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BIODIVERSITY CONSERVATION: STUDIES IN ITS ECONOMICS AND MANAGEMENT, MAINLY IN YUNNAN, CHINA

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Economics as a Basis for Conserving Nature

by

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Rural nature reserves can have negative as well as positive spillovers to the local region and policies need to be implemented to maximise the net economic benefits obtained locally. Thus an 'open' approach to the management and development of nature conservation (biodiversity) programmes is needed. The purpose of this study is to concentrate on these economic interconnections for Xishuangbanna National Nature Reserve and their implications for its management, and for rural economic development in the Xishuangbanna Dai Prefecture but with some comparative analysis for other parts of Yunnan

The Project will involve the following:

1. A relevant review relating to China and developing countries generally.
2. Cost-benefit evaluation of protection of the Reserve and/or assessment by other social evaluation techniques.
3. An examination of the growth and characteristics of tourism in and nearby the Reserve and economic opportunities generated by this will be examined.
4. The economics of pest control involving the Reserve will be considered. This involves the problem of pests straying from and into the Reserve, e.g., elephants.
5. The possibilities for limited commercial or subsistence use of the Reserve will be researched.
6. Financing the management of the Reserve will be examined. This will involve considering current sources of finance and patterns of outlays, by management of the Reserve, economic methods for increasing income from the Reserve and financial problems and issues such as degree of dependence on central funding.
7. Pressure to use the resources of the Reserve comes from nearby populations, and from villagers settled in the Reserve. Ways of coping with this problem will be considered.
8. The political economy of decision-making affecting the Reserve will be outlined.

Commissioned Organization: University of Queensland

Collaborator: Southwest Forestry College, Kunming, Yunnan, China

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ECONOMICS AS A BASIS FOR CONSERVING NATURE

Abstract

The relationships of economists with ecologists and conservationists have improved following global interest in the concept of sustainable development. In addition, international and other bodies interested in nature conservation have increasingly turned to economics to provide justifications for nature conservation projects and policies to support these. While this is welcome, it behoves users of such techniques to be aware of their limitations, as well as their advantages. As a first step, it is useful to be aware of the ethical foundations of economic analysis. These are outlined. As a prelude to discussion of the use of social cost-benefit analysis as a method of evaluating nature conservation, classifications of the economic values of wildlife are- discussed. Classificatory schemes are a useful aid to determining the total economic value of wildlife and it is emphasised that both consumptive values and non-consumptive values are important. While social cost-benefit analysis is a well-developed technique for economic assessment and has been widely applied to nature conservation projects, it is not without critics. Critics include those who support the use of safe minimum standards. For nature conservation this is often taken to imply a minimum viable population of a species and requisite habitat to support it. Further qualifications to the use of social cost- benefit analysis have been made by advocates of strong conditions for sustainability and the implications of these for nature conservation are considered. Economic reasons for biodiversity conservation are outlined but it is concluded that economists still have a long way to go in determining economic values for biodiversity.

Selected economic policy proposals and issues are discussed. Limits to private property (privatisation) as a means for nature conservation are mentioned and risks associated with the commercialisation and farming of species from the point of view of biodiversity loss are discussed. The problem of biodiversity loss in less developed countries is given particular attention. In conclusion, it is stated that connections between economic analysis and nature conservation can be expected to grow. Even in cases where values are not entirely anthropocentric, economics will have a policy role because cost- effectiveness is likely still to be relevant.

ECONOMICS AS A BASIS FOR CONSERVING NATURE

1. Introduction

The relationship between economists and those interested in ecology and the conservation of nature has not always been an easy one. Many conservationists look(ed) on economics and economic development as an enemy of nature conservation. There can be no doubt that past economic growth has been major factor leading to destruction of nature and loss of biodiversity (Swanson, 1994). However, a more accommodating view has emerged between economists and conservationists with growing interest in and widespread acceptance of the desirability of sustainable development. This new outlook has provided common ground for interaction between economists and non-economists.

In this regard, the *World Conservation Strategy* (IUCN, 1980), and its update *Caring for the Earth: A Strategy for Sustainability* (IUCN-UNEP-WWF, 1991) made an important contribution, as did the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. The *World Conservation Strategy* promoted the idea that economic development and ecological conservation could be made compatible. *Caring for the Earth* emphasized that economic methods could be employed to evaluate nature conservation projects, favourably in many cases, and that economic instruments and policies might usefully be employed to support nature conservation. Thus the idea was sown that economic development and economics could be the ally of nature conservation. Today, authorities wishing to gain financial support for projects for nature conservation are increasingly required to provide supporting economic evaluations (McNeely, 1988; McNeely et al., 1990). While this is welcome, we need to be attentive to the basis of such evaluations, their limitations and alternative viewpoints. Economic evaluation is an aid, not a substitute, for personal assessment of situations.

In this contribution, relationships between economic evaluation and ethical values are discussed first and then traditional economic approaches to decision making about conservation based on cost-benefit analysis are outlined. Less traditional methods such as the use of safe minimum standards are then covered. Debate is occurring among economists about the conditions (weak and strong) that need to be satisfied for sustainable economic

development. As pointed out, the outcome of this debate has important implications for nature conservation, including conservation of biodiversity, which is also given coverage here. Finally, selected economic policy proposals for supporting nature conservation are examined critically.

2. Ethics and the Economic Evaluation of Nature Conservation

Economic evaluations of nature conservation are not ethically free and it is doubtful whether any social evaluation can ever be ethically free. This need not be a debilitating problem from a decision making point of view, but it is important to bear it in mind, especially in cases where relatively precise quantitative evaluations are given as is the case when benefit-cost ratios are used or social rates of return are calculated. In other words, apart from the adequacy of the estimates of the value of nature conservation (a positive matter), it is necessary to be clear about the value system underlying the estimates, a normative matter.

Economic systems currently in use for evaluation of nature are predominantly anthropocentric. This means that conservation of nature is only valued insofar as it is of value to humankind (Tisdell, 1991). Consequently, other living things have no rights of their own and there is no obligation, independent of human preferences, to conserve other species. Thus standard economic methods of evaluation exclude ecocentrism or the placing of a positive weight on the conservation of other species independently of the wishes of humans.

Another aspect of economic evaluation is that it is normally limited to values can be expressed in monetary terms. Debate exists about the extent to which all valuations (values) can be expressed in monetary terms. Pigou (1932) suggested that only a part of the value of many projects or undertakings could be expressed in monetary terms. Because both sets of values (those which can be monetised and those that cannot) can be important, economics is unlikely to be the final arbiter of a range of social choices. Economic evaluation should be regarded as an input into social decision making rather than a determinant of social choice.

Nevertheless, it can be an important consideration and in recent years considerable progress has been made in placing economic or monetary values on indirect values such as existence, option and bequest values of nature or natural environments. Contingent valuation methods have for example been widely used for this purpose (see for example, Tisdell, 1991, Ch. 7). In addition, the travel cost method has also been employed to place economic values on

unpriced natural areas and so on (see for example, Tisdell, 1991, Ch. 7). While these methods have their limitations, they have substantially expanded the application of economics to the evaluation of nature.

With the above brief background in mind, let us consider the application of social cost-benefit analysis to nature conservation after considering broad anthropocentric classifications of the economic value of wildlife.

3. Classification of the Economic Values of Wildlife

A number of broad classifications of the economic values associated with wildlife (and natural areas) exist. Some such classifications are (1) consumptive and non- consumptive values (McNeely, 1985), (2) on-site and off-site values and (3) use values (direct and indirect) and non-use economic values (Barbier, et al., 1990; Driml and Common, 1995). The economic values of the African elephant *Loxodonta africana* in terms of its consumptive and non-consumptive values are given for example in Table 1. Note that unlike McNeely (1988) and others, I classify all economic values, other than consumptive values, as non-consumptive.

Table 1 Consumptive and Non-Consumptive Economic Values of the African Elephant

Consumptive Values	Non-Consumptive Values
Tusks (ivory)	Tourism (viewing)
Meat	Photography
Hides	Favourable impact on ecosystem
Amateur hunting, including trophy hunting	Gene pool preservation
	Existence value
	Option value

In earlier times, the consumptive economic values of wildlife were emphasized at the expense of their non-consumptive economic values thereby giving a distorted picture of the value of wildlife. In addition, such a view resulted in the over exploitation of wildlife for consumptive purposes and inadequate attention to the conservation of wildlife from the standpoint of its total economic value. In fact, the non-consumptive economic value of many species exceeds their consumptive economic value. This is for example claimed to.be true of the African

elephant, especially because of its high tourism value (Brown and Henry, 1989). On the other hand, some species-such as tuna species, have a very low non-consumptive value but a high consumptive value.

Note that as far as humans are concerned, economic values may alter with the passage of time. Whales provide such an example. They have gone from being valued mainly for consumptive purposes to being highly valued for non-consumptive purposes.

Sometimes it is also useful to classify economic benefits and costs of wildlife conservation, especially of protected areas, according to whether these occur on-site or off-site. As a rule, on-site benefits do not capture the total economic benefits of nature conservation.

Off-site benefit and costs are closely associated with the economic concept of spillovers or externalities. These need to be taken into account in the total social evaluation of projects for wildlife conservation.

The initial important step in evaluation of wildlife projects is to identify **all** the benefits and costs associated with these. Classificatory schemes can assist with this identification. From an economics viewpoint, the next step is to quantify these benefits and costs where possible. Some may not be precisely quantifiable, but nevertheless it may be feasible to order their magnitude or make significant qualitative assessments of them.

4. Social Cost-Benefit Analysis and Nature Conservation

The technique or method most widely used in economics to assess projects is social cost-benefit analysis. It relies upon benefits and costs being expressed in monetary terms. Where commodities are marketed this is easier than when they are not marketed or are incompletely marketed, as is the case with wildlife. .

As mentioned earlier, economists usually rely on methods such as contingent valuation methods (involving interviews) or travel cost methods (surrogate methods) to provide monetary estimates of the value of nature where monetary transactions do not occur or are incomplete. Generally these monetary values are assessed in terms of the willingness of individuals to pay for conserving the aspect of nature under consideration. They are then totalled to give the total economic valuation.

Note that the total economic evaluation in these circumstances is influenced by the distribution of income or wealth in society. If for instance, two individuals value something with equal intensity, the individual with the higher income will be willing to pay more for it.

An alternative to 'willingness to pay' is 'willingness to accept compensation'. In relation to the conservation of nature, this requires determining how much individuals would have to be paid to forgo the natural feature under consideration. Usually this is a much higher sum than their willingness to pay (Hohl and Tisdell, 1993a). Consequently, the actual benefit estimated for nature conservation will vary according to the approach adopted. Furthermore, note that travel costs methods (or site-related methods) of evaluation can, at most, only capture the on-site benefits of a protected area or the prime attraction there. Hence, values derived by contingent valuation methods will normally be larger than those obtained by travel cost methods.

Economic evaluations rely on the current 0r a recent situation and predictions or extrapolations must be made about the future stream of benefits and costs if cost-benefit analysis is to be applied. The accuracy of the method depends on the extent to which the current situation can be projected forward and the skill of the analyst in allowing for circumstances which may change. Uncertainty and some errors in prediction seem to be unavoidable.

The travel cost method relies on information about recent visits to a protected area for example. Future values and visits might be affected by changes in income, education, tastes, population variation and the availability of substitutes as well as other factors. Improvements in transport and reductions in the real cost of transport have been important factors raising visitation rates to many protected areas.

Contingent valuation methods rely on past interviews with individuals. One has to consider whether individuals are likely to maintain these values in the future. Furthermore, if a long-term perspective is taken, as seems necessary with biological conservation, will future generations hold similar values to those expressed by current generations? Assumptions are required in all these respects if quantification .or monetisation of economic values is to be fully applied.

The economic approach to valuation is to monetise benefits and costs to the greatest extent possible. Having done this, it is necessary to determine a planning horizon and so come up

with an interval of time for which planning using cost-benefit analysis applies. Often the planning horizon is arbitrarily determined. For example, it may be set at 20 years on the grounds that discounting makes values beyond that period very small indeed and therefore of little consequence for decision-making.

In any case, social cost-benefit analysis is used in economics relies on discounting with the rate of discount being determined by the current rate of interest. The higher this rate of interest, the lower are future discounted benefits and costs, and the further these occur into the future, the greater is their rate of discount. This reflects the fact that from an individual's point of view, a dollar available in the future is worth less than a dollar now, and the longer the availability of a dollar is delayed, the less it is worth. For one thing, a dollar available now can always be invested with little risk to earn interest and so provide the investor with more than a dollar in the future.

Social cost-benefit analysis requires that all nature conservation projects give a rate of return not less than the rate of interest. Note that this approach supposes that total economic evaluation of benefits occurs. If funds available for supporting nature conservation projects are limited, maximisation of social net benefits requires that preference should be given to those projects with the highest ,benefit-cost ratio but only those projects should be undertaken for which the benefit-cost ratios exceed unity.

Some authors have objected to discounting on the grounds that it does not give equal weight to future generations. Kula (1992) for instance suggested a modified discounting rule. Debate continues about the socially appropriate rate of discount.

Application of social cost-benefit analysis can result in the extinction of some species. This is a logical outcome if the **social** rate of return from a species is less than the rate of interest (Clark, 1976). For example, if the prime economic value of a species is its consumptive value, this outcome is a likely if individual members of the species grow slowly on the net reproduction rate of the species is low, e.g., if it is *k*-selected. Slow growing forests and slowly reproducing species such as dugongs provide possible examples. In any case, one has to accept the possibility that if social cost-benefit analysis is applied, it can support the extinction of some species even assuming that **total** economic evaluation is undertaken.

5. Dissenters from Cost-Benefit Analysis: Safe Minimum Standards

In order to deal with uncertainty, many practitioners of cost-benefit analysis use subjective or other probabilities to estimate expected net benefits. When learning is important and allowed for in the analysis, irreversibilities associated with the extinction of species can result in this analysis favouring conservation. However, this does not satisfy all economic analysts.

Ciriacy-Wantrup (1968) was one of the first economists to express serious reservations about the use of cost-benefit analysis as a tool for managing nature. Given uncertainty about the future value of species, he considered cost-benefit analysis to be of limited value and proposed instead the use of safe minimum standards for the conservation of species. More recently, Bishop (1978) has strongly supported this point of view.

Their basic argument is that the possible economic value of saving a species from extinction can be a very high in relation to the cost of conserving it. Thus, if it is not conserved, one may be forgoing a very large potential benefit. The possible opportunity cost of not conserving a species is very high. One the basis of minimising maximum possible regret, conservation of species should be the rule.

Ciriacy-Wantrup (1968) takes the view that the economic costs of conserving most species is relatively low and was of the opinion that the minimum viable population (which would constitute the safe minimum standard) could be relatively low. It is probably true that the cost of saving many species from extinction is low. Nevertheless, the minimum populations and the home ranges required to provide some large mammals (such as polar bears and elephants) with a reasonable chance of survival may not be all that low and the costs involved not negligible. Furthermore, there may be no minimum population which ensures the continued survival of species (Hohl and Tisdell, 1993b). This provides an extra complication for the analysis.

Note that this approach, like social cost-benefit analysis, is anthropocentric. It is concerned with minimising the maximum possible regret experienced by human beings. If the costs of conservation of a species in relation to the possible future benefits from it are high enough even this method would not support investment in the conservation of the species.

6. Strong Conditions for Sustainability: Further Qualifications to Cost-Benefit Analysis

As mentioned earlier, interest in the concept of sustainable development provides another interface between nature conservation and economics. The most common economic definition of sustainable economic development is that it is development that ensures that the income per head of future generations is no less than that of current generations, or more generally development that results in the standard of living of future generations be not lower than that of present generations (Tientenberg, 1988, p. 33). Once again, this is an anthropocentric approach. However, depending upon the school of thought, it may have positive implications for nature conservation.

On the one hand, there are economists who believe that strong conditions may have to be imposed on the conservation of natural resources, whereas another group of economists believe that only weak conditions need to be imposed to ensure that economic sustainability is achieved.

Advocates of strong sustainability conditions, argue that the world's natural environmental resource stocks have already been reduced to dangerously low levels. Such stocks are natural capital and play a major role in sustaining economic production and welfare. The economic growth process so far has involved converting many of these stocks into man-made capital. From an economic standpoint, this may have been justifiable when these natural resource stocks were more plentiful but they are now at critically low levels and further accumulation of man-made capital at the expense of living environments will imperil the standard of living of future generations. It is now not acceptable or indeed, dangerous to **substitute** man-made capital for the natural resource stock, particularly since man-made capital has a very limited life in comparison to living natural resources (Pearce, 1993).

This view does not rule out no economic change. However, where an economic development damages the environment, it must be offset. For instance, if an economic development reduces the habitat of a species, investment may be required to provide habitat which can be used as a substitute. For example, if forested habitat is destroyed, re-forestation of presently cleared land may be required to provide substitute habitat for species. This approach restricts the use of social cost-benefit analysis. While social cost- benefit analysis is still used, projects overall are subject to the constant natural capital stock rule or subject to the conservation of

the core of the natural capital stock (see Tisdell, 1993, Ch. 8).

Yet, not all economists accept this view. In reality, it is probably a minority viewpoint. A considerable number of economists favour the imposition of weak sustainability conditions. They argue that environmental externalities should.be taken into account using social cost-benefit analysis and that continuing accumulation of man- made capital, even at the expense of the natural resource stock, is a suitable way to provide for the incomes and standard of living of future generations, especially given the presence of technological progress.

The danger with this approach is that it addresses the balance effect but not the scale effect of economic activity (Tisdell, 1991, sec 2.2). It also places considerable faith in continuing technological progress and the occurrence of self-correcting social mechanisms, for example, a slowing rate of human population growth is a result of economic growth. The debate is continuing.

Note that from a policy point of view, economic advocates of strong sustainability conditions have common grounds with those holding ecocentric views or at least with those who place value on the conservation of species independently of human valuation. While these groups differ in their ethics, both favour conservation of nature for different reasons: one for its economic advantage to mankind, the other for its beneficial effect on other species.

7. Economics and the Conservation of Biodiversity

As pointed out by Pearce and Moran (1994), what most economic studies of the value of nature measure is the economic value of ‘biological resources’ rather than the economic value of their diversity. Usually such values are estimated for some natural area rather than for a particular species, and mostly they are estimated just for one area rather than for a diversity of areas and species. In part, this may be because it is only relatively recently that economists have become interested in the economic evaluation of biodiversity.

The subject is not an easy one, not least because biodiversity has many possible dimensions (Pearce and Moran, 1994) and future economic value of biodiversity is subject of considerable uncertainty.

Possible reasons why biodiversity may be valuable in economic terms include the following:

1. Some individuals believe that humans have an obligation to try to save the whole of God's creation. Mankind, therefore, has a stewardship role. Presumably believers in this would be willing to pay to help conserve the whole 'creation'.

2. Biodiversity is likely to be of direct consumptive value in the future. It may be the source of new useful medicines, of new crops or be necessary to help sustain the health and vigour of existing domesticated plants and animals.

3. It may be of value for future non-consumptive economic purposes, e.g., for recreation and tourism.

4. It may be of scientific value and through science, result in direct economic values.

5. Up to a point, biodiversity may be necessary for the maintenance of an ecosystem. The ecosystem as a functioning whole may have a high economic value. In this respect, note that there may be keystone species in. an ecosystem which are themselves not highly valued by the use of contingent valuation methods, but are essential to the maintenance of the ecosystem.

Estimates of the economic value of retaining tropical forests for their plant biodiversity as a future source of medicinal drugs have been done by Pearce and Moran (1994, Ch. 4). Because of the uncertainty of their estimates, these values range from negligible to an upper value of $420 per ha. (Pearce and Moran, 1994, p. 109). This value is small in relation to the possible carbon sequestration value of tropical forests which in primary forest is estimated to be $4000-4400 per hectare. However, it should be observed that Pearce and Moran, only measure the value of biodiversity of tropical forests for one purpose whereas it presumably also has additional value for a number of the other purposes listed above. Clearly much more economic work remains to be done in assessing the value of biodiversity.

8. Selected Policy Issues

While economic systems can be harnessed to promote nature conservation, at the same time one must be aware that the thorough going use of such systems is unlikely to ensure adequate conservation of biodiversity from some points of view. In general, commercialisation will tend to favour the survival of species of greater direct commercial value at the expense of those of lesser commercial value.

Particularly in the past, open economic access to species was a factor leading to the demise of some species. The tragedy of the commons is well known (Hardin, 1968). However, it does not thereby follow that the universal or even widespread creation of private property is a practical solution to conservation of nature. In some cases, it is a possibility. In other cases, the best available approach may be to establish communal property or state property for management purposes.

The fanning of species is sometimes suggested as the best way to save a species from extinction. While commercially viable farming may save a species from extinction, it can accelerate the loss of wild stock due to competition for use of habitat from fanning. Loss of habitat has been the major cause of extinction of species in recent times and the development of agriculture has been a prime source of the loss of such habitat (Swanson, 1994). There is also the further complication that those species developed earliest for commercial use tend to retain their dominance over later contenders for farming due to the accumulation of knowledge, experience and development of 'improved' varieties of species farmed first (Swanson, 1994). The timing of the domestication of a species can therefore be a factor influencing the long survival of a species. There is no guarantee that the 'optimal' commercial species are developed first. If not, they may never be developed as a commercial success because of the blocking effect of earlier developments. This means that the commercialisation of species and their survival prospects in relation to this are time-path dependent.

Much of the world's remaining biodiversity is in less developed countries. Naturally most of these countries want economic growth in order to enjoy a higher standard of living. Unfortunately, however this puts much of the remaining biodiversity in these countries at risk because economic growth, at least in its early stages, involves economic intensification of land use. In turn, this results in mounting habitat loss for many species and considerable loss of biodiversity.

It can also be said that it leads to increasing uniformity in habitats so reducing biodiversity. In the very long term, uniformity of habitats, presumably would also reduce speciation and alter the path of evolution of species.

A major problem for those who favour the preservation of the world's remaining biodiversity is how to provide economic incentives to less developed countries to conserve biodiversity in

these. While increased commercial use of such resources for tourism, sale of genetic material and so on can help, this is unlikely to be sufficient to ensure conservation on a scale which may be wanted internationally. International aid is required to help foster this goal.

Economic incentives for conservation within a country must be well targeted and particular attention needs to be given to the economic benefits which local communities obtain from conservation (Tisdell, in press). Local communities form the interface with nature, and conservation projects are unlikely to succeed if they are opposed or ignored by local communities.

9. Concluding Comments

Whether we like it or not, economics is bound to have a continuing and probably a growing influence on nature conservation. Economic systems will continue to influence conservation and economic methods will continue to be employed in valuing nature and devising management strategies for it. While economic means for valuing nature have advanced substantially, they are basically anthropocentric and subject to a number of limitations several of which have been mentioned here. Often, however, they can be regarded as giving a lower bound to the value of nature. For those with a more ecocentric-bent, economics will still be of significance. For example, it can be useful in devising cost-effective strategies to achieve set aims. Furthermore, economic incentives and economic impacts have to be taken into account even by those who do not take a human-dominated attitude to the conservation of nature. Thus economics is likely to increasingly become a basis or tool for nature conservation even though it cannot provide complete guidance.

10. References

Barbier, E.B., Burgess, J.C., Swanson, T.M. and Pearce, D.W. (1990) *Elephants, Economics and Ivory*, Earthscan, London.

Bishop, R.C. (1978) 'Endangered species and uncertainty. The economics of a safe minimum standard', *American Journal of Agricultural Economics*, **60**, 10-18.

Brown, G. And Berny, W. (1989) *The Economic Value of Elephants*, LEEC Discussion Paper 89-12, London Environmental Economics Centre, London.

Ciriacy-Wantrup, S.V. (1968) *Resource Conservation: Economics and Policies*, Division of Agricultural Science, University of California, Berkeley.

Clark, C.W. (1976) *Mathematical Bioeconomics: The Optimal Management of Renewable Resources*, John Wiley, New York.

Driml, S. And Common, M. (1995) 'Economic and financial benefits of tourism in major protected areas', *Australian Journal of Environmental Management*, **2**(1), 19-29.

Hardin, G. (1968) 'The tragedy of the commons', *Science*, **162**, 1243-1247.

Hohl, A. and.Tisdell, C.A. (1993b) 'How useful are environmental safety standards in economics? - The example of safe minimum standards for protection of species', *Biodiversity and Conservation*, **2**, 161-181.

IUCN (i980) World Conservation Strategy, IUCN, Gland, Switzerland.

IUCN-UNEP-WWF (1991) *Caring for the Earth: A Strategy for Sustainability*, IUCN, Gland, Switzerland.

Kula, E. (1992) *Economics of Natural Resources and the Environment*, Chapman and Hall, London.

McNeely, J.A. (1988) *Economics and Biological Diversity: Developing and Using Economic Incentives to Conserve Biological Resources*, IUCN, Gland, Switzerland.

McNeely, J.A., Miller, K.R., Reid, W.V., Mittermeir, R.A. and Werner, T.B. (1990) *Conserving the World's Biological Diversity*, IUCN, Gland, Switzerland.

Pearce, D and Moran, D. (1994) *The Economic Value of Biodiversity*, Earthscan Publications, London.

Pearce, D.W. (1993) *Blueprint 3: Measuring Sustainable Development*, Earthscan, London.

Pigou, A.C. (1932) *The Economics of Welfare*, 4th edn., Macmillan, London.

Swanson, T.M. (1994) *The International Regulation of Extinction*, New York University Press, New York.

Tietenberg, T. (1988) *Environmental and Natural Resource Economics*, 2nd edn., Scott, Foresman and Company, Glenview, Illinois.

Tisdell, C.A. (1993) *Environmental Economics*, Edward Elgar, Aldershot, UK.

Tisdell, C.A. (1995) 'Issues in biodiversity conservation including the role of local communities', *Environmental Conservation*, **22**(3), 216-222.

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