Valuation of Coral Reefs: The Next 10 Years

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Abstract

This paper outlines the role economic valuation could play in the conservation and sustainable use of coral reefs over the next 10 years. It also highlights some key issues that must be dealt with in the valuation of coral reefs. In addressing these points, the paper (i) recognizes the need to tackle the root causes of coral degradation; (ii) considers shifts in natural resource management techniques towards integrating economic and social aspects, and, in the future, encompassing financial, legal, and ethical considerations; (iii) acknowledges the increasing role of tools such as sustainability and performance indicators; and (iv) draws upon some recent projects involving applied environmental valuation. Key roles for environmental valuation include option appraisal, natural resource damage assessments, assisting in the application of market-based instruments (MBIs) and developing sustainable financing opportunities. Issues that need resolving relate to integration of socioeconomic aspects, understanding of cause-and-effect linkages, the assessment and aggregation of non-use values, use of benefit transfers, dealing with distributional effects, and appropriation of environmental values.

Introduction

Decision-makers around the world are at last slowly beginning to understand and acknowledge the considerable economic value afforded by healthy coral reefs. It was 10 years ago that the concept of total economic value (TEV) was first applied to coral reefs (Spurgeon 1992). The concept highlighted the significant economic values that can accrue from the wide range of direct, indirect and "non-use" values associated with coral reefs. At that time few published references existed on the economic value of corals. Notable exceptions included publications referring to the establishment of the recreational value of coral reefs in Florida (Mattson and DeFoor 1985); a cost benefit analysis (CBA) comparing the economic benefits from coral reef based tourism and fisheries with those from logging forests in Palawan (Hodgson and Dixon 1988); an outline of the environmental, economic and social costs of coral reef destruction in the Philippines (McAllister 1988); and an estimate of the non-use value of the Great Barrier Reef (Hundloe 1990).

Since then, the number of papers written and published on the valuation of coral reefs has grown substantially. Coral reef valuations have now been undertaken for entire countries, such as Indonesia (Cesar 1996). Furthermore, a collection of papers on coral reef valuation has been published as a book (Cesar 2000) and seminars have been organized on the subject (ICLARM 2001).

However, whilst there is increased awareness of their value, globally the status of coral reefs is in serious decline (Wilkinson 2000). Approximately 11 per cent of the world's corals were destroyed prior to 1998 but 16 per cent were destroyed in 1998 alone, mostly as a result of the mass-bleaching event linked to the El Nino and global warming. It is predicted that a further 14 per cent may be destroyed within the next 2 to 10 years, and 18 per cent within the next 10 to 30 years, reaching a total loss of coral reefs of almost 60 per cent. The causes of coral mortality are related to a multitude of natural and anthropocentric factors, in particular global climate change (Wilkinson 2000).

Is there a role for environmental valuation to help protect and manage the world's remaining coral reefs? In answering this question, this paper explores some relevant trends in environmental

management and highlights various recent applications of environmental valuation in natural resource management. The paper concludes by identifying key issues in coral reef valuation that need greater attention over the next 10 years.

Trends in environmental management

To determine what place environmental valuation may have in coral reef management over the next 10 years requires an understanding of current and future trends within the overall context of environmental management. Below, four such trends are briefly considered.

Tackling the root causes of environmental degradation

It is essential for the long-term success of environmental conservation that the "root causes" of environmental damage be fully understood and appropriately addressed. All too often, the "solutions" implemented are short-term superficial "fixes" rather than fundamental changes that harness natural forces and tendencies and result in win/win situations.

Figure 1 highlights a few examples of root causes of coral degradation, their circular relationship, and their impacts, symptoms and consequences. One significant root cause is the failure of current market forces to take into account the wider economic and financial implications of social and environmental impacts that result from new developments. This means that many impacts on corals are often not accounted for in decision-making processes. In such cases the impacts are known as "externalities", because they are external to the conventional economic and financial values often considered in decision-making, particularly by the private sector. For example, the decision to allow deforestation of land can lead to sedimentation and loss of coral reefs many miles away from the logging activity. Furthermore, many of the coral reef values affected will have no obvious financial or economic market values, rendering an accountable loss even less likely. Effectively, such losses simply become someone else's problem.

In order to overcome this market failure, it is necessary to change the way that decision-making is undertaken, so that wider development implications are taken into account. This can be achieved by valuing environmental and social impacts that have no obvious market values, using environmental valuation techniques, and incorporating them within economic CBA.

In addition, greater use of MBIs should be adopted. Examples of these are natural resource damage assessments, and user fees that help capture (i.e. appropriate) externalities within the market place (Pearce et al. 1989; Pearce and Barbier 2000). Accurate environmental valuation is integral to the development of appropriate pricing and charging policies for such market-based instruments.

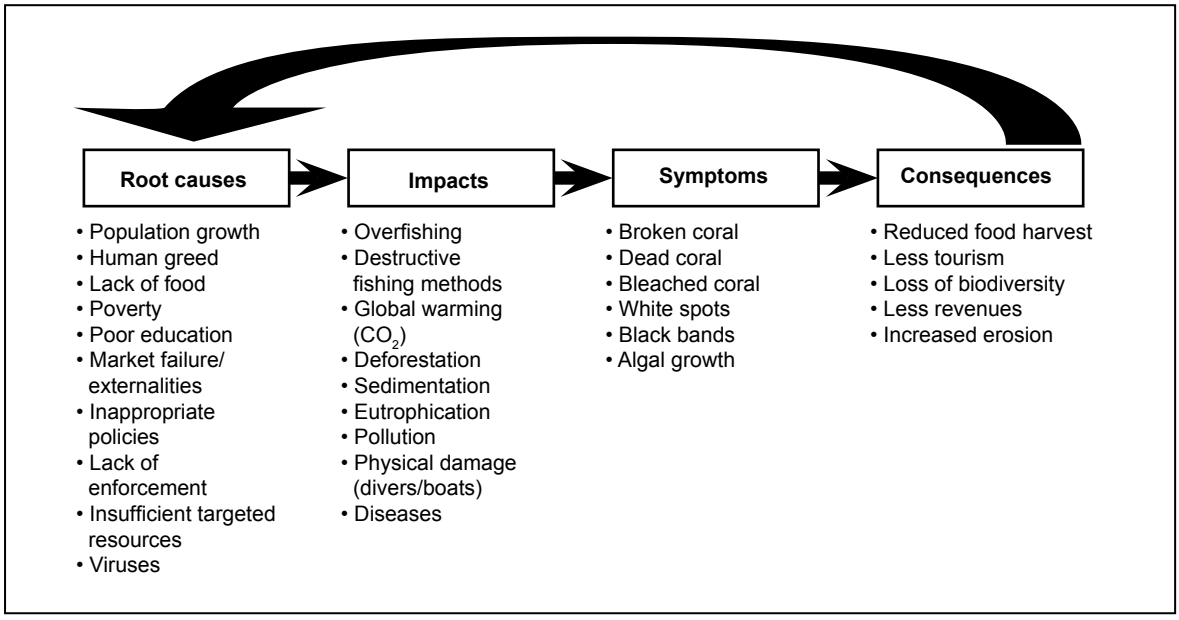

Figure 1. The cycle of coral degradation

It is only by fully understanding and appreciating wider environmental and social values, and by identifying ways of accounting for, and capturing such values, that the long-term economic benefits of tackling the root causes of environmental degradation become apparent.

Focus of international funding agencies

Poverty is one key root cause of environmental degradation that international funding agencies such as the World Bank and the UK's Department for International Development (DfID) are now actively trying to tackle. Accordingly, a much larger proportion of development projects and associated funding will be targeted at poverty alleviation. In particular, the links between different values of coral and the opportunities for alternative and sustainable livelihoods need to be fully explored. Associated with this is the need to pay greater attention to the socioeconomic benefits provided by corals, such as employment and nutrition.

Since the Rio Earth Summit in 1992 there has been considerable global emphasis on climate change and biodiversity conservation. These are two other areas where environmental valuation of coral reefs is now increasingly being used. Likewise, outcomes from Rio + 10 will influence the focus of future coral reef valuation efforts.

Changing approaches to natural resource management

In the past, natural resource and protected area management was generally focused on understanding and managing ecosystems from a biological perspective. This approach was supported by limited stakeholder consultation and use of ecological models to identify population dynamics.

Current management strategies are beginning to incorporate wider, social and economic factors. Stakeholder consultation has evolved into stakeholder participation, and capacity building and institutional strengthening are now seen as vital, particularly in developing countries. The feasibility and design of new development projects are often assessed using CBA and environmental impact assessment (EIA); occasionally bio-economic models are used to support decision-making.

However, in the future, financial, business, legal and ethical disciplines and factors will also be playing a pivotal role in natural resource management. Stakeholders will become actively engaged in the management process. The private sector will become heavily involved, often through private/public partnerships. Some marine protected areas will become privatized, commercial operators and co-operatives will manage others, and corporate/business sponsorship may become commonplace. The success of protected areas will, however, continue to depend upon obtaining public and local support.

New market-based instruments will be adopted to complement appropriate policies and regulations. CBA and strategic environmental assessment (SEA) will be increasingly undertaken at a policy level as well as the project level. And finally, fully integrated management models will be developed, often based on remote sensing images and GIS databases. Understanding the full current and potential values of coral reefs will become critical to a successful outcome in this radical transformation of management approaches.

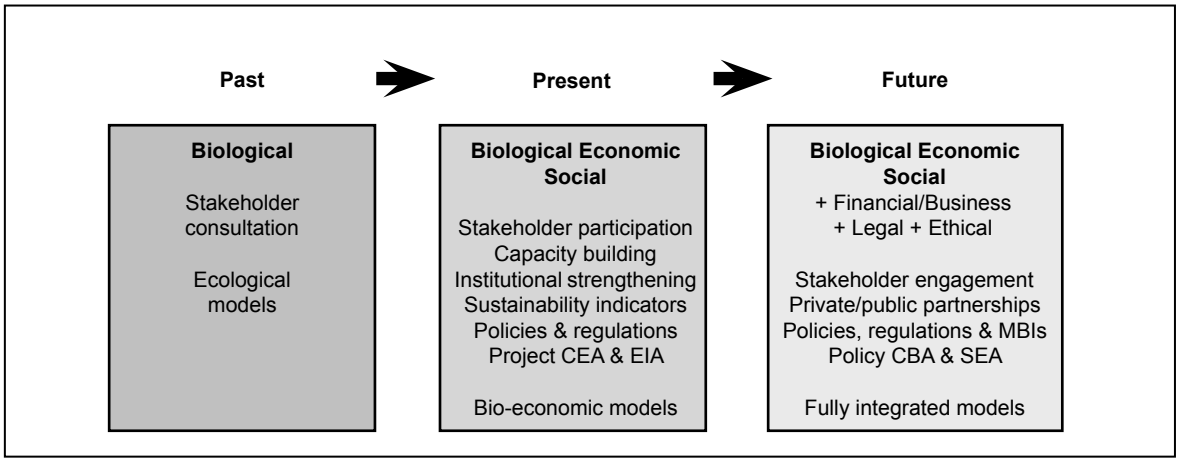

Figure 2. Changing approaches to natural resource management

Diversification of measuring tools

Governments and organizations are moving towards use of a range of indicators to support their approach to environmental monitoring and management (World Bank 1997). Many indicators are being developed by different organizations. They include, for example, sustainability indicators, key performance indicators, and quality of life indicators (DETR 1999).

Environmental values, based on the theory of economic welfare, are just one type of indicator. They need to be used in conjunction with other indicators and evaluation approaches, such as multi-criteria analysis. These approaches, however, also have their own advantages and disadvantages (Pearce and Barbier 2000).

The role of environmental valuation and economics

Resource management decisions

Environmental valuation has begun to play a major role in option appraisal for resource management decision-making. This generally involves undertaking CBAs to compare the economic viability of different options. Examples relating to coral reefs include demonstrating the economic viability of implementing marine protected area management (White et al. 2000), assessing the economic viability and enhancing the effectiveness of coral restoration (Spurgeon 2001), demonstrating the economic losses from blast fishing (Pet-Soede et al. 2000) and from coral mining (Ohman and Cesar 2000), and selecting a preferred coastal zone management approach (Gustavson and Huber 2000). By incorporating environmental costs and benefits within CBA, the most efficient sustainable option can be selected. Furthermore, such an approach can be a powerful means of justifying additional expenditure on environmental management.

However, there is an increasing need to assess options in a broader sense, reflecting wider social benefits. For example, in the UK, the Environment Agency (known as the Agency) has a statutory duty to consider the wider economic and social costs and benefits of its environmental management actions. In accordance with this duty, a study was undertaken to help the Agency select a preferred salmon fishery management option for the River Lune in northwest England (GIBB Ltd[1] 1999). Salmon numbers in the river had been in decline for around 10 years; this had led to a growing conflict between anglers and fishers. On the one hand, the many anglers caught relatively few salmon through fly-fishing, but injected large sums of money into the local economy through tourism and so, indirectly, supported local jobs. On the other hand, a small number of local fishers caught many salmon using nets, contributing relatively little to the local economy, but earning a direct living. Issues relating to the overall distribution of benefits were of great importance.

The study involved several low-cost socioeconomic questionnaire surveys that incorporated a contingent valuation method (CVM) component (i.e. asking individuals their "willingness to pay" (WTP) for certain options). An economic model was developed that incorporated a fishery model predicting future salmon numbers under various management scenarios. The overall implications of various net fishers and angling restrictions (e.g. numbers of licenses, catch limits and seasons) were then assessed in terms of three key indicators. These indicators were: (i) the net economic benefit to the nation (i.e. welfare benefit); (ii) the gross financial expenditure/revenues injected into the local economy; and, (iii) the number of jobs supported. The results were used to help select and justify the combination of fishing restrictions eventually imposed by the Agency.

A major impediment to widespread use of environmental valuation is the expense of carrying out original valuations of public preferences using techniques such as contingent valuation. Robust values often require a carefully constructed and rigorously tested questionnaire, a large sample size (e.g. 500), and a lengthy face-to-face interview process (e.g. 30 minutes). It is, therefore, often not economically justifiable to do such a study for every valuation required. A solution to this cost problem that is rapidly gaining popularity involves benefit transfers. This means taking environmental values from one situation where an in-depth valuation study has been applied, and using the values (often adjusted or as a function) to value environmental changes in similar situations elsewhere.

[1] Now known as JacobsGIBB Ltd, an international firm of consultants (also formerly known as Sir Alexander GIBB).

In order to facilitate the Agency's decision-making process through use of benefit transfers, several major valuation studies have been undertaken on their behalf. The aim has been to estimate standard values for specific environmental changes and develop a model whereby the standard values are adjusted for different situations to reflect variation in key explanatory variables.

Two such studies[2] involved conducting national CVM surveys covering all eight Agency regions around the UK to assess use and non-use values associated with fish stocks in inland water bodies (Spurgeon et al. 2001). One was a telephone CVM survey aimed at anglers and designed to determine standard values for angler consumer surplus and expenditure. The other was a face-to-face CVM survey, targeted at the general public and designed to assess their recreational use values and non-use values for inland fish stocks. In each case, overall national standard WTP values were determined. These could be multiplied by different adjustment factors to reflect differences between regions, types of water body, types of fish and the extent to which fish stocks are improved. It is worth noting that variations in regional adjustment factors give rise to potential distributional impacts, an increasingly sensitive issue in CBA. The study highlighted the considerable importance and value to the public of non-use values.

Another ongoing Agency study involves the development of a robust benefit transfer model relating to recreational use values and public non-use values associated with improving water levels and flows in rivers in the UK (JacobsGIBB 2002). The need for the study arose from the fact that a large number of rivers in the UK suffer from low flows, often caused by excessive water abstraction. The Agency is keen to return the rivers to their natural state wherever it is economically justifiable to do so. However, a previous attempt by the Agency to reduce a licensed abstraction rate on the basis of arguments using non-use benefit transfers was dealt a major blow in court (Moran 2000). Various criticisms of the benefit transfer process were noted, a major one being the lack of empirical evidence as to the relevant population over which to aggregate household non-use WTP values. Although small on a per person basis, overall non-use values for natural resources can often be the largest component of benefit. Hence their correct valuation and acceptance can be highly influential in the decision-making process.

It is not considered economically viable to undertake original non-use valuation studies for every potential river improvement scheme. Consequently, the study has involved an in-depth CVM survey eliciting WTP values for recreational use values and general public non-use values associated with improving water levels on just one river, the Mimram, in Hertfordshire. The survey focused on how recreational use values and non-use values vary with distance from the river. In addition, scoring and rating exercises were included to assess the relative importance of different river characteristics and types of benefit. The results are being used to develop a benefit transfer model using a set of adjustment factors that will facilitate application of the approach to other rivers.[3] Important findings of the study show:

- Users predominantly live within 12 km of the river;
- In addition to their use value, users also hold a large non-use value for the river, around 50 per cent of their overall WTP value; and
- The majority of the public living at least up to 130 km from the river hold non-use values for the river.

A groundbreaking aspect of the Mimram study has been the extent to which stakeholders have been actively engaged in the valuation process. This was achieved initially through a widely advertised "open day", which identified typical stakeholders and benefits associated with healthy flowing rivers. Focus groups were then held to gain a more in-depth understanding of stakeholder perceptions and benefits. A questionnaire survey was subsequently designed that included a combination of ranking, rating (scoring) and WTP elicitation techniques. Further, local resident and general public focus groups/discussions were used to test for understanding and completeness. The stakeholders were also re-consulted to confirm that the results adequately captured their values.

In addition to helping assess project options, environmental valuation can, and is, playing a

[2] Undertaken jointly by GIBB Ltd and McAllister Elliott and Partners.
[3] Another stated preference technique known as "choice modeling" is also becoming a powerful means of assessing the value of different characteristics to help in benefit transfers (Bennett 1999).

valuable role in assessing wider policy options in terms of their overall economic, social and environmental efficiency. Indeed, this is now happening for many new environmental policies under consideration within both the UK and European Union.[4]

Enhancing environmental assessments

Not only should environmental valuation come into economic CBA decisions, but it also has a place in environmental impact assessments (EIAs). JacobsGIBB have been incorporating the concept of environmental values for coral reefs and other habitats within EIAs (e.g. EIAs related to port and power developments in Zanzibar and Abu Dhabi), in strategic environmental assessments (SEAs) (e.g., for the Saudi Arabian Tourism Master Plan) and in due diligence studies for international lending banks (e.g. for power plants and marine cables in the Philippines and Thailand). A critical issue that arises in these studies is the need to disentangle scheme impacts from other impacts, and to understand the cause-and-effect linkages.

In such cases, the use of environmental values can be a powerful way to demonstrate the need for suitable mitigation and compensation measures and cost-effective targeted monitoring programs. If carried out appropriately, the approach can potentially save developers and project sponsors considerable latent costs and liabilities. In SEAs, the additional advantage of being able to highlight and promote the benefits of using environmental valuation and market-based approaches for strategic environmental management purposes may arise. For example, this includes the use of environmental charges and damage fees to help raise revenues and minimize environmental damages.

Market-based instruments and funding opportunities

There are excellent opportunities for using MBIs to help manage natural resources more efficiently, although these are also not without their problems (Huber et al. 1998; Pearce and Barbier 2000). Nevertheless, economic instruments can both help generate revenues for environmental protection and directly modify human behavior, thereby protecting natural resources. Such instruments include user fees, damage fees, waste/discharge fees, transferable quotas/licenses and tourist taxes (e.g. accommodation or airport taxes).

In order to further explore the potential benefits of MBIs, a recent study[5] examined in outline a number of ways to maximize opportunities for raising revenues for coral reef management (Spurgeon 2000). It also developed a framework and an eight-stage approach for achieving such a goal, based on the concept of TEV. At the heart of the methodology is the importance of identifying the full range of coral reef stakeholders (both beneficiaries and impactors) at local, regional, national and international levels.

In addition, the study identified a significant role that businesses could play in supporting the management of coral reefs, particularly given the global drive towards corporate social responsibility. Figure 3 highlights an outline framework proposed for identifying coral reef beneficiaries. Each dot in the matrix represents a type of benefit or value for which there will be one or more potential arguments or MBIs to help capture the value and raise revenues for conservation. A similar matrix was developed for those with an impact on coral reefs.

Natural resource damage assessments

There is growing recognition around the world that people or organizations imposing significant damage to valuable natural resources can be brought to justice through environmental liability. Estimates of the value of damages can be made and, depending on the relevant national laws, the polluter can be made to pay.

Natural resource damage assessments are often associated with shipping incidents. Recent studies[5] include assessment of the environmental value of damage to coral reefs from ship-groundings in the Red Sea and the Philippines, and to the wildlife and pristine image of the Galapagos Islands from the Jessica oil spill. Under such circumstances, damage claims and compensation payments of millions of dollars are not uncommon. However, it is interesting to note the considerable scope to adopt a wider charging regime for smaller-scale damages caused by boats, divers and dredging operations.

[4] For example, JacobsGIBB are currently determining the full economic costs and benefits associated with 300 "Natura 2000" protected areas in Scotland designated under the EU Birds and Habitats Directives.
[5] Undertaken by JacobsGIBB and part funded by DfID.

Stakeholder Groups:	Use Values												Non-Use	
	Direct Use Values								Indir Use Values		Option Value		Non-Use Value	
	Recr		Fish		Prods		Res/Educ							
Communities/ general public	●	•	●	●	●	●	●	●	●	•	●	●	●	●
	•	•	•	•	●	●	●	●	•	•	●	●	●	●
Fishers	●	•	●	●	•	•	●	●	●	•	●	●	●	•
			•	•	•	•	•	•	•	•	•			
Recreational users	●	●	●	•	•	•	●	●	•	•	●	●	•	•
	●	●	•	●	•	•	●	●	•	•	●	●	•	●
Conservation groups	●	●	•	•	●	●	●	●	•	•	●	●	●	●
	•	•	•	•	●	●	●	●	•	•	●	●	●	●
Schools/ Universities	●	●	•	•	•	•	●	●	•	•	●	●	●	●
	●	●	•	•	•	•	●	●	•	•	●	●	●	●
Government	●	•	●	•	●	●	●	●	●	●	●	●	●	●
	•	•	•	•	●	●	●	●	●	•	●	●	●	●
Businesses	●	•	●	•	●	•	●	●	●	•	●	●	•	•
	•	●	•	●	•	•	●	●	•	•	●	●	•	•

Notes: Location where the effect occurs:

Local	Regional
National	International

- • Potentially some impact/link
- ● Potentially significant impact/link

Figure 3. Framework for identifying revenue opportunities from coral reef beneficiaries

These studies clearly demonstrate the importance of considering the magnitude of non-use values when justifying expensive restoration and other suitable compensatory measures. Again, benefit transfer approaches are commonly used in damage valuation assessments. However, it is important that particular care is taken to use appropriate adjustment factors to account for site-specific differences. Furthermore, a good understanding of cause-and-effect linkages is essential.

Other research (Spurgeon 1999) also suggests that economic valuation that encompasses environmental values could play a valuable role in deciding the most effective means of restoration, and the best use of money obtained in such damage claims. In relation to this, the considerable cost of some coral restoration schemes may be questionable.

Some challenges and issues to overcome

Environmental valuation techniques and their inclusion as part of a suite of decision-making tools have progressed rapidly over the past couple of decades. However, there is scope for improvement. A number of issues still need to be resolved. Some of the current key challenges with respect to coral reef valuation are summarized below.

Understanding and assessment of cause-and-effect linkages, required in virtually all environmental valuation, need improvement. This is essential for both environmental impact linkages (e.g. pollution effects on corals) and environment-economy linkages (e.g. coral cover and economic values).

There is a need to develop an agreed acceptable approach to undertaking benefit transfers for coral reefs. Reliable environmental valuation studies determining public preferences are expensive to conduct. However, cost-effective valuation based on benefit transfers is possible provided there is sufficient understanding of the link between key environmental variables and values. A coordinated global approach is needed to develop sufficient robust valuations for use in benefit transfer models.

A database of values for different coral reef benefits is needed. This should incorporate appropriate details on valuation scenarios and site-specific characteristics affecting the values.

The accuracy and robustness of each valuation must also be clarified.

Problems associated with equity and distributional bias need to be overcome. There is a danger that WTP analysis will be biased towards providing environmental benefits in favor of the wealthy to the detriment of those less well off. A generally accepted approach to handling this issue is needed.

The quality and credibility of environmental valuation studies must be standardized and enhanced. Although beginning to gain credibility with some decision-makers, there is still considerable skepticism about the use of environmental valuation techniques by others. The situation is not helped by poorly designed valuation studies and use of grossly inaccurate assumptions.

The understanding and valuation of non-use values requires much additional research. Several of the studies outlined above have indicated the importance of non-use values. Non-use values relating to coral reefs are likely to be significant and will often considerably outweigh coral reef use values. There is, therefore, a need to accurately assess unit values and determine over what populations the values should be aggregated.

To raise the credibility and importance of non-marketed values, new approaches are required which can help appropriate/capture such values.

Conclusion

In conclusion, environmental valuation can and should play an increasingly important role in coral reef management over the next 10 years. However, valuation will only be one of the suite of tools required to be incorporated into robust and consistent decision-making. It is also apparent that valuation of coral reefs is many years behind valuation of other environmental goods, such as water resources. Based on the trends, studies and issues alluded to above, the following predictions concerning valuation of coral reefs over the next 10 years can be made.

Integration of stakeholder involvement, socioeconomic aspects, alternative livelihoods and poverty alleviation will become more common in developing approaches to environmental valuation, especially in the developing world.

Non-use values will play an increasingly important role, as will methods to appropriate such values.

Benefit transfers will be commonly used to help facilitate the spread of environmental valuation within decision-making.

Environmental values will become one of several key indicators used to help protect and manage coral resources.

MBIs will increasingly be used to assist in coral reef management and in financing conservation. The application of user fees and environmental damages will become more sophisticated with time.

As the potential financial value of coral reefs is recognized, management of coral reefs and marine protected areas will become more business-like, with increased private sector participation. This needs to occur in a socially inclusive and highly ethical manner, in partnership with government bodies, NGOs and local communities.

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