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INCENTIVE MEASURES: AN EXPLORATION OF TOOLS AND METHODOLOGIES FOR VALUATION OF BIODIVERSITY AND BIODIVERSITY RESOURCES AND FUNCTIONS

Note by the Executive Secretary

I. INTRODUCTION

1. In paragraph 12 of decision VII/18, on incentive measures, the Conference of the Parties requested the Executive Secretary to:

> "[E]xplore, in cooperation with the Millennium Ecosystem Assessment, the Organisation for Economic Co-operation and Development and relevant international organizations, existing methodologies for valuation of biodiversity and biodiversity resources and functions, as well as other tools for prioritization in decision-making, by preparing a compilation of existing valuation tools that provides an overview of the discussion on their methodological status, if appropriate, as well as an assessment of their applicability in terms of effectiveness and capacity preconditions, and to prepare proposals for the application of such tools. These proposals should include the identification of options to strengthen international collaborative partnerships for assessing biodiversity values, especially for the refinement and advancement of valuation tools, and shall be submitted to the Subsidiary Body on Scientific, Technical and Technological Advice for its consideration at a meeting prior to the eighth meeting of the Conference of the Parties."

2. In paragraph 8 of the same decision, the Conference of the Parties invited Parties, Governments and international organizations to submit case-studies, best practices and other information, *inter alia*, on the application of methodologies for the assessment of values of biodiversity and its functions, as well as other tools for prioritization in decision-making, to the Executive Secretary. The Executive Secretary communicated this invitation to Parties, Governments and relevant organizations by notifications 076/2004 and 077/2004 as well as 026/2005 and 028/2005. Pertinent submissions received further to this invitation were taken into consideration in the preparation of the present note.

3. In accordance with the request of the Conference of the Parties, the present note provides an exploration of existing methodologies for valuation of biodiversity and biodiversity resources and

* UNEP/CBD/SBSTTA/11/1.

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functions, as well as other tools for prioritization in decision-making, by providing an overview on existing valuation tools and their methodological status as well as an assessment of their applicability in terms of effectiveness and capacity preconditions.

4. Parties and Governments as well as relevant international organizations and experts were invited, by notification 2005-066, to review the first drafts of the present note as well as of pre-session document UNEP/CBD/SBSTTA/11/9, which is based on the present note. Further to this invitation, the following Parties provided reviews: Argentina, Canada (three reviews), Egypt, European Community and its Member States, India, Kenya, Netherlands, Sri Lanka and Ukraine.

5. Comments were also provided by the United States of America, as well as by the Food and Agriculture Organization of the United Nations (FAO), the Organisation for Economic Co-operation and Development (OECD), and the Economics and Trade Branch of the United Nations Environment Programme (UNEP/ETB). Reviews were also provided Prof. Ronaldo Seroa da Motta, Research Institute for Applied Economics, Rio de Janeiro, Brazil; and by Dr. Renat Perelet, Institute for Systems Analysis, Russian Academy of Sciences, Moscow, Russian Federation.

6. The Secretariat gratefully acknowledges the valuable support of Dr. Dominic Moran in the preparation of this note.

II. METHODOLOGICAL ISSUES IN VALUATION

A. Defining value

7. Biodiversity as well as biodiversity resources and functions are intuitively valuable. Few would contest the fact that the decline of biodiversity would be costly to mankind, in particular with regard to those functions that cannot be replicated. But this general truth does not shed much light on how to identify, describe and measures the specific values that are held in respect of biodiversity and biological resources and functions.

8. The term value is used in different ways amongst a range of academic disciplines. According to the Oxford Dictionary, there are three main types of uses of the term "value": (i) *exchange value*, that is, the (relative) price of a good or service in the market; (ii) *utility*, that is, the use value of a good or service, which can be very different from the market price (e.g. the market price of water is very low, but its use value very high; the reverse is the case for, for example, diamonds or other luxury goods); and (iii) *importance*, that is, the appreciation or emotional value attached to a given good or service (e.g. the emotional or spiritual experience some people have when viewing wildlife or natural scenery, or our ethical considerations regarding the existence value of wildlife).

9. Different disciplines define and use these terms in different ways. In economics, value and utility are unambiguously anthropogenic. 1/ For instance, in the case of marketed goods and services, it is humans who reveal value, in terms of their so-called willingness-to-pay, by the process of exchange. Similarly utility is derived by humans. Even the concept of importance is only meaningful if assigned by, and inferred from, human choices or decisions on behalf of other living organisms. But other disciplines may assign different interpretations to value or importance, which may or may not be linked to values ascribed by human beings. For example, anthropology may infer value from cultural norms and practices

1/ A distinction is made in philosophy between anthropo*centric* and anthropo*genic* value. Something has anthropocentric value when it is good for a human subject. Foods and other goods used by humankind have anthropocentric (and instrumental) value. Anthropogenic value, on the other hand, is value that is attributed *by* a human subject, but not necessarily value *for* a human. So, for example, many people take an old growth forest to have value whether or not it is actually used or appreciated firsthand by a person. See Hiller 2005, Callicott and Baird 1999. Because of the concept of existence value, explained further below, the term anthropogenic is used here.

that are in some sense non-negotiable (e.g. sacred groves). Theologians and ethicists may base importance on moral or spiritual criteria that are neither observed nor measurable (but nevertheless strong motives), and may also point out that the predominant role of humans in utilitarian thinking displaces intrinsic value and the right of other species to exist. And last but not least, ecologists will be interested in the importance of attributes or functions of a system to maintain ecosystem resilience. This is an objective criterion, that is, irrespective of its relevance to humans.

10. In what follows it is important to bear in mind these disciplinary distinctions and the fact that different perspectives on value lead to differing views on the practicality of measurement and, by extension, use in policy making.

B. Valuation

11. While there is growing awareness of the value and importance of diversity *per se*, there is a lack of consensus on how diversity can be defined and measured. For example, species richness is frequently the only accessible indicator of species diversity, although it is well known that a head count of the number of apparently different species in an area may not be a good proxy for the portfolio effect of genetic distance between them. Some context-sensitive index or set of indices of biodiversity change would be fundamental to any economic valuation of diversity. Indices could in theory could be based on phylogenetic data. In practice this data is not readily available as a basis for prioritization. However, other prioritization devices, discussed below, employ non-monetary measures of value that may encompass genetic distance.

12. In consequence, valuation does normally not entail measuring the economic value of bio*diversity as such*. 2/ Instead, valuation typically focuses on the economic values of the goods and services generated by biodiversity resources and/or functions – the so-called ecosystem services. 3/ A comprehensive assessment of the values of ecosystem services 4/ has recently been undertaken by the Millennium Ecosystem Assessment. The Millennium Ecosystem Assessment adopted a wide understanding of ecosystem services, which includes goods under the concept of "provisioning services. While this understanding departs for the usual economic distinction between "goods" and "services", it will be will be adopted in the remainder of the note for the sake of ensuring consistency with the terminology introduced by the Millennium Ecosystem Assessment. 5/

13. It is noteworthy that the term "economic" is to be understood in a broad sense. Based on welfare economics, economic valuation recognizes that individuals may assign value for different reasons or motives, and not only for the immediate benefits of commercial exploitations of resources (as a narrow interpretation of the term "economic" may suggest).

2/ Pearce and Moran, 1994; Pearce 2001. There is however some literature that seeks to determine the value of biodiversity components by the genetic composition of species rather than by the species themselves (see, for example, Polasky et al., 1993; Metrick and Weitzman, 1996; 1998; Weitzman, 1998). Empirical applications of these methods have been presented by Weitzman 1993 and Solow et al. 1993.

3/ See for instance Daily and Dasgupta for an explanation of this concept. As the same functions often contribute to the production of different services, simply adding the values of different services would likely not produce an accurate estimate of the value of the underlying functions. See Pearce and Moran 1994.

4/ See Millennium Ecosystem Assessment 2003. See also Christie 2004 as well as Daily and Dasgupta 2001 for further discussion, and Eftec 2005 for a literature review of the economic, social and ecological value of ecosystem services.

5/ See also Daily and Dasgupta 2001 for a similar conceptualisation. The Millennium Ecosystem Assessment was carried out between 2001 and 2005 to assess the consequences of ecosystem change for human well-being and to analyze options available to enhance the conservation and sustainable use of ecosystems and their contributions to human well-being. Responding to requests for information including through the Convention on Biological Diversity, it was carried out by approximately 1,360 experts from 95 countries, and has been extensively peer reviewed by governments and experts.

14. In a recent note, leading scientists under the Millennium Ecosystem Assessment clarified that, as used and defined in the Assessment and as already used in existing international documents, the term and concept of "ecosystem services" in no way implies an automatic requirement or obligation on the part of the consumer to pay directly for the supply of the service. The term does, however, imply that the service is of value to people (in terms of economic, health, cultural or other benefits) and that the degradation or loss of the service represents a harmful impact on human well-being. The note also highlighted the different policy options at hand for reducing the degradation of ecosystem services, and underlined that it is a matter of societal choice which option or options to use. 6/

15. Economics generally assigns value on the basis of direct or indirect tradeoffs, that is, actions that show people making sacrifices in favour of specific goods and services, thus revealing their willingness-to-pay for these goods and services by exchanging them on markets. These actions can be explained by a robust theory of demand that posits specific axioms or rules about the consistency in which these choices are made. It is the consistency of the predictions of this theory that enables economists to infer what people value based on what they actually do.

16. Environmental economics has extended demand theory to goods and services that are not traded on markets, including most ecosystem services (which include goods according to the understanding of the Millennium Ecosystem Assessment). As they are not traded on markets, their value is not captured in market prices. The reason is that many ecosystem services bear characteristics of what economists call "public goods". One important characteristic of public goods is that nobody can be excluded from their use. For this reason, markets cannot spontaneously develop for public goods, and the value of these public goods will therefore not be reflected in a market price. This has also the consequence that the prices of many marketed goods and services will not adequately reflect the essential role of these services in their production, which, in turn, will lead to distorted decisions by consumers and producers. Public decision-making and its allocation of public funds will also be distorted if the repercussions of governmental activities on these biodiversity resources and functions, and the associated ecosystem services, are not adequately factored in.

17. In consequence, undertaking valuation does not only raise awareness of the hidden benefits of biodiversity conservation in terms of maintaining critical ecosystem services. It has also the potential of improving public decision-making as well as, under specific circumstances, of improving legal decision-making.

18. The proposals on the design and implementation of incentive measures, endorsed by the sixth meeting of the Conference of the Parties as far as they are consistent with Parties' national polices as well as their international obligations, underlined that valuation can also support the design of other incentive measures for the conservation and sustainable use of biodiversity. 7/ It was recognized by the Conference of the Parties that incentive measures should not negatively affect biodiversity and livelihoods of communities in other countries. In that regard, valuation could also contribute. For instance, the valuation of the ecosystem services that are relevant under a given decision-making problem, at all relevant scales (local, regional and/or global, on-site and/or off-site), could contribute to ensure that repercussions on biodiversity at all scales are taken into consideration in decision-making.

6/ See Reid, V. et al. 2005. The note reacted to concerns raised in the context of the discussion on water pricing and the privatisation of water resources.

7/ Decision VI/15, annex I, paragraph 22. It has been noted by the OECD that such calibration is of particular importance for those instruments that seek to directly correct prices, such as fees or direct payments for environmental services. In cases where property rights could be established on the relevant biodiversity assets, a market price would emerge endogenously. Even in the latter case however, valuation would still be useful to determine the magnitude of the policy problem and which policy instruments to choose.

19. Since the 1960s, considerable efforts have been made by economists to develop methods that can elicit the "hidden" value of non-marketed natural resources. These methods use the aforementioned sacrifice or "willingness to pay", 8/ based on actual or hypothetical behavior, to infer the value of the resource. There are many reasons why people are indirectly observed to, or directly state that they are willing to, make tradeoffs between their endowment (in terms of time, labour effort, monetary income or wealth) and safeguarding non-marketed natural resources, including safeguarding as specific levels of ecosystem services. The framework commonly used for describing the different types of economic value ascribed to natural resources is known as the Total Economic Value (TEV) and will be presented below.

20. Valuation usually attempts to measure the value of ecosystem services in monetary terms, in order to provide a common metric in which to express the benefits of the variety of services provided by ecosystems. This explicitly does not mean that only monetary sacrifices, or only services that generate monetary benefits, are taken into consideration. What matters is that people are willing to make tradeoffs. If the relevant people were for instance subsistence farmers, these tradeoffs could be initially measured by the labour time they are willing to provide for achieving some environmentally-friendly outcome. In order to have a common metric, this effort could then be transformed into a monetary figure by applying for instance the local or domestic wage rate.

21. The economics profession is divided on whether valuation is adequate or sufficient to deal with the more fundamental issues that are also involved in biodiversity management. It is in particular suggested that some biodiversity functions are key to the survival of global ecosystems including humans (the so-called life support function) and should therefore be treated as a fundamental constraint and not as an element of the set of possible economic choices. Put another way, all economic choices must be made within some ecological constraints otherwise the global system may collapse. The standard toolbox of economic valuation is said to be of limited if any use for the identification of these global constraints. Alternative approaches such as setting a safe minimum standard may be more suitable for those cases, in particular when changes are irreversible. 9/

22. In consequence, valuation usually focuses on the value of comparatively small (incremental or "marginal") *changes* in ecosystem services that result (or would result) from management decisions or from other human activities. 10/ Some recent efforts have been made to derive the global (as opposed to incremental) value of ecosystems at a given time 11/ and to simulate the value of ecosystem services in an integrated Earth system model. 12/ However, the methodologies underlying these efforts, and the figures they produced, remain controversial; 13/ moreover, as the Millennium Ecosystem Assessment notes, their usefulness for policy is limited, as it is rare for all ecosystem services to be completely lost and even

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8/ Depending on the question that is to be investigated, focus is sometimes given to the so-called "willingness-to accept." For instance, if an area is to be protected and people who have the legal title to use that area would be no longer allowed to do so, they might be asked for how much compensation they are willing to voluntarily give up their right to use the area. Willingness-to-accept generally raises important problems with biases, which is why the concept of willingness-to-pay is generally preferred. See Hanemann 1991.

9/ See Pagiola et al. 2005.

10/ Changes in ecosystem services may also result from natural impacts that lead to a different state of the ecosystem. In such cases, management decisions may, for instance, include whether and how to mitigate these impacts on the ecosystem condition.

11/ See Costanza et al. 1997.

12/ See Boumans et al. 2002.

13/ For instance, Dasgupta states that *"the value of an incremental change to the natural environment is meaningful because it assumes that humanity will survive the change to experience it. The reason (that) estimates of the total value (of the environment) should cause us to balk is that if environmental services were to cease, life would not exist."*.See Dasgupta 2000.

then, such a complete loss would usually happen only over time. 14/ For these reasons, and consistent with the approach chosen by the Millennium Ecosystem Assessment, 15/ this note focuses on methods for assessing the value of *changes* in ecosystem services.

C. Total Economic Value

23. The framework commonly used for describing the different *types* of economic value ascribed to natural resources is known as Total Economic Value (TEV). The framework comprises use values (direct, indirect and option value 16/) and non-use values. These types of value are summarized in figure 1. 17/

24. **Direct use value** is the value derived from direct use or interaction with environmental resources and services (e.g., timber, fuelwood, recreation are direct use values of a forest). They involve commercial, subsistence, leisure, or other activities associated with a resource.

25. **Indirect use value** relates to the indirect support and protection provided to economic activity and property by the ecosystem's natural functions. For example, carbon sequestration is a function of forest ecosystems whose value can be derived from the avoided costs of having to sequester by other means, or from avoiding the actual effects of warming. Similarly, the watershed protection function of a tropical forest may have indirect use value through controlling water quality and flood drainage that affect downstream agriculture, fishing, water supplies and other economic activities. While these functions have in principle long been recognized, precise field experimentation has often been lacking in order to show more precisely the relationships between ecosystem functions and the services generated.

26. **Option value** is a type of use value in that it relates to future use of the environment or biodiversity resources and functions. Option value arises because individuals may value the option to be able to use the natural resource some time in the future. For example, there may be an additional premium placed on preserving a forest system and its resources and functions for future use, particularly if prospects of future value are high and if current exploitation or conversion is irreversible. 18/ The logic of the option motive is to maintain a diverse portfolio of resources as a means to reducing the risk of large fluctuations in value. Quantification of option value is often complex. For instance, several attempts have been made to evaluate the expected benefits of bioprospecting of genetic resources of naturally occurring wild plants and organisms for pharmaceutical use. These attempts remain however controversial due to a number of open questions including: the role and extent of previous knowledge and its impact on probabilities of finding a resource of actual value; and the role and extent of potential replacement by human-made diversity. 19/

27. **Non-use values** such as existence value (sometimes also dubbed passive value) are derived neither from current direct or indirect use of the environment. For example, there are individuals who do not use the tropical forest but nevertheless wish to see it preserved because they simply derive utility from the ongoing existence of the ecosystem, or because they wish to conserve it for future generations (bequest value). A similar observation applies to some species, in particular charismatic mega-fauna such

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14/ Millennium Ecosystem Assessment, volume one, chapter 2.3.3. This conclusion only applies to the limitations of valuation. Multi-disciplinary research will still be important to identify causal chains and interaction effects as well as the impacts of biodiversity loss.

15/ Ibid.

16/ Option value is also sometimes classified as a non-use value.

17/ It is important to not confound this concept with the attempts, explained in paragraph 22 above, to quantify the global (as opposed to incremental) value of ecosystem services worldwide.

18/ See Conrad (1997) for an application to old-growth forest.

19/ See Simpson, Sedjo and Reid 1996, Rausser and Small 2000, Firn 2003.

as whales or tigers. The concrete reasons why they derive utility may vary and may be based on, for instance, religious, spiritual, or ethical motives. In particular, a non-use motive may coincide with the recognition of an intrinsic right of existence. In this sense, valuation that is based on the concept of total economic value will also capture, at least to some extent, non-utilitarian values. 20/

28. Of all the value categories, existence or passive value is most complex in terms of quantification and its role in decision-making. Yet, it is a type of economic value that is significant in defining both national and global biodiversity management priorities.

III. VALUATION METHODS

29. In the last decades, valuation methods have reached a considerable degree of sophistication. The last decades have also witnessed a gradually emerging consensus on the state-of-the-art of the range of valuation methods at hand, which is reflected by the fact that recent handbooks and manuals on the topic provide very similar overviews and assessments of the individual tools, with differences remaining essentially on the level of terminology and classifications. 21/

30. Valuation studies are increasingly applied not only in developed countries, but also in developing countries and countries with economies with transition. Rietbergen-McCracken and Abaza (2000) explain that:

> "[U]p to recently, there was considerable skepticism, particularly among international development organizations and developing country governments (as end users of the valuation results) about the possibilities of using valuation methods outside the relatively resource-rich and data-rich environments of developed countries. It was generally felt that developing countries and countries with economies in transition presented too many difficulties (including a scarcity of statistical information; the presence of price distortions or undeveloped markets; and in some cases largely illiterate communities) to allow valuation methods to produce meaningful results. However, over the last five to ten years a growing body of evidence has emerged to refute these claims." 22/

31. Rietbergen-McCracken and Abaza (2000) present a number of case-studies of valuation studies undertaken in Africa, Asia, Latin America and Central and Eastern Europe, some of which also deal with biodiversity resources and functions, and the related ecosystem services. The IUCN guidelines for protected areas managers on economic values of protected areas also provide summaries of a number of valuation studies in developing countries, 23/ A survey on the use of contingent valuation studies in developing countries, some of which address biodiversity-related issues, was conducted by FAO in 2001. 24/ Humavindu (2002) presents an analysis of valuation studies addressing nature-based tourism in Namibia.

32. The remainder of this sub-section is largely based on the review and assessment of valuation tools provided in chapter 2.3.3.1 of volume 1 of the Millennium Ecosystem Assessment. The reason for

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20/ Millennium Ecosystem Assessment (2003), 133.

21/ For recent handbooks and manuals, see e.g. Barbier et al 1997 (published by the Burau of the Ramsar Convention on Wetlands), IUCN (1998), OECD (2002), and Pagiola et al. 2005 (published by the World Bank).

22/ Rietbergen-McCracken and Abaza (2000), 2.

23/ IUCN (1998).

24/ By discussing issues of relevance to successful implementation of this technique in these countries, the report can be used by FAO and its Member countries for guiding the work of practitioners who have a leading or technical contribution role in the design of CVM surveys. It is available under http://www.fao.org/es/ESA/en/pubs_wp01.htm .

choosing this approach is that the report of the Millennium Ecosystem Assessment has already been extensively peer-reviewed by governments and experts.

33. Many methods for measuring the values of ecosystem services are found in the resource and environmental economics literature (Mäler and Wyzga 1976; Freeman 1979; Hufschmidt et al. 1983; Mitchell and Carson 1989; Pearce and Markandya 1989; Braden and Kolstad 1991; Hanemann 1992; Freeman 1993; Pearce 1993; Dixon et al. 1994; Johansson 1994; Pearce and Moran 1994; Barbier et al. 1995; Willis and Corkindale 1995; Smith 1996; Seroa da Motta 1998; Garrod and Willis 1999; Seroa da Motta 2001; Pearce et al. 2002; Turner et al. 2002; Pagiola et al. in review). The table annexed to the note by the Executive Secretary on proposals on valuation of biodiversity (UNEP/CBD/SBSTTA/11/9) summarizes the main economic-valuation techniques.

34. Some techniques are based on actual observed behaviour data, including some methods that deduce values indirectly from behaviour in surrogate markets, which are hypothesized to have a direct relationship with the ecosystem service of interest. Other techniques are based on hypothetical rather than actual behaviour data, where people's responses to questions describing hypothetical markets or situations are used to infer value. These are generally known as "stated preference" techniques, in contrast to those based on behaviour, which are known as "revealed preference" techniques. Some techniques are broadly applicable, some are applicable to specific issues, and some are tailored to particular data sources. As in the case of private-market goods, a common feature of all methods of economic valuation of ecosystem services is that they are founded in the theoretical axioms and principles of welfare economics. These measures of change in well-being are reflected in people's willingness to pay or willingness to accept compensation for changes in their level of use of a particular service or bundle of services (Hanemann 1991; Shogren and Hayes 1997). These approaches have been used extensively in recent years, in a wide range of policy-relevant contexts.

35. Any one valuation method is unlikely to be able to cover *all* of the different types of value given in the concept of Total Economic Value. 25/ Different techniques may also be required for the same biodiversity resource evaluated at different scales. For example, the range of services of a forest, the type of value of those services, and their actual value to a local community living at the fringe of the forest, may differ significantly from the types of value and the value that the national and/or international community may assign to different services of the same forest. The selection of the method or methods should therefore depend on which types of value, and on which levels, are deemed the most important or likely in a given situation.

36. Valuation is a process involving several steps. First, the services being valued have to be identified. This includes understanding the nature of the services (bearing in mind that, under the Millennium Ecosystem Assessment understanding, services may also include goods) and their scale (being local, regional and/or global, on-site or off-site), and how they would change if the ecosystem changed; knowing who makes use of the services, in what way and for what purpose, and what alternatives they have; and establishing what trade-offs might exist between different kinds of services an ecosystem might provide. The bulk of the work involved in valuation actually concerns quantifying the biophysical relationships. In many cases, this requires tracing through and quantifying a chain of causality. Valuation in the narrow sense only enters in the second step in the process, in which the value of the impacts is estimated in monetary terms.

25/ See, e.g., Nunes and van den Bergh (2001).

Overview of valuation methods 26/

1. Changes in productivity

37. One widely used technique, thanks to its broad applicability and its flexibility in using a variety of data sources, is known as the change in productivity technique. It consists of tracing through chains of causality so that the impact of changes in the condition of an ecosystem can be related to various measures of human well-being. Such impacts are often reflected in goods or services that contribute directly to human well-being (such as production of crops or of clean water), and as such are often relatively easily valued. The valuation step itself depends on the type of impact but is often straightforward.

38. The impact of hydrological changes on use of water for human consumption, for example, begins by tracing through chains of causality to estimate the changes in the quantity and quality of water available to consumers. This is itself often difficult. For instance, the relationship between tree cover and water productivity in a watershed is complex and often not well understood. Further scientific research into this relationship and the chains of causality will in such cases be a key precondition for valuation.

39. In the case of marketed goods, the actual valuation is relatively straightforward. For instance, the net value in reductions in irrigated crop production resulting from reduced water availability is easy to estimate, for example, as crops are often sold. (Even so, it is a very common error to use the reduction in the gross value of crop production rather than the net value. Using gross value omits the costs of production and so overestimates the impact.).

40. Where the impact is on a good or service that is not marketed or where observed prices are unreliable indicators of value, the valuation can become more complex. In the example above, it has to be noted that the prices charged to consumers for water consumption are typically not reliable measures of the value of the water to consumers, as they are often set administratively, with no regard for supply and demand (indeed, in most cases water fees do not even cover the cost of delivering the water to consumers, let alone the value of the water itself). The value of an additional unit of water can then be estimated in various ways, such as the cost of alternative sources of supply (cost-based measures are described later) or asking consumers directly how much they would be willing to pay for it (contingent valuation, described later). Note that it is very important to use the value of an additional unit of water, since some amount of water is, of course, vital for survival. Thus an additional unit of water will be very valuable when water is scarce, but much less so when water is plentiful. In this case, as in many others, averages can be misleading.

41. When the impact is on water quality rather than quantity, the impact on well-being might be reflected in increased morbidity or even mortality. Again, the process begins by tracing through chains of causality, for example by using dose-response functions that tie concentrations of pollutants to human health. Valuing the impact on health itself can then be done in a number of ways (see cost of illness and human capital, in the next section).

42. In some cases, the impact is on relatively intangible aspects of well-being, such as aesthetic benefits or existence value. Starting in the 1960s, particular efforts have been made to develop techniques to value such impacts, including hedonic price, travel cost, and contingent valuation methods, and considerable progress has been made since then.

26/ In accordance with the mandate set out in decision VII/18, this section focuses on the methodological status of the individual methods. References to actual studies undertaken with these methods can be found in paragraphs 30 and 58.

2. Cost of illness and human capital

43. The economic costs of an increase in morbidity due to increased pollution levels can be estimated using information on various costs associated with the increase: any loss of earnings resulting from illness; medical costs such as for doctors, hospital visits or stays, and medication; and other related out-of-pocket expenses. The estimates obtained in this manner are interpreted as lower-bound estimates of the presumed costs or benefits of actions that result in changes in the level of morbidity, since this method disregards the affected individuals' preference for health versus illness and restrictions on non-work activities. Also, the method assumes that individuals treat health as exogenous and does not recognize that individuals may undertake defensive actions (such as using special air or water filtration systems to reduce exposure to pollution) and incur costs to reduce health risks.

44. When this approach is extended to estimate the costs associated with pollution-related mortality (death), it is referred to as the human-capital approach. It is similar to the change-in-productivity approach in that it is based on a damage function relating pollution to productivity, except that in this case the loss in productivity is that of human beings, measured in terms of expected lifetime earnings. Because it reduces the value of life to the present value of an individual's future income stream, the human-capital approach is extremely controversial when applied to mortality. Many economists prefer, therefore, not to use this approach and to simply measure the changes in the number of deaths or in the probability of death (without monetary values), or measures such as disability-adjusted life years.

3. Cost-based approaches

45. The costs of replacing or restoring the services provided by the environmental resource can sometimes be relevant variables in decision-making. For example, if ecosystem change reduces water filtration services, the cost of treating water to make it meet the required quality standards could be used. The major underlying assumptions of these approaches are that the nature and extent of physical damage expected is predictable (there is an accurate damage function available) and that the costs to replace or restore damaged assets can be estimated with a reasonable degree of accuracy. It is further assumed that the replacement or restoration costs do not to exceed the economic value of the service, bearing in mind that potential externalities generated by the replacement options should also be taken into consideration. These assumptions may not be valid in all cases. It simply may cost more to replace or restore a service than it was worth in the first place—for example, because there are few users or because their use of the service was in low-value activities.

46. Even while there is not necessarily any relationship between the replacement or restoration cost and the value of the service, cost-based approaches can provide useful guidance in a number of cases, in particular when the specific decision-making problem calls for a comparison of the costs resulting from all different replacement or restoration options. For instance, in an often-quoted case, the New York City water authority avoided spending $6-8 billion on water purification plants by investing $1.5 billion for protection and restoration of the upstate watershed of the Catskills mountains. 27/ Here, the decision-making problem was simply to minimize the cost of meeting an objective, by comparing the costs resulting from replacement and from restoration options. The priority given to the objective itself (a reliable supply of drinking water meeting certain quality standards) was unquestionable and, hence, not part of the decision-making problem.

4. Hedonic analysis

47. The prices paid for goods or services that have environmental attributes differ depending on those attributes. Thus, a house in a clean environment will sell for more than an otherwise identical house

27/ See Postel and Thompson 2005.

in a polluted neighbourhood. Hedonic price analysis compares the prices of similar goods to extract the implicit value (also dubbed "shadow price") that buyers place on the environmental attributes. This method assumes that markets are transparent and work reasonably well, and it would not be applicable where markets are distorted by policy or market failures. Moreover, this method requires a very large number of observations, so its applicability is limited.

5. Travel cost

48. The travel-cost method is an example of a technique that attempts to deduce value from observed behaviour in a surrogate market. It uses information on visitors' total expenditure to visit a site to derive their demand curve for the site's services. From this demand curve, the total benefit visitors obtain can be calculated. (It is important to note that the value of the site is not given by the total travel cost; this information is only used to derive the demand curve.) This method was designed for and has been used extensively to value the benefits of site-seeing or of recreation at particular sites, but it has limited utility in other settings.

6. Contingent valuation

49. Contingent valuation is an example of a stated preference technique. It is carried out by asking consumers directly about their willingness-to-pay to obtain an environmental service. 28/ A detailed description of the service involved is provided, along with details about how it will be provided. The actual valuation can be obtained in a number of ways, such as asking respondents to name a figure, having them choose from a number of options, or asking them whether they would pay a specific amount (in which case, follow-up questions with higher or lower amounts are often used). 29/

50. Contingent valuation can, in principle, be used to value any environmental benefit simply by phrasing the question appropriately. Moreover, since it is not limited to deducing preferences from available data, it can be targeted quite accurately to ask about the specific changes in benefits that the change in ecosystem condition would cause. Because of the need to describe in detail the good being valued, interviews in contingent valuation surveys are often quite time-consuming. It is also very important to identify the relevant population, to ensure representativeness of the sample of respondents, and to have the questionnaire extensively pre-tested to avoid various sources of bias.

51. A potentially important limitation in terms of applying these methods to ecosystem services is that respondents cannot typically make informed choices if they have a limited understanding of the issue in question. Choosing the right approach and the adequate intensity of efforts in improving the understanding of biological complexity of the sample group is a challenge for stated preference methods.

52. Contingent-valuation methods have been the subject of severe criticism by some analysts. A "blue-ribbon" panel was organized by the United States Department of Interior following controversy over the use of contingent valuation to value damages from the 1989 *Exxon Valdez* oil spill. The report of this panel (NOAA 1994) concluded that contingent valuation can provide useful and reliable information when used carefully, and it provided guidance on doing so. This report is generally regarded as authoritative on appropriate use of the technique. 30/

28/ Or, sometimes, their willingness-to-accept. See footnote 8 for further discussion.

29/ Respondents do not necessarily have to provide a monetary figure. See paragraph 20.

30/ See NOAA 1994.

7. Choice modelling

53. Choice modelling (also referred to as contingent choice, choice experiments, conjoint analysis, or attribute-based stated choice method) is a newer approach to obtaining stated preferences. It consists of asking respondents to choose their preferred option from a set of alternatives where the alternatives are defined by attributes (including the price or payment). The alternatives are designed so that the respondent's choice reveals the marginal rate of substitution between the attributes and money. These approaches are useful in cases in which the investigator is interested in the valuation of the attributes of the situation or when the decision lends itself to respondents choosing from a set of alternatives described by attributes.

54. Choice modelling has several advantages: the control of the stimuli is in the experimenter's hand, as opposed to the low level of control generated by real market data; the control of the design yields greater statistical efficiency; the attribute range can be wider than found in market data; and the introduction or removal of products, services and attributes is easily accomplished (Louviere et al. 2000; Holmes and Adamowicz 2003; Bateman et al. 2004). 31/ The method also minimizes some of the technical problems associated with contingent valuation, such as strategic behaviour of respondents. The disadvantages associated with the technique are that the responses are hypothetical and therefore suffer from problems of hypothetical bias (similar to contingent valuation) and that the choices can be quite complex when there are many attributes and alternatives. The econometric analysis of the data generated by choice modelling is also fairly complex.

8. Benefits transfer

55. A final category of approach is known as benefits transfer. This is not a methodology *per se* but rather refers to the use of estimates obtained (by whatever method) in one context to estimate values in a different context. For example, an estimate of the benefit obtained by tourists viewing wildlife in one park might be used to estimate the benefit obtained from viewing wildlife in a different park. Alternatively, the relationship used to estimate the benefits in one case might be applied in another, by using adjusted data from this case in conjunction with some data from the site of interest ("benefit function transfer"). For example, a relationship that estimates tourist benefits in one park, based in part on their attributes such as income or national origin, could be used in another park, but with data on income and national origin of that park's visitors.

56. Benefits transfer has been the subject of considerable controversy in the economics literature, as it has often been used inappropriately. 32/ According to the Millennium Ecosystem Assessment, a consensus seems to be emerging that benefit transfer can provide valid and reliable estimates under certain conditions. These conditions include the requirement that the commodity or service being valued be very similar at the site where the estimates were made and the site where they are applied and that the populations affected have similar characteristics. 33/ Of course, the original estimates being transferred must themselves be reliable in order for any attempt at transfer to be meaningful.

57. As the conditions at the two sites are unlikely to be perfectly identical, some transfer error is to be expected. This feature, however, does not speak *as such* against the application of benefits transfer in real-world decision-making. This is because estimates based on benefits transfer can be generated with considerably less time and resources than primary studies. In a world of scarce resources and typically

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31/ Conjoint analysis to value ecosystem services in different rural areas has been used in Colombia in a project by the Alexander von Humboldt Institute in cooperation with the University of Massachusetts. See Colombia 2002.

32/ See Brouwer 2000; Christie et al. 2004, 40, for further discussion.

33/ Up to a limit, differences in the population's characteristics can be addressed by using benefits functions transfer. See paragraph 55.

very costly primary studies, decision makers may be willing to trade quick and cheap numbers against a certain loss in accuracy, provided that minimum quality standards are met. They may even be more ready to do so when the relevant alternative, under given resource constraints, is simply to have no estimate at all. Moreover, benefits transfer may be attractive when decision makers request, as is frequently the case, quick (but not necessarily final) answers from administrators—it may hence play a role within rapid assessment methodologies. 34/

9. Summary assessment of valuation methods

58. Each of the approaches reviewed above has seen extensive use in recent years, and considerable literature exists on their application. These techniques can and have been applied to a very wide range of issues (Rietbergen-McCracken and Abaza 2001), including the benefits of ecosystems such as forests (Bishop 1999; Kumari 1995; Pearce et al. 2002; Hanley et al. 2002, Merlo and Croitoru in press), wetlands (Barbier et al. 1997; Heimlich et al. 1998), watersheds (Aylward 2004; Kaiser and Roumasset 2002). Other studies have focused on the value of particular ecosystems services such as water (Young and Haveman 1985), non-timber forest benefits (Lampietti and Dixon 1995; Bishop 1998), recreation (Bockstael et al. 1991; Mantua at al. 2001; Herriges and Kling 1999; Humavindu 2002), landscape (Garrod and Willis 1992; Powe et al. 1995), biodiversity for medicinal or industrial uses (Simpson et al. 1994; Barbier and Aylward 1996), natural crop pollination and cultural benefits (Pagiola 1996; Navrud and Ready 2002). Many valuation studies are catalogued in the Environmental Valuation Reference Inventory Web site maintained by Environment Canada (EVRI) 35/ or the ENVALUE environmental valuation database developed by the New South Wales Environmental Protection Agency of Australia. 36/

59. It appears that, when applied carefully and according to best practice, valuation tools can generally provide useful and reliable information on the changes in the value of non-marketed ecosystem services that result (or would result) from management decisions or from other human activities. Data requirements may be quite demanding for a number of tools, as are the preconditions in terms of technical expertise. Moreover, conducting primary valuation studies is typically time-consuming and costly.

60. According to the Millennium Ecosystem Assessment, measures based on observed behaviour are generally preferred to measures based on hypothetical behaviour, and more direct measures are preferred to indirect measures. However, it is also pointed out that the choice of valuation technique in any given instance will be dictated by the characteristics of the case, including its scope, and by data availability.

61. Several techniques have been specifically developed to cater to the characteristics of particular problems. The travel-cost method, for example, was specifically developed to measure the utility derived by visitors to sites such as protected areas, and could also be applied to similar areas of interest, but is of limited applicability outside that particular case. The change in productivity approach, on the other hand, is applicable to a wide range of issues.

62. Contingent valuation is potentially applicable to any issue, simply by phrasing the questions appropriately and as such has become very widely used – probably excessively so, as it is easy to misapply and, being based on hypothetical behaviour, is inherently less reliable than measures based on observed behaviour. For instance, if the focus is on the quantification of indirect use values, the

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34/ Christie et al (2004) note in this connection that: "Finding acceptable benefits transfer methods is essential to the wider use of environmental valuation in policy. However, the standards of accuracy required in academic work may exceed those viewed as tolerable by policy-makers. (…)The key question is: how close is close enough for policy purposes?"

35/ http://www.evri.ca .

36/ http://epa.nsw.gov.au/envalue/ .

application of other valuation tools would often seem to be preferable. For some types of value, however, stated preference methods may be the only alternative. Thus, existence value can only be measured by stated preference techniques. Guidance on the appropriate use of the technique exists and should be followed closely.

63. Benefits transfer has often been used inappropriately but can provide valid and reliable estimates under certain conditions. Given the cost of undertaking primary valuation studies, benefits transfer when used cautiously is likely to be an increasingly appealing way for extending the use of valuation, including in developing countries.

IV. VALUATION AND DECISION-MAKING

64. As said earlier, undertaking valuation has the potential of improving public decision-making on projects or regulations as well as, under specific circumstances, of improving legal decision-making. In this connection, the synthesis report of the Millennium Ecosystem Assessment also notes that:

> "[M]ost resource management and investment decisions are strongly influenced by considerations of the monetary costs and benefits of alternative policy choices. Decisions can be improved if they are informed by the total economic value of alternative management options and involve deliberative mechanisms that bring to bear non-economic considerations as well."

65. Existing methods to support decision-making use valuation information to a greater or lesser extent. Economic frameworks such as cost-benefit analysis (CBA) and cost-effectiveness analysis (CEA) involve explicit monetary valuation. An important advantage of the valuation tools reviewed in the last section is that they provide numbers in a common (monetary) metric, which can thus easily be incorporated into these standard appraisal methods. In contrast, multi criteria analysis (MCA) typically avoid using a monetary unit of account. Other non-economic approaches to prioritization include deliberative processes, scorecard approaches, expert judgment and satisficing.

66. All of these approaches are but *tools* to *support* decision-making. All of them have specific advantages and limitations, and it cannot be claimed that one tool is generally superior, or that it should be used as an *exclusive* tool in decision-making. For instance, with regard to cost-benefit-analysis, it has to be acknowledged that economic efficiency is seldom the sole criterion for public investment decisions. The distributional impacts of decisions are often also important. While cost-benefit-analysis can be helpful in clarifying distributional impacts, 37/ it does not deliver recommendations with regard to preferable decisions from a distributional perspective. It will be shown in the subsequent paragraphs that the different methods may be used in a complementary manner in order to support decision-making.

A. Economic frameworks

1. Cost-benefit analysis and cost-effectiveness analysis

67. Cost-benefit analysis compares monetary costs and benefits in commensurate terms. This comparison is sometimes expressed as a cost-benefit ratio, with benefits as the numerator and costs as the denominator. Alternative options can then be ranked in accordance with their cost-benefit-ratio. Depending on the specific activities under investigation, the value associated with ecosystem services will be included as a cost or as a benefit. For instance, if the cost-benefit-ratios of different conservation projects were compared, the value of improved ecosystem services would be included as benefits of the

37/ For instance, many direct use values in developing countries arise in the context of subsistence activities that are often crucially important to rural populations. A range of studies has concentrated on the links between poverty alleviation and the sustainable exploitation of naturally occurring products. See e.g. Cavendish 1999 and 2003.

individual projects. If, however, different development projects were considered, such as for instance different options to invest into public infrastructure with negative impacts on biodiversity, the value of the associated loss of ecosystem services would be included as a cost to the individual option. 38/

68. As costs and benefits typically occur at different points in time, some way must be found to collapse the recognized cost and benefit flows to a commensurate basis. This conventional economic process is known as time discounting, and the outcome of this process is called the "present value" of costs and benefits. A crucial variable in the calculation of present values is the choice of a discount rate; i.e. the value that is used to collapse future values to their present equivalents. Any positive rate of discount is tantamount to saying that the future (costs and benefits) are worth less in relative terms than the present, that is, costs and benefits that are realized immediately.

69. For conventional investment purposes, the rate of discount is simply the relevant market interest rate. But when it comes to choosing the appropriate rate for making a judgement on government projects or policies with important social and environmental impacts, important ethical and philosophical issues arise that relate to the status of present versus future (possibly unknown) preferences. While most contributors would seem to agree that the rate of discount should be positive, the correct number is the subject of much debate.

70. Discount rates used in public decision-making tend to vary between 3 and 15 per cent across different countries. The choice of discount rate is in the first instance be guided by the rate that is used by the public sector for appraising its other investments, which implies that biodiversity-related "investments" would be treated like all other investments. In many cases, however, lower rates are used. One important reason why not to accept a standard discount rate for biodiversity has been advanced in the shape of the so-called Krutilla-Fisher method. 39/ Even if future preferences for biodiversity are uncertain current trends mean that the future of many biodiversity components and resources is looking bleak, implying that they will be increasingly scarce, or more valuable, in the future. As future generations will place a higher value on scarcer resources than current generations, this reasoning then gives rise to a positive premium on the future, which offsets the discounting process described above.

71. Cost-effectiveness analysis (CEA) leaves the numerator in qualitative terms and simply compares the different costs of attaining some objective stated in the numerator. Different options *that deliver the same objective* are then compared and prioritized based on their cost-effectiveness-ratio. 40/ CEA, therefore, does not ask nor attempt to answer the question of whether the goal of the policy is justified, in the sense that the social benefits expected from this goal exceed the costs necessary to reach the goal. In fact none of the options may be economically efficient, in the sense of monetary economic costs outweighing economic benefits. Hence, CEA is appropriate whenever there are good reasons to believe that the benefits of meeting the objective outweigh the costs, and the priority given to meet the objective is therefore not under doubt. 41/ In other cases, however, CEA may only be helping to select the least worst option among a list of (potentially) inefficient options. Even in those cases, CEA is sometimes used as a second-best option when a full-blown CBA would be desirable, but many benefits cannot easily be monetized.

38/ This procedure would allow to capture what economists call the "opportunity cost" of the individual development project, that is, the cost in terms of the most valuable opportunity foregone and the benefits that could be received from that opportunity. The consideration of opportunity costs is one of the key differences between the concepts of economic cost and accounting cost.

39/ See Pearce and Turner 1990, Krutilla and Fisher 1975, Hanley and Craig 1991.

40/ Alternatively, CEA may assume a fixed budget and seeks the alternative that will result in the maximum effect on a specific target variable.

41/ The case discussed in paragraph 46 provides an example.

72. Both CBA and CEA are common governmental appraisal methods in OECD countries and among international organizations. While the methods were originally developed for appraising basic infrastructure, many government guidance documents now include advice on the inclusion of environmental and social costs and benefits. 42/

2. National income accounts

73. While CBA and CEA are decision-making tools relevant to projects and regulations, national income accounts are a key indicator framework for setting priorities in domestic macroeconomic policies. National income accounts are a long-standing economic convention by which economic performance are measured. In essence, the accounts measure national output from all sources (known as gross domestic product), and then deduct a measure of depreciation, which is the amount of (typically) man made capital that is used up in production. The result is a figure that depicts, in economic terms, how well off a country is year on year. While conventional accounts already include many biological products (e.g. production of timber and fish), in the last two decades there have been numerous attempts, at national and international levels, to include environmental externalities and, more importantly, some measure of environmental depreciation to reflect the environmental losses that occur as a result of economic activities. 43/ For instance, recent work of the World Bank along these lines has shown that several countries that perform well on conventional grounds were actually performing less well once the new measure of depreciation was included. 44/ Identification of this environmental drag on economic growth can serve as a basis for prioritizing national environmental policies and a focus on mitigation or reversal of environmentally damaging activities.

74. While valuation is central to the exercise of environmental adjustment, many theoretical and methodological challenges remain with regard to an adequate incorporation of biodiversity values in conventional macro economic indicators of growth. 45/ For instance, many of the valuation tools at hand are simply too costly and demanding to apply them on a scale that would be needed for a *comprehensive* valuation of the annual changes in domestic biodiversity resources. 46/ Nevertheless, national income accounts remain an important vehicle into which more information about biodiversity loss must be directed. Further research directed at the development of a biodiversity adjustment is an important means to have biodiversity losses more reflected in macroeconomic discourse. 47/

B. Non-economic frameworks

75. The economics approaches mentioned so far are all potentially informed by the tools for the valuation of biodiversity resources presented in the previous section. The following approaches are more qualitative in nature but may occasionally use valuation information in the decision process.

42/ See for example chapter 4 of the United Kingdom Treasury Green Book on public appraisal. http://greenbook.treasury.gov.uk/

43/ See for instance the United Nations System of Economic and Environment Accounting, introduced by the United Nations Statistic Division in 1993 and revised in 2003. See http://unstats.un.org. A United Nations Committee on Environmental-Economic Accounting was established to promote and implement this work.

44/ The World Bank has developed the concept of adjusted net savings, which measure the true rate of savings in an economy after taking into account investments in human capital, depletion of natural resources and damage caused by pollution.

45/ See for instance Nordhaus and Kekkelenberg (eds) 1999 for further discussion.

46/ Such problems are not alien even to conventional National Accounting. For instance, many of the issues involved in including environment values at the macro level are not uncommon to problems involved in measuring the cost of living. See Nordhaus and Kekkelenberg (1999).

47/ Some systems, such as the United Nations System of Economic and Environmental Accounting, have also introduced a set of satellite accounts in which changes in important natural assets are accounted for in physical terms.

1. Multi criteria analysis

76. Multi-criteria analysis (MCA) is in fact a family of methods that use different scoring approaches to weigh the different attributes of a decision. They are used to structure a policy problem in terms of possible policy alternatives and to assess each alternative under various criteria. Most of the variants of MCA are structured approaches used to determine overall preferences among alternative policy measures, where each policy measure may pursue several objectives. Participants in the analysis are typically given the criteria that define different options and are asked to score or weigh these criteria using some pre determined points system.

77. Multi-criteria analysis is mainly applicable to cases where a single-criterion approach is insufficient. Instead, an MCA may accommodate a range of social, environmental, technical, economic, and financial criteria. MCA is therefore applicable especially where significant environmental and social impacts are present, which cannot (easily) be expressed in monetary terms. 48/ MCA are often integrated with deliberative and participatory approaches and are said to facilitate such input to a larger degree than the monetary assessment tools CBA and CEA. 49/

78. There are very few applications of MCA in developing countries. However, MCA is often difficult to use and understand for lay people. Most variants require an expert to explain how the method works, and to help users to define options, criteria and weights, as well as to choose the appropriate aggregation procedure. The method also makes no claim to be searching for economically efficient outcomes. Like CEA, all options under consideration may be inefficient.

79. CBA and MCA are not mutually exclusive. CBA can be used to define a set of efficient options, that is, options where net benefits are positive (that is, gross benefits are greater than costs). Options with net economic benefits of similar magnitude could be further assessed by MCA so as to identify the various non-economic trade-offs associated with the alternative courses of action.

2. Deliberative and participatory approaches

80. Deliberative processes (sometimes also referred to as “deliberative and inclusionary processes” or “DIPs”) include participatory appraisal, focus groups, Delphi approach, consensus conferences and citizen’s juries. These methods are aimed at creating better informed decisions that are owned by and have the broad consent of all relevant actors and stakeholders. They therefore contrast to the more technocratic approaches such as cost-benefit or cost-effectiveness analysis or even MCA. DIPs seek to build a process of defining and redefining interests that stakeholders introduce as the collective experience of participation evolves. As participants become more empowered, i.e. more respected and more self-confident, so it is assumed they may become more ready to adjust, to listen, to learn, and to accommodate to a greater consensus.

81. In many countries, the benefits emanating from some ecosystem services are well known to local and indigenous communities – it is captured by their *traditional knowledge*. As long as these communities are adequately included in economic valuation exercises (for instance, by ensuring that they are adequately represented in the population sample for a stated preference study), the value *they* put on these ecosystem services would be captured by economic valuation.

48/ Biodiversity indicator frameworks may play a key role in assessing the impacts of the project or policy under consideration. See, for further information, the guidance, lessons learned and list of indicators provided in document the note by the Executive Secretary on monitoring and indicators prepared for the ninth meeting of SBSTTA (UNEP/CBD/SBSTTA/9/10) (paragraph 8 of decision VII/8, on national-level monitoring programmes and indicators, refers to this document).

49/ See Nichols et al. 2000 for further discussion.

82. However, traditional knowledge of ecosystem services is often not adequately received by the wider public. Here, deliberative and participatory approaches may play an important role in promoting the wider recognition of this knowledge. It may also contribute, with the approval and involvement of these communities, to its wider application including within economic valuation studies. For instance, it was explained above that a limitation of stated preference techniques is that respondents cannot typically make informed choices if they have a limited understanding of the issue in question. Deliberative and participatory approaches, by disseminating pertinent knowledge, may play an important role in broadening the understanding on the issue of all stakeholders.

83. The adoption of such methods varies across countries, with some having formal processes for undertaking participation in the formulation of contentious area of public policy. The use of economic information in these methods is entirely at the group's discretion. Hence, valuation data may or may not consistently inform the outcome of such processes, and they cannot guarantee that outcomes are an efficient use of public resources. Moreover, in many countries, the relative weight that the outcome of these processes is given in final decisions is unclear.

3. Satisficing

84. A satisficing approach can be described as an assessment procedure to obtain an outcome that is good enough, rather than seeking the best solution. The approach can thus be contrasted with an optimizing approach that seeks to identify the "best" solution, as is the case, for example, with cost-benefit analysis or multi-criteria analysis. For the implementation of a satisficing approach, one or more criteria need to be identified that the measure is expected to fulfil. The subsequent analysis can then either investigate all possible measures to achieve this objective(s), and list the successful options without ranking them. Alternatively, the analysis may also be terminated once the first option has been identified that fulfils the requirement(s).

85. In decision theory, the term satisficing is also used to refer to an optimization process where *all* costs, including the cost of the optimisation calculations and the cost of getting information for use in those calculations, are considered. This takes account of the fact that, in some cases, the costs of gathering and processing information may not be justified by the subsequent improvements in decision-making that can be achieved through the improved information. This is likely to be the case in decision situations with a low level of complexity, where only few well-defined options are available, where the targets are clearly specified and where little or no trade-offs between targets are necessary.

86. One difficulty associated with such an approach is that the added value of better information for the decision-making process may only be apparent if this information is available: if it is not available, it may be hard to assess in what way better information might have changed the results of the decision, and what impact this would have had.

4. Liability and redress

87. In some countries, the legal framework for liability and redress priorities has been an important driver for the analysis and refinement of valuation methods. For instance, in the United States, the ability to use valuation information as the basis for legal redress has been a significant impetus for considering the value of damaged biological resources. High damage costs, derived including through non-market valuation have given plaintiffs a large incentive to demonstrate the monetary value of any damaged resources. As a result, valuation methods, and contingent valuation in particular, has come under considerable scrutiny in high profile legal cases such as the *Exxon Valdez* oil spill, with guidelines having been developed for the appropriate use of stated preference techniques (NOAA 1994). Under the natural resource damage assessment (NRDA) regulations of the National Oceanic and Atmospheric Administration (NOAA), valuation (the so-called value-to-value approach) is applicable when the injured

and restored resources and services are not of the same type, quality, and value, and is used to calculate the value of gains from the proposed restoration actions and the value of the interim losses. 50/

88. The European Union also explored the legal basis for using of non-market values as evidence. Under current regulation, it is within the discretion the competent authority to use economic valuation to determine the extent of the necessary complementary and compensatory remedial measures, if it is not possible to use the so-called resource-to-resource or service-to-service equivalence approaches. 51/

89. In many other countries, however, weak legal systems, poorly defined and enforced property rights over damaged resources, and/or the fact that many damaged resources are governed by customary law or practices that are not necessarily recognized by legal systems in a national context, mean that (formal) legal drivers for the application of valuation tools are currently weak to non-existent.

C. Conclusions

90. The use of formal appraisal methods and the nature of decision-making processes generally vary across countries. Even when formally documented procedures are in place it is impossible to generalize how and when different methods are most appropriate. In general, methods such as cost-benefit analysis seem to be less controversial, and are commonly applied, when financial costs and benefits are relatively clear to identify and when for instance social impacts are comparatively small. There seems to be a need to include decision-making tools that are more consensual and participation-oriented, in particular when external costs have significant social consequences, when they are captured by traditional knowledge that is not widely available, and/or when the local socio-cultural systems pose a serious limitation to valuation based solely on economic terms. The combined utilization of different decision making tools may be useful.

91. Mirroring the research progress made in developing reliable tools and methodologies, valuation studies in many countries play an increasing role in contemporary environmental policies, as they provide additional knowledge to support better decision-making. However, the integration of valuation information into decision-making frameworks still seems to be not satisfactory in many countries.

92. Conducting primary valuation studies is time-consuming and costly. Given the limited budget and manpower in many administrations, the need to conduct or manage primary research can pose a strain on the available resources. Capacity, both in conducting valuation studies and in overseeing their preparation and ensuring their quality, is often limited. Problems are exacerbated when the rationale for valuation is poorly conveyed to higher-level administrators. In many cases, the people that matter can be left with an impression that new research will not produce added value for the quality of decision-making. More commonly, poorly conducted studies, 52/ with limited follow-up, can leave officials with an impression that valuation studies can only tell them what they already know. Resources that flow into the studies become harder to justify.

93. Hence, it is important to apply and interpret valuation results in their appropriate context and to be aware of the pitfalls involved. However, this applies to most methods and techniques, whether in

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50/ See Penn 2005 for a brief summary.

51/ Under these approaches, actions that provide natural resources and/or services of the same type, quality and quantity as those damaged shall be taken, or alternative natural resources and/or services shall be provided. See Annex II, paragraphs 1.2.2 and 1.2.3, of Directive 2004/35/CE, on environmental liability with regard to the prevention and remedying of environmental damage. See EC (2001) for background information. In Canada, a recent Supreme Court decision confirmed the acceptance of valuation approach to support damage valuation.

52/ For instance, a problem frequently identified in the literature is high values derived though contingent-valuation studies. For many observers excessive stated preferences defy intuition and apparently discredit the method. See section II B above for further discussion.

economics or in any other field. Many basic criticisms levelled at valuation can be avoided when best practice is followed while conducting valuation studies; for example, a contingent valuation study can well be integrated with and extended into a public participation exercise. The main question is rather—given their high costs and the expertise required—how their use can be targeted at those cases where valuation studies actually provide an added value in terms of improved decision-making.

94. Resistance to the use of valuation in OECD countries has in recent years been addressed by attempts to produce both valuation guides and protocols as well as standard environmental values for use in benefits transfer. These efforts have revealed to be fruitful in terms of increasing the credibility and acceptability of valuation methods. More importantly, these resources have also simplified and reduced the cost of undertaking policy appraisal.

V. STRENGTHEN INTERNATIONAL COLLABORATIVE PARTNERSHIPS FOR ASSESSING BIODIVERSITY VALUES

95. Valuation is beginning to play a significant role in biodiversity management decisions in OECD countries. Many Governments espouse its use, with the predominant framework being cost-benefit analysis, even if they acknowledge the technical difficulties of consistent implementation of valuation in decision-making. While it would be premature to suggest that biodiversity values are always consistently considered, the important thing to note about the experience is that there is a formally documented approach that should be followed in determining resource allocations and in setting priorities. 53/

96. International organizations such as the OECD, the European Community, the World Bank and the Global Environment Facility (GEF) have all advocated greater use of valuation in policy making and project design. Other United Nations organizations, such as the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the Food and Agriculture Organization of the United Nations (FAO) have, at various times, either sponsored meetings on the topic or undertaken projects, which have a strong biodiversity valuation component. Several governments have also facilitated greater use through the sponsorship of meetings and information databases sources such as EVRI or ENVALUE, mentioned above. 54/

97. Similarly a number of non-governmental organizations, such as IUCN, WWF and Conservation International, have continued to sponsor research and wider application and dissemination about biodiversity valuation, and its role in creating incentives for conservation and sustainable management of biodiversity.

98. A combination of poor institutional capacity and a lack of trained staff can generally be identified as the main barriers to further promotion of valuation as a biodiversity management tool, in particular in developing countries and countries with economies in transition. Overall, valuation can normally be advanced in most countries by the development of high profile studies that help to raise the

53/ In the United Kingdom for example, there is clear guidance on the importance of considering non-market values in central government project and regulatory appraisal. This guidance in nominally the responsibility of the Treasury (Ministry of Finance), which advocates good appraisal practice across a range of government ministries, including environment and transport. This model of appraisal practice is mirrored in several other countries.

54/ Other databases include the Ecosystem Services Database (ESD) developed by the Gund Institute for Ecological Economics, University of Vermont; the Valuation Study Database for Environmental Change in Sweden (VALUEBASE SWE; see http://www.beijer.kva.se/valuebase.htm), and the Review of Externality Data database developed by the European Commission under the Energy, Environment and Sustainable Development Program of DG Research (http://www.red-externalities.net/). Lantz and Slaney (2005) provide a recent evaluation of different valuation databases.

issue of biodiversity in national debates. 55/ Many countries have reached this stage, but many others have not. This critical phase requires international collaboration and enhancement of domestic capacity.

A. Institutional capacity

99. Poor institutional capacity is often an important impediment for consistent policy and regulatory appraisal. However, even where staff and infrastructure are relatively adequate, institutional weakness manifests in poorly defined lines of responsibility and the absence of clearly defined governmental practices for appraising basic policy changes such as projects and regulations.

100. These institutional weaknesses can be summarized as a checklist, which can in turn provide a basis for the identification of needs:

(a) Does a single ministry or agency hold a clearly defined remit for biodiversity management?

(b) Is there a formally documented procedure for conducting environmental impact assessments of new projects and regulations?

(c) Is there a formally documented economics appraisal process for: (i) new projects; and (ii) new regulations?

(d) Do the project or regulatory appraisal procedures include quantitative as opposed to qualitative assessments of costs and benefits?

(e) What role does cost-benefit analysis play in appraisal?

(f) Do formal guidelines for cost-benefit analysis exist?

(g) Do formal guidelines include guidance on how to deal with non-market costs and benefits and biodiversity in particular?

(h) What is the legal status of the findings of government appraisals?

(i) Who conducts any appraisal and how is the process audited for quality control?

B. Capacity-building and training

101. The answers to many of the preceding questions are likely to be qualified by the issue of adequate capacity-building and training. At the governmental level, capacity needs to be enhanced, by appropriate training, for conducting the actual valuation studies, for improved oversight and auditing for quality control, as well as for putting valuation results to good use in governmental decision-making by an effective and credible follow-up. Moreover, training could also include staff of relevant non-governmental organizations. In accordance with national needs and priorities, institutional capacity could be enhanced, for instance by establishing or strengthening of specialized agencies or agency units.

102. As regard the conduct of the actual studies, two levels of training seem to be required: first, basic courses are needed to provide non-economists with sufficient insights into the logic of valuation and environment economics. To meet this objective, easily readable manuals could also be developed and disseminated. Courses may also be needed to provide economists with basic scientific background on the linkages between biodiversity resources and functions and ecosystem services, with a view to raise their awareness of the need for inter-disciplinary cooperation. Second, more specialized training is needed for those supervising the conduct of valuation studies and steering project implementation, which

55/ Typically one finds that an exercise such as a national accounts adjustment or one study of an endemic or charismatic species is sufficient to kick-start a national debate on the topic.

is likely to be best undertaken by economists equipped with prior knowledge in microeconomics. Well-planned modules can normally be sufficient to impart the basics of environmental valuation to trained economists. This activity could also include the training of trainers.

1. International cooperation in enhancing domestic capacities

103. Most expertise in valuation is arguably located in several OECD countries that have established research institutions specifically in the area, and it appears to be important to tap into this expertise as a basis for sponsoring training arrangements such as regional workshops on biodiversity valuation.

104. In non-OECD countries, notable centres of expertise are, for instance, the Environment and Economics Program for South East Asia (EEPSEA) 56/ and the Forum for Economics and the Environment located in South Africa. 57/ EEPSEA offers courses that are predominantly for post-Masters level ability in economics. The South African initiative coordinates exchange of information and training between the countries of Southern Africa. In addition, in many developed countries, many university departments offer exchange opportunities that are normally supported by their own national development ministries (e.g., the Swedish International Development Agency (SIDA), Danish Ministry for Foreign Affairs). Short-term courses are offered by other agencies including the World Bank, which offers a course in environmental economics and development policy.

105. Another means of extending training is for bilateral arrangements between agencies for temporary secondment. For instance, the Overseas Development Institute (ODI) in the United Kingdom has been running such a fellowship scheme for several decades. The scheme sends young postgraduate economists to work in the public sectors of developing countries in Africa, the Caribbean and the Pacific on two-year contracts. It has worked in over 30 countries concentrating on those most in need of trained staff. Currently, 20 developing country Governments and three regional bodies are partners in the scheme.

106. The demand-led nature of the scheme means that it is an attractive way for Governments to build capacity in their public sectors and improve the execution of economic policy. Its excellent reputation and unique form of technical assistance means that it is held in high regard by the development community. The costs of the scheme are shared between the recipient Government and ODI. ODI finances the scheme primarily under grants provided by the Department for International Development (DFID) in the United Kingdom, the Commonwealth and AusAID. In recent years, the scheme has been picking a number of graduates in environmental economics who have gone to work in environment related agencies.

2. Web-based resources

107. Possibly the most cost-effective partnership arrangements can de developed using web access. The World Bank offers a range of e-learning resources. Moreover, several sites provide good overviews of environmental valuation. A simple and accessible site is provided by Dennis King, of the University of Maryland, and Marisa Mazzotta, of the University of Rhode Island. 58/ This site sets out all the relevant issues in relation to valuation and contains some practical demonstrations of how to collect relevant data. The site provides an excellent introduction, but those who follow it probably need to be faced with more complex case-studies to gain hands-on experience. In this regard, other web-based learning and training resources are also available, with varying levels of theory and applied examples. For instance:

56/ http://www.idrc.ca/en/ev-7890-201-1-DO_TOPIC.html

57/ http://www.econ4env.co.za/.

58/ http://www.ecosystemvaluation.org/

(a) A UNEP sponsored training guide on the valuation of biological diversity for national biodiversity action plans and strategies is available at the IUCN biodiversity economics site; 59/

(b) The IUCN site also provides access to online guidelines for protected area managers on the economic values of protected areas; 60/

(c) The site of the Ramsar Convention on Wetlands provides access to the Ramsar guide for policy makers and planners on the economic valuation of wetlands; 61/

(d) A recent report prepared by the World Bank in cooperation with The Nature Conservancy and IUCN, on assessing the economic value of ecosystem conservation, is also available online. 62/

3. Enhancing global capacities: international information systems and databases

108. A number of other web sites contain valuation data for more advanced practitioners. Most noteworthy is a range of sites developed to facilitate benefits transfer, such as the Environment Valuation Reference Inventory (EVRI) database sponsored by number of countries and hosted by Environment Canada, and Envalue sponsored by the government of New South Wales in Australia, as well as some other initiatives discussed in paragraph 96 above. These databases are compilations of primary valuation data from studies conducted in different countries around the world. The basic idea is for the user to define a resource to be valued (e.g. a rare species or a water body), and to search the database for studies that have generated similar information. If the studies are suitably similar, then the database provides the basis of a transfer value that fills in an information gap at the site of interest.

109. Benefits transfer is still under development, with numerous academic research exercises focused on the validity of transferring benefit or willingness-to-pay unit values or the statistical functions that predict these values. Nevertheless, the use of value transfer seems to be an appealing way to advance the use of valuation information in particular in resource poor countries where time and resource constraints will typically prevent extensive primary research in many decision-making situations.

110. Existing databases contain a variety of studies from different developing countries, but are not specifically tailored to developing country needs, either in terms of the likely valuation studies included, or in terms of the required modifications, for instance, exchange rates and currency deflators, needed to translate values for use. Therefore, a useful collaborative initiative could be to further develop existing transfer databases and to increase cooperation among database providers with a view to increase compatibility and inter-operability, such as through the establishment of common criteria for auditing valuation work, standardized coding procedures, etc. 63/ Access fees should not represent a substantial hurdle in order to ensure maximum use of the databases in particular by decision-makers and researchers in developing countries.

C. Fostering research

111. As explained above, considerable progress has been made in the last decades in developing reliable valuation tools and protocols for their application, in particular on stated-preference techniques and benefit transfer. However, challenges for further research and development also remain, in particular with regard to the conditions for validity and robustness of the benefits-transfer approach. Furthermore,

59/ http://www.biodiversityeconomics.org/valuation/topics-612-00.htm .

60/ http://biodiversityeconomics.org/valuation/topics-34-00.htm .

61/ http://www.ramsar.org/lib_valuation_e.htm .

62/ http://www-wds.worldbank.org.

63/ see Lantz and Slaney 2005.

further research directed at the development of a biodiversity adjustment for national accounting seems to be another important means to have biodiversity losses more reflected in macroeconomic discourse.

112. It was also explained earlier that valuation typically addresses ecosystem services, but not biodiversity as such. Inferring the value of biodiversity requires an in-depth understanding of the links between biological diversity, biodiversity functions, and the services that are subsequently generated. Despite recent progress made in this regard, as summarized in the Millennium Ecosystem Assessment reports, this understanding is still limited and fragmented, with many unresolved questions remaining on the specific nature of interdependencies between the structure and diversity of biotic communities, the functioning of ecosystems, and the generation of ecosystem services under different states of nature or environmental conditions. Further national and international research in addressing these important questions, including research cooperation at the international level, is therefore crucial. The involvement of all relevant stakeholders, including biodiversity-dependent industry, should be ensured, as it will gear research towards developing practical mechanisms based on plausible, realistic situations. New insights on the relationship between changes in biodiversity, for example through sudden shifts in ecosystem equilibria, and the generation of ecosystem services may lead to the further improvement of existing tools as well as to the development of new tools and methodologies for the valuation of biodiversity and ecosystem functions.

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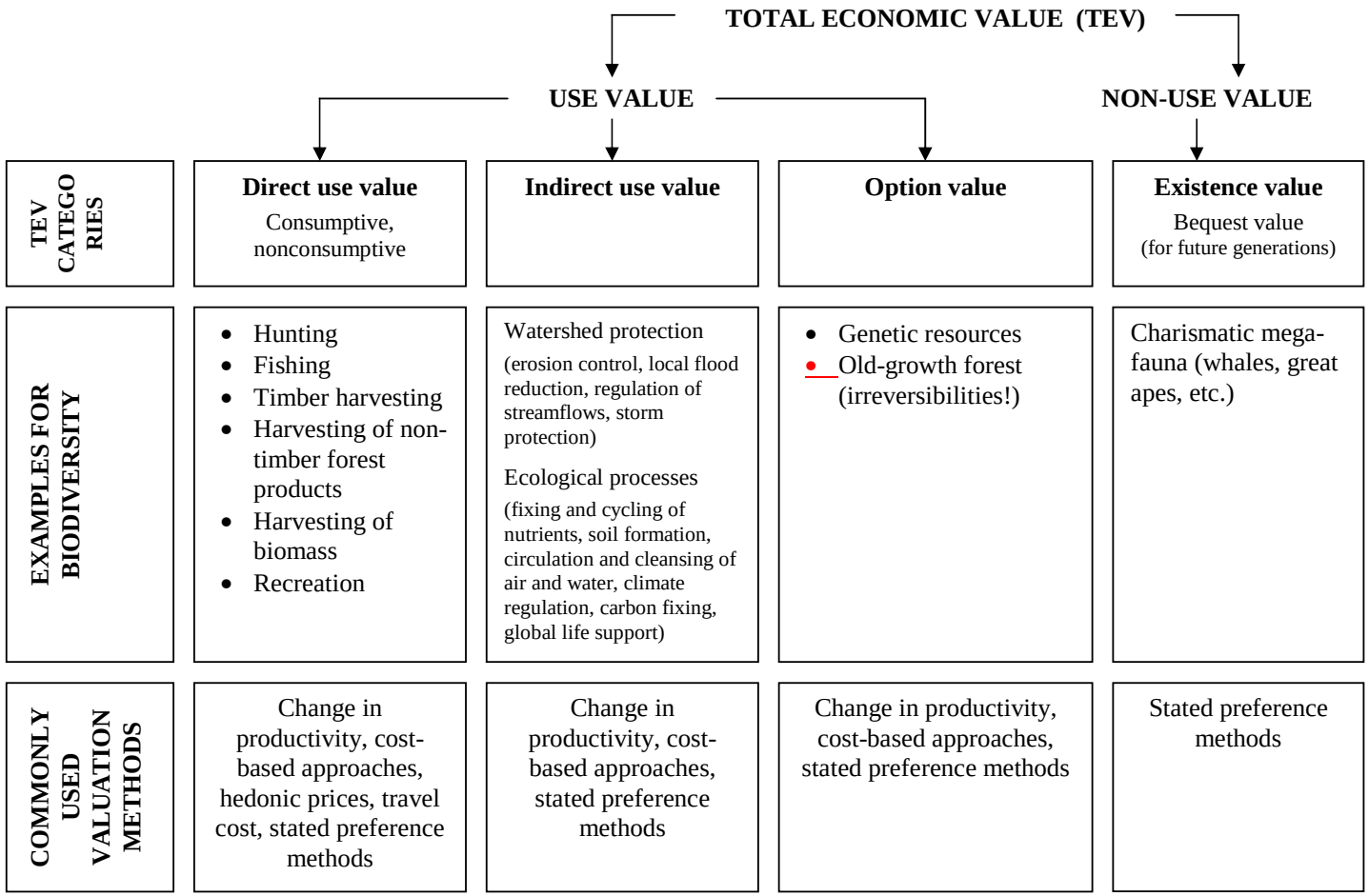
Figure 1: Total Economic Value and valuation



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