" services they would not otherwise be permitted to engage in. Some examples include:

- using charges and non-compliance fees for forestry activities to ensure that harvesting is undertaken at sustainable levels (Barde and Braathen, 2002), and where the revenue is used to provide supporting or related services;
- implementing liability fees to buy services for rehabilitation or maintenance of ecologically sensitive lands (Robinson and Ryan, 2002);
- the application of fishing and hunting license fees (*e.g.* International Paper and other private foresters who charge for hunting on lands they hold);
- the use of levies for the abstraction of groundwater (OECD, 2003), which buy related services;
- charges for:
  - the use of sensitive lands (*e.g.* the Great Barrier Reef Marine Park generating in excess of USD 500 million annually);
  - the limited and tightly controlled hunting or fishing of some threatened species (CAMPFIRE program in Zimbabwe);
  - tourism in natural parks (Lindberg, 2003).

Regulatory measures

Another form of negative incentive is the regulatory measures that mandates objectives to be met. Since they are generally accompanied by adverse consequences when the regulations are not adhered to, they can be considered as negative incentives.

The manner in which regulations are implemented can indirectly lead to the creation of markets. Flexibility in the implementation of regulations provides

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opportunities for creative individuals to adhere to them in novel ways. The use of offsets for wetlands in the US was discussed earlier for the regional flexibility it provides. It is, however, also a good example of how flexibility on the part of the regulator can lead to market creation. Unlike other environmental regulations that are written and applied in a very restrictive manner, the policy intended to arrest the loss of wetlands was not specified or applied with a very high degree of detail. This left some room for individuals implementing the policy to find ways of allowing the objective to be met at the lowest possible cost. Since the objectives of the wetlands policy was that there should be no *net* loss of wetlands, local administrators allowed offsets to occur. Private developers were allowed to degrade wetlands in one area if they compensated for that loss by building an equivalent wetland close enough to the original to satisfy the local administrator. What is remarkable about this outcome is that nothing in the original policy specified this trade-off. The administrators within the United States Environmental Protection Agency acted flexibly to permit creative solutions.[2]

It has been noted elsewhere that, in general, regulatory measures are less flexible than market-based measures. Since they tend to specify more detail in process, they leave less discretion to the regulated entity. The preceding example suggests that this argument needs to be more nuanced than it often has been. Moreover, the flexibility of market measures sometimes comes at the cost of having to build up institutional structures with transactions, information and other costs that are typically associated with markets. In some cases, those costs can be quite high. The archetypical example in an environmental context is where small but dispersed sources of pollution exist and where *a priori* the marginal abatement costs across sources can be expected to be similar. Attempting to use a market instrument in that case will likely create more administrative costs than a simple regulatory measure would. A cost-effective policy would be to simply limit the pollution by regulation rather than providing monetary disincentives to polluters. Perhaps the most cost-effective policy would be to find creative ways of combining regulatory and market measures, as the United States wetlands example showed.

Removal of harmful subsidies

Market creation for biodiversity also needs to consider impediments that prevent markets from forming or functioning efficiently. It is sometimes the case that biodiveristy-friendly goods and services are disadvantaged by particular incentives. Since the reform (or removal) of harmful subsidies can immediately cause markets to form, it should be an integral part of a market creation strategy.

An important source of harmful subsidies is in unforeseen consequences of industrial policy that is intended to promote development of economic sectors. An incentive measure given in one economic sector will always have implications beyond the sector in which it is applied.[3] Governments attempt to take as many consequences as possible into account when developing and implement policy measures. Nevertheless, analysis of proposed policy is rarely able to *ex ante* account for most of the impacts that will result when the measures are enacted. There are always surprises when policy proposals are tested through implementation. Many of the unforeseen impacts can significantly affect the net benefits that the policy was intended to bring. Incentive measures that are implemented in economic sectors such as agriculture and forestry may, for example, have an impact on biodiversity by leading to the overuse of facets of the environment that support biodiversity. Since people care about biodiversity and the quality of the environment, there may be a sufficiently large negative impact in those areas that the overall effect of the policy is negative. That is, if all the impacts had been foreseen from the outset, the policy would likely have been implemented in a substantially different form, if at all. Such incentives are termed "perverse" when they do harm to biodiversity and are economically inefficient – in the sense that other policies could have achieved the same target without the biodiversity impacts. Perverse incentives that are associated with *subsidies* are particularly unfortunate because, in that case, the government is *paying* for an activity that is harmful to the welfare of the community.

As reforms in New Zealand have shown (Box 5.5), removing harmful subsidies can assist markets by removing distortions that can lead to the overuse of environment and biodiversity-related resources.

Inter-linkages and incentive measures

The need for detailed attention to be given to various incentive measures, and their impacts, is underscored by the inter-connectedness between policies and economic activity. Achieving an improvement in economic outcomes through subsidy reform, however, is not sufficient to ensure that in the long term those gains will be maintained. If a review of subsidies occurs only once, new subsidies may subsequently arise that could slowly erode the gains made during the original review. A process of examining all new subsidies is therefore called for, in order to consider their *potential* impact on biodiversity before they are implemented. Because many of the repercussions of existing subsidies could not have been predicted when they were first put in place, it will also be necessary to undertake periodic reviews of past decisions. This will ensure both that the original purpose remains socially desirable, and that the most recent information is used to consider the repercussions on ecosystems.

Box 5.5. **Harmful subsidies: Agriculture**

Government programmes to address environmental problems caused by agricultural production can be undermined by government policies which encourage the intensification of agriculture. The approach of the New Zealand Government towards agriculture and its effects on the environment has been to help ensure some level of coherency in policy so that environmental management is not undermined by government funded programmes.

In the mid-1980s, New Zealand removed a wide range of support measures for agriculture, including minimum prices for wool, beef, sheepmeat, and dairy products; land development loans; fertiliser and irrigation subsidies; and subsidised credit. Central government subsidies for soil conservation, flood control and drainage schemes were also substantially eliminated. The subsidies were removed largely for economic reasons, in conjunction with macroeconomic reforms.

Following the removal of subsidies, livestock numbers declined, the use of fertilisers and pesticides decreased, and there was an increase in afforestation as increasing returns to forestry were reflected at the farm level. Irrigation activity is also thought to have stabilized as a result of the removal of support. Conversion of regenerating and established native forest to agriculture virtually ceased, as did development of new irrigation and drainage schemes. All of these changes lessen the likelihood of farming systems causing degradation of marginal lands and off-site contamination of water resources.

Source: MAF Policy (1996).

Harmful subsidies and their impacts

To highlight the manner in which harmful subsidies damage biodiversity and disadvantage potential markets, it is worth considering them on a sector-by-sector basis. The following sub-sections discussion six economic sectors where the interface between economy and biodiversity is particularly strong. A key observation that is worth highlighting at the outset is: the impact on biodiversity is most often directly related how extensive a particular economic activity has become. For example, a policy that causes geographic expansion in economic sectors such as agriculture, forestry, or fishing will be an important source of biodiversity loss.

Agriculture

Some of the more prominent subsidies are those given on the basis of output, per area or animal or input use – in the terminology of the Uruguay Round Agreement on Agriculture, *Amber Box* and *Blue Box* support measures. These payments tend to encourage farming practices that are either not sustainable in the long run, or adversely affect the environment off the farm. Reducing subsidies that are output- or input-linked can lead to the creation of markets that are more biodiversity-friendly. Moreover, any subsidy that favours conventional agriculture to the disadvantage of alternatives (*e.g.* organic farming) damages biodiversity, without necessarily providing additional agricultural output (Jones, 2003).

The case of reductions in subsidies in New Zealand led to a substantial realignment of incentives in agriculture and caused markets for forestry products to be developed. With the removal of agricultural subsidies in the mid-1980s, a gradual change in land use occurred from agriculture to forestry. The area used for pasture declined from 141 thousand km^2 in 1983 to 135 thousand km^2 in 1995 (MAF Policy, 1996). Given that conversion back to its natural state is a gradual process, this number may in fact understate the actual land area reverting to woody vegetation.

At the same time, the area of planted forest increased from 10 thousand to over 15 thousand km^2 – a 50% increase. This occurred despite the removal of forestry establishment grants in 1984. The new forestry plantings are typically found on the same land that is being taken out of sheep and beef production – particularly in locations close to an export port and with conditions favouring tree growth. Although some tree planting is being undertaken by farmers seeking to diversity their operations, much is not. Often, it is undertaken by investors who see an opportunity for investment and market creation that has been made profitable by the removal of subsidies. That is, the increase in forest planting is driven by an increased return to forestry that is enhanced by the declining returns to pastoral farming. The removal of agricultural subsidies allowed this divergence in returns to be fully reflected in farm profitability and land prices.

Much of the assistance given to agriculture encourages the extension of agricultural lands. In doing so, those subsidies result in land being converted from forests, rainforests, and wetlands into agricultural production (Runge, 1994). In the US, for example, some 50% of wetlands have been lost mainly due to agricultural conversion (OECD, 1999);[4] in Europe, that number is closer to 60%. The threatened loss of farm support payments to US farmers who convert wetlands to agricultural activity has not only resulted in substantially reduced losses of wetlands, but has also contributed to the development of markets for wetlands offsets.

Water and irrigation

The impacts of subsidies for irrigation water have been well documented in developed countries, such as the US (SJVPD, 1991) and Australia, where they have been linked to groundwater depletion, over-tapped rivers, water logging, and salinization. The adverse results of subsidies have also been observed in other parts of the world where the link has been made to the destruction of ecosystems (Postel, 1999). Indeed, subsidies regarding irrigation that lead to these damages are so pervasive that farmers (globally) rarely pay more than 20% of the real cost of water (Postel, 1999).

Removing water subsidies and allowing trading in water rights to occur will result in market creation that benefits biodiversity – when sufficient conditions are imposed on those rights so that market prices reflect the full value of the water. This was done in Australia's Murray-Darling Basin where the removal of water subsidies and an implementation of full-cost pricing were accompanied by market creation in the form of trading water rights. Young *et al.* (2000) undertook a two-year review of that program and found that the economic benefits of full-cost pricing were considerable in terms of allowing scarce water to be used at it highest economic/social value. That market creation effort was also thought to have led directly to some immediate (although small) environmental benefits. Its main impact, however, was in establishing a framework within which future environmental benefits can be achieved. That is, a trading system will allow water extraction to be limited to that which is environmentally (and biodiversity) sustainable, but require water to go to uses which will minimise the economic consequences.

Some have argued that the demand for irrigation is inelastic, so the removal of subsidies would not do much more than to simply lower incomes for farmers. Garrido (2001) counters this argument by observing that water demand for agriculture is elastic, but only when its price is high enough for users to notice. Previous studies suggested that price changes had no effect on demand by irrigators because the initial and final prices were inconsequential. The implication is that when users have to face the real cost of irrigation, there will be a reduction and the impacts on biodiversity, and the environment will be mitigated. Removing subsidies and creating markets for water (for non-essential use) would therefore allow more rational use of water to occur. A good example of this is found in Arlosoroff (2002). He notes that in countries where users face a market-determined price for water (*e.g.* Israel), the use of water is significantly lower for the production of the same crops that are grown elsewhere. Since irrigation is a disproportionately high user of water in OECD and non-OECD countries, the cost of water to irrigators is the dominant factor in overall water use. Moreover, when irrigation water is priced at levels similar to that for households and industry (*i.e.* the marginal price of water is equal between uses), scarce water will be allocated to the application where it has maximum value across all sectors.

Energy

Subsidies in the energy sector come in many forms: ranging from those that lower the cost of producing energy, to those that affect the price faced by producers and consumers of energy. The amount of subsidies given to energy has varied over the years, but recent studies still find substantial support (Porter, 2003). Support to the energy industry affects the manner and quantity of energy used – contributing in the process to biodiversity/environmental consequences.

Subsidies for energy have their strongest impact on biodiversity when they encourage energy production in modes that require significant land conversion. For example, large-scale hydro-electric dams can result in the loss of substantial land areas to flooding. The construction of dams is typically dependent on a limited accounting of purely private costs (*i.e.* negative environmental externalities are not accounted for – McCully, 1997). Even limiting consideration to private costs, the construction of hydro-electric facilities still requires government assistance to engage the private sector (Anderson, 1996). That is, publicly funded infrastructure such as roads, communication networks, etc., often have to be provided *gratis* in order for the final cost of the electricity produced to be competitive with alternatives. In some cases, this is justified on the basis of values for public-good benefits, particularly recreation, fishing and hunting. Some observers consider these values to be inflated (GAO, 1997).

Subsidies to coal and other fossil fuels have been argued to lead to high emissions of carbon dioxide (Anderson and McKibbin, 1997). Their reform would therefore contribute to reduced emissions, which would have beneficial impacts on biodiversity through lower climatic disruptions or reduced air pollution. In both the United Kingdom and Germany, emissions of carbon dioxide fell substantially, following the removal of large coal subsidies. Market creation in the form of tradable emissions permits for carbon dioxide has already begun in a number of countries, and could play a very significant role in future climate change abatement activity.

Transportation

Some of the major forms of transportation generate significant environmental impacts through the emission of various pollutants (*e.g.* NO_x and ozone). In many cases, those transport modes receive substantial amounts of subsidization through preferential tax treatment or via government provision of infrastructure. OECD (2002) examined available data on subsidy levels and concluded that, even in countries with substantial fuel taxes, subsidies to transportation are large. From an environmental perspective, however, certain subsidies are more harmful than others. Subsidies that go to rail transport, for example, have substantially less impact on the environment than those that go to diesel-fuel consuming trucks.

For biodiversity, the direct impact of subsidies to transport comes through two major sources, one of which is direct, while the other is indirect. Mader (1984) shows that roads can create isolated populations of flora and fauna, which MacArthur and Wilson (1967) argue become less resilient and more susceptible to extinction. Road density (*i.e.* length per unit area: km/km^2) has been found to be a critical factor in the survivability of species within a given area (Forman and Herpsberger, 1996). Large predators, such as wolves and mountain lions, have difficulty maintaining viable populations in the United States when the density reaches 0.6 km/km^2 (in the UK there are few areas that have densities below this level).

Perhaps the most biodiversity-related repercussions of transport is one that is both indirect (often accidental) and not easily quantified. Perrings *et al.* (2000) explore the economics of invasive alien species and find that substantial costs to both economies and environment occur through the introduction of non-native species to environments where they have no natural predators. In some cases, they cause economic damages which have been estimated to be very large on an annual and ongoing basis. For example, in the US, the European Zebra Mussel, *Dreissena polymorpha,* has infested over 40% of internal waterways and may have required between USD 750 million and USD 1 billion in expenditure on control measures between 1989 and 2000. The damage to biodiversity is also very large because entire ecosystems are often impacted and changed by the intruder. Transportation of people and goods is the primary factor behind this phenomenon. Careful consideration would have to be given to determine the extent to which non-internalisation of the impacts of invasive species represents an indirect subsidy to that industry.

Fisheries

Given the inherent "problem of the commons", one would expect over-fishing to occur in the absence of government intervention to protect the collective good. The impact, therefore, of public assistance to fisheries is difficult to distinguish from other sources of influence – they mostly operate through the same channels.

High prices for fish and fish-products may also be reflective of problems with the resource, rather than causes relative to public subsidy. When scarcity increases, prices will rise to reflect the conditions of demand. Higher prices will reflect the fact that fishers are spending more time and effort in catching specific species (the fish are scarce). Since the return that each individual fisher receives will always be greater than that which accounts for the impact on other fishers (the "problem of the commons"), the incentive to over-fish may remain until the price becomes exhorbitantly high. If fish populations exhibit non-linearities in the impacts of continued reductions, permanent damage may occur which markets may be unable to avoid.

One area where subsidies are known to have a large impact is in the way in which the industry catches fish. Some observers find that the capital used by fishers changes substantially in response to incentives thrown up by policy (*e.g.* Flaaten and Wallis, 2000). Perhaps the most serious impact of fishing methods on biodiversity is through by-catches that are discarded (lowering species population) and bottom trawling that damages seabed habitat (Waitling and Norse, 1998; Collie and Russo, 2000). These can be aggravated by subsidies when they help sustain non- or marginally-profitable fishing.

Box 5.6. **New Zealand ITQ**

The environmental objective of the ITQ was mainly to ensure that the fisheries are exploited at a level that promotes long-term sustainability. Other social factors within the fishing communities were not intended to be part of the goals of the ITQ scheme – though they could be addressed through other means.

Quotas are created in two dimensions: species and location. In 1998, the total number of species covered by the program was 33, which were traded to varying degrees in 157 markets (*i.e.* there are numerous geographical regions but not all species are traded in all regions. Each year, the Minister of Fisheries sets a total allowable catch for each species that is based primarily on a biological assessment of the stock, but also accounts for environmental, social and economic factors. This allowable catch is the basis on which the transferable quotas are created. Consultations occur between government departments, scientists, industry and environmental representatives to determine the allowable catch. The explicit objective of setting the allowable catch is to move the fish population to the level that will support the maximum possible sustainable annual catch.

Since ITQs are individually held by fishers, changes in the allowable catch would have to be reflected in changes in the ITQs. If government had to buy "excess" ITQs in order to ensure the allowable catch was respected, it would be assuming all risk inherent in annual changes. On the other hand, if an ITQ specified that it represented a certain fraction of the allowable catch, then fishers would bear the annual risk. In New Zealand, the choice was made to have the fishers bear the risk so the ITQ is specified as a percentage of the allowable catch.

Source: OECD (2004).

Market creation that benefits biodiversity in fisheries is seen in a number of examples of countries creating limitations on fishing in the form of quotas and then making the quota rights tradable. The individual tradable quota (ITQ) in New Zealand is perhaps one of the best examples of a system that has created a sustainable fishery that has reduced its environmental/biodiversity impact. It was implemented as part of the 1980s reforms that occurred in New Zealand which deregulated many industries, and removed most subsidies.

Forests

The provision of roads and infrastructure can be a crucial factor in both forest use and the preservation of forest ecosystems. Rodgers (1997), for example, points out that, following a period of sustainable forestry management in Côte d'Ivoire, large-scale forest loss began to occur when roads were built that permitted easy access to densely forested areas. As a result, 79% of the forested areas have now been cleared. Moreover, they have been left in a state that makes it difficult for the forest to regenerate itself. The provision of subsidized roads appears to have been the key factor that made the difference between a gradual harvest over a long period of time, and a rapid cutting down of the forest. The implication is that when the forestry companies face the full cost of getting the wood, its use is closer to a sustainable level.

How much the assistance given to the forestry industry affects changes in biodiversity is difficult to quantify, given that the most important component involves measuring what the fees for logging *should have been,* as opposed to what *was* paid. In an interesting analysis of the difference between sustainable and non-sustainable forestry management, Howard (1997) examines the opportunity cost of ecosystem management in the Pacific Northwest of the US. The study looked at the harvest value of forest resources and compares that to its economic value if 100 or 200 year harvest cycles were used. These longer cycles would reflect the need to maintain sufficient old-growth forest so that species dependent on it would not be threatened. The results found a substantial difference between management schemes, suggesting that if species-preservation is a socially desirable objective, the implicit subsidy given to industry is large. A straightforward interpretation of this result suggests that stumpage fees are failing to reflect the social opportunity costs of the harvested wood.

Removing subsidies for forestry is perhaps one of the strongest steps that can be taken in market creation for biodiversity. The non-timber uses of forests where markets could form include high value services as:

- *Gene pool:* Forests provide a reservoir of diversity of habitats, species, and genes. Unfortunately, this characteristic is difficult to measure in an economic sense because it is difficult to monetise. For example, forests provide the changing conditions of climate and soil and can provide the raw materials for breeding higher-yielding strains.

- *Water:* Forests absorb rainwater and release it gradually into streams, preventing flooding and extending water availability into dry months when it is most needed.
- *Fisheries:* Forests protect fisheries in rivers, lakes, estuaries, and coastal waters. There are roughly 112 stocks of salmon and other fish in the Pacific Northwest that are believed to be dependent on natural, old-growth forests.
- *Climate:* Forests have an important role stabilising climate. Tropical deforestation removes carbon sinks and releases the greenhouse gases carbon dioxide, methane, and nitrous oxide.
- *Recreation, tourism:* Forests serve as recreation destinations and as tourist attractions. Forest biodiversity values for recreation are slowly becoming better known and measured. Given the very large, and growing, expenditures on recreational activities, the value of forests in their natural state has been argued to be substantial. Some of this value is reflected in the global increase in protected areas that was witnessed during the 1990s.

These various values of forests have been estimated by some researchers and have been found to rival the value of timber. For example, it was estimated that the value of tourism and recreation in and around the Australia's Wet Tropics World Heritage Area was USD 377 million in the early 1990s. Logging (partially subsidised) in those areas would have had a negative impact on tourism, the effect depending on logging practices, and the attraction of the area involved. Tourism activity was clearly in a position to rival the value of the region as a source of timber. In such situations, subsidies can make the difference between various potential uses of forests. Reducing the subsidies (both explicit and implicit) given to forestry activity would therefore strengthen the ability of markets to provide the services mentioned above. When this is done simultaneously with the institution of competitive bidding for extraction rights (as was done in Victoria and Western Australia), market creation through competitive bidding can ensure that the forest is used for the best social purposes.

Reforming harmful subsidies

As was noted at the beginning of this discussion on subsidies, market creation can be impeded by subsidies that distort relative values in the market place. The reform of subsidies is therefore an important element of a market creation strategy.

Given the inter-connectedness of the economy, some effort needs to be made to distinguish between incentive measures that are unambiguously harmful and those that actually provide some benefit. While many subsidies

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are harmful to both the environment and the economy, the positive effects cited in some studies (*e.g.* Fullerton and Mohr, 2003) also call for careful consideration. It may also be possible to substitute a biodiversity-harmful subsidy for one that achieves the same social objective without harm. At an abstract level, since all policy instruments distort market outcomes in some way, when more than one instrument is available, each should be used until the marginal welfare losses are equal among them. Part of that calculation should, of course, account for the tendency for incentive measures in the form of subsidies to be over-used.

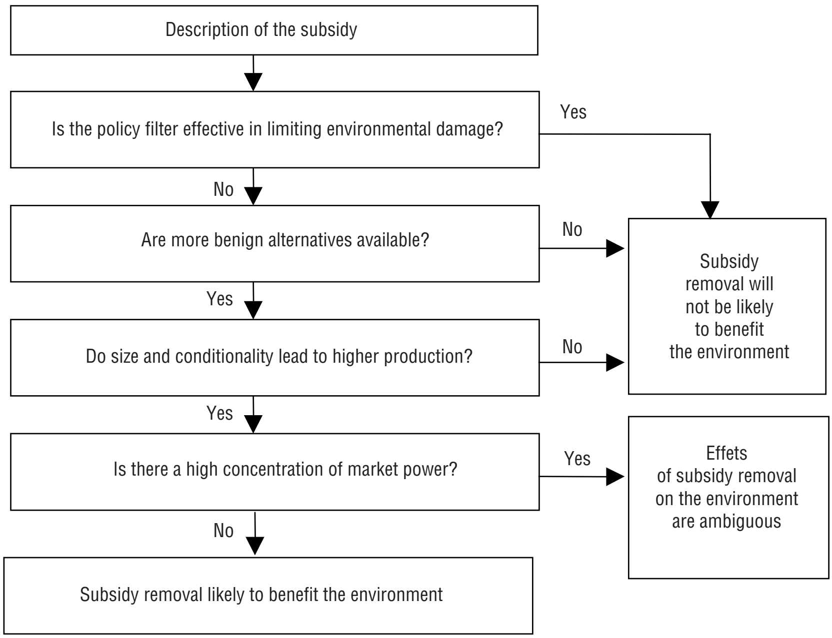
Significant subsidy reform has already occurred in a number of countries/ industries, and the results have generated considerable benefits for government finances, as well as some tentative environmental gains. New Zealand, for example, removed many of the supports it was providing to the private sector across a wide range of industries. In sectors like forestry, responsibility for activities such as tree planting was given to the industry. Ten years after that change, more trees were being planted by the private sector than both public and private sectors combined had previously done (Rhodes and Novis, 2002). Other industries have also successfully made the transition from receiving assistance to self-sufficiency.

Quantifying incentives, however, remains incomplete, and considerable work is still to be done. In many cases, data are simply unavailable. In others, data are not comparable across sectors of the economy (Steenblik, 2003). In OECD economies, many incentive measures are explicit and therefore potentially quantifiable. Some measures, however, are less obvious and are dominated by cases where external effects on the environment are not accounted for in private decisions. These hidden incentives tend to occur more frequently in non-OECD economies.

The complexity of interactions in the economy calls for the use of numerical tools that are capable of illustrating the wide range of repercussions of policy initiatives. The tools that would be most useful are those that could incorporate many of the existing sources of distortion in the economy, so that analysis could explore policy options in a "second-best" context.

A useful starting point to examining incentives for potential removal would be the "Checklist" that was suggested by Pieters (2003) for exploring which subsidies do the most damage and are the most easily reformed. The Checklist is intended to identify significant instances of environmentally harmful subsidies. It provides a series of questions for ranking the options for subsidy removal according to their possible environmental harm. It explores the link between subsidies and the regulatory and resource management frameworks already in place. It then tests whether the subsidy operates in a way that leads to an increase in production processes with negative

Figure 5.1. **"Checklist" to determine if a subsidy is harmful**



Source: Pieters (2003).

environmental impacts. Finally, it leads to an assessment of whether the impacts are unavoidable, or if other measures could mitigate the harmful effects.

Notes

1. Total economic value refers to the full range of economically valuable aspects of biodiversity, see Chapter 4.
2. For completeness, it should be noted that there have been some who have questioned the equivalence of the "created" wetlands being used to offset the original ones that are being lost.
3. Since market economies are generally either at, or close to, what can be termed a "dynamic" equilibrium, impacts in one sector will *necessarily* spill over into others. However, in an economy with a number of taxes and other government policies impacting on production and consumption, it may become difficult to determine the *net* impact of a particular measure. "General equilibrium" implies that many sectors will be indirectly impacted by policies introduced elsewhere; therefore, determining the amount of harm done by a particular subsidy needs to begin by first accounting for the impact of other policies.
4. This is an area comparable to the landmass of Germany.

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Chapter 6

Policies Facilitating Market Creators

The influence of non-government participants in forming and sustaining markets can be just as powerful as that exerted by government policy. Policies that take into account and harness these other participants can have a much greater impact and are more likely to be successful. Information regarding biodiversity impacts can be important since many consumers are willing to pay a premium to reduce that impact. Creating the structures for the provision of accurate information can be a pivotal step in developing markets. In many cases, non-government organisations can be encouraged or empowered to provide information. Financial markets can also play an important role in getting markets up and running, by providing the necessary funding for startup firms. Any encouragement given to financial firms would involve ensuring that the public values of biodiversity are reflected in the private returns to investments in activities that are biodiversity-friendly. Facilitating markets is also part of the process that is engaged through scientific and technical capacity-building. Knowledge of biodiversity is important for understanding its public value and is thus a foundation for getting markets operating at a level that is consistent with the maximum of social benefits from all biodiversity's facets.

The role of governments in setting up and directly influencing markets, as outlined in the preceding sections, is of primary importance in ensuring that biodiversity's resources are used sustainably. There are, however, important roles for other stakeholders (and lesser roles for government) in *facilitating* market creators. Direct activities that aid market creators include the development and enforcement of certification systems. Indirect activity includes such things as the provision of helpful information, the organisation of voluntary activity, the development of scientific capability, and supporting the engagement of financial markets. All of these activities are capable of deepening markets and enhancing the gains from them. Encouraging their formation, whether by favourable tax treatment or by other initiatives can be done by government with careful forethought. The objective of the government here is to provide the policy structure that facilitates market creation by private entities, such as investment funds and certification agencies.

Information instruments

The provision of information related to a product is an important part of the "package" that is being purchased by consumers in the marketplace. As discussed before, the consumption of biodiversity often comes in complicated bundles. For example, biodiversity goods and services might be part of a bundle consisting of the purchase of sustainably harvested timber. At the same time, the demand for information has increased as economic specialisation makes the "distance" between consumers and producers greater – often consumers know very little about how their goods were produced. Finally, consumers tend to value the environment more as incomes grow, and so consumers demand more information of this nature as their economies develop. Consumers are unable to perceive the biodiversity inherent in these products, as they are unable to ascertain the production methods used in the production of that good. Although it is clear that many consumer groups value these goods and services, it is difficult for them to acquire the information that enables them to purchase them in markets.[1]

Providing information so as to assist consumers in making these consumption choices itself has a cost. Providing such information in a credible manner is very difficult, on account of the "lemons" problem outlined previously (Chapter 2). Every producer has the incentive to provide

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information indicating that biodiversity is inherent in its products but, perversely, has an equal incentive to do so without incurring the costs of producing those goods and services. Segregating between those producers whose claims are true and those whose claims are false is an important role in these markets.

One option is for governments to require specific labelling information to be provided for specific types of consumption goods. These involuntary labels often convey information that is important to proper use of products in cases where health and safety may be at issue. They sometimes require manufacturers to provide cautionary information so that consumers can be informed regarding risks involved in using the product. Mandatory labels on packaged foods are intended to convey information that allows individuals to make lifestyle choices regarding the nutritional value of foods. In other cases, such as with some processed agricultural good in some countries, mandatory labels may convey information with regards to the appearance and processing of the product rather than its health or nutritional content. In each of these cases the government acts as the entity specifying the standards, monitoring for compliance and certifying compliance for the consuming public.

Another option is for a standard or metric to be established by an independent group (*e.g.* the insurance industry's Underwriters' Laboratories) but for the government to take responsibility for monitoring and certifying compliance. In such cases, the government is certifying that anyone using the label has met the standard. Other measures may also be implemented. The standard might be certified by some independent, nongovernmental entity, alternatively the standard might be set and certified by the producer itself.

Certification as a practice is not a universal success story (OECD, 2003). The proliferation of labels (and the disillusionment with them by consumers in some countries) poses a significant challenge. The success of eco-labels in gaining market share has naturally spawned defensive measures by competitors. Many forms of defence involve diluting the value of the label by creating a proliferation of alternatives. Where this defence is successful, it can lead to greater scepticism toward labels in general (OECD, 2003, reports on significant differences scepticism toward labels across OECD countries). The use of pseudo-labels imposed and certified by firms upon themselves constitute little more than advertising, and create a "lemons problem" in the market for certification. In general, the problem of certification continues to require governments to address and resolve the underlying problem of information requirements of consumer groups.

For policy that is concerned with incentives for biodiversity, the lesson that comes from these observations is relatively straightforward: a commitment to developing markets for biodiversity-friendly products must include strategies for the provision of information. This can take many forms. For example, policy may be primarily designed to establish or reinforce the rigor of claims made as to the biodiversity relevance of products. Alternatively, it may provide a clearing-house function – where information is collected and stored in a form that is easily accessed by consumers (perhaps in comparative formats for easy reference). The simple act of drawing attention to information concerning the definition and origin of product labels would, in itself, constitute an important step in ensuring that labels are effective tools for biodiversity conservation and sustainable use.

Involuntary information instruments (e.g. mandatory standards and government labels)

The most direct approach to resolving the information requirements for these markets is for the government itself to specify information requirements. Important characteristics of many goods and services – that individual consumers would otherwise have to learn in a duplicative, wasteful process (*e.g.* regarding the effectiveness of a drug or the performance of an appliance) – are thus readily available. Social welfare is improved because the cost of providing and acquiring the information is minimised.

In this spirit, governments impose standards that must be met if a biodiversity-related product is to be produced and sold. As discussed in Chapter 2, one example of this is the mandatory standard in the Convention on International Trade in Endangered Species. Countries are required to ban trade in the species that are most at risk, but they also provide information relating to those that are vulnerable.

For organic agriculture many OECD countries have moved to government-backed labels that require standards to be met for use of the label. The term *organic* has not been reserved to the exclusive use of the government label, instead it is the label itself that guarantees a particular standard of organic production. For the organics industry, information is the prime marketing ingredient. The final product is generally cosmetically similar to non-organic products so the information to distinguish organic from the others is crucial. Since consumers have been willing to pay premiums of up to 25% for organic products, there is an important incentive to getting recognition for the product – especially since the cost of producing organically is often higher than with conventional farming techniques.

Organic agriculture is part of a broader labelling issue that covers many aspects of the goods available on the market. More broadly, eco-labelling has been growing in use during the past decade to the extent that there are now a wide variety of proposed and used labels. OECD (2003) reports that, globally, there are dozens of different schemes that based on either voluntary or non-

Box 6.1. **Swan Eco-label**

The label shows that the product causes less environmental impact in one or more areas than other products in the same product category. For a licence to use the label, the producer or importer must prove that the product complies with certain criteria in terms of its impact on the environment, its quality, operation, etc. These criteria are also drawn up on the basis of a lifecycle analysis and are set so that a third of products on the Nordic market are eligible for the label. The criteria are agreed by the five member states of the Nordic Eco-Labelling Board and are revised every three years. Producers and manufacturers must apply for a licence to use the Swan label on their products before they can be sold on the Nordic market.

voluntary standards. One risk with this wide-spread use of labels is that consumers may find it difficult to distinguish between them and are then overwhelmed when making choices. While this is indeed a real risk, it should not be over-emphasised. It may take time for the market to distinguish between those that provide information of value to consumers and those that are "noise". In the long term, the market will punish those who take advantage of consumers of providing information that is intentionally misleading or frivolous. Clearly, labelling has an important place in the market. The question that may remain is how its usefulness will ultimately be adopted.

Voluntary schemes

Other more voluntary eco-labelling schemes also may attempt to provide consumers with useful information. Since consumers have shown a willingness to pay premiums for goods and services that address environmental concerns, markets to capture those premiums have naturally arisen. For biodiversity, this means that providing information which is particularly relevant to biodiversity concerns may find market niches among concerned consumers. See Nunes and Riyanto (2001) for an overview discussion of voluntary eco-labelling schemes.

While an optimal outcome might be to have biodiversity addressed through unique channels of information – such as specialised labels, etc. – this is not always required (or, in some cases, even desirable). Addressing biodiversity concerns by allowing consumers to make informed choices between products can be accomplished through a number of different approaches. Existing labels may be enhanced to incorporate biodiversity concerns, or information can be provided by other means (*e.g.* information

Box 6.2. **Certification of marine ornamentals**

Marine ornamentals (*e.g.* ornamental fish, clams, plants, live rock and associated resources) are extracted from coral reefs (mostly located in the developing world) and sold to aquarium hobbyists (mostly residing in OECD countries). In the early 1990s the global trade volume in marine ornamentals was around USD 10 billion providing significant employment possibilities to local people in exporting countries. In fact, marine ornamentals are considered as one of the highest value added products possible to harvest from coral reefs, bringing a higher economic return than most other reef uses.

Destructive harvesting techniques and over-fishing for marine ornamentals have brought about environmental damage to reef ecosystems and have jeopardised the livelihoods of local communities from exporting countries. At the same time numerous sources of information suggest that aquarium hobbyists would support an industry that produces quality products using sustainable practices – both for ethical/environmental concerns as well as for personal reasons (*i.e.* these products are considered to be better value since they have a longer life span). Yet, despite the existence of the appropriate demand and supply conditions, a market for sustainable marine ornamentals that would provide incentives for the conservation of coral reefs has been missing. This can be attributed to the absence of a certification mechanism that would ensure the environmental standards of the product being sold.

In response to this institutional void the Marine Aquarium Council (MAC) was established in 2000-2001 consisting of 2 200 stakeholders from the marine aquarium industry, conservation groups, government agencies and the scientific community. The aim of the MAC was to establish a certification program that distinguishes marine ornamentals that were acquired using techniques that do as little damage as possible to coral reefs and other aspects of marine biodiversity. As a result, the certification programme facilitated the creation of a market for sustainable marine ornamentals.

Source: Holthus (2001).

campaigns, internet websites, etc.). In some cases, the link to biodiversity is important enough that it is able to generate premia in excess of 25% over other products (Nieberg and Offermann, 2003). Examples of three major labelling organisations already exist relating to biodiversity are: the Marine Stewardship Council, (a certification programme for sustainable fisheries sponsored by the World Wide Fund for Nature); the Forest Stewardship Council, (a certification programme for sustainable forest management sponsored by the World Wide Fund for Nature); and the International Federation of Organic Agriculture Movements, (a certification group for organic agriculture).

A particularly successful example of a voluntary scheme is the International Federation of Organic Agriculture Movements (IFOAM). It brings together organizations involved in organic agriculture throughout the world into a collective umbrella – giving it some influence on the world stage. In some cases, it has even had influence on the specification of national legislation. Its success is seen in the widespread development that organic agriculture experienced even prior to its adoption by many governments. Since organic agriculture has some association with biodiversity benefits (OECD, 2003),[2] it is a natural channel for promoting biodiversity goals.[3]

Markets for "certified" environmental products may have either a direct or an indirect impact on biodiversity. The example mentioned above of organic farming falls in the second category. A similar example is that of markets for certified renewable energy (Nunes and Riyanto, 2003). Other certification programmes are designed to have a more direct impact on biodiversity. These mainly concern markets for goods and services that are directly produced from biological resources. Examples include markets for goods from coral reefs (Holthus, 2001; Cesar 2001), timber products (Baharuddin, 2003; Pearce, 2001; Kahn, 2001), non-timber products (Acharya, 2001; Kahn, 2001), wildlife (Hutton, 2001), and certified ecotourism services (*e.g.* European Charter for Sustainable Tourism in Protected Areas).

One of the most recognized certification program for tropical timber is SmartWood which certifies sustainable forestry operations in the Brazilian Amazon. This program has already had an important impact on the profitability of the forestry operations that have gained certification for their timber. Recently, one of the world's largest chain of home improvement stores agreed to sell only eco-certified wood products (Kahn, 2001).

Financial instruments for biodiversity

On a broad level, the role that financial markets play is to direct available financial resources from one part of the economy (world) where savings are occurring, to another where investment is required. The specialised knowledge of local branches in local markets, combined with the national and even international coverage of some financial institutions allows, in principle, for savings in one region to find its way anywhere in the world where it can be used most profitably. As a result, investors often participate in unfamiliar markets at a great distance from their own location and experience. Many investors, as with consumers, are interested in placing their funds into places and projects that combine reasonable financial returns with flows of other

Box 6.3. **Financial markets and biodiversity conservation**

Over the past few years a range of financial products have been developed that promote biodiversity conservation. These include:

Leased products

With operational environmental leases, the banking institution itself invests in a capital asset that has a positive effect on the environment (*e.g.* energy conservation of environmental protection equipment).

Thematic project-related investment funds

These are investment funds for specific sustainable projects (for example, wind energy, organic agriculture, innovation, forest plantations, climate projects).

Share investment funds (or mutual funds)

Investment funds which invest in shares of companies that meet sustainability criteria. This form of investment is expanding very rapidly.

Venture Capital

Venture capital firms invest in companies that have not yet gone public. Often they have some knowledge of the industry in which they are investing, but more likely they are interested in a "business model" and the firm's potential.

Fiscal green funds (including Green mortgages)

These are funds in which the government provides fiscal encouragement to make the system more effective. The funds provide soft loans to environmental projects. The Dutch green funds are an example that will be discussed extensively below.

Payment accounts

There are payment accounts in which a part of the transaction is donated to causes that are associated with nature or the environment (*e.g.* to the WWF).

Savings accounts

These include types of account in which the bank guarantees that the deposited capital will only be invested in companies or projects that make a contribution to sustainable development.

Source: Bellegem and Eijs (2001b).

goods and services that are important to them, such as biodiversity. Many financial advisers and funds may advertise that they are willing and able to provide a combination of services, both financial and environmental, but once again this requires some form of certification. Standards, monitoring and certification are essential to inform consumers of financial services, just as they are for consumers of other goods and services.

Role of governments in facilitating financial markets

As mentioned earlier, financial markets serve the role of linking sources of funding with investment opportunities. In the case of biodiversity, opportunities for investment in projects that could combine flows of biodiversity goods and services are found frequently in regions of the world where little financial-market infrastructure exists. One role of government in this area might be to develop funds that focus on regions where development projects and biodiversity conservation might be compatible. Government initiated funds and activities are potentially one means of channelling some of the funding available from capital markets into areas that would be beneficial to biodiversity (see Box 6.4).

Since biodiversity conservation activities inevitably provide some of their services (and returns) in non-marketed form, it is likely that the returns from such combined investments will be lower than those available from other industries. However, the return that investors have received thus far on "environment friendly" businesses has been comparable, if not better, than many other industries (OECD, 2003). For this to continue, it is likely that governments will have to be actively involved in the sponsorship of investment activities that combine biodiversity conservation and economic returns. In principle, government initiatives should occur to the point where non-marketed benefits of biodiversity are fully internalised into the economy. Just as with other government-encouraged initiatives, favourable tax treatment of biodiversity conservation activities makes sense to the extent that social returns exceed the private ones. Such complementary activities might include targeted tax deductions, favourable capital gains treatments, or even some form of government backing that may translate the activity into a low risk opportunity.

Finally, the government can also play the more indirect role in financial markets that it plays in other markets concerning biodiversity, *i.e.* the role of standard-setter and certifying organisation. The claims of many enterprises concerning the worthiness of their projects lack essential credibility, absent some independent form of verification. The government is a natural source of such standards and certification in this arena as in the case of consumer goods. Its ratings of the various financial mechanisms would be important for enabling the unsophisticated investor to assess the environmental claims of competing funds.

Box 6.4. **Thematic project-related investment funds in the Netherlands**

The Green Investment Fund is a scheme initiated by the Dutch government in which private individuals can put their savings or investments into a "green fund" that is exclusively invested in environmental projects (*e.g.* forestry, organic agriculture, nature conservation, etc.). That is, the fund operates on a project base and not on a corporate base (*i.e.* it does not buy shares as in the case of mutual funds). Interest and dividends derived from this green fund are exempt from income tax. By ensuring that investors' returns on such projects are untaxed, this allows them to compete with the returns of regular investment funds on the market. The aim of this tax concession is to encourage investment in major environmental projects, involving forests and nature areas, sustainable energy supplies and environmental technology.

The presence of tax advantages is one of the major incentives for private individuals to participate in the Green Fund System. However, in practice, private savers benefit from the tax exemption only to a small extent since the gains are counter-balanced by a usually lower rate of return. Despite the moderate gains, investors continue to participate in the fund partly due to environmental reasons and partly due to its low risk. Most of the tax advantage is applied to provide a lower interest for entrepreneurs investing in green projects. The rate is usually about 2% less than commercial interest rates. This is possible because of the lower interest rate obtained by savers. The GIF has proven a fast growing and highly successful financial instrument for providing capital to sustainable projects.

Source: Bellegem *et al.* (1997).

Venture capital

Since many of biodiversity's goods and services have the potential for commercial application, in the areas of biotechnology or medicine for example, it may make sense to think of the development of financial markets in these fields as attempts to appropriate complex flows of benefits from biodiversity. A specialised segment of financial markets deals with investments of above average levels of risk at early stages of development; this is the "venture capital market". Participants in that market generally understand that their investments are vulnerable but that risk is tempered by the potential for substantial returns. A number of venture capital firms have been operating with at least part of their interests in biodiversity. Many of these combine the enthusiasm of non-governmental organisations with the skills of private entrepreneurs and investment experts. The EcoEnterprises

Fund is a creation of the Nature Conservancy and focuses on environmentally compatible businesses in Latin America and the Caribbean in partnership with non-profit organisations (see Box 6.5).

The appearance of such hybrid funds is particularly beneficial for biodiversity because the managers have more freedom to invest than do their counterparts in mutual funds. A similar instrument, the Sustainable Equity Fund (SEF), is being created in Costa Rica (see Geelhaar, 2001). The fund will mainly invest in companies from the organic food and sustainable timber industries. Some prominent initiatives have provided lessons in how difficult this terrain is to manage. These include the Terra Capital Fund which operated in Latin American countries for a number of years (see Moles, 2001; and Box 6.6).

While mutual funds are primarily interested in buying shares in companies that are (or will be) publicly listed, venture capital firms invest much earlier and generally sell their interests in the firm when it becomes of interest to the public. Often they have some knowledge of the industry in which they are investing, but more likely they are interested in the business model that the firm is pursuing and the firm's speculative potential. This is a financial model that fits well with biodiversity development. It is important to combine sophisticated or motivated investors with speculative opportunities to appropriate returns from biodiversity projects.

Venture capital is a useful addition to other sources of financing for biodiversity, but it needs to be placed in a particular context within those other instruments and processes. It is useful only for combining either very sophisticated or highly motivated investors with speculative projects investigating potential usefulness of biodiversity. Governments need to regulate these markets to ensure that the investors involved meet these requirements, and that the activities pursued operate as advertised. Venture capital may continue to flow to these activities so long as governments manage the markets to keep the unscrupulous operators from preying upon the uninformed investors.

Debt-for-Nature swaps

It is also possible to operate more indirectly through financial markets in the furtherance of biodiversity conservation objectives. One possibility is to invest in acquiring debt (rather than equity shares) that may then be exchanged for the supply of biodiversity goods and services. Various debt-for nature swaps (DfNSs) have been developed since the late 1980s that as a means for inducing heavily indebted developing countries to preserve biodiversity. The schemes absolve a country from part of its debt conditional on the provision of certain biodiversity services.[4] Pearce (2004) notes that

Box 6.5. **EcoEnterprises Fund**

The EcoEnterprises Fund consists of two components: a USD 6.5 million Venture Fund that invests in small- to medium-scale environmentally compatible enterprises in Latin America and the Caribbean, and a USD 3.5 million Technical Assistance Fund that covers fund management costs and provides business advisory services to prospective projects.

The Venture Fund invests in companies at all stages of development. It provides financing to kick-start a long-term growth process in each venture. Investments are structured using a variety of instruments, including:

- Minority equity participations.
- Subordinated debt with equity features.
- Debt securities.
- Combinations of these instruments.

Decisions regarding financing instruments are based on considerations as:

- Needs of the enterprise.
- Potential benefits to conservation.
- Other environmental and social aspects of the project.
- Economic and financial situation of the country.
- Projected rate of return.
- Development stage of the enterprise.

Exits on the equity include negotiated buyouts, sales of companies, and payouts through earnings.

The **Technical Assistance Fund** covers land management costs and pays for business advisory services to prospective projects and their nonprofit partner organisations.

Business advisory services can include:

- Business planning.
- Marketing.
- Training in technical subject areas such as ecotourism and organic agriculture.
- Financial control and accounting.
- Establishment of environmental indicators and monitoring programs.

The complex nature of the fund, part-development project and part-environment project, provides the biodiversity-related project with the capacity to pursue complicated forms of production. The charitable nature of the backing also makes clear that the potential returns may come entirely from biodiversity flows rather than financial flows.

Box 6.6. **Terra Capital Fund**

The venture capital fund was established in 1998 by a partnership of agencies from the financial, banking and conservation sectors. At one point it was worth USD 25-50 million.

Assessment in 2002

- Portfolio was considered too risky, with no assurance of returns after 3 years.
- Manager had to adopt a proactive, attitude in problem deals, therefore increasing the risks to shareholders.
- A development "type" work was required, but no structure had been foreseen to tackle this limitation.
- Steep learning curve (first two projects were bad investments).
- Very difficult operating environment (from a macroeconomic and regional basis), with most sectors suffering from informal competition.
- Governance of the fund was jeopardized by small scale. Close monitoring of the board was not cost effective.

Conclusions for Investors

- Terra Capital did not meet expectations of investors.
- Lessons learned on structure:
  - Make it simple.
- Lessons learned on Operations:
  - Create track record prior to setting up the fund (do pilot projects, direct investment, etc.).
  - Allocate resources to training both managers and entrepreneurs.
  - Be sure the risk profile of the activities is constantly aligned with expectations of key investors.
  - Be careful with tropicalizing "advanced" countries' models. What works in the US probably does not work in Latin America.

Source: Moles (2003).

DfNSs are clear forms of markets creation: "the indebted country has the property rights to a natural resource and accepts some attenuation of that right in exchange for payments by the beneficiaries of the resulting conservation. The involvement of at least the host government is necessary because rights are being attenuated and because issues of national sovereignty arise. But government involvement also helps reduce transactions costs. The involvement of lender governments is also clearly necessary where the debt is official debt".

Pearce (2004) and Sudo (2003) highlight the characteristics of these programmes:

- All swaps have been confined to debts owed to private lenders such as commercial banks – and official bilateral debt, *i.e.* debt owed to foreign governments. No multilateral debt (*e.g.* World Bank loans) is involved in the swaps. This has limited the prospects for developing this instrument.
- The swaps involve the purchase (usually by an international conservation organisation or governments), of the secondary debt of a developing country in the secondary debt market.
- The amount of the debt purchased is quite heavily discounted. That is the redemption price is well below the face value.
- The purchaser of the secondary debt is required to give up the debt holding – usually by converting foreign exchange debt to domestic currency debt – in exchange for an undertaking by the debtor country government, usually through a local conservation NGO, to protect provide some form of biodiversity services (in the form of protecting environmentally important areas, train conservationists, reduce pollution threats, etc.).

Box 6.7. **Dept-for-Nature swaps**

One of the most celebrated debt swaps involving governments and NGOs are those under the Enterprise for the Americas Initiative (EfAI), established in 1990. The scheme included Latin American and Caribbean that had received loans from the USA. The US Tropical Forest Conservation Act (TFCA) of 1998 paved the way for allowing debt reductions against forest conservation. From 1991 to 1993 EfAI conversions amounted to USD 875 million face value, creating local trust funds in seven Latin American/Caribbean countries of USD 154 million. The TFCA has provision for USD 325 million of funding. Another significant government player in DFNSs is Switzerland which set up a Swiss Debt Reduction Facility in 1991. The Swiss programme involves several forms of conditionality: there must be economic reform in the indebted country, there must be rule of law, and there must be a general debt reduction programme in the country in question. The Swiss deals have involved some USD 460 million face value debt or over USD 160 million of redemption value and investment funds (leverage appears to be zero on the Swiss deals).

Source: Pearce (2004).

Table 6.1. **Debt-for-Nature swaps 1987-2003**

Host country [number of swaps]	Donors/Purchasers	Years	Total face value of debt (USD million, rounded)	Total discounted value of debt (USD million, rounded)
Bolivia (6)	CI, EAI, TNC/WWF Switzerland, Germany	1987, 1991, 1992, 1993, 1996, 1997	115	> 10
Peru (6)	WWF, CI, TNC, Switzerland, Germany, Canada, Finland	1993, 1995, 1998, 1999, 2002	232	36
Mexico (13)	CI, USAID (share of one swap only)	1991, 1992, 1993, 1994, 1995, 1996, 1997	5	3
Costa Rica	WWF, TNC, Sweden, Netherlands, NPF, Rainforest Alliance, Canada, Spain	1988, 1989, 1990, 1991, 1995,1999	100	25
Ecuador (6)	Switzerland, Japan, Belgium, WWF, TNC, MBG	1987, 1989, 1992, 1994	> 62	> 19
Nicaragua (3), Honduras (2), El Salvador (2), Jamaica (2), Panama (2), Chile (1), Brazil (1), Colombia (1), Guatemala (2), Belize (1), Dominican Rep. (1)	Germany, TFCA, Canada, Switzerland, TNC, CI, USAID	1991, 1992, 1993, 1994, 2000, 2001	465 (includes 271 in one EAI swap with Jamaica)	> 68
Tunisia (5)	Netherlands	1992, 1994, 1995, 1996, 1997	26	n.a.
Jordan (6)	Germany, Italy, France, Switzerland	1994, 1999, 2000, 2001	203	> 50
Egypt (2), Syria (1), Morocco (1), Algeria (1)	Switzerland, Italy, Germany	1995, 2000, 2001, 2002	528	> 281
Philippines (7)	WWF, USAID, Germany, TFCA	1989, 1990, 1991, 1992, 1993, 1996, 2002	64	39
Vietnam (3), Bangladesh (1)	Germany, TFCA	1996, 1999, 2000, 2001	56	24
Madagascar (6)	WWF, CI, UNDP, Netherlands	1989, 1990, 1991, 1993, 1996,	16	> 7
Guinea Bissau (2), Côte d'Ivoire (1), Tanzania (2), Nigeria (1), Ghana (1), Zambia (1)	Belgium, Switzerland, NCF, DDC, CI, SI, WWF	19891991, 1993, 1995, 1997	51	5
Poland (2)	Polish Ecofund via Paris Club	1992	2 897	571
Bulgaria (1)	Switzerland	1996	20	20
TOTAL excluding Poland (100)			**1 943**	**582**
TOTAL including Poland (102)			**4 840**	**1 153**

Source: Pearce (2004), adapted from Sudo (2003).

Table 6.1 summarises several DfNSs up to 2003. The table provides some indication of the success and future potential of such instruments. First, the deals have predominately focused on "mega-diverse" or "biodiversity hot-spots" countries. Pearce (2004) questions the effectiveness of such a tendency. He notes that hot spot locations tend to be classified as such because they face the greatest threat of biodiversity loss, but those very threats may mean that investments in conservation are very high risk. Further, most swaps involve Latin American and Asian countries. Only fourteen swaps have taken place in Africa. This may suggest that DfNSs deals tend to be reached in relatively more stable countries reflecting their reduced risk profile. Yet, many mega-diverse countries are those with the least investment stability (*e.g.* African nations). Moreover, we observe that in many cases, the swaps involve very small amounts of funds (*e.g.* about half all deals have purchase prices less than USD 2 million). Finally, experience to date suggests that the role of international NGOs in these deals is significant. About 50% of all swaps involved a major NGO, with Worldwide Fund for Nature (WWF) and Conservation International (CI) being the predominating ones.

The actual environmental effectiveness of such schemes is not clear, due to public good nature of the services being traded. Pearce (2004) notes there will be many other beneficiaries who are paying nothing for the resulting protection, so that the actual payment does not measure the *world's* willingness to pay for the conservation. Rather, as Ruitenbeek (1992) notes, the figure is a supply price. Different DfNSs can be expected to come up with different implicit prices since the nature of the "good" being bought will vary (*e.g.* the quality of the area protected will vary, and different packages of measures will be involved). Pearce and Moran (1994) have calculated the implicit "price" being paid for the "average" swap is around USD 500 per km^2 of protected land. Note that, because of free-riding, this cannot be interpreted as an aggregate world value. Whether such is amount sufficient to offset the opportunity cost of conservation is not easy to assess.

Though it appears that such forms of markets can provide an important supplement to traditional means of conservation finance, it is not certain whether they are sufficient to offsets the value of alternative uses *on their own*. Work by SCBD (2001) and Pearce (2003) shows that whereas remote tropical forest-lands have a near-zero commercial value, more lower-land forested areas have an opportunity costs well above USD 500. This would imply that at a minimum some DfNSs are contributing towards the conservation of remote areas that are under lower risk of conversion. Further, due to the absence of a "counterfactual", it is not clear whether the funds devoted towards conservation as result of the DfNS are truly "additional" to the funds that would have been available for conservation generally. Hence, until we have proper *ex post* appraisal of conversion threats and the environmental impacts of DfNSs, it is hard to reach a conclusion (Pearce, 2004).

Scientific and technical capacity-building

A final form of investment in market creation may take the form of investment in fundamental information and research activities. Markets thrive on information and expertise, and biodiversity's markets will function better when the nature of the goods and services are better understood. Governments may fund either basic research in this area, or provide funding for more networks and clearinghouses that enable existing research to be communicated.

Scientific capacity-building is intended to provide the kind of information and expertise that allows countries to realise the potential value of their resources. For biodiversity, it begins from a narrow definition that refers primarily to the collection, systemisation and dissemination of knowledge. On a scientific level, the need for capacity building is clear. Estimates of the total number of species on Earth range between 5 and 100 million. Of these, little more than 1.5 million have been formally described and named in a taxonomic sense. Moreover, the geographic and ecological coverage of the taxonomic knowledge is very uneven globally – for example, two thirds of the known species are insects. However, along with a need for ecological data, there is also a need for socio-economic data such as valuation and attitudinal. Both ecological and socio-economic data are important facilitators of market creation. The agencies involved in these capacity-building endeavours are almost exclusively governmental and non-governmental institutions, indicative of the public good nature of such a service. Examples include the Global Taxonomy Initiative and Millennium Ecosystem Assessment (MA). Markets for biodiversity also have a private-good dimension; hence, there is room for private stakeholder groups to become more actively involved in developing (and funding) such capacity building activities.

Scientific and technical capacity-building facilitates the creation of markets for biodiversity conservation in two important ways:

- Improving consumer and stakeholder awareness, knowledge and information on biodiversity.
- Disseminating sustainable methods for biodiversity conservation to central policy agencies as well as to local communities and stakeholders.

Users of the information from these endeavours are consumers, stakeholders, policy decision-makers, and planners. For consumers, diffusion of information and increasing awareness of biodiversity affects preferences and consequently niche market formation. Such public awareness is vital for biodiversity markets to develop. Stakeholder groups benefit from the dissemination of biodiversity knowledge in numerous ways, such as training in sustainable methods for biodiversity conservation, as well as, production and marketing skills. Such sharing and exchanging of information spreads R&D and production costs and minimises transactions costs. It also helps decision-makers and planners who require a constant flow and exchange of information to help set priorities and policy objectives. Appropriate information gathering and dissemination can also improve monitoring and enforcement of biodiversity – both directly by using the information as well as indirectly through capacity building.

Many countries have put in place national initiatives to promote the dissemination of scientific information and to enhance scientific capacity. The UK Darwin Initiative, for example, has funded Project Biomap in Columbia (among others). USAID has funded the Southern African Botanical Diversity Network (SABONET) and its efforts in collection and dissemination of information. The European Environment Information and Observation Network (EIONET) provides support for the Global Biodiversity Information Facility. Many other examples exist of funding of small-scale data collection activity – especially by OECD countries.[5]

Important global initiatives for the collection, systemisation and dissemination of knowledge of biodiversity include the Global Taxonomy Initiative (GTI) and the the Millennium Ecosystem Assessment (MA). The former seeks to meet the CBD objective of developing worldwide expertise in finding and cataloguing species. Implementation of the GTI is currently at the stage of completing regional workshops aimed at determining the needs of individual countries in carrying out taxonomic research – so prioritisation of taxonomic needs can occur. The GTI is sponsored by government agencies from numerous countries. The MA is the most ambitious scientific capacity building activity undertaken at the global level. It is an international work program designed to meet the needs of decision-makers and the public for scientific information concerning the consequences of ecosystem change for human well-being and options for responding to those changes. The MA was launched by the United Nations in June 2001, and is intended to help to meet assessment needs of the Convention on Biological Diversity, Convention to Combat Desertification, the Ramsar Convention on Wetlands, and the Convention on Migratory Species, as well as needs of other users in the private sector and civil society. The MA synthesizes information from the scientific literature, datasets, and scientific models, and makes use of the knowledge in the private sector, amongst practioners, as well as local communities and indigenous peoples. The MA findings are intended to be scientific results and therefore undergo peer review. A 13-member assessment oversees the technical work of the assessments undertaken by more than 500 authors involved in four expert working groups.

Policies facilitating market creators – conclusion

Governments have important roles to play in aiding other actors in forming new markets. The role as facilitator is a bit more subtle but can be equally important.

The first aspect of this role is as information provider. Just as in the markets for goods and services, governments also have an important role to provide in monitoring and certifying actors and entities in the realm of biodiversity markets. Market creators in the realm of biodiversity can be legitimate operators, or not, and government regulators perform an important function in separating out the sham operators. Without this function being performed, any of these markets may fail for lack of credibility.

The second aspect of this role is as promoter of markets with significant positive externalities. Just as in other areas of private activities with significant impacts on public policy objectives, the government is able to foster these positive externalities through favourable tax treatment or other systematic advantages. This advantageous treatment is justified when the flows of social returns exceed the financial returns, and has already been extended to a wide variety of schemes in a large number of member states.

The third aspect of this role is in the encouragement of speculative markets in activities that may internalise the externalities of biodiversity. This may take the form of sponsorship or backing of some more speculative schemes, or in the funding of information-generating activities. Both fundamental research and networking activities have important roles in providing the base experience necessary for the development of some of the more complex goods and services from biodiversity.

Notes

1. This argument can be inferred from the behaviour of firms who spend considerable amounts of money advertising their environmental performance. Most polling information also reveals strong preferences for clean and natural environments.
2. Jones (2003).
3. Also see Moran (2001), Bellegem and Eijs (2001a), and CEC (1999) for overview discussion of organic agriculture and certification.
4. Other such schemes exist for the implementation of health-care and anti-poverty policies.

5. See *Assessment of the Information Contained in the Second National Reports Concerning Cross-cutting Issues Under the Convention*, document UNEP/CBD/COP/6/INF/10. Available at *www.biodiv.org/doc/meetings/cop/cop-06/information/cop-06-inf-10-en.pdf*.

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Chapter 7

Policy Mixes for Biodiversity

Policy-makers have many approaches and numerous instruments at their disposal for creating markets for biodiversity. Given that there are many objectives to be reached, a full policy mix needs to be considered to achieve desirable outcomes. That mix will need to achieve the appropriate combination of public versus private provision of goods and services, as well as the combination and intensity of instruments that will be used. Since the part of biodiversity that is purely public cannot be easily brought into a market system, it should be dealt with through non-market means. However, many aspects of biodiversity that initially appear to be public can, in fact, be made part of the market economy – and will be best dealt with using the tools and techniques discussed in earlier chapters. The important task for government will be to decide at what point using those tools and techniques are more costly than alternative (less market-oriented) policy options.

The process of creating and developing markets for biodiversity's products and services presents many obstacles for the policy-maker. From the initial implementation of legal and economic frameworks, to implementing many of the specific instruments that make markets work, the very broadness of biodiversity creates challenges to finding effective solutions. Not surprisingly, this sometimes leads to several instruments being implemented that overlap each other in dealing with inter-related problems. Agricultural policy, for example, may influence a wetlands policy, which may overlap with a forestry policy. Even within a limited geographical area such as an ecosystem, several instruments may be in effect. Integrating the various components that were explored earlier (to solve biodiversity-related problems) into a coherent policy is an important process that needs to be explicitly considered. To avoid costly missteps, policy integration should be addressed at the beginning of the market creation process. Nonetheless, occasional systematic review of how well various policies are integrated will help to eliminated unintended overlap and ensure objectives are being met.

This chapter looks at the question of integrating instruments into mixes of policies for biodiversity. As earlier chapters have demonstrated, market creation is an objective that can be attained through numerous means – often operating simultaneously. Since these include non-price measures, it will be important to verify that the combination of instruments is operating to bring about the best outcome for biodiversity in the least economically disruptive manner. Like many complex areas of public policy, the solutions to implementing a framework for the conservation and sustainable use of biodiversity will not be simple or straightforward. Mixes of policies have to be implemented that account for the many dimensions of biodiversity, and to account for whatever pre-existing policies are already acting on the policy issue.

Policy mixes

Biodiversity has many public characteristics as well private ones. This public/private mix engages a discussion of the balance between market and non-market instruments in achieving biodiversity goals, *i.e.* what the policy mix will be. Since the part of biodiversity that is purely public cannot be easily brought into a market system, it should be dealt with through non-market means. But many aspects of biodiversity that initially appear to be public can,

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in fact, be made part of the market economy – and will be best dealt with using the tools and techniques discussed in earlier chapters. The important task for government will be to decide at what point attempting those tools and techniques are more costly than alternative (less market-oriented) policy options.

To see some issues that arise in this policy mix, consider that non-market instruments, such as rules and regulations, can be substitutes for market instruments, but they can also be complements. They can, for example, facilitate or create markets by reducing transaction costs – as is the case when they provide legal contexts in which parties to a transaction have redress if a contract is not upheld. They are substitutes in other situations where, rather than using a price instrument to achieve a particular goal, a regulatory instrument is used which mandates that the desired outcome should be brought about in a particular way.

Another aspect of the policy mix that needs to be considered (and is related to the public/private mix) is the mix of instruments within each group (*i.e.* market and non-market). As was argued above, it will rarely be the case that a single instrument will be sufficient for dealing with the multiple dimensions of biodiversity in particular situations. Getting the mix right within the group of price-based instruments to encourage market development will have to be an explicit part of policy development. Similarly, getting the right combination of non-price instruments to encourage markets will be important.

A policy mix therefore operates on a number of levels simultaneously: the **public versus private** mix and the **intensity of instrument use** (particularly market-based ones) within a mix.

Public versus private goods

As was noted earlier, when goods have a strong characteristic of being public, they will be under-supplied relative to what society would want (and is willing to pay for in terms of trade-offs with other economic activity). The extent, however, to which a good or service is public is not a static issue. It may change over time for a number of reasons, including technological advances that may make it easier to control by whom (and how) a resource is being used. Just as technological advance made it possible to introduce markets in a number of areas which were once dominated by public monopolies (*e.g.* telecommunication and electricity), technology will also impact biodiversity policy. One of the areas where this is most likely to occur is in surveillance and monitoring of biodiversity. Remote sensing and satellite observation promise to make the availability of information, and even the enforcement of policy, a much less costly task in the future (for example, see various articles in Volume 32, Number 8 of *Ambio*, December, 2003).

Box 7.1. **Choosing appropriate measures**

Choosing the appropriate incentive measure requires careful consideration to ensure that the right instrument is used to solve a particular problem. While this may seem obvious, it is not always straightforward. Most biodiversity-related problems have a number of solutions but only one will result in the least cost.

As background, consider the early work that pointed out the equivalence between taxes and tradable permits. Weitzman (1974) studied the circumstances under which one would be preferred over the other. In principle, the two instruments can be used to solve similar problems. In practise, the contexts and outcomes can be very different. Market creation through permits, or quotas, targets quantity but leaves the price increase essentially unpredictable. Depending on the possibilities for reducing the quantity to the targeted level, the price increase – and the economic impact – can be very large. Moreover, day to day fluctuations in demand, as well as fluctuations in the supply can cause daily fluctuations in price, much like exchange rates and other nominal indicators. On the other hand, a tax fixes the wedge between consumer and producer prices but allows quantity to fluctuate. For biodiversity, the distinction can be seen in a fishery. A certain level of fishing will allow the stock to replenish itself, whereas going much beyond that point may reach levels of exploitation that jeopardise the viability of the resource – a real concern for some of the world's fisheries. Fixing the quantity of fish that are allowed to be taken (*e.g.* through an ITQ) and allowing the price of fish products to fluctuate accordingly is the preferred solution.

An implicit lesson that comes from this discussion is that the wide range of circumstances in which biodiversity policy must operate calls for a wide range of instruments. This implies a creative application of the many instruments at the policy-maker's disposal. Unlike some policy areas, which require an exceedingly careful application of a limited number of policy levers (*e.g.* monetary policy), creating markets for biodiversity is a multifaceted endeavour. Broad knowledge of the strengths and weaknesses of each policy instrument is therefore essential to address most efficiently, and effectively, the problem at hand. Policy analysts working in this area are called upon to develop that broad knowledge and be able to apply it to suit particular situations. The conceptual discussions provided in this Handbook, as well as in other related work, provides a means for thinking through the various policy contexts and selecting a good fit between instrument and problem.

Policies for predominantly private goods

When a good is predominantly private, market creation will likely result from the simple establishment of legal frameworks that reduce the costs of acquiring information (concerning characteristics, quality and price of products) and enforcing market rules. Once markets have been established, enhancing their performance will generally be more efficiently achieved through the use of market (*i.e.* price) instruments than through alternatives. The reason for this is that market instruments have lower information requirements. That is the policy-maker needs to know the (socially desirable) objective, and to be capable of manipulating policy levers to achieve that objective. However, the actual details of how best to get there is left to individuals and firms.

Policies for predominantly public goods

When goods are not suited for private markets, a different type of policy intervention will be needed. For public goods, the focus of policy will be on attempting to ensure that the link between the benefits received by people and the payments (implicit or explicit) made to maintain the resource are in balance. The essential problem of a public good is its lack of economic scarcity. That is, in a market economy, biodiversity will only have substantial value if it is scarce relative to how much humans want/need. Ensuring that all its uses and functions are understood can help in determining how much is needed from the point of view of human comfort and health – thereby helping to define its level of economic scarcity. Getting a handle on the inherent values that people place on biodiversity-related resources will also help to ensure that its use reflects the desires of people to maintain biodiversity.

More importantly for the purpose of exploring policy alternatives is the situation where lack of economic scarcity is the result of a particular physical characteristic. Many cases exist where a good or service is physically scarce but economically abundant. The structure of a chemical compound discovered in nature is only scarce until chemists can synthesise the drug in the laboratory. Once that happens, the ability of others to use or copy it must be controlled in order to maintain a high economic value. To some extent, the drug becomes a public good once it is discovered – the willingness of others to pay for it will depend on how easily its essential elements can be reproduced. Copyright laws and the protection of intellectual property can create the scarcity that maintains value – they can correct for the public good characteristic. Similar means are also available to governments for products and services not currently covered by international conventions on intellectual property (*e.g.* traditional knowledge). What is important in developing these measures, however, is that a balance must be reached between providing incentives for product development, and protection of the public interest. In the case of drugs, the balance would be one of ensuring that manufacturers received an adequate return on their R&D activity, and providing affordable drugs to those who need them. The analogy to biodiversity is that, to the extent biodiversity-related resources are public goods, they will be under priced in the market. Policy initiatives will have to aim at either establishing economic scarcity or correcting the price of the resource.

How this can be accomplished is subject to considerable discretion by policymakers, but the underlying principles are relatively clear. All policies impose some cost on those affected. In some cases the cost is obvious, such as when a tax is used, while in other cases the cost is less visible such as when a regulation is used. In this latter case, given that the regulatory requirement must be respected and firms and individuals have costs associated with meeting it, there is a cost that is analogous to a tax. For the policymaker, the attempt to get the right policy setting is a two-fold exercise: find the least disruptive policy, and then get the cost of that policy aligned with the benefit derived from its implementation – in this case, the benefit from biodiversity.

Intensity of instrument use

The general principle for public policy is that the mix among price and non-price instruments should be made on the basis of a full consideration of efficiency and cost-effectiveness. Any instrument that has some impact on the objective of creating or developing a market is therefore a candidate for inclusion in an instrument mix. The criteria for selecting between instruments is that the incremental (net) benefit from each should be made equal across all instruments. Included in the measurement of net benefit, however, will have to be any consequences that occur in other markets and other areas of social outcomes. For example, different policies will create different requirements for monitoring and enforcement. The related costs for both monitoring and enforcement, as well as the likelihood that they will be feasible over the long term, and even for consequences when they are required but not undertaken, should be part of the consideration given to the mix.

Considerations for choosing among the wide range of instruments available to policymakers include:

- the direct and indirect impact on people of missing the target;
- the degree of uncertainty in the economic impacts of achieving the target;
- the transactions cost of alternative instruments;
- the amount of information that governments need to have to achieve the optimal social solution;
- monitoring cost: both whether policy is being adhered to, as well as the areas where it creates risks;

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- the cost of enforcement of the rules and potential social losses when not enforced.

When choosing from among instruments to develop an effective mix, there are some guiding principles that can be used which have been developed for other public policy areas and can be adapted to biodiversity-related issues. From macroeconomic policy, the general lesson is that in order to achieve a set of objectives, there needs to be a match between the number of targets that are being sought and the number of instruments that are available. For biodiversity policy, however, this straightforward advice is generally not applicable. Given the multiple dimensions of biodiversity, there are often more objectives than there are price instruments. Adopting that advice to biodiversity requires a consideration of how to pursue multiple objectives with a limited number of policy levers. The Annex to this chapter discusses this issue in more depth for readers interested in more detail. For our purposes, the important insight is that multiple objectives can be pursued, but that no one can be fully attained.

With more objectives than instruments, the policy-maker is forced to make tradeoffs and prioritise those objectives so that emphasis will be given to the ones that are more desirable in policy planning. The overall goal of that decision-making process should be to generate the maximum net benefit to society by considering all factors relevant to the disposition of the resources, and the costs of moving toward those objectives. For biodiversity, this typically means that a policy mix will have to be implemented which may explicitly choose between biodiversity outcomes. Given the very broad definition of biodiversity, the potential number of individual goals is indeed large. The selection of targets and instruments, and the feasibility of achieving them, is therefore a daunting task.

Implementation of the mix

The implementation of the policy mix will require consideration of numerous factors that affect both the choice of instruments as well as how they are applied.

Box 7.2. **Policy mix for multiple goals**

In the saline steppe of Upper Kiskunság, which is situated in the central region of Hungary in the Northern part of the Danube-Tisza Ridge, some 50 km^2 of land are rented by a farmer from the Kiskunság National Park Directorate. The largest part of this area is protected and also belongs to the environmentally sensitive area network. The vegetation is mostly comprised of species that tolerate or prefer salty conditions. This area provides habitat for protected plants and for the protected and endangered Great Bustard (*Otis tarda*).

For more than 10 years the farmer has been cooperating with the Park Directorate to achieve the following goals:

- realisation of grazing, the optimal nature management of the land;
- preservation and improvement of the native grey cattle livestock and preservation of its genetic heritage;
- participation in the Great Bustard project (rehabilitation of meadows);
- improvement of the wetland habitats and the fishponds (feeding the birds in the protected areas).

All these activities are governed by a complex system of environmental and nature conservation rules and regulations, which include: the nature protection law, ministerial orders on the management of protected areas, on environmentally sensitive areas and on the local indigenous livestock. In addition guidelines and action plans, prepared by the Ministry of Environment and Water assist the farmer in its nature-conservation activities. These include the guidelines for the management of grasslands, action plan for the great bustard and guidelines for keeping grey cattle.

In the lease signed with the national park directorate some restrictions and required additional activities are described as well, in harmony with the management plan of the area. As well, the farmer has joined the national agri-environmental program, where he receives yearly payment for undertaking certain measures and accepting restrictions. In 2003 the payment ranged from around HUF 2 500 000-3 700 000 per km^2 depending on the land type (arable land, wet or dry grassland). He also receives subsidies for breeding grey cattle.

The multiple system of regulations, programs, and subsidies combine to achieve a complex series of nature conservation goals while ensuring that the farming activity remains profitable.

Source: Flachner and Kovács (2003).

Context of the policy mix in market creation

In policy development, the context in which new policies are being introduced can be of first order importance. For example, it has long been known that introducing a policy that exactly corrects a market problem in a context where other problems (*i.e.* market distortions) exist may make things worse rather than better. This is known as the theory of the "second best" and has been discussed in other contexts for environmental policy. Some analysts have even suggested situations where failing to account for other problems (like pre-existing market imperfections) can lead to new policies that fix particular issues, but lead to an overall worsening of social well-being. That is, they very significantly exaggerate those pre-existing problems (Babiker, Metcalf and Reilly, 2003).

Similarly, the impact of policies already implemented for other purposes needs to be made part of the policy mix. A generalised "theory of second best" (see Boadway, 1995) will inevitably be part of the overall policy approach since pre-existing policies create something less than a clean slate for the introduction of new measures.

What is implied for biodiversity is that existing measures and problems need to be taken into account when designing new policies. For example, encouraging markets for non-timber forest products can lead to a net loss in overall well-being when property rights for the resources are not well defined – especially when damage to other markets also occurs. Acharya (2001) notes cases where a rapid expansion of non-timber forest products led to harm being done to the source of the resource.

Measures that are in place for other environmental and economic objectives will intrude indirectly on biodiversity to a substantial degree. Environmental and related policies (*e.g.* agricultural) impact on biodiversity. Moreover, many of those measures will not be oriented to creating market incentives. Pollution control, for example, has a history of predominantly using non-market measures. In areas where pollution control overlaps with biodiversity policy, it will make incentive measures and other policy instruments for biodiversity difficult to calibrate – new policies need to account for existing policies or risk introducing new distortions.

In non-OECD countries, however, there often exists a relatively open policy arena. Unfortunately, it is also frequently accompanied by a lack of institutional capacity to monitor and enforce policy. In such circumstances, the policy initiative must be effective in creating its own reinforcing dynamics; that is, the desired outcome must be incentive-compatible. For example, establishment of communal property rights has, in a number of cases, led to group enforcement of resource protection in order to maintain the value of the resource (the Campfire program in Zimbabwe).

Policies for a mix of values

In the preceding discussion the focus was on a mix that was intended to achieve particular goals. With biodiversity, its multiple dimensions often require consideration of multiple values that need to be considered simultaneously as part of an overall objective. An example is found in the case where market creation is going to be used in a rainforest context to balance timber and non-timber uses so that sustainable use/conservation is achieved.

Box 7.3. **Multiple market values of rainforest**

A look at a tract of rainforest in Peru for marketable products and services shows that many exist which can be overlooked if a detailed perspective is not taken. Peters *et al.* (1989) examined a 0.01 km^2 area and estimated revenues from activities such as fruit picking, latex production, and selective logging. These were compared to alternative uses of the same area that substantially altered the biodiversity. Their survey of the area yielded 11 different types of fruit and palm trees whose annual production could be estimated, and valued at local market prices. Some trees with a medicinal value (to the local culture) were omitted from the analysis.

The results showed that a valuation of the net gains from fruit production exceeded that from a clear cutting. This result is understandable since cutting the trees provided one year of revenue and then had to be left to regenerate for many years afterwards. The fruit production combined with selective tree harvesting, however, even exceeded the value of clearing cutting followed by use of the land for pasture (which would bring an annual income stream). This was true even if the optimistic assumption was made that the land would be indefinitely suitable for pasture.

What was clear from the analysis was that creating markets for the fruit and other non-timber products was more involved and required more focused intervention on the part of the policy-maker. General policies that subsidised the taking of timber from the forest put other activities at a disadvantage. They had the advantage of being easier to administer and created products that generated foreign currency (wood for export). Moreover, they were measured in the national economic accounts (fruit collection that goes to own use or is bartered does not appear in the national accounts). Even when the fruit is sold in local markets it will not be counted in national statistics if the statistical agency isn't well enough advanced to measure and include that activity.

To realise the potential for market creation, however, would require a number of policy instruments, each working toward achieving a particular outcome. The subsidies for forestry will have to be removed while fruit and palm cultivation will have to be individually encouraged for their contribution to biodiversity without allowing monoculture to harm it.

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The use of the forest as outlined in the box would provide more benefit than a simple harvesting of the trees and conversion of the land for use in pasture. To achieve such an outcome, a balancing of measures must be achieved if the biodiversity is to be maintained. This is particularly true of situations where particular products find considerable success in the market place. Rattan in Southeast Asian and the tagua nut in Latin America are examples of markets that have been developed to the point where exploitation may be harming biodiversity. That is, the market for those products is large enough to drive production into a monoculture mode. For the tagua nut, this has meant that other trees that compete for space have been removed so that the net effect for biodiversity is ambiguous (the forest is not cut down but it is altered). The mix of policies in these situations would attempt to find the means to encourage production without allowing the destruction of the surrounding environment. Governments from the four major suppliers of rattan (Indonesia, Malaysia, the Philippines, and Thailand) have responded with policy mixes aimed at both protecting the resource and encouraging value-added processing in the country of origin.

More generally, policy mixes will have to fulfil two roles: *a)* find the right balance between how much of a good or service can be made private instead of public; and *b)* ensure that within the public/private domains, the provision of goods and services is achieved at the most cost-effective level.

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ANNEX

Instruments and targets

It has traditionally been the view of economists that in order for policymakers to achieve objectives, at least one instrument must be available for each target (Hansen, 1963). While this is necessarily true when all objectives are required to be fully met, it will not necessarily be the case when there is some flexibility in attaining goals (*e.g.* when the cost of achieving them must be kept to within reasonable limits). To illustrate, consider two policy targets in unrelated areas (call them T_1 and T_2). If two instruments are available (call them I_1 and I_2) which move outcomes toward T_1 and T_2, respectively, then solutions in which the policy-maker fully reaches the objectives are possible. The simplest case is where I_1 influences T_1 but has no side-effect on T_2, and I_2 influences T_2 but has no side-effect on T_1. It should be clear that a policymaker will be able to achieve T_1 and T_2 without much difficulty: I_1 is used for T_1, and I_2 is used for T_2. Both targets are reachable. If we modify this illustration to include the possibility that I_1 influences T_1 *and* has some side-effects on T_2, while I_2 similarly has a strong impact on T_2, *and* has some impact on T_1, the problem of achieving the two goals becomes more difficult. In fact, even when there is a proportional (*i.e.* linear) relationship between instruments and targets, it may not be possible to fully achieve the targets if the instruments can not be used to create either positive or negative inducements (*e.g.* cannot be used as either subsidies or taxes, depending on circumstances).[1]

When the link between instruments and targets is not proportional, the challenge to achieving goals will be formidable. The policy-maker will first have to "learn" what the relationship is and then correctly apply it. Moreover, the stability of the targets, once achieved, will become a source of concern since non-proportionality raises the possibility of multiple and unstable solutions to a policy problem. Given these broader issues, the simple context where each objective has an instrument and the goal is easily attainable seems to be a special case rather than a general one.

When more objectives exist than there are instruments, the public-policy problem becomes even more complex – even when the relationship between instruments and targets is proportional. In the above example this can be illustrated by adding a third target T_3 where both I_1 and I_2 have impacts related to the attainment of T_1, T_2, and T_3. Clearly all three goals will not be reachable since two instruments can not simultaneously hit three targets. There is, however, the possibility that I_1 and I_2 can go part of the way toward achieving all three targets. In that case, a trade-off will have to be made between the three objectives. That is, since each instrument moves some way toward attaining each objective, but complete success is not possible, some combination of instrument setting will have to be chosen that produces an outcome relating to all three objectives. Choosing those instrument settings should, in principle, be done on the basis of the social welfare maximisation goal – which will in turn require the policy-maker to ensure that people's relative preferences for the outcomes are understood.

Note

1. Technically, the problem becomes one of solving two equations in two unknown variables. The system may not have a solution if the variables are restricted from taking on both positive and negative values.

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Chapter 8

Implementation of Market Creation: Summary

Correcting market imperfections where they exist and creating new markets for biodiversity where possible emphasises the social objective of maximising net benefits (to everyone). Markets can, by themselves, result in the right amount of use or conservation of biodiversity-related resources when they reflect the full value to society of public goods, and when all externalities associated with their use are fully reflected in management decisions. Trading in (illegal) products from endangered species, for example, highlights the potential adverse consequences of markets that do not take account of public values and externalities. Correcting such problems will ensure that the market's use of resources will result in a net gain to society as a whole. Implementing a market creation agenda, however, must be purposeful if it is to succeed. Attempting to harness entrepreneurial forces necessarily engages self-interested participants in attempting to achieve objectives in biodiversity/environmental issues. By using certain underlying (economic) principles that improve the probability of success, it is more likely that well-being can improved through the sustainable use and conservation of biodiversity.

The preceding chapters outlined the issues that are important in the implementation of markets for biodiversity. The early chapters presented a framework that, at a conceptual level, emphasised the reasons for policy interventions – to quantify what was needed and provide a rigorous foundation for action. Underpinning the discussion in this Handbook is an economic foundation that suggests that when market activity is undertaken with a *full* accounting of the costs and benefits of using resources, then those markets will result in resource use that achieves the best outcome. Public goods and market externalities prevent such a full accounting in market transactions.

Creating markets

For each source of public goods, and externalities, there are preferred means of dealing with the problem. Some of those means were outlined in the previous chapters where detailed discussions were given. Box 8.1 synthesises those chapters as parts of an overall market creation strategy.

What problems are underlying biodiversity loss

Identifying the underlying source of biodiversity loss is important because the goal of policy is not purely to prohibit further loss – the goal is to ensure a sustainable use and level of conservation that benefits everyone. To that end, biodiversity policy must achieve a balance between gains in well-being (that includes the use and conservation of biodiversity) and losses in biodiversity. Market failures are the primary reasons to engage the apparatus of public policy, so the source of the loss and the reason for the market failure must be clearly linked.

Setting up the rules

What laws, regulations and other legal frameworks will be necessary?

The framework for market creation has important elements of legal and regulatory requirements that act to ensure that transactions can occur with some minimum level of enforcement. Unfettered markets that are allowed to operate with only the self-imposed discipline of “buyer beware” can impose significant transaction costs on both buyers and sellers. Such markets require the expenditure of resources to determine, among other things, whether the

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Box 8.1. **Elements of market creation and enhancement**

- **What problems are underlying biodiversity loss**.
- **Setting up the rules** :
  - ❖ What laws, regulations and other legal frameworks will be necessary?
  - ❖ Are there zoning possibilities that would help achieve goals efficiently?
  - ❖ Government or non-government provision?
  - ❖ How much of the biodiversity goal can be captured through markets; when is a regulatory solution the least-cost option?
- **Values and valuation** :
  - ❖ When markets cannot be directly created to address the problem, what information may be necessary to address the public good or externality: valuation?
  - ❖ When is valuation cost-effective?
- **Direct policy-maker interventions** :
  - ❖ Where are positive incentives best adapted?
  - ❖ How to best use disincentives?
  - ❖ Need to remove adverse incentives.
- **Facilitating markets** :
  - ❖ Are there possibilities for assisting markets through information provision?
  - ❖ Do scientific and technical capacities need to be enhanced?
  - ❖ How can financial market be brought into picture?
- **Policy mixes and implementation**.
- **Monitoring of results** :
  - ❖ Did the policy achieve its objective?
  - ❖ Are there policy corrections that might lower the social/economic cost?

goods are "as promised" by the seller and whether payment will actually be made by the buyer. Those transactions costs, of course, can determine whether the market is viable over the long-run: a trade can only occur when both the buyer and the seller receive sufficient benefit that an exchange will result in a gain for both.

The legal framework often defines who will bear the transaction cost of providing information. By removing transaction costs from buyers (*e.g.* requiring sellers to conform to standards) or removing them from sellers (*e.g.* providing remedies for non-payment), the framework influences the gains to individuals from trading. As such, the legal framework can determine the viability of markets. It also conveys information that has economic value – which market participants can more or less take for granted – since it will be the state that will undertake enforcement. That is, buyers and sellers can trade with the knowledge that the judiciary branch of government can be used to settle disputes that may arise.

Government or non-government provision

A public good requires intervention because, either someone's use (direct or indirect) of a good or service does not diminish it for others (non-rivalry), or others cannot be excluded from using it (non-excludability). In either case, marketability is weak because the provider can not be certain of recovering any costs that might be incurred in developing the good or service – even when those costs may be small.

When dealing with the sources of pressure on biodiversity leads to a decision that non-government provision will work best, establishing the correct regime of property rights will be the key issue. This is not to say that it is a simple question of turning things over to the private sector. Property rights come in many forms, and engage complicated legal and institutional dimensions. Often they require direct support or intervention by the government. Once the appropriate form of property right has been developed, there will also be considerable additional effort needed to ensure that supporting functions by government and other participants are forthcoming.

When centralised provision is expected to work best, the involvement of government will be greater but there will still be opportunities for engaging markets. Since governments have numerous demands on their resources, finding the means to create self-sustaining services, even when centrally provided, will be an important objective. Creating secondary industries, or even support for them, can help achieve that goal.

Biodiversity loss is a more acute problem in some areas than it is for others. Protection of an endangered species, for example, is more immediately urgent and requires stronger measures than do reductions in populations of specific species. Different instruments will have different characteristics. For the types of policy initiatives that set up the market contexts, the implications can be profound. Simple zoning requirements can lead to substantial impacts on the economic use of large areas, which will itself create subsequent pressure on biodiversity.

How much of the biodiversity goal can be captured through markets: when is a regulatory solution the least-cost option?

Setting up the rules for market creation is an important stage in thinking about the policy mix that will deal with marketable and non-marketable aspects of biodiversity. In choosing between options to achieve social objectives, a number of factors come into consideration. Biodiversity-related goods and services are seldom purely public goods and often have elements that are privately marketable. The important role for the policy analyst is in finding how much of the good can be brought into the private market and how much must be provided through non-market means. The solutions to this problem are many. For example, goods can be made partially excludable by establishing clubs (of which there exist many forms), or they can be made private goods though the establishment of property rights than combine restrictions on how the right can be exercised.

The underlying consideration is to find the means that achieve the policy objective in a least-cost manner. But the definition of cost needs to be a wide one that includes subsequent monitoring and enforcement, and whatever other social costs that may be incurred.

Valuation

When markets cannot be directly created to address the problem, what information may be necessary?

In circumstances where direct markets are not feasible for achieving biodiversity objectives, policy-makers will have to have information concerning preferences in order to achieve the correct outcome. One means of obtaining that information is through valuation – so that policy instruments can be calibrated as needed. To see what underpins this assertion, consider the case where there is an externality to a particular activity – the traditional case of a fishery. The most straightforward market solution is to create a property right to the fishery and require firms to purchase the right to catch fish. In many cases, this may not be possible. The government may not know the "right" level at which to set the quantity, or the cost of establishing a property right may be high, or the resource in question might be indivisible (unlike a fishery). In that case, valuation can help establish the correct costs (implicit or explicit) that should be imposed on the source of the externality.

When direct market creation is not possible, government will be setting the price itself, either directly or indirectly: through a levy on the firm, or by imposing mandates on the firm (there will be an implied cost that the firm bears). These latter circumstances nonetheless create opportunities for indirect market creation (*e.g.* markets for supporting goods and services), but require information on the value of the target good or activity.

Direct policy-maker interventions

Where are positive incentives best adapted?

Given their vulnerability to overuse (Damania, 2003), positive incentives should generally be advocated with some care as a corrective measure. In general, they should only be used when there is a clear and compelling case to be made that the use of positive incentives will result in substantial gains to society. For example, payments for agricultural activity that is specifically intended to be biodiversity-friendly would be justified on the basis that a biodiversity amenity is being purchased that society desires. How this policy is implemented, however, is the key to determining the benefits that will accrue. Payment for services where the rules are not very carefully specified will almost certainly result in an oversupply of those services – even to the point where it can damage the biodiversity it was intended to help provide. When it is more carefully implemented, such as the Natura 2000 in the EU or the Conservation Reserve Program in the US, it can supply benefits that make a substantial difference for biodiversity.

How to use disincentives?

The goal of public policy that uses disincentives is to add a premium to the market price that is equal to the incremental public value or externality of the resource. For a good that is partially public, the premium should be set so that it reflects the incremental value that people are willing to put on the public resource. Setting the disincentive at that level ensures that for whatever use the biodiversity resource is put, it will reflect the value that the resource has to other people – their loss will be compensated through the government's ability to use the money to provide alternative goods and services. A disincentive is thus primarily a support measure that is undertaken in support of market creation. Moreover, it should be used in conjunction with some level of valuation to assure that it is being properly targeted.

Disincentives also need to account for any existing accommodation that individuals may have already achieved. In some cases, private individuals will organise themselves to autonomously account for public goods or externalities. This may happen when the number of individuals affected by the resource decision is small and the cost of finding each and coming to an agreement is also small. In such cases, policy that does not take into account these accommodations will itself become a source of distortion in the economy (Cropper and Oates, 1992).

Need to remove perverse incentives

Significant subsidy reform has occurred in a number of countries/ industries, and the results have generated benefits for government finances, as well as environmental gains. New Zealand, for example, removed many of the supports it was providing to the private sector across a wide range of industries. In sectors like forestry, responsibility for activities such as tree planting was given to the industry. Ten years after that change, more trees were being planted by the private sector than both public and private sectors combined had previously done (Rhodes and Novis, 2002). Other industries have also successfully made the transition from receiving assistance to self-sufficiency.

Given the inter-connectedness of the economy, some effort needs to be made to distinguish between incentive measures that are unambiguously harmful and those that actually provide some benefit. While many subsidies are harmful to both the environment and the economy, the positive effects cited in some studies (*e.g.* Fullerton and Mohr, 2003) also call for careful consideration. It may also be possible to substitute a biodiversity-harmful subsidy for one that achieves the same social objective without harm.

Policy mixes and implementation

Market creation needs to be accompanied by due consideration for the mix of supporting measures that may be applied. The manner in which market creation occurs will have to account, to the maximum extent possible, for the public goods characteristic of the resource and/or for any externalities in how resources are used. Since it is unlikely that a single action to create a market will achieve complete results, a number of measures may need to simultaneously be implemented. Moreover, those measures may have to account for pre-existing policies that will interact with the new initiatives and cause the outcome to be less than optimal.

Monitoring of results

Did the policy achieve its objective?

Monitoring the success of a policy after it has been implemented is an integral part of a biodiversity strategy. Corrections that may be needed can only be implemented if there is subsequent review for unexpected outcomes. However, in ensuring that objectives have been met, goals have to be quantifiable. There are essentially two areas in which objectives can be specified, and where quantification can occur. These are 1) results-oriented objectives, and 2) process-oriented objectives. Results-oriented objectives specify quantified targets, whereas process-oriented objectives state that certain criteria should be met for how the system will work. In general, results-oriented goals are more compatible with economic instruments since they are more likely to specify outcomes and leave the details of how to get there to knowledgeable individuals. Monitoring of results-based goals is similarly more easily accomplished since observing outcomes is easier than observing processes. In either case, however, monitoring usually requires the commitment of just enough resources to ensure a good probability of knowing what is happening; that is, monitoring effort should be undertaken economically.

Deciding if objectives have been met in terms of putting in place a framework is more difficult than fixing targets and using policy instruments to achieve those targets. Various indicators for monitoring outcomes can be developed which can provide information on where the framework *might* be failing. However, whether or not policy is actually failing when an indicator does not meet its expectations must be determined by careful linking of the indicator back to potential interconnections within the framework itself. It may very well turn out that indicator reflects public preferences and nothing should be done about it.

Enforcement must also be undertaken to ensure that incentive compatibility is maintained. It should not, however, extend beyond the value of the resource. Since enforcement is always undertaken to dissuade individuals from undertaking undesirable activity, the right level of enforcement is where the marginal expenditure on it is just equal to the marginal benefit from dissuasion

Are there policy corrections that might lower the social/economic cost?

Apart from the issue of whether the policy achieved its objective, there is another important question of whether it did so in the most cost-effective manner. The process of implementing policy can potentially lead to new insights and other means of achieving the same objectives. In some cases it might be worthwhile to review the entire approach that is being used for the problem.

Building a review process into the policy itself will help avoid potential problems that may subsequently arise in overcoming inertia in bureaucracies.

Over the long term, it will often be the case that with economic development the need for various policy measures will have to be reconsidered. This occurs for a variety of reasons but perhaps the most frequent is that relative values change as individuals move away from subsistence and access to environmental amenities becomes more important.

Caveats and dilemmas

While markets are inherently good at providing welfare-enhancing outcomes (people only trade when it is in their private interest to do so), the conditions under which those private actions are good for everyone are not universally applicable. For biodiversity, the problems mentioned earlier for market outcomes can lead to markets whose outcome could be significantly improved, or even markets that exert a net negative impact on human well-being. In this sense, markets have to be *harnessed* to help provide desirable biodiversity outcomes. A good example of this exists in markets for non-timber forest products where market creation that is initially beneficial for biodiversity can, in fact, increase harvests to unsustainable levels. In turn, this can impact the biodiversity and health of the ecosystems from which these products are derived.

As discussed in Acharya (2001), the rattan industry illustrates a successful product which increasingly became unsustainable. Rattan is a valuable product with an estimated worldwide market for the unprocessed cane running into the USD hundreds of millions, and USD billions for furniture. Godoy (1990) noted that the internal rates of return for green and processed rattan in Indonesia were well above market returns for other industries (21% and 22%, respectively, at that time). There was thus a high potential return for local producers. These rates of return, however, led to unsustainable extraction rates. Governments from the four major suppliers of rattan, Indonesia, Malaysia, the Philippines, and Thailand responded with legislation aimed at both protecting the resource and encouraging value-added processing in the country of origin. The success of an industry that was initially compatible with maintaining biodiversity can eventually lead to damage to biodiversity if demand reaches levels where monoculture is encouraged so as to gain production efficiencies. Encouraging the development of any industry needs to be done in a manner that does not focus on a single crop or product.

A smaller market also experienced a similar trend. Conservation International help develop an initiative to collect and market vegetable ivory, a product derived from the tagua nut and used for buttons, jewelry, and other products. The harvesting of tagua resulted in over-harvesting and degradation of the forest areas in general (Southgate, 1988). The producers began to weed out the non-commercial species, thereby reducing biodiversity. Conservation International responded by trying to ensure that the tagua it marketed was collected in a way that sustained the diversity of the ecosystem.

Markets are capable of taking care of these types of problems when participants are made to account for all the costs and benefits of their actions. The alternative use (and non-values) of any resource must be internalised into market transactions in order to ensure that its disposition is in everyone's best interest. Property rights also must be well defined so that self-interest becomes clearly linked to the long-term disposition of the resource. That is, when a resource has to be used by an individual to generate an income over a long period of time, the use of that resource is more likely to be sustainable.

In the absence of such framework conditions, the success of a particular product will inevitably lead to overproduction since individuals will be primarily interested in short-term outcomes – to get the resource before others do. A complimentary measure that can work from the other side of the market to limit demand is through increased information for consumers to be able to make choices based on the "biodiversity value" of the goods they are purchasing. This value, and the consumer's willingness to pay for it, is reflected in the marketing success of goods such as Ben & Jerry's ice-cream, organic coffee, the products sold by The Body Shop, etc.

Application to ecosystems

The application of policies to create markets for biodiversity objectives can occur within a very wide range of domains. Given the Convention on Biological Diversity's characterisation of thematic areas under which work is being organised, it is useful to briefly touch on each area for market creation.

Agricultural biodiversity

Since agriculture now accounts for one third of land use globally, it is one of the largest sources of impacts on biodiversity – occurring mainly through the loss of habitat for plants and animals. Some forms of agriculture, however, have less impact on biodiversity than do others. Organic agriculture and various other forms of sustainable agriculture have been promoted as being more biodiversity-friendly in comparison to other farming techniques sometimes used in various parts of the world. Creating markets for products that are farmed using organic or other forms of sustainable agriculture might be expected to reduce biodiversity loss. Since the products of agriculture cannot be easily distinguished across agricultural techniques, information becomes the primary factor in market creation for such products. Labels, specialised cooperatives, speciality stores, etc. are all means of distinguishing products and creating the demand needed to ensure the viability of markets.

Market creation in other agricultural contexts have also been developed. Payments to farmers to supply biodiversity-related amenities are being used in a number of countries and the process looks likely to expand.

Dry and sub-humid lands biodiversity

Dry and sub-humid lands receive limited amounts of rainfall and thus what water resources are available become crucial to maintaining ecosystems. Biodiversity in these areas includes some unique and well-adapted features that can be easily disrupted. Markets oriented to assisting biodiversity in these areas include, for example, those for many forms of livestock where care is given to the impact of grazing patterns on grasslands and harvesting of fuel-wood and wild species.

Forest biodiversity

While forests are one of the richest sources of terrestrial biodiversity, they are also the source that is being lost at the highest rate. The potential to make forest biodiversity compatible with economic activity clearly exists. Marketing techniques, such as certification, have created markets for forest products that are generally considered more biodiversity friendly than alternative products.

Markets for forests can also come from unexpected sources. Since many people value biodiversity and are willing to pay premiums for access to it, the potential exists for creating additions to biodiversity in the form of enhanced forests near urban areas. The analysis by Anthon and Thorsen (2004) shows that property values can be significantly affected by afforestation programs and that the government is capable of capturing much of that increase in value through increased tax revenues.

Box 8.2. **Incentives for afforestation**

In urbanized Europe, the welfare-economic importance of forests consists to an increasing extent of their ability to produce positive externalities. In Denmark, urban afforestation programs are established and financed partly by the Government and partly by the EU to ensure the provision of such externalities, especially recreational opportunities for local population. However, increased budget restrictions in the state agency administering the program have raised the question whether other actors could take over part of the financial burden. In particular those who stand to gain the most from the program.

When comparing the estimated costs of a project with the estimated future tax revenue, it is evident that the possibility of financing afforestation projects through increased tax revenues is not unambiguous. The large differences between two areas studied closely are among other things due to:

- the households in Skjoldhøjparken have a higher average income than those in Vemmelev;
- there are more houses close to True Forest compared to Bakkely Forest;
- there is a higher increase in house prices in Skjoldhøjparken compared to Vemmelev.

True Forest and Bakkely Forest were afforestation projects in Skjoldhøjparken and Vemmelev, respectively. These factors impacted on the magnitude of the tax gain from afforestation, and thus on the ability of local authorities to finance them. Nevertheless, it is clear that there were tax gains.

Thus, due to the tax revenue changes following hedonic effects of the environmental benefits caused by urban fringe afforestation, local communities may have a clear incentive to actively secure the supply of these benefits to their inhabitants.

Source: Anthon and Thorsen (2004).

Inland waters biodiversity

Since almost half of the world's population lives within an inland water ecosystem, creating markets that are compatible with the biodiversity in those systems implies reducing the stress humans create. New or existing markets can be made more biodiversity-friendly by accounting for some of the issues identified throughout this book. Some of those markets include: agriculture, water supply, energy production, transport, recreation and eco-tourism.

Island biodiversity

Given the relative isolation of islands, the ecosystems tend to be specialised to local conditions and the unique geological history of each island. Markets in this case can be oriented to eco-tourism, but creating the context for agriculture and natural resource use to be sustainable over the long term will be crucial for maintaining ecosystems.

Marine and Coastal biodiversity

The world's marine areas are the most vulnerable to overuse given their tendency to most often be treated as public goods. Markets for marine products are very easily established through the definition of property rights for such products as tradable fishing quotas. The establishment of certification standards and other techniques to provide information to consumers willing to discriminate in their purchases will also help to develop markets that are more compatible with the maintenance of biodiversity.

Concluding remarks

In the same way that market-based incentives operate to reduce inappropriate pressures on biodiversity-related resources, use of markets more broadly can contribute to improved biodiversity management. Market creation works through the removal of barriers to trading, and policy mixes work to ensure that the creation of markets occurs within a context of achieving goals in the least economically disruptive manner.

Governments have two important roles to play in supporting markets for biodiversity-related resources and selecting policy mixes. First, they need to establish the right framework-conditions under which private operators can efficiently supply biodiversity-related resources to users (while ensuring that non-marketable aspects of biodiversity are properly accounted for). Second, governments need to ensure that public biodiversity-related goods are provided in the most efficient and effective manner possible. Creating markets implies putting in place the right legal/incentive frameworks to overcome characteristics such as *non-excludability* and/or *non-rivalry* in use, both of which can make public goods unsuitable for trading in markets – even when individuals would be willing to pay for them.

Markets can, by themselves, result in the right amount of use or conservation of biodiversity-related resources when they reflect the full value to society of these public goods, and when all externalities associated with their use are fully reflected in management decisions. For example, trading in (illegal) products from endangered species highlights the potential adverse consequences of markets that do not take account of public values and externalities. Market *creation* for biodiversity, therefore, is the culmination of efforts to ensure that the market's use of the resource will result in a net gain to society as a whole.

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