A Blueprint for Maximising Sustainable Coastal Benefits: The American Samoa Case Study

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Abstract
This paper proposes the need for new integrated guidance for a "value-based" approach to facilitate more sustainable management of global coral reefs and other coastal resources. Values in this context include not only economic welfare values, but also a range of other indicators of value. The paper suggests a series of supporting principles, frameworks and methodologies upon which the guidance should be based. Their application is then discussed with reference to a case study in American Samoa for which the economic value derived by residents and visitors to the islands are estimated to be a minimum US$ 5 million/year (or US$ 161 million in total or US$ 0.7/m^2) for coral reefs and US$ 0.7 million/year (or US$ 24 million in total or US$ 50/m^2) for mangroves respectively. With the inclusion of non-use values potentially held by the US general public, the total value of these habitats could be more than double these figures. Innovative aspects of the study include a spatial GIS-based approach highlighting the extent to which values vary spatially, a contingent valuation study that assesses non-use values, and consideration of both present and future potential values under alternative management scenarios. The paper concludes by highlighting recommendations as to what further steps need to be taken in development of the new guidance.

Keywords:
Coral reefs, mangroves, economic valuation, contingent valuation, economic model, GIS

Introduction

The true environmental, social and economic value of global coral reefs is rarely fully appreciated nor managed appropriately in a sustainable and equitable way (Cesar *et al*, 2003; Spurgeon, 2004). Moreover, although economic valuation studies are becoming more widely used and accepted as an environmental management tool, the information produced is often not available in a format easily applied by coral reef managers. Even if environmental values are recognised, there is often insufficient funding available, inadequate and ineffective management, and the wrong incentives in place. At a global level, these factors contribute significantly to the continued degradation of coral reef resources.

What is needed is readily available, simple and fully integrated guidance for a "value-based" approach to facilitate more effective and sustainable management. Such guidance must consider the full range of economic, environmental, social, and financial values (in their broadest sense) provided by coastal resources. It must be multi-disciplinary and applicable to a wide range of coastal regions and management scenarios. It should also be disseminated widely through appropriate outputs targeted at all levels, from the general public through to government decision makers.

This paper begins by outlining some preliminary ideas for such guidance in terms of a set of principles, frameworks and methodologies that could be used to maximize sustainable coastal resource benefits, enhance the capture of monetary values and optimise coastal management costs. The paper then provides the results of a case study that assesses the current and potential value of American Samoa's coral reefs and mangroves. Here, the Government has taken the bold step of pursuing coastal management based on understanding the full range of coastal resource values. There is then a brief discussion regarding how the case study fits into the proposed approach, followed by recommendations as to what further steps need to be taken.

Developing an Approach to Maximise Sustainable Coastal Resource Benefits.

This section highlights ten preliminary principles identified as being critical to help maximise the sustainable benefits of coastal resource use. The principles are not considered exhaustive but do provide an initial basis to ensure "value-based" concepts are incorporated appropriately within coral reef management decision-making. Linked to the principles are examples of various frameworks and methodologies that also need further consideration and development.

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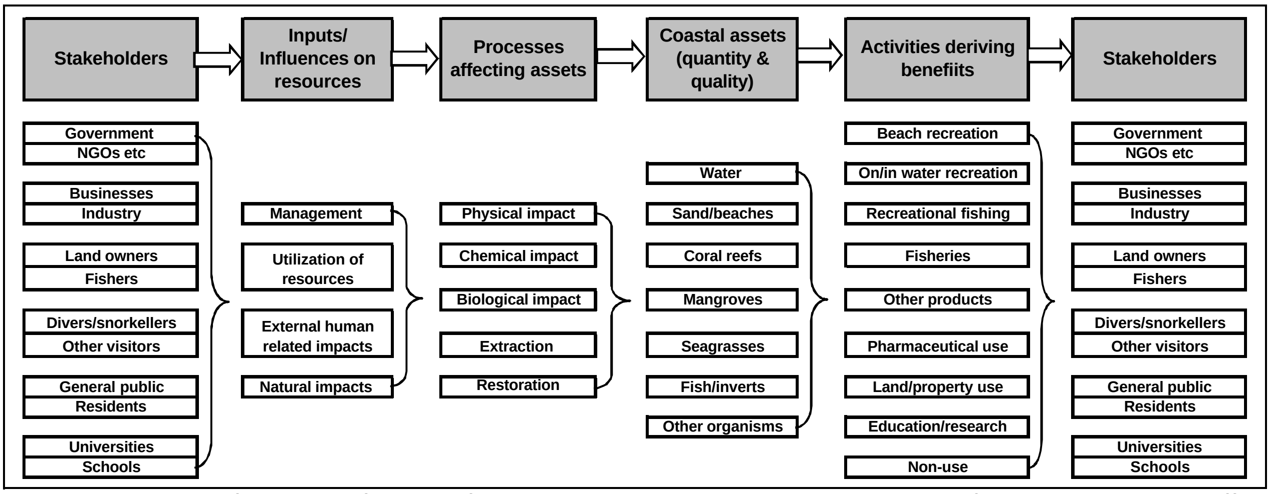

Fig. 1 Preliminary framework for identifying linkages and assessing costs and benefits associated with different stakeholders

Principle 1: Recognise the diverse ways that value-based approaches can be used. A variety of applications exist whereby value-based approaches can help maximise coastal resource benefits. These include for example: incorporating environmental values to improve decision-making approaches (e.g. within cost-benefit analysis, environmental and strategic environmental impact assessments, multi-criteria analysis and regulatory impact assessments) for projects, policies, and programmes; informing natural resource damage assessments; helping to prioritise management focus and expenditure; justifying additional environmental management expenditure; assisting in the control of resource usage; and informing ways of raising revenues, enhancing benefits and minimising management costs.

Principle 2: Develop an integrated stakeholder and system-based (i.e. coastal and river basin) approach to fully understand both the costs and benefits of resource management and the cause-effect linkages. It is essential to understand who the different stakeholders are that use, affect and benefit from coastal resources. To be of any use, this must also consider impacts caused by off-site activities (e.g. land clearance in upper river catchments and atmospheric/global issues) at a systems level. Fig. 1 outlines a preliminary framework to help consider: the full range of stakeholders; the costs of resource use and management; the state of coastal resources; how they are affected; and what benefits they give rise to and to whom.

Principle 3: Consider and account for all values but avoid double counting. To support decision-making, there is a need to bring together conventional welfare economic values such as total economic values (Spurgeon, 1992), with other values such as: economic impacts, for example revenues, expenditures and jobs (Spurgeon, 2004); social and socio-economic benefits (e.g. Bunce *et al*, 2000; Whittingham *et al*, 2003); and other ecological and spiritual values (Moberg & Folke, 1999 and Spurgeon in press).

Principle 4: Consider the full range of compatible techniques for quantifying values. The new guidance should draw upon a broad range of methods for measuring economic values such as choice-modelling, contingent valuation, replacement costs and input-output models, as well as methods for quantifying other social and ecological benefits and values. In addition, use of benefit transfers whereby values determined in one location are applied elsewhere should be considered where appropriate adjustments are made. Furthermore, there is a need for up-to-date guidance on valuation techniques as applied to coral and coastal resources.

Principle 5: Determine both current and potential future values. It is important not only to assess current values, but also to predict how values are likely to, or could potentially change over time. For example, an unutilised coral reef could have considerable potential for tourism or as a protected area. Fig. 2 shows the key steps needed to determine potential values by considering underlying trends (e.g. population changes and pollution), current and potential threats and impacts, ways to mitigate these, and ways to enhance benefits. One can then compare alternative development and management options to identify the option yielding the overall optimum benefits based on agreed priorities and criteria.

Principle 6: Understand the key factors that affect values. Coastal resource values vary spatially due to a range of different factors. It is essential to understand what the key factors are to determine how best to maximise benefits. Key factors include, for example, the number of residents and visitors and their socio-economic characteristics, the extent to which local people depend on resources for subsistence, the type and condition of resources and various other spatial features.

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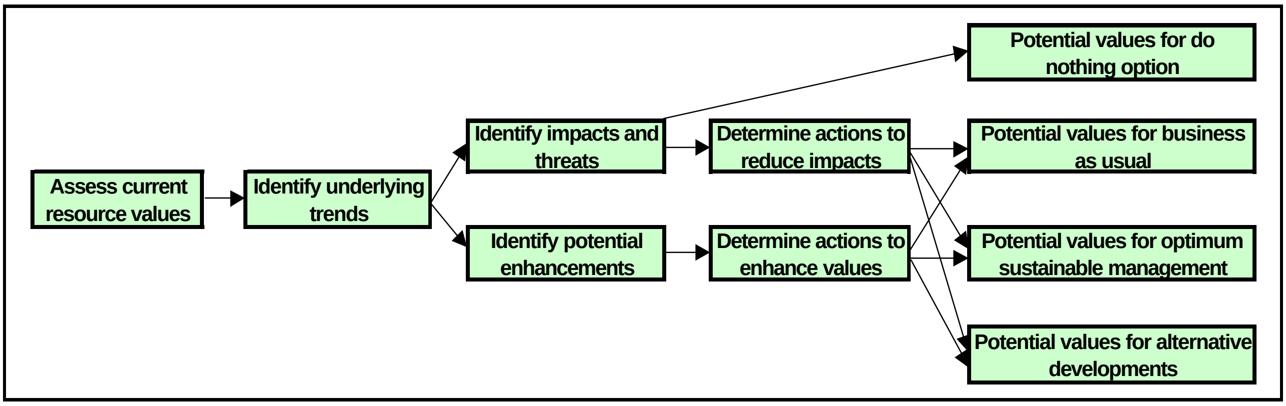

Fig. 2 Framework for assessing current and potential values

Principle 7: The polluter/user pays. To ensure long term sustainable use of coastal resources and adequate funding for their management, the polluter pays principle should be adopted based on a stakeholder/cause-effect relationship approach (Spurgeon, 1999 and 2004).

Principle 8: Adopt the precautionary principle and target key gaps in our understanding. There is considerable uncertainty over some values (e.g. non-use values) and cause-effect relationships (e.g. relating to pollution impacts). Where uncertainty exists over a value or potential impact, one must err on the side of caution and bias actions towards maintaining the resource base. Key gaps in our understanding of value-based approaches need to be identified and filled.

Principle 9: Draw upon a wide range of disciplines. It is essential to draw upon the latest and most relevant tools and techniques from a broad range of disciplines including business management. This is particularly important to help enhance benefits and reduce costs. Table 1 identifies several examples and briefly summarises the potential contribution of each.

Discipline:	Improves our:	Values gained:
Science (ecology, chemistry, coastal processes, etc)	Understanding of habitat/species and cause-effect linkages.	• Enhanced benefits • Reduced costs • Captured monetary values • Equity of values (present & future)
Sociology (psychology, philosophy & ethics)	Understanding of values and what drives people.	
Economics (environmental economics)	Ability to quantify values and improve resource allocation decisions.	
Finance (financial & management accounting)	Ability to maximise cash flows and stabilize operations.	
Business (operations management, marketing, strategy & organizational behaviour)	Efficiency in delivering better value from the resources.	
Law	Ability to manage and enforce activities.	
Technology	Efficiency of management and research.	

Table 1 Key disciplines to draw upon for the new guidance

Principle 10: Develop awareness and capacity at all levels. To engender change it is critical to build capacity and awareness of the above at all levels using a variety of approaches. These should range from technical manuals and training seminars to television and radio programmes and advertisements and simple leaflets and posters.

The American Samoa Case Study

The case study presents the results of an economic valuation of the coral reefs and mangroves in American Samoa, central South Pacific (Spurgeon *et al*, 2004). The study was conducted in 2003-2004 by Jacobs together with several specialists on behalf of the American Samoa Government Department of Commerce (DOC). It was initiated to better understand coastal resource values to help balance the islands' economic needs with those of sustainable management and Fa'asamoa (the Samoan way of life). The key objective was to assess both current and potential future welfare values to guide future coastal management initiatives.

American Samoa hosts around 222km^2 of coral reefs at depths of less than 30m (Spurgeon *et al*, 2004), including extensive fringing reefs around the five main volcanic islands (Tutuila, Aunu'u, Ofu, Olosega and Ta'u), two coral atolls (Swains Island and Rose Atoll) and a number of submerged offshore bank reefs. The banks comprise around 71% of the reef area. In total, American Samoa's reefs represent around 7% of coral reefs in the US (including all territories) and around 0.001% of coral reefs globally (see Spalding *et al*, 2001). Several well-developed mangrove wetlands are also found on Tutuila, totalling around 0.48km^2 (Scott, 1993; Spurgeon *et al*, 2004). Mangroves are absent from the other islands and atolls. Other habitats typically associated with tropical coastal ecosystems, such as seagrass beds and lagoons, are less well represented in American Samoa and are were not considered in the study.

Coral reefs and mangroves are without doubt amongst the territory's most valuable natural assets. However, rapid population expansion and a steady shift from a subsistence to a cash economy has led to major changes in land-use, increased urbanization and significant losses of coastal resource services and values. The problem is particularly acute on the main island Tutuila, where 95% of the territory's 66,000 residents live (Craig 2001; Green, 2002). In contrast, coral reefs of the less developed Manu'a Islands (Ofu, Olosega and Ta'u) and the isolated and uninhabited Rose Atoll are still considered amongst the world's most pristine.

Case Study Methodology

Coral reef and mangrove values were assessed using a Total Economic Value (TEV) approach. This is based on the theory that environmental assets give rise to a range of economic goods and services (functions) that include use and non-use values (Spurgeon, 1992). Use values relate to both direct (e.g. recreation and fishing) and indirect (e.g. shoreline protection from storms) benefits. Non-use values relate to the how much enjoyment or satisfaction people gain from maintaining a resource irrespective of actual personal use. Motives may be just so that they know it continues to exist for their own enjoyment (existence value), for others to enjoy (altruistic value), or for future generations to enjoy (bequest value). If people want to hold open the option for potentially using a resource in the future, this is known as option value.

Values were estimated using carefully selected techniques based on suitability, data availability and compatibility, ensuring no double counting of benefits (e.g. see Dixon *et al*, 1988).

Coral reef and mangrove subsistence and artisanal fishery values were estimated based on 2004 market prices for fish (US$ 5.5/kg) and shellfish (US$ 15.7/kg). Individual consumer surplus (the difference between the overall benefit gained by someone using or enjoying a resource and the monetary expenditure they incur in doing so) associated with subsistence fishing (US$ 1.40/trip) and recreational diving (US$ 10–20/trip) and snorkelling (US$ 4–24/trip) were estimated based on benefit transfers (i.e. values measured elsewhere and adjusted based on key factors). Recreational expenditures for divers (US$ 10–90/trip) and snorkellers (US$ 4–100/trip) were based on informant interviews. The aforementioned individual values varied depending upon resident/visitor status and location of trip. The indirect shoreline protection values were based on cost savings from delaying the need to install and repair shoreline defences (at US$ 1,650–3,270/linear metre). Non-use values for local residents were based on a contingent valuation method (CVM) questionnaire survey. Respondents were asked how much money they were willing to pay or how much time they were willing to contribute to prevent the complete loss of corals and mangroves in American Samoa. Elicited willingness-to-pay (WTP) values were then appropriately apportioned between corals and mangroves and adjusted to exclude the proportion of WTP that related to respondents personal use values. Use values are already accounted for in estimates of fishing and recreation values detailed above. For coral reefs, Caucasians had non-use WTP values of US$ 207/adult/year, other Pacific Islanders US$ 131/adult/year, US Samoans US$ 89/adult/year and Asians US$ 31/adult/year. Non-use coral values for visitors were based on conservative and relatively robust benefit transfer values (US$ 2.1-8.5/adult/trip) multiplied by annual visitor numbers. Non-use coral values for the US population were based on a conservative guesstimate value (US$ 0.04/household/year) multiplied by total US households. Note again that American Samoa do contain amongst the USA's most pristine coral reefs.

Expenditure values were increased by a factor of 1.25 to account for the multiplier effect. This takes into account the overall increase in economic activity resulting from recipients re-spending the money in successive indirect rounds (i.e. indirect expenditure) and employees spending their increased wealth (i.e. induced expenditure). The adjusted expenditures were then reduced to exclude the costs of production (by a factor of 0.75 for tourism, 0.4 for artisanal fisheries and 0.05 for subsistence fisheries) to derive net benefits or producer surplus (i.e. net added value) to be summed with the other economic welfare benefits.

Data collection was based on four main approaches. First, the study involved a review of available published and unpublished environmental, social and economic data. Second, informant interviews were undertaken with representatives of key organisations and stakeholder groups. Third, discussion meetings were held in a number of coastal villages to collect information on coral reef and mangrove benefits and to discuss the design and implementation of a general public questionnaire.

Fourth, a general public CVM questionnaire was used to collect information about the use and importance of coral reefs and mangroves to residents of American Samoa. The main aim was to elicit a WTP value for the maintenance of coral reefs, mangroves and associated fisheries (covering use and non-use values). The questionnaire was used as the basis for structured interviews with 300 residents from 44 villages on Tutuila, Ofu and Olosega. Interview locations and respondents were selected to be representative of population distribution and socio-economic characteristics.

Coral reef and mangrove values were then analysed using a spatial economic model developed specifically for the study. Key characteristics of the model are that it: (a) uses GIS-maps to highlight the relative significance of values at different locations (see examples in Figs. 3 and 4), and (b) generates site-specific per unit area direct, indirect and non-use values based on key explanatory factors (e.g. contribution to fishery productivity, access, distance to population centres, proximity of coastal infrastructure at risk from erosion, protected area status, etc). This approach has the advantage of highlighting the considerable differences in value at different locations and enabling any given area of reef or mangrove to be valued individually. The model also provides a series of tabular outputs that summarise the type and extent of values derived by key stakeholder groups.

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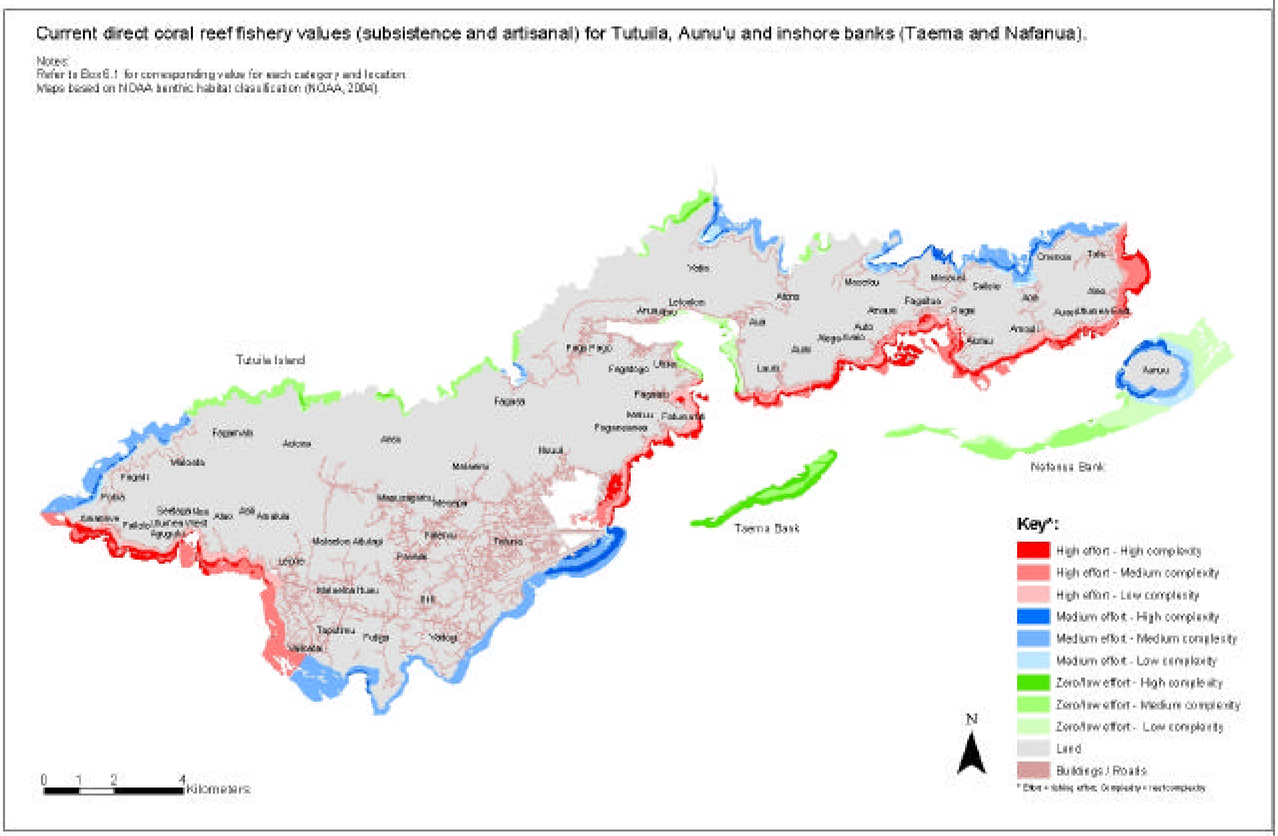

Fig. 3 Example of map output showing current direct coral reef subsistence and artisanal fishery values for Tutuila.

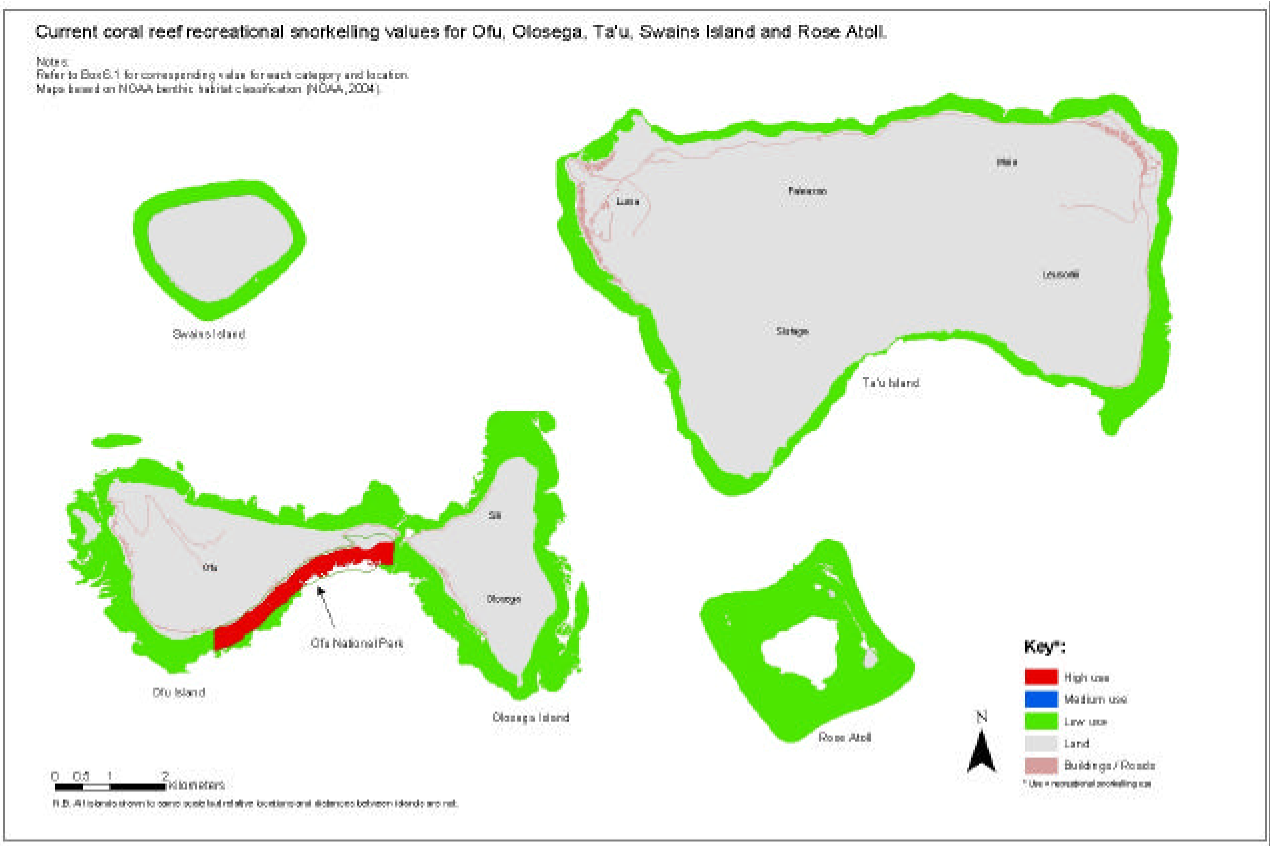

Fig. 4 Example of map output showing recreational snorkelling values for other islands.

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In addition, potential future values were calculated based on the approach outlined in Fig. 2 for two scenarios (both over a 25 year time horizon): (1) a “business as usual” (BAU) scenario, representing a continuation of current trends and impacts affecting coastal resource quality, benefits and values, and (2) an “optimum sustainable management” (OSM) scenario, representing the ideal situation based on effective implementation of current DOC management initiatives and the mitigation and enhancement measures proposed in this study.

Results

A breakdown of the current coral reef and mangrove values is given in Tables 2 and 3 respectively. Total benefits to American Samoa residents and visitors are estimated to be worth around US$ 5 million/year for coral reefs and US$ 0.7 million/year for mangroves. When non-use benefits potentially derived by US general public are added, overall benefits could be in the order of at least US$ 10 million/year for coral reefs and US$ 1.5 million/year for mangroves.

Overall values are clearly dominated by non-use benefits. With estimates of US public non-use values included, overall non-use values for corals are around US$ 8.8 million/year (88%) and for mangroves US$ 1.3 million/year (88%). For corals, 8% of the remaining value relates to direct use and 4% to indirect use, whereas for mangroves, 2% relates to direct use and 10% to indirect use.

Tables 1 and 2 also highlight that with US public non-use values included, around 50% of coral reef and mangrove values accrue to residents of American Samoa, equivalent to US$ 4.9 million/year and US$ 0.7 million/year respectively. For both, around 75% of the resident values are related to non-uses, which partly capture cultural, traditional and other social values. However, with respect to corals, of particular significance for residents are subsistence fishery catches (worth US$ 0.6 million/year), shoreline protection services (US$ 0.5 million/year) and subsistence consumer surplus, which represents part of the way of life (US$ 73,000/year).

Given the methods used to derive the values and the authors’ understanding of non-use values, resident and visitor non-use values may be underestimated by a factor of up to 10. The US population values may be overestimated by a factor of 10, but equally they could be underestimated by a factor of up to 20 or higher. Until specific comprehensive non-use value stated preference surveys (such as CVM or choice modelling) are undertaken for the US population, the magnitude of such values will remain unknown.

Based on resident direct uses for coral reefs alone, the Present Value (PV) (i.e. that is the sum of future values that would be lost if the resources were destroyed today) is around US$ 24 million (US$ 0.11/m^2) and, including resident indirect uses, US$ 40 million (US$ 0.18/m^2). However, by also including resident and visitor non-uses the PV becomes US$ 161 million (US$ 0.72/m^2). With inclusion of US public non-uses the total would be US$ 318 million (US$ 1.43/m^2).

Similarly, for mangroves, based on resident direct uses alone, the PV is around US$ 1.3 million (US$ 2.2/m^2) and, including resident indirect uses, US$ 5.7 million (US$ 11.9/m^2). By also including resident and visitor non-uses the PV becomes US$ 23.8 million (US$ 50/m^2). With inclusion of US public non-uses the total for mangroves would be US$ 1.5 million (US$ 99/m^2). The fact that per unit area values are much higher than for corals is partly explained by the relative scarcity of mangroves in American Samoa.

Note that the PVs assume a 3% annual discount rate on benefits accruing over 100 years. Discounting is commonly used in economic analysis to reflect the fact that people place a greater value on money and goods available today compared to the future.

The GIS-based model revealed considerable spatial variation in coral reef values. For instance, subsistence fishery PV alone ranged from a maximum of US$ 2.52/m^2 in parts of Ofu and Olosega to zero in other locations (e.g. Pago Pago harbour, where pollution precludes most fishing, and other uninhabited islands). Similarly, the coast protection PV alone ranged from a maximum of US$0.89 /$m^2$ for reefs fronting villages on Tutuila’s north shore (which are particularly prone to hurricane damage) to zero in nearby areas with no settlements or risk from erosion or flooding.

Comparison of potential future values under the BAU and OSM scenarios reveals a considerable divergence in value over time (Table 4). For example, the BAU estimate of coral reef value in 25 years time is US$ 19 million/year (almost a two-fold increase on current levels, ignoring inflation) compared to the OSM estimate of US$ 52 million/year (over a five-fold increase). Note that the increase in overall BAU value is solely due to increased non-use values (due to population growth and gradual increase in awareness of coral reef issues and consequent WTP values). More importantly for local residents, use values would be expected to decline (by as much as 41% for reefs and 25% for mangroves) mainly due to continued reduction in subsistence fish catches.

Other observations made include the fact that the activity of mining coral rubble and sand from the foreshore (over the past few decades) has resulted in additional costs to the American Samoa economy of between US$ 0.5-2.3 million/year, at a value of between US$ 90-450 per cubic yard of material. Sand and rubble foreshores provide an efficient shoreline protection function which has had to be replaced (2.6 km has been or is planned to be installed between 1977 and 2007) at a current cost of US$ 1,650–

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Table 2 Current annual coral reef values per stakeholder beneficiary group (US$/year)

Type of benefit		Stakeholder group			
		Residents	Visitors	US public	Total
Use benefits:	Direct subsistence fishery PS[1]	572,000	-	-	572,000
	Direct artisanal fishery PS	44,000	-	-	44,000
	Direct subsistence fishing CS[2]	73,000	-	-	73,000
	Direct snorkelling/diving CS	38,000	12,000	-	50,000
	Direct snorkelling/diving PS	17,000	7,000	-	23,000
	Indirect artisanal fishery products[3]	70,000	-	-	70,000
	Indirect shoreline protection	447,000	-	-	447,000
Non-use benefits		3,598,000	216,000	4,964,000	8,778,000
Total benefits		4,858,000	235,000	4,964,000	10,057,000

Notes: 1 PS = Producer Surplus (i.e. market price/expenditure less costs incurred) 2 CS = Consumer Surplus (difference between the overall benefit gained by someone using a resource and the monetary expenditure they incur in doing so) 3 Offshore reef-associated bottomfish catches.

Table 3 Current annual mangrove values per stakeholder beneficiary group (US$/year)

Type of benefit		Stakeholder group			
		Residents	Visitors	US public	Total
Use benefits	Direct subsistence fishery PS[1]	29,000	-	-	29,000
	Direct subsistence fishing CS[2]	4,000	-	-	4,000
	Indirect fishery products[3]	13,000	-	-	13,000
	Indirect shoreline protection	135,000	-	-	135,000
Non-use benefits		541,000	32,000	745,000	1,316,000
Total benefits		722,000	32,000	745,000	1,499,000

Notes: 1 PS = Producer Surplus 2 CS = Consumer Surplus 3 This is a component of the direct coral reef fishery accounted for in Table 2 (thus should be excluded if adding coral and mangrove benefits).

Table 4 Current and potential future coral reef and mangrove values.

Habitat type	Benefit type	Current values (US$/year)	Business as Usual Scenario		Optimum Sustainable Management Scenario	
			Value per year (US$/year)	% change from current	Value per year (US$/yr)	% change from current
Coral reefs	Use	1,280,000	754,000	-41%	3,036,000	+137%
	Non-use	8,778,000	18,131,000	+107%	49,317,000	+462%
	Total	10,057,000	18,885,000	+88%	52,353,000	+421%
Mangroves	Use	181,000	135,000	-25%	228,000	+26%
	Non-use	1,318,000	3,200,000	+143%	8,703,000	+560%
	Total	1,499,000	3,335,000	+122%	8,931,000	+496%

3,270/linear metre. The additional costs incurred, which are set to continue, excludes the associated forfeited beach recreation and tourism value, also potentially worth millions of dollars each year in revenues and enjoyment.

Discussion

The approach adopted in the American Samoa economic valuation has generally followed all the preliminary principles outlined in the Introduction section of this paper. As such, it represents a good initial case study that can be built upon and learned from, particularly with respect to valuing current and potential coastal resource benefits, and understanding spatial variation in values.

However, two of the principles have not been fully applied. First, the study did not aim to explore and consider the economic costs of management and resource use (part of Principle 2). This means it only focuses on one aspect of trying to maximize sustainable coastal benefits. Second, the study focus from the outset was not to identify, quantify and bring together all types of welfare and other values (Principle 3). Due to budgetary and practical constraints, the study intentionally concentrated on estimating selected key welfare values in detail. Additional attention on integrating social and economic values would have been useful, particularly in terms of assessing the relative reef dependency (e.g. in terms of food supply and income) of certain poorer communities, and economic impacts in terms of overall expenditures and jobs created.

A number of other key benefits were identified but not quantified or valued, including: education, research, bioprospecting and genetic diversity values for reefs and mangroves; and other ecosystem functions such as sand supply of reefs and pollution absorption of mangroves. In addition, it should be noted that the health benefits related to snorkelling and fishing activities are also worthy of future investigation.

When considered at a macro-scale (e.g. the entire territory or an individual island etc), the total values appear reasonably large. For example, annual coral benefits of US$ 5 million/year for residents and visitors and US$ 10 million/year including US citizen non-use values, appear particularly significant when compared to the current coastal zone management expenditure of around US$ 2 million/year. The only other reasonably comparable value available in the literature is that for the coral reefs of Hawaii of US$ 363 million/year (Cesar *et al*, 2002), but that understandably includes considerably greater recreation and property related values.

On the other hand, when considered at a micro-scale, the values appear relatively small. The best estimate average PV of coral reefs in this study is US$ 1.43/m^2. However, this value does compare favourably to Cesar *et al* (2003) who estimated PVs of US$ 0.8/m^2 of corals for the Pacific and US$ 2.8/m^2 worldwide. If as discussed in the results section the non-use values were larger, the average PV for coral reefs in American Samoa could be significantly greater (e.g. up to US$ 15/m^2). Though even this could be an underestimate for reefs in some areas because, as discussed above, values vary spatially.

This has major implications for how the values are used. Based on these values, where small-scale impacts are likely (e.g. direct destruction of corals from a ship grounding or land reclamation), the apparent economic loss is unlikely to be too significant. It is thus worth considering other approaches to valuation and compensation. For example, it would be better to argue that all corals are integrally linked and represent a national treasure that must be maintained, and hence pursue restoration of an equivalent area of corals (and gaining compensation for the loss of services until the corals are fully replaced). A review of restoration costs following ship grounding incidents revealed an average cost of over US$ 1,000/m^2 of damaged coral (Spurgeon & Roxburgh, 2004). Under such circumstances it is often better to carefully consider each incident on a case-by-case basis.

An interesting finding of the study is the extent to which coral reef values vary spatially. This also has major implications for application of values at a micro-scale. For instance, values were orders of magnitude higher for reefs with: (a) better access and hence higher recreational use (e.g. Fagatele National Marine Sanctuary and Alega Beach), (b) high coral rugosity (complexity of structure) and hence higher fishery productivity (e.g. parts of the south shore of Tutuila), and (c) provide locally significant coastal protection benefits to valuable and erosion prone coastline (e.g. parts of the north and south shores of Tutuila). As stated in Principle 5 of the proposed new guidance, when considering development impacts or management of any given reef area, be it for formulation of an Marine Protected Area (MPA) zoning strategy or identification of an appropriate permit fee to construct a seawall, locally specific factors that affect values must be examined.

It must be recognised that all values reported are considered as absolute minimum values due to the use of conservative assumptions and omission of other values as mentioned above. In particular, consumer surplus and non-use values (particularly future values) may be significantly underestimated. More accurate estimates would require additional comprehensive questionnaire surveys and studies.

Nevertheless, the study has shown that American Samoa's coral reefs and mangroves provide significant benefits to both local residents and the international community alike. The significant proportion of benefits that accrues locally is of particular relevance for coastal management policy in the territory. However, the use value component of this, on which local communities depend and gain significant enjoyment, are also the most at risk from unsustainable management and development.

Non-uses were identified as a major component of coral reef and mangrove values, particularly for the international community, but also for local residents and visitors. As noted above, the magnitude of such values is highly uncertain and could be far higher, particularly for US citizens if they were made aware of the uniqueness and significance of American Samoa's corals and the fact that it is an American territory. It is worth bearing in mind that other international populations may also derive relevant non-use values.

The study clearly demonstrates that appropriate consideration of non-use values can be fundamental to begin to understand the true value of coral reefs and other coastal resources. This is particularly true for resources with minimal human impact and where indigenous communities depend upon them for their livelihoods.

Conclusions and Recommendations

A number of coral valuation studies exist that can be drawn upon to help value coral reefs elsewhere in a meaningful way through benefit transfers. However, detailed spatial economic studies such as this one begin to highlight key aspects and parameters that need to be better understood to improve our estimates of values and the transferability of the results to other situations. Additional detailed studies to explore consumer surplus and non-use values focusing on key explanatory attributes would dramatically enhance our understanding of the total economic value of corals.

The American Samoa valuation study has been an important first step in understanding the coastal values for the territory. The spatial valuation approach has helped identify the location of the more valuable coral reefs that can now be better protected through more targeted coastal management initiatives.

The value-based approach has also highlighted the need to: (a) deal with sand and gravel mining from the beaches (potentially using appropriate fines), (b) enforce fishery restrictions to begin to control fishing effort and maintain the islands' long-term subsistence fishery potential, (c) provide better information and facilities to improve coral reef recreation opportunities and values, and (d) enhance non-use values and capture them through targeted public awareness campaigns and innovative voluntary assistance and funding mechanisms respectively. This is recommended within America Samoa for residents and visitors and within the US, possibly in conjunction with other coral rich US territories.

At a global level, the decline in status of coastal resources (and in particular coral reefs) could be slowed or potentially reversed if their full current and potential value was fully appreciated and accounted for, and their funding and management were more effective. To achieve this, creation of a comprehensive set of simple guidance on an integrated value-based approach is needed along with agreed standard methods (e.g. for valuation), targeted training, successfully applied case studies and a programme for rolling it out using appropriate media to all levels of stakeholder. It should ideally complement existing guidelines and frameworks, draw upon existing economic valuation studies and be applicable to all major global coral reef regions.

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