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Estimating the Total Economic Value of Coral Reefs for Residents of Sampela, a Bajau Community in Wakatobi Marine National, Sulawesi. A Case Study.

By

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A report submitted in partial fulfilment for requirement for the MSc and/or the DIC.

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DECLARATION OF OWN WORK

I declare that the thesis

'Estimating the Total Economic Value of Coral Reefs for Residents of Sampela, a Bajau Community in Wakatobi Marine National, Sulawesi. A Case Study.'

is entirely my own work and that where any work could be constructed as the work of others, it is full cited and referenced, and/or with the appropriate acknowledgements given.

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My translator, Andar (centre) with other OpWall translators Tikung, Ella, Sabir and Astri.

ABSTRACT

Coral reefs are ecosystems with enormous value, including intrinsic, ecological, economic, cultural and aesthetic values. Reefs provide food and employment to millions of people in the developing world and generate billions of dollars for local and global economies, from diving related tourism. Coral reefs are a precious natural endowment of wealth for any country that has them. Yet 60% of the remaining reefs are threatened and those in Southeast Asia particularly so. Recent developments in the economics of coral reefs have made explicit to policy makers the considerable economic losses that coral reef destruction entails. Increasingly advocated 'bottom up' conservation initiatives require local information for areas of particular biological, economic or social significance. The Wakatobi National Park in Southeast Sulawesi, Indonesia is in the global epicentre of marine biodiversity and has been chosen as the target for the largest coral reef conservation programme anywhere in the world. The total economic value (TEV) framework was employed to identify and quantify the most significant benefits that a 26km^2 area of coral reefs provides the local Bajau community of Sampela with. The largest (use) value was attributable to fisheries, which produce an average of Ruipah 94 million per km^2 annually and had a present value (PV) of over Rp20 billion (over 20 years with a 10% discount rate). A fisheries and livelihood survey demonstrated this community's reliance on these reefs for food and employment. There are also significant eco-tourist revenues entering Sampela, facilitated by Operation Wallacea, providing almost Rp12 million per km^2 in 2004 and an expected PV of Rp2.6 billion, despite relatively modest development. The indirect benefit of 'coastal' protection was estimated to be worth Rp12 million annually or Rp4.3 million/km^2. The non-use, recreational and spiritual benefits of this area were estimated with contingent valuation to be Rp412,000/km^2, (PV of Rp91 million), a fifth of that associated with all the reef's benefits. Households were estimated to have an average annual willingness to pay of Rp222,000 to access and use these reefs, despite the availability of other reefs in the vicinity. The TEV for this area of coral reefs was estimated to be Rp2.8 billion or Rp110 million/km^2 for this community alone. If the future of these reefs is to be ensured, then the uses, attitudes and values of these local subsistence communities, who are the major stakeholders, needs to be incorporated into local management and policy decisions.

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Abbreviations and Acronyms

AS$	Australian Dollars
CBA	Cost benefit analysis
CV	Contingent valuation
CVM	Contingent valuation Method
EoP	Effect on Production
NOAA	National Oceanic and Atmospheric Administration
NPV	Net Present Value
PV	Present Value
RC	Replacement cost
Rp	Indonesian Rupiah
SE	Southeast
TCM	Travel cost method
TEV	Total Economic Value
US	Untied States
WTA	Willingness to accept
WTP	Willingness to pay

1. INTRODUCTION

1.1. Rationale for Research.

Coral reefs are ecosystems with enormous value, including intrinsic, ecological, economic, cultural and aesthetic values. Highly productive ecosystems based on rigid lime skeletons, they contain 32 of the 34 recognised animal phyla. Coral reefs support over 25% of marine life, despite occupying only 0.25% of the world's oceans. Sadly 27% of the world's coral reefs have already been lost. Present rates of destruction will cause 60% of the remaining reefs to be destroyed over the next thirty years (Cesar, 2003). Informed and targeted conservation of these precious ecosystems is urgently required.

Recent developments in the economics of coral reefs have made explicit to policy makers the considerable economic losses that coral reef destruction entails. For example the World Resources Institute calculates that destroying 1km of coral reef costs US$137,000–1,200,000 over 25 years, due to losses in fisheries, tourism and coastal protection alone (Burke et al, 2002). Valuation studies have also been able to demonstrate that the costs of investment in marine protected areas are economically justified, sometimes many times over. In fact, the latest estimates suggest that reefs provide nearly US$ 30 billion per year in global benefits (Cesar, 2003).

Southeast Asia, the area this study addresses, is the global epicentre of coral reef diversity and contains 34% of the world's reefs. Indonesia and the Philippines alone hold 77% of Southeast Asia's reefs and nearly 80% of threatened reefs. Over 600 of the world's 800 reef building coral species, are found in this area . However, 88% of SE Asian reefs are severely threatened by human activities such as fisheries, pollution and sedimentation from agricultural clearance (Burke et al, 2002). This endangers the food security and employment of millions of people. This may provoke further depletion of the reefs through use of destructive methods to catch the remaining depleted fish stocks. Lauretta Burke, co-author of Burke et al (2002) commented "Coral reefs are the cornerstone of the economic and social fabric of Southeast Asia, yet they are the most threatened in the world".

Previous studies looking at reefs throughout the world have been able to demonstrate the significant financial benefits from coral reef fisheries and other traded reef organisms. The Indopacific reef fisheries are known to constitute up to 25% of total fishery catches (Cesar, 1996). However, concentrating only on the value of extracted resources underestimates the wider significance of reefs. Fisheries are only one of many valuable goods and services. They are relatively easy to study, as they are traded in market places. Today there is much wider appreciation of the crucial ecosystem services, including physical, biotic and biogeochemical services that reefs carry out (Molberg and Folke, 1999). These and other benefits such as social, aesthetic and spiritual gains are not directly bought or sold. If prudent resource allocation and management decisions are to be made, which maximise the welfare gains from reefs, the true value of reefs needs to be known, which incorporates all the various tangible and intangible costs and benefits they provide. Calculating the total economic value (TEV) of these reefs provides a framework to account fully for these diverse values. This is possible because TEV encompasses many different benefits from goods and services, including those not traditionally traded in market places.

Whilst it is possible to use benefits transfer and aggregation of average figures from reefs elsewhere to calculate monetary values of these reefs, it is preferable to choose a case study site to research in detail. Extrapolation and aggregation of generalised numbers was one of the chief criticisms of the Costanza et al (1997) study, which estimated the economic value of the world's ecosystems. This is essential as the relative values of different sites will vary enormously, with the attributes of the coral reefs, the nearby costal ecosystems and the local uses and perceptions of the reefs.

The Wakatobi marine national park contains many pristine reefs and is the focus of several NGO's work. These NGOs are initiating co-management conservation projects which involve both local communities and scientists deliberating appropriate management systems to enable simultaneous use and conservation of environmental resources. Despite being part of the largest coral reef conservation programme anywhere in the world (see section 2.4), which is funded by the World Bank and the Global Environmental Facility, the value of the reefs this study examines is unknown.

Infact very few reefs anywhere have been studied from this perspective and additional economic information will be very useful.

The people living in the village of Sampela which this study addresses, are a Bajau community (see section 2.5). They are the primary stakeholders within the park, as they rely almost exclusively on the marine resources for their food and livelihood. Previous studies have not addressed values of indigenous subsistence communities like this one. As a result, there is inadequate understanding of the issues facing communities like these, some of the poorest in the world. Any conservation effort in this area needs to balance the needs of the residents, with the need to maintain the rich level of biodiversity.

Ruitenbeek and Cartier (1999) found that and bequest values held both by tourists and local people can be a significant part of the coral reef value. These types of values may also be important to this community, and therefore need to be incorporated into the marine park management decisions, by being properly accounted for.

By analysing the costs and benefits afforded by a reef system locally, local policy and management decisions can be better informed. Understanding the economic incentives that cause destructive resource use, will help to identify appropriate management solutions, to ensure long term sustainability. Detailed insights such that this study will provide should be able to inform the Kaledupan stakeholder management[1] and other conservation initiatives being set up within the Wakatobi National Park, to safeguard the future of the reefs.

1.2 Aims

- To identify the costs and benefits of key significance associated with the local reefs for the Bajau community of Sampela.
- To gain an understanding of the extractive and non-extractive uses of these coral reefs by this community.
- To quantify the different values of the people in Sampela using appropriate environmental valuation approaches.

[1] Being launched in 2004 by Operation Wallacea and National Park authorities.

- To aggregate these values to calculate a total economic value (TEV) for the community and a present value of the reef within an appropriate timeframe.
- To assess the different methodologies suitable to value reefs.
- To assess the appropriateness and validity of the contingent valuation methodology in this context.
- To gain an understanding of the attitudes and preferences of this community towards the reefs and its conservation.

1.3 Objectives.

- To be able to 'put some numbers on the table' to highlight the financial and economic values of these coral reefs to this community, at this time. These numbers can be used to calculate and justify appropriate financial investment into resource management and conservation initiatives.
- To estimate a TEV that can be repeated over time to investigate if the value of the reef is increasing or declining over time with different management schemes, new policies or financial activities.
- To develop a methodology for valuation of marine resources with distinct reef attributes, including less tangible values held by subsistence communities in developing countries, with low literacy and education, which could be used to investigate the economic implications of potential impacts or policies, in terms of change in TEV.
- To estimate a TEV that will enable comparison of this reef to others in the region, to help target the most valuable reefs for conservation.
- To help focus attention onto values of indigenous communities and reefs which have not had substantial tourist development.

2. BACKGROUND TO THE CASE STUDY REGION AND COMMUNITY

2.1 Southeast Asian Coral Reefs.

More than 350 million Southeast Asians live within 50 km of the coast and they have co-existed with coral reef ecosystems for thousands of years (Burke et al, 2002). Reefs are inextricably linked to their cultures, ways of life and their local and international economies. Southeast Asian reef fisheries have a crucial role in local subsistence economies as well as in the international live fish and ornamental fish trades. Recent estimates suggest that the annual net benefit of sustainable coral reef fisheries is US$2.4 billion for South East Asia (Burke et al, 2002).

Currently 58% of the world's reefs are potentially threatened by human activity. Reefs in South East Asia are likewise at risk, from development, pollution and often the fisheries themselves as over-fishing is a widespread problem. Destructive fishing methods such as cyanide and blast bomb fishing continue to be commonplace in this area, despite the enormous economic losses they generate, both locally and globally (Cesar, 1996).

2.2 Indonesia.

Indonesia is the world's largest archipelagic state with 95,000km of coastline. Here 60% of people live in the coastal zone (Elliot *et al*, 2001). There are over 7000 coastal villages, many of which are dependent on inshore fisheries, often in underdeveloped areas with low educational standards. Fish provide almost two-thirds of protein in the Indonesians diet and the fishing industry employs over 5 million people. Subsistence fishing occurs nation-wide with 95% of Indonesian fishers considered subsistent (Resosudarmo et al, 2000). Half of Indonesian fishers still use dugout canoes, of which 80% have incomes less than the national level of poverty. Southeast Sulawesi (the area under investigation) contains 9.47% of national fishers (FAO, 2002).

Figure 1. Map of Indonesia

Image provided by OpWall.

Indonesia holds 75,000km^2 of coral reefs, roughly an eighth of those in the world (Cesar et al, 1997). However, 86% of Indonesian reefs are at medium or higher threat, principally from destructive fishing (50%) and over-fishing. Resosudarmo et al (2000) suggest that Indonesian coral reefs are at risk due to a number of underlying issues, particularly population growth and the resultant increase in dependence on marine resources, coupled with a lack of marine management solutions and an inadequate understanding of marine ecosystems. This dependence has been compounded by the 1997 currency collapse.

2.3 Operation Wallacea

Operation Wallacea (hereafter OpWall), is a UK based not for profit organisation that promote conservation and sustainable development through scientific research in collaboration with other organisations. OpWall provided logistical support for my expedition to Sampela such as visas, food and accommodation. They also facilitated access to interviewees and provided local translators for interviews and surveys.

2.4 The Wakatobi National Park

The Wakatobi National Park found in Southeast Sulawesi is at 13,900km, the second largest MPA in Indonesia. It was established in 1996 to protect the pristine reefs it contains and their considerable biodiversity. It is found at the core of the Indo-Pacific, the region with the highest diversity of hard corals. Its biological importance is reflected in the fact that it was selected as a key target area for the COREMAP (Coral Reef Mapping Project) Phase 2 programme, in Indonesia. As a result the Indonesian government will receive loans from the World Bank and Global Environmental Forum, to fund the largest coral reef conservation programme anywhere in the world.

Figure 2. Map of Southeast Sulawesi

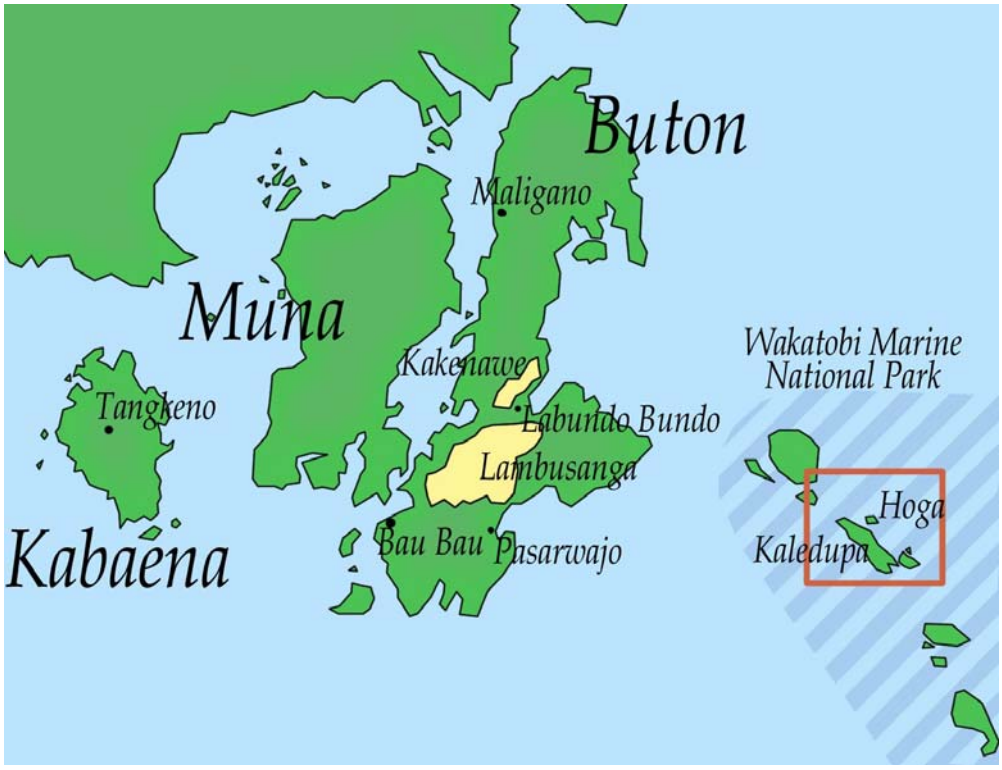


Image provided by OpWall.

The area includes the Tukan Besi archipelago which covers four main islands plus 16 uninhabited islands and atolls. This area has fringing shallow reefs and reef walls to 200m. Kaledupa has 78km of fringing reef, with 28-68% live coral cover and 135km^2 of reef and reef flat (100-500m wide) above a 30m contour, beyond which the depth rapidly increases until it plateaus at 300-400m (May, 2003). There are over 40 villages with over 76,000 people (Elliot et al, 2001). Many of these people are subsistence

fishermen who rely on the reefs and inter-tidal areas for food and income. A stakeholder initiative is being set up in this area, with limited success. This is partly due to cultural differences and lack of communication between different ethnic groups within the park.

2.5 The Bajau and Sampela

Historically the Bajau were a group of nomadic sea people, who lived in mobile boat houses. Many were forced to settle during Indonesia's occupation during the Second World War (Sather, 1997) and are today scattered over Southeast Asia. They have animistic beliefs, involving sea spirits, which form a key part of their cultural identity. They rely exclusively on marine resources for fuel, food and building materials, and engage in small scale trading of surplus catches (Burns, 2002). Bottignolo (1995) describes the Bajau as "people wandering the sea …. Not burdened with responsibility, trusting in the abundance and benevolence of nature".

Plate 1. The Village of Sampela

Image provided by OpWall.

Sampela is one of three Bajau villages on the coast of the island of Kaledupa (see figure 3 below), which was established 50 years ago. There are at least 9880 Bajau within the Wakatobi (May, 2003). These constitute 11% of the population and 59% of the total fishers. They have built their houses on the reef flat area, several kilometers away from the land (see plate 1). Their houses are built on wooden stilts or platforms from mined coral that provide support and protection from storms. Sampelan fishers supply most of

the fish in the Wakatobi and therefore are key stakeholders who must be included in any long term management plans. They are culturally distinct from the Kaledupans found on the nearby island. They have a history of animosity with these people and little contact other than sales of their catches to Kaledupan middlemen.

Figure 3. Map of the 78km of fringing reefs around Kaledupa island in the Waktobi Marine National Park. (*From May, 2003*)

OpWall recently negotiated a no-fishing zone with the Bajau along the western shoreline of Hoga Island, which began in September 2000. This area will be used to assess the benefits of protected areas and as an area for recreational scuba diving. OpWall pays rent the community of Sampela each month to compensate them for fishery losses from this area. This money is used for community development projects within Sampela.

The local presence of OpWall over the last eight years has also enabled several studies to be made of the Bajau in Sampela. These have gathered data to be used to assess the feasibility of a stakeholder area, as a form of co-management for conservation. These

have included studies assessing the local perception of the environment, however no studies to date have looked at the locally held values and perceptions of the reef. There have preliminary data on reef fisheries gathered however. That which is relevant to this study is summarised below.

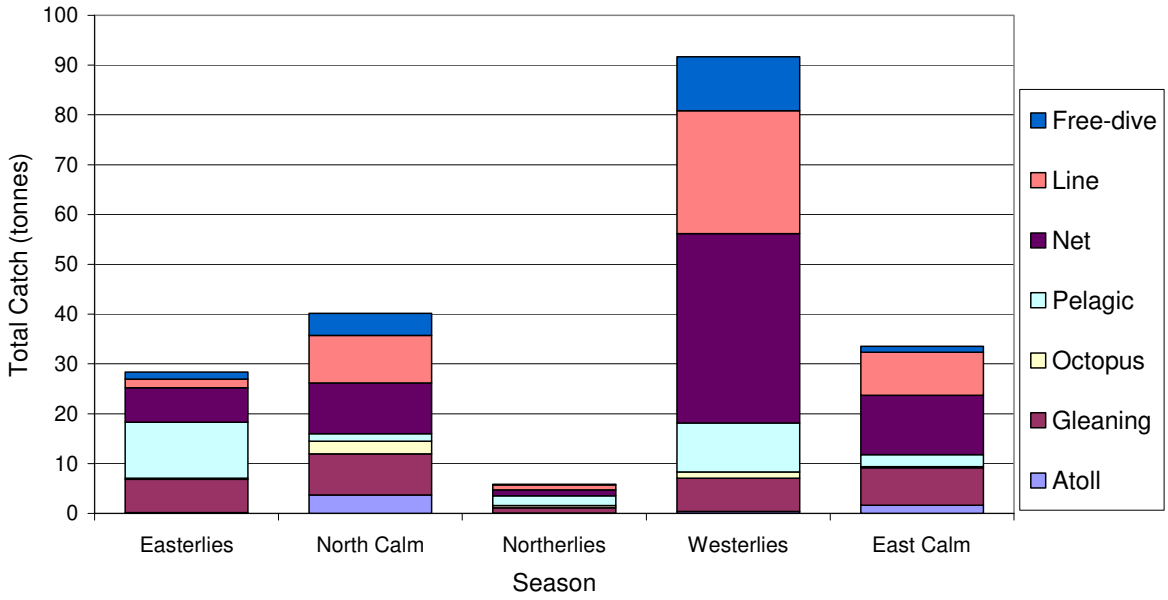
2.6 Sampelan Coral Reef Fisheries.

Traditional methods such as hand spears and hand lines and gillnets are still common (May, 2003). Nevertheless, fishing techniques have broadened in the last 5 years to include modern techniques which are associated with higher fixed operating costs, but greater efficiency, such as large motorboat equipped with nets for pelagic fishing. The key habitats that are fished include reef flats (33%), reef walls (29%), sea grass (29%), lagoon (8%) and the reef crest (1%). Catch per unit effort varies with different methods from 0.69 kg / hour for line fishing to 0.96kg / hour for net fishing (Burns, 2002). It also varies with habitat, but is highest in the reef flats; the most productive areas around Sampela (Mitchell, 2002).

Fish prices are known to vary with availability of fish in the different seasons. In addition to local fish markets, the live fish and lobster trade for export markets has increased substantially in importance and pelagic tuna fisheries continue to expand (May, 2003). Catch per fisher per day has been shown to vary from 2.47kg to 13.77kg $fisher^{-1}$ $trip^{-1}$, depending principally on the fishing method employed. Burns (2002) shows that costs associated with reef fishing techniques are low. For example line fishing requires infrequent investments of Rp5,917 spear gun fishing Rp100,000 and net fishing Rp325,000. Mean economic return per trip is calculated to vary from Rp 4,000 for spear fishers to Rp 11,000 for net fishers.

The fisheries in Sampela have been estimated through interview surveys to produce an annual catch of 137 - 200 tonnes/year (May, 2003). Tides and moon phases have a central impact on fishing effort and catches, in addition to seasonal influences. Graph 1 shows how fishing effort and catch varied throughout the year in 2002. This data includes catches from outside the area being valued in this study, but as the diagram shows, these are relatively minor in comparison to the nearby reefs. This is probably due to the fact that few people have motorboats.

Graph 1. Variation in Catch in Sampela in 2002.



Data from May (2003).

Attitudinal surveys show a general consensus that stocks have declined over the last 5 years. Destructive methods have been used here for many years, further jeopardising the fishery. Data gathered in 2002 shows the Kaledupan fishery to be unmanaged and overexploited (May, 2003), principally due to increases in fishing effort caused by large population

3. RESEARCH METHODS

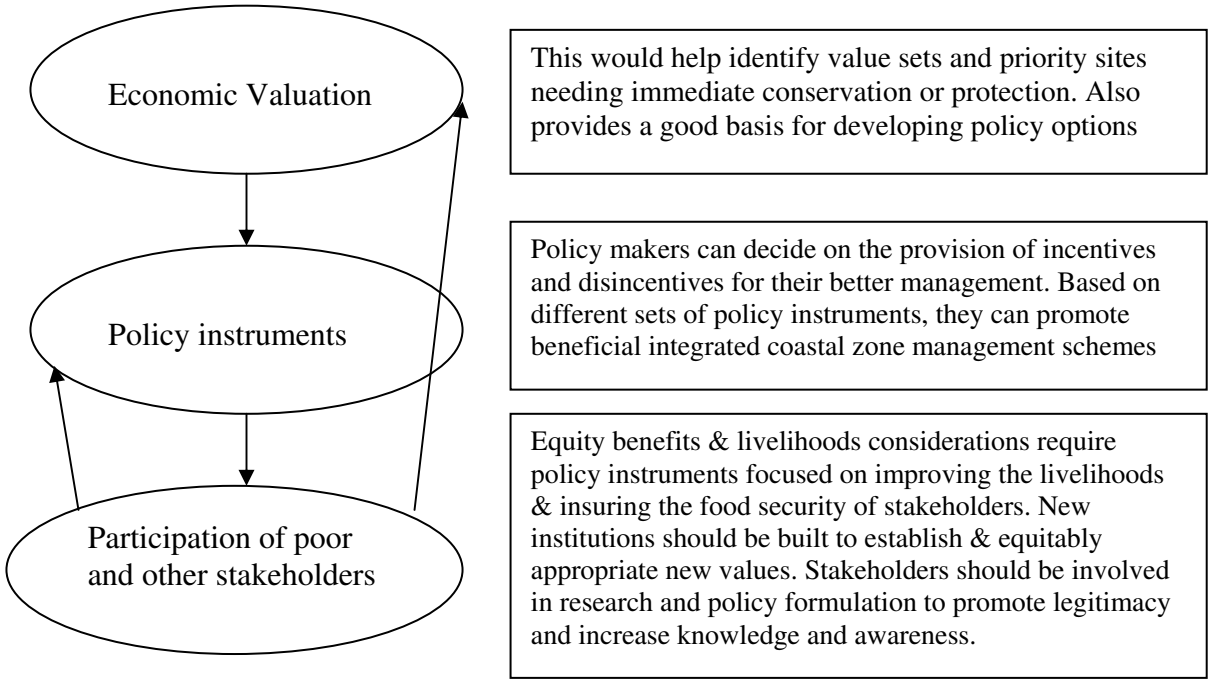
3.1 What are the Benefits of Environmental Valuation?

The rationale for coral reef valuation has been outlined in section 1.1. Environmental valuation has particular importance in the context of social welfare-based public policy. Dixon (2002) describes five areas of political decision making that can benefit from natural resource valuation;

- Raising the profile of environmental concerns in setting national or regional sectoral priorities for the distribution of legislation or finances
- Intervening in the market with taxes, regulations and incentives to correct the under provision of public goods (see section 3.2)
- Providing information for cost-benefit analysis to help include environmental concerns into the decision-making process.
- Full cost accounting in government statistics
- Evaluating the true impact of projects, programmes and policies.

Full economic analysis is essential if policies and management initiatives are to change destructive uses of the reefs. Economic valuation should be part of a feed back process, as social, economic or ecological conditions are never static. Co-management is being increasingly promoted as a way of ensuring long term stability of resource use. Economic valuation can provide important information, both for policy makers and the local populations to inform these initiatives. Figure 4 illustrates the role of economic valuation in this context. In addition to this, valuation information will be valuable when combined with other kinds of information for multi-criteria analysis and other broader decision-making frameworks.

Figure 4. The role of economic valuation in coral reef policy
(Ahmed et al, 2004)



3.2 Theory of Economic Environmental Valuation.

In economics there is no absolute measure of value, only equivalences between one thing and another (Bateman et al, 2002). Costs and benefits are defined in terms of individual preferences, as an individual can receive a benefit when giving up something else of value. The magnitude of the benefit is demonstrated by what an economic agent is willing to give up, or 'pay'. Conversely, value can also be measured by what an individual would accept as compensation for the cost of losing something (Bateman et al, 2002). In this way, economics provides a framework which equates instrumental value with money. Traditional markets reveal the value of items, as the price paid for goods. Prices paid will reflect the personal utility derived from that object (the benefits) as well as the costs of production.

Some of the goods provided from reefs have prices, as they are traded. Therefore, calculating their monetary value is relatively straightforward. This can simply be inferred from the market clearing prices, where demand is equal to supply of a good. Here financial rather than economic flows are sufficient.

However many of the benefits provided by coral reefs have public goods characteristics. That is, they are non-excludable and/or non-rival e.g climate control. This means it is not possible to exclude some and not others from the resource and/or the consumption by one individual will not affect the level of provision of another. As a result no markets exist for these goods and services. These 'positive externalities' will be undersupplied[2] because free riders can receive benefits without paying the costs of provision (Hanley et al, 2001). Here the price mechanism fails to show the real worth of the good and potential welfare gains of investment are not achieved.

Information that enables a government to allocate appropriate funding to public goods provision is therefore important. TEV and cost-benefit frameworks, which rely on environmental valuation, are effective as tools for value neutral rational decision and policy making, where otherwise decisions might be highly subjective. Indeed, they are being increasingly utilised by public and private bodies for this purpose. This can help avoid global market failures which mean that whole ecosystems are being lost, despite the major social benefits they provide (Rolfe et al, 2000). This occurs because although demand for extracted goods is transmitted by the market, demand for preservation is not. Inclusion of many values in decision making could promote investment in preservation at local and global scales.

Valuation theory is based on the assumption that households maximise utility subject to an income constraint, when choosing bundles of market and non-market goods. It assumes that willingness to pay (WTP) for a good or service is a function of prices, income, household tastes and conditioning variables such as environmental attitudes. This type of valuation depends on acceptance of the consumer sovereignty paradigm i.e. 'what people want matters' (Pearce and Barbier, 2000). Some researchers advocate expert judgment or deliberative and participatory decision making processes as an alternative to 'consumer sovereignty'. These can be limited by subjectiveness and can also be mutable over time and sensitive to available information.

[2] unless there is government intervention to correct the market failure e.g. a subsidy

3.3 What Benefits do Coral Reefs Provide?

Coral reefs provide a multitude of benefits to ecosystems and species at local and global levels. For example, reefs are recognized and valued for their intrinsic beauty throughout the world. As a result dive tourism has become an enormous industry. Molberg and Folke (1999) describe the range of goods and services that coral reefs provide, from which humans benefit (see table 1). They distinguish goods into those that are renewable and those that are not, such as coral mining. There are 6 categories which span from physical to ecological to social services. This classification provides a starting point to look at the values that may be of importance to the people of Sampela.

Table 1. Goods and ecological services of coral reef ecosystems identified in Molberg & Folke (1999).

Goods		**Ecological services**					
Renewable resources	Mining of reefs	Physical structure services	Biotic services (within ecosystem)	Biotic services (between ecosystems)	Bio-geo-chemical services	Information services	Social and cultural services
Live fish and coral for aquarium trade	Mineral oil and gas	Shoreline protection	Maintenance of habitats	Biological support through 'mobile links'	Waste assimilation	Climate control	Support recreation
Raw materials and medicines	Raw materials for lime & cement production	Build up of land	Maintenance of biodiversity and a genetic library	Export organic production etc. to pelagic food webs	Nitrogen fixation	Monitor-ing and pollution record	Support of cultural, religious and spiritual values
Other raw materials (e.g. seaweed)	Coral blocks, rubble / sand for building	Promoting growth of mangroves and sea grass beds	Regulation of ecosystem processes and functions		CO_2 / Ca budget control		Aesthetic values and artistic inspiration
Curio and jewellery		Generation of coral sand	Biological maintenance of resilience				Sustaining the livelihood of communities
Sea food products							

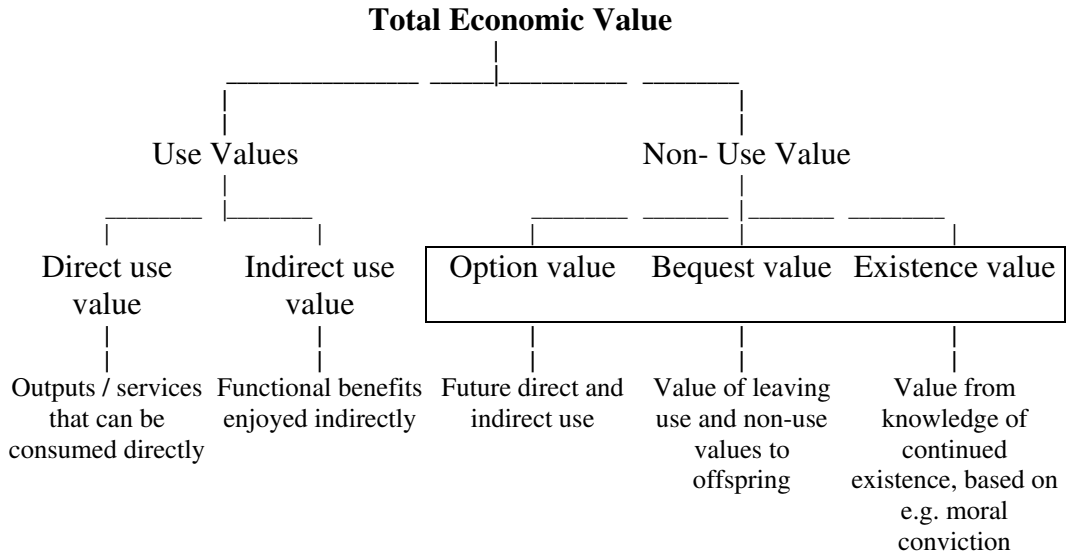
Adapted from Molberg and Folke (1999). .

3.4 What is Total Economic Value?

Total economic value (TEV) is a framework for aggregating economic values. TEV is consistent with weak sustainability[3], which asserts the belief that all forms of capital are substitutable. It also proposes that economic growth will not be constrained by absolute or relative resource scarcities. This can be contrasted with the eco-centric view, where intrinsic values and non-human rights are emphasized. TEV is presented in several sources e.g. Pearce and Turner (1990), Spurgeon (1992) and Barton (1994) and is increasingly used as a valuation tool. TEV is the appropriate valuation measure for examining local level conditions (Lal, 2003). It enables policy makers to consider the biological, social and economic welfare of communities and individuals. The value calculated will depend on a variety of factors, including spatial and temporal variation, accessibility to users and the relative value to different stakeholder groups.

TEV is made up of both use values and non-use values (see figure 5). The values become less tangible and more abstract or theoretical from left to right. This means that they are increasingly difficult to monetize. These more abstract values would not be accounted for in a financial assessment, but may be in an economic one.

Figure 5. The Components of TEV.



Based on Cesar (2000).

[3] The foundations of weak sustainability are: utilitarian philosophy, consumer sovereignty and instrumental anthropocentrism.

Use values relate to actual use, planned use or possible use of the good in question (Bateman et al, 2002). These are divided into direct uses and indirect uses. Direct uses can be either extractive, such as reef fisheries, or non-extractive, such as ecotourism and recreation. *Indirect uses* are those that provide support and protection to other economic activities and are referred to as 'ecosystem services'. Examples include nutrient cycling or biodiversity maintenance. *Option value*s describe the benefit gained from preserving the resource and therefore maintaining the option to use the resource in the future. These are sometimes categorised as use values (Bateman et al, 2002) and sometimes non-use values (Cesar, 2000). This should not affect the values measured however. Potentially large option values may exist for coral reefs, as the organisms may contain bioactive compounds that will have large financial value in the future for pharmaceutical products.

Non-use values have two frequently recognized elements, existence and bequest values. *Existence* values relate to the utility gained from simply knowing that something exists, without any intention to personally or otherwise visit or use the resource. *Bequest* values are related to the satisfaction gained from preserving the resource to pass onto future generations for future use. Financial donations to resource preservation in financial legacies are evidence for these values. There may be other components of non-use value, but in practice these are difficult to disentangle from other non-use benefits and do not have wholly defined boundaries. Turner (1999) describes several possible motivations for non-use values. These include self interested intra-generational altruism (moral satisfaction), inter-generational altruism and stewardship motivation. Poorer communities, such as that at Sampela, with a high degree of reliance on natural resources may associate the resource with their way of life or sense of place (Turner, 1999), which would be part of the non-use values they held for the resource.

Using this framework to look at all benefits that humans gain from reefs, it is possible to see which values may be of relevance in this study. There is a large range of potential values (see table 2).

Table 2. Economic Values Attributed to Coral Reefs

Use Value	**Direct Use**	**Extractive:** fisheries, mariculture, aquarium trade, curio/jewellery, pharmaceutical products, industrial, constructional, agricultural products, genetic material, mineral oil and gas. **Non extractive**: tourism, recreation, research, education (pollution and climate record), aesthetic, artistic, religious and spiritual values.
	Indirect Use	**Biological support** to species & other ecosystems **Physical protection** to other coastal ecosystems, coastline, navigation **Global life support (ecosystem processes and functions)**: biodiversity (resilience), build up of land, genetic library, export of organic production, nitrogen fixation, carbon/calcium control, waste assimilation. **Social services:** employment opportunities, food security Coral sand generation National coastal zone extensions
	Option Value	Species, habitats, biodiversity.
Non-Use Values	**Bequest Value**	Species, habitats, way of life and livelihoods connected to traditional uses
	Existence Value	Threatened habitats, endangered species, charismatic species, aesthetic reefscapes

Adapted from*: Furst et al (2000), Munasinghe & Lutz (1993), Spurgeon (1992), Barton (1994) and Molberg & Folke (1999).*

3.4.1 Limits to Total Economic Value.

TEV has several limitations that must be taken into account. First, TEV rarely reflects the interdependence of highly complex systems such as coral reefs. Second, TEV can understate the dependence of subsistence communities with small ability and therefore willingness to pay, on the income and food from these resources. Third,

economic analyses, such this one, are static. Ecological-social-economic interactions and their economic interactions can easily change, so they become out of date[4]. Economic values need to be updated as conditions change. However, outdated values still provide a valuable contribution as a baseline for comparison with proposed or predicted changes.

TEV does not claim to measure the absolute or true value of an ecosystem. TEV is a relative concept that looks only at the benefits provided to humans. This is because it looks at financial and economic flows of goods and services and how they benefit humans. A number of authors stress that ecosystems such as coral reefs have a large number of intrinsic values. This concept stems from the assertion that organisms have rights regardless of whether they have any utility for humans (Spurgeon, 1992). Holland and Cox (1992) argue that environmental and monetary values are incommensurable, so that economic valuation only devalues nature. Sagoff (1998) develops an argument that not all preferences are informed by consumerism, environmental values are made by a different mind-set from those towards ordinary goods. Intrinsic values may well exist and constitute a major part of an ecosystem's value. They are however unclear and immeasurable. The ubiquitous economic paradigm is founded on utility based (human welfare) measures and it is not clear what rationale could be used to quantify intrinsic or primary values. In addition, they are not considered here, as this study aims to measure the TEV of the reefs to the residents of Sampela, rather than the whole value of reefs per se.

3.4.2 Total Environmental Value.

Perrings (1995) and Lal and Young (2000) develop a concept of total environmental value. This is made up of TEV, plus ecological process value (underlying ecological processes and life support functions e.g. photosynthesis), plus cultural function value (cultural sense of identity and belonging). Neither value can currently be measured in financial terms, as no appropriate techniques have yet been developed. These are therefore excluded from the scope of this study although they are undoubtedly highly important.

[4] E.g. the benefits assessed by Hogdson (2000) of establishing a MPA in Palawan was incorrect due to unexpected changes in-between the study and the initiation of the MPA.

3.5 Which Methods are Available to Measure TEV?

Several of the values identified (see table 2) cannot be measured using standard micro-economic techniques and market information. Techniques have therefore been designed to measure values such as non-use values, by estimating people's preferences. They are needed in addition to traditional supply or production focused valuation methodologies, to highlight social benefits. These can be estimated indirectly, from proxy goods e.g. travel cost method, replacement cost method. Techniques that infer values indirectly are called 'revealed preference' techniques. Alternatively, preferences are obtained directly, by asking respondents what their preferences are. These 'stated preference' techniques involve survey based methods and hypothetical markets. The most commonly used techniques for the valuation of various component parts of TEV are listed below (modified from Cesar and Chong, 2004).

Type of Value	**Valuation Method**
Direct Use Values	
Fisheries	Effect on Production (EoP)
Tourism (consumer surplus)	Travel Cost (TCM), Contingent Valuation (CV)
Tourism (producer surplus)	Contingent Valuation (CV)
Research & education values	Effect on Production (EoP) Survey methods
Aesthetic, spiritual, cultural values	Contingent Valuation (CV)
Indirect Use Values	
Coastal protection	Replacement Costs (RC); Damage Costs (DC)
Non-use values	
Option Values	Contingent Valuation (CV)
Bequest Values	CV
Existence Values	CV

As extracted resources such as fishery catches or construction materials are already traded, simple productivity approaches can be used to estimate their value (see Spurgeon, 1992). Data on revenues and costs, such as operational and labour costs should be incorporated to gain net values. Fisheries data can be collected from long-term surveys of catches or by using repeated interviews. The highly variable nature of fisheries, which is affected by the season, tides, weather and lunar cycle, means high sampling frequencies are necessary, over long periods of time, to gain an accurate

picture of long term trends for this "multi-species, multi-gear and multi-landing site" fishery (May, 2003). This may not be possible due to the considerable costs and time constraints. Using interviews enables fisheries data to be quickly collected and can utilise the fisher's in-depth knowledge of the resource. As recall bias can be a problem, recent catches should be focused on.

Effect on Production (change in productivity) relates changes in revenues from extractive goods, to changes in the resource base, as a basis for valuation. These are particularly useful, in addition to simple production approaches, to investigate possible future changes, such as potential damages or potential management interventions e.g. see Hodgson and Dixon (1988). It is most applicable and frequently used to examine fishery and tourism values.

The non-extractive benefits of education and research values can be calculated from annual expenditures or research budgets. Valuing the benefits of acquired knowledge is more difficult to do, however. For valuing the other non-extractive uses and social benefits, the travel cost method (TCM) or contingent valuation (CV) can be used. These methods are also able to capture consumer surplus. Consumer surplus is the amount consumers would be willing to pay above the market price (the social benefit). TCM calculates welfare benefits from real expenditures and opportunity costs paid to visit a site or resource e.g. entry fee, e.g. train journey. TCM is frequently used to estimate welfare associated with recreation of tourists and visitors.

CV is an analytical survey technique which can be used to measure many different values, including welfare estimates associated with spiritual, recreational and cultural values, or existence and bequest values. CV is based on the psychological theory of reasoned action. It is one of the most commonly used and widely applicable stated preference techniques (Pearce and Turner, 1990). CV estimates preferences by asking respondents what they are willing to pay to secure a gain over a resource they have no property rights over. CV can also be used to ask those with property rights, what they would be willing to accept as compensation, to avoid a loss. CV asks for an estimate of willingness to pay (WTP) or to accept (WTA) contingent on a hypothetical market, presented to the respondent in a valuation scenario (Mitchell and Carson, 1989). As WTP and WTA are highly dependent on income elasticity, socio-economic data should

be gathered simultaneously. There can be a large discrepancy between WTP and WTA. WTA measures are usually higher, as humans are known to be more sensitive to loss, so WTP is a more conservative measure (Pearce and Barbier, 2000). CV is crucial to this study as it is the only technique available to measure non-use values and capture an individual's utility (including their consumer surplus) associated with a hypothetical scenario. TEV can be calculated from the net sum of all relevant WTPs or WTAs (Bateman et al, 2002).

Undertaking a CV study involves several key stages (Hanley and Spash, 1993):

1. Setting up the contingent valuation / hypothetical market
2. obtaining WTP or WTA amounts
3. estimating mean and median WTP or WTA amounts
4. aggregating the WTP or WTA amounts
5. assessing the validity of the CV exercise.

Guidelines and conditions for CV were produced by NOAA (Arrow et al) in 1993 to ensure streamlined and legitimate studies and wider acceptance of the method. The principal recommendations were:

- A minimum response rate of 70% from the target sample
- Use in-person interviews
- Use WTP (not WTA) measures
- Calibrate CV results against experimental findings
- Remind respondents of their budget constraints
- Give 'adequate' information about the environmental change in question
- Use a dichotomous choice format.

The relatively high cognitive burden associated with CV and its hypothetical nature make studies more difficult to perform in developing countries. It is nevertheless increasingly used here to assess the value of development projects, such as sanitation systems. Whittington (1997, 2002) has produced guidelines for administering CV studies in developing countries. He cautions that respondents can be willing but unable to pay and emphasizes the importance of cultural awareness when interpreting responses. He advises setting wide ranges of potential bids where the top bid is

rejected by 90% of the respondents. He maintains that there is great potential for administering high quality CV surveys in developing countries.

For the indirect benefits of coastal protection, data on investments to control coastal erosion can used as a proxy for the coastal protection service provided by a healthy reef. The cost of replacing the coral reef with protective constructions, such as underwater wave breakers, is used in the replacement cost method. Alternatively, Cesar (1996) uses the value of property at risk to approximate protective benefits. This is calculated from the area of land at risk and the value of the land or houses, the 'value at risk' method. Gustavson (1998) assumes that the first one hundred feet of shoreline is at risk if the function of the reefs is compromised. The market value of the land is assumed to be its net present value.

3.6 Which Values will be Measured with which Techniques?

This project aims to monetize different values, on many diverse aspects of coral reefs. These will be calculated using several different methods and then aggregated appropriately to produce a TEV estimate. The relevant population has been chosen to be the self-contained community of Sampela. Only values that are held by this community will be measured and included in the TEV estimation. As a result, regional, national or global benefits such as carbon sequestration or biodiversity maintenance will be non-applicable at this local level. Option, quasi-option and research values e.g. from potential discoveries of biologically active compounds, will also be disregarded, as the residents of Sampela currently have no intellectual or other property rights to the reef and are therefore unlikely to capture significant benefits from any discoveries. Similarly values held by eco-tourists and reflected in the costs of their trip (travel cost method) are also not applicable here. The remaining values that may be of relevance to this community and the methods that could be used to measure them are summarized in table 3.

Table 3. Components of Total Economic Value attributed to Coral Reefs for the community in Sampela, and the methods employed to study them.

Component of TEV	Type of Benefit	Valuation Methodology
Direct Use	**Extractive:** Fish, invertebrates and other species, seaweed production, coral mining, live fish etc.	Use value survey: data on harvested reef products for households on different day of the week.
	Non extractive: Tourism	Interviews, observation and surveys.
	Recreation, artistic or cultural values, way of life Religious and spiritual values.	Contingent Valuation.
Indirect Use	Physical protection for their houses	Value at risk. Interviews and surveys.
Bequest Value	Species, habitats, way of life and livelihoods connected to traditional uses.	Contingent Valuation.
Existence Value	Threatened habitats, endangered / charismatic species, and aesthetic reefscapes.	Contingent Valuation.

3.6.1 Extractive Use Values.

Fishing and gleaning may provide significant benefits to this community. Important goods may include fisheries, seaweed production, octopus gleaning and the aquarium trade, although all the extracted resources will be included. Official fishery statistics are unreliable (Cartier and Ruitenbeek, 1999) and also rarely include small scale subsistence catches, so are inadvisable to use. Methods to value the local fishery will resemble those used by Gustavson (1998) and USAID (1996). This will also enable a comparison of the values estimated with production method techniques and contingent valuation.

3.6.2 Indirect Uses Values

The coastal protection benefits could be measured using either replacement or damage

costs (value at risk). Replacement costs have no relationship with utility gained and have been shown to overestimate and underestimate underlying preferences. Therefore the coastal protection benefits will be measured, by collecting information on the area of houses in Sampela at risk during the stormy seasons, and the value of houses and platforms that would be lost in the near future if the reef were to be destroyed. This is feasible as stock or value at risk can be used as a straightforward estimate of this value (Cesar and Chong, 2004).

Coastal protection functions are the sole indirect use value that can be quantified. The value of support the reef provides to Sampela's pelagic fishery could be a value of significance. Many pelagic species spend part of their lives on the reef e.g. jacks and fusiliers. Coral reefs are important as spawning, nursery, breeding or feeding areas. Also many pelagic species benefit from the export of organic production (Molberg and Folke, 1999). However, there are no theoretical tools available to quantify the economic relationship of coral reefs to inshore and pelagic fisheries (Gustavson, 1998). This is also true of information provision and waste assimilation functions.

3.6.3 Eco-tourism Values

These will be gathered by collecting data on all the revenues generated by eco-tourists that accrue directly to the people of Sampela.

3.6.4 Recreation Values, Spiritual Values, Existence and Bequest Values

As this study aims to calculate an overall value, choice modelling[5] is not appropriate. As the people of Sampela live on the coral reef, the TCM is also inappropriate for this study. CV will be used to calculate WTP for all these benefits. WTP (not WTA) is appropriate here, as the Sampelan's have no formal rights over the reefs in question (Hanley et al, 2001).

CV will be conducted on a household level, as households in Sampela are known to share food, income and other resources. Various formats can be used to elicit WTP values. Open ended formats should be avoided (Mitchell and Carson, 1989) and

[5] Choice modelling is used when values for specific attributes that occur in a bundle of attributes are required (Garrod and Willis, 1999).

dichotomous choice format would be difficult to administer, due to translation issues. Therefore a payment ladder approach will be used (see Bateman et al, 2002). Respondents are presented with a range of bid values of potential bid values. This approach is relatively straightforward and can be helpful to overcome the language barrier, as it is relatively visual. This method avoids starting point bias and reduces the number of outliers, but is still vulnerable to biases associated with the range of values offered (Bateman et al, 2002).

Spash (1998) shows that lexicographic preferences can have important effects on CV results, and can be a key source of bias. Lexicographic preferences occur when individuals place infinite value on a good or service and will not make any kind of trade-offs. These are frequently due to strong ethical rights and duty based beliefs towards environmental assets e.g. a belief that humans have a duty to protect reefs even if this involves sacrificing personal welfare. A question will be included in the CV study, to assess if these are a significant determinant of the Sampelan's WTP. Reasons given for bids should also be assessed for these, as they can be consistent with both 0 and positive WTP .

In addition to these areas, two other issues will be investigated. A livelihood analysis will be conducted to provide an indication of the reef's relative importance to this community. Plus, examining the attitudes of the local population will enable a better understanding of the TEV and possibly help to advise potential management strategies to encourage sustainable resource use.

3.8 Aggregating the Component Parts of TEV

The small population size for the case study community means that a relatively high sampling frequency should be possible for all the attitudinal and CV studies. This means that results should be representative of the whole community. The appropriate community to aggregate WTP and other values over is clearly defined. This means that the results can be aggregated with a relatively high level of confidence.

Present value will also be used to aggregate valuations over time. This will require use of a discount rate. This adjusts annual values to account for the fact that benefits such

as income are worth less in the future than now, as future generations will be richer. Choosing a discount rate for an environmental resource is controversial, particularly as the costs and benefits are likely to stretch far out into the future. Many studies use several and report values for each, such as 5, 10 and 15% rates. These have a large influence on the results e.g. see Gustavson (1998). A relatively conservative rate of 10% will be used here, compared to the 3% used by Cesar et al (2003).

4. LITERATURE REVIEW

4.1 Key Findings on the Economics of Coral Reefs.

Costanza and colleagues estimated the value of the ecosystem services provided by coral reefs in 1997. Services valued included disturbance regulation, waste treatment, food production, raw materials and recreation. Each hectare was calculated to produce $6,075 of services annually. This meant that reefs provided a total global flow value of $375 billion per year to the world. Whilst there has been criticism of the benefits transfer and aggregation techniques used, this paper initiated heated debates and more valuation studies, whilst highlighting the irreplaceable value of these services.

Cesar et al (2003) recently published more conservative estimates of the potential annual net benefit streams and net present value (NPV) of the world's coral reefs. Values were measured in US$ and were estimated to be

- Recreation $9.6 billion
- Coastal protection $9 billion
- Fisheries $5.7 billion
- Biodiversity value $5.5 billion.

All these values are the author's own and are net of costs. Unfortunately, no description of the method of calculation is provided. A total annual figure of $29.8 billion was reached. Over a 50 year period, with a 3% discount rate, this suggests that reefs have a NPV of $797.4 billion to global economies. This value is likely to be an underestimate as it does not include any non-use values associated with coral reefs or any estimate of their intrinsic value. The values for Southeast Asia alone are US$12.7 billion, with a net present value of over US$338,000 million (50years, 3% discount rate).

Balasubramanian et al (2003) recently examined the number of marine resource valuation studies that focused on various aspects of TEV. In the Caribbean they found that 83% of studies focused on direct use values, 4% indirect values and 25% non-use values. Similarly in Southeast Asia 93% of studies looked at direct use values, 7% indirect and 21% non-use values. Overall 65% of studies only considered direct use values. Their calculations and models suggested that due to the gaps in value categories, the research on economic values within these regions only captures a quarter of the TEV of these coral reef ecosystems. This highlights the need for more thorough

valuations to enable better informed policy and management decisions.

As there are few studies examining TEV for coral reefs, those looking at component parts of TEV are also informative. Some studies examine different values associated with reefs. Others apply these values to cost benefit analyses, to investigate potential management options e.g. setting up a marine national park. Sadly no studies have yet revisited reefs to investigate if and how their values have changed. Appendix I summarises the valuation studies marine resources, with specific emphasis on of coral reef goods and services carried, which are referred to in the text below. The most relevant of these will be discussed.

4.1.1 Extractive Direct Use Values.

The majority of the coral reef valuations have focused on fisheries or other extracted resources, probably as these are easiest to measure and of most interest to policy makers, as they generate real income flows. Driml (1999) shows that the Great Barrier Reef generates A$143 million per annum. Gustavson (1998) calculates a net present value of US$1.31 million from the Montego Bay fisheries, in Jamaica. Whilst some studies look at gross values, others look at net values, which value is used will have large consequences on the final valuation and should be noted (Lal, 2004).

Most studies however do not just carry out a valuation, but look at change in revenue generated (Cesar and Chong, 2004), using cost benefit tests, either from destructive uses of the reef or by potential management options e.g. comparing the costs and benefits of establishing a marine national park. These studies employ supply orientated production approaches to value benefits, which they use to measure the contribution of the reef to the value of output of a good or service.

For example Sawyer (1992) demonstrates the economic argument for management of reefs and Hodgson and Dixon (1988) show that logging will provide less long term benefits than fishing in Bacuit Bay. McAllister (1988) made explicit the social losses that destructive fishing involves, which are an estimated $80 million loss in fish production in the Philippines alone. Cesar (1996) also carries out a stakeholder analysis, which shows to whom the gains and losses are occurring. These studies have

enormous value for policy recommendations.

The Bunaken Marine Park study (USAID, 1996) is unusual as it examines benefits to local users (see appendix 1). Extractive uses, including artisanal fisheries, commercial fisheries, seaweed production and gleaning provide US$3.9 million per annum to local fishers. 65% of this value was generated by artisanal fisheries, of which 58% was from reef fisheries, highlighting the importance of reef fishery to the local population.

Ruitenbeek & Cartier (1999) show significant potential financial gains from preserving reef species and coral abundance, due to future pharmaceutical discoveries. They calculate the average net social value of a species, to be $7775. This type of valuation is important in making a simplified, but rational case for coral reef conservation. Future benefits models require many assumptions concerning many factors such as intellectual property rights agreements and discovery rates, which make their predictions difficult to interpret.

4.1.2 Non-Extractive Direct Use Values.

There have been many studies that have assessed the recreation and tourism values for coral reefs. Driml (1999) and Gustavson (1998) show the large revenues from tourist spending generated by specific areas of coral reefs. For example, Driml (1999) finds that the Great Barrier Reef had a gross recreational value of A$769 million (in 1996). Pendleton (1995) and USAID (1996) look at the recreational value of marine parks. Although much of this will be due to the refs they contain, the value associated with the reef alone, are not known. Seenprachawong (2003) shows that each hectare of reef in Ko Phi Phi, generates US$6,243 annually in recreational benefits.

Several studies look at consumer surpluses (CS) associated with coral reef areas, such as Ahmed et al (2003) who calculates a CS of $223 per person. Hundloe (1987) uses two methods to calculate CS. The CV study produces a much lower estimate (of $6 million) than that calculated from travel cost study (A$144 million) for the CS associated with the Great Barrier Reef. Pendleton (1995) uncovers a consumer surplus of $180 million associated with Bonaire Marine Park, which is over two times greater than the net present value of $74 million of the park. This indicates that there are

significant potential gains to be made, if these values can be captured e.g. by introducing a park user fee.

Again, several studies focus more on management issues e.g. Hodgson and Dixon (1988) reveal that logging will provide less long term benefits than tourism in Bacuit Bay. Yeo (2002) predicts, from the WTP estimate the contingent valuation produces, that US$390,000 could be raised from the introduction of an entrance fee into a Malaysian marine park.

Spurgeon (1992) reports two calculations of research value based on research budgets. A research value of US$150,000 per year is calculated for Belize's reefs and $2.5 million in 1991 for Panama's reefs. These will be an underestimate, as in each case, the values are both calculated from the budget of only one research organisation.

4.1.3 Indirect Use Values.

Indirect values are challenging to measure. Studies have to date only addressed coastal protection values. McAllister (1988) uses the replacement cost method to estimate a protection value of US$22 million for Philippine coral reefs. Gustavson (1998) suggests a coastal protection, net present value of US$65 million for reefs in Montego Bay, Jamaica. Cesar (1996) again demonstrates large economic losses of coastal protection values associated with blast fishing and coral mining in Indonesia.

4.1.4 Non-Use Values.

There are a small number of non-use valuations associated with coral reefs or marine resources (page 31). Of the few that have been carried out, CV is the most commonly used valuation technique. Ayob et al (2001) demonstrates significant WTP for non-use values for Pulau Payar marine park (appendix 1). Spash et al (1998) carried out non-use value range estimates in two different locations. These were then aggregated, based on total populations of tourists and locals. Montego bay had a non-use NPV of US$19.6 million. Interestingly, the locals were found to have higher non-use values than visitors for the reefs. The Montego Bay study was designed to address lexicographic preferences and their effect on WTP, as a potential source of bias (see section 3.6.4).

4.1.5 Total Economic Values.

Looking at a variety of use and non-use values of coral reefs requires lots of information and often assumptions, but enables the relative magnitude of the different values to be compared. Damage to coral reefs will harm many of these benefits concurrently. Therefore it is helpful to know the total value of benefits at risk if the reef is lost.

Some of the studies looking at TEV of coral reefs have used several valuation methodologies. For example White and Cruz Trinidad (1998) calculated potential annual net revenues of US$29-113,000 per km^2 of Philippine reefs. Fisheries and coastal protection had the highest values. They estimate that the reefs in the Philippines contribute US$1.35 billion to the national economy.

Similarly, Burke et al (2002) used valuation estimates from several studies of Indonesian and Philippine reefs to calculate potential sustainable annual net economic benefits per km^2 of Southeast Asian reefs (table 4). Five values were explored which were judged to be the most significant, from several different sources. The fisheries estimates are based on estimates by White et al (2000) from the Philippines and the tourism and coastal values are based on Cesar (1996) from Indonesia. The aesthetic and biodiversity values assume that the 600-2000 tourists visiting each km^2 annually, are willing to pay a $4 a day entry fee. No estimates of local cultural values are included.

Table 4. Potential Sustainable Annual Economic Net Benefits per km^2 of Healthy Coral Reef in Southeast Asia

Resource Use (direct and indirect)	Production Range	Potential Annual Net Benefits (US$)
Sustainable fisheries (local consumption)	10 - 30 tonnes	$12,000 - $36,000
Sustainable fisheries (live fish export)	0.5 – 1 tonnes	$2,500 - $5,000
Coastal protection (erosion prevention)		$5,500 - $110,000
Tourism and recreation	100 – 1000 persons	$700 - $111,000
Aesthetic / biodiversity value (willingness-to-pay)	600 – 2000 persons	$2,400 - $8,000
Total		**$23,100 - $270,000**

Total benefits arising from the five most significant uses are calculated to be US$23-270,000. The value for fisheries and coastal protection alone is US$20-151,000, showing that tourism and aesthetic value can generate a large amount of additional value to reefs in this region. The values included here are not exhaustive however. They do not include option values from pharmaceutical discoveries that could be significant (Ruitenbeek and Cartier, 1999). They are calculated on the basis of coral reef area, extent of areas with tourism potential and the level of coastal development. Other factors such as local uses and perceptions would also be expected to affect TEV. They are omitted from the study however. These will provide an important comparison for my results, although the reef at Sampela may not be 'healthy'.

Burke et al (2002) estimate the TEV of Indonesian reefs, to be US$1.6 billion annually (by simply multiplying the estimates above by the reef area in Indonesia). Here, sustainable fisheries provide the most value (US$1.2 billion), followed by coastal protection and tourism. Aesthetic and biodiversity values provide a modest US$9 million annually, although these are likely to be underestimates, as mentioned above.

Other studies have employed contingent valuation (CV) to calculate TEV (see appendix 1). Here TEV is the net sum of all relevant willingness to pays (WTP) or willingness to accepts (WTA) (Bateman et al, 2002). Wright (1994) calculated a WTP of $31 per visitor per year, to maintain the Negril coral reefs and $49 per visitor per year WTP to restore reefs to an 'excellent' condition. Ngazy et al (2004) looked at the WTP of dive tourists to dive on sites with less coral bleaching in Zanibar, which were estimated to be US$84.70 per person per year. Seenprachawong (2003) found a total use and non-use value of over US$15,000 per hectare per year for the Ko Phi Phi reefs. The mean WTP for domestic visitors was very similar to that of international visitors, but divergent travel costs mean that the total values of the reefs were $147,000 for domestic visitors compared to $1.24 million for foreign visitors. Importantly, these studies have all focused on tourist values for reefs with large numbers of tourists.

4.1.6 How do the Various Estimated Values Compare?

These studies are difficult to compare directly, as some calculate values per hectare and others per kilometer, others still calculate values of marine areas as a whole. Nevertheless, it is possible to see that where reefs are in areas with high tourist

potential[6], the financial flows generated by tourists are the highest of all the values. This is due to scuba diving, recreational fishing and park entrance fees (Spurgeon, 1992). These areas also tend to have high coastal protection benefits, due to the relatively high cost of the land and property in these areas. Reefs like the Great Barrier Reef will also have high existence and bequest values, by those who do not visit them. This is because they are globally recognised as marine resources of great aesthetic and biological importance.

Of the reefs in areas with less tourist development, reef fisheries can provide the most lucrative benefit. Indonesia is one of these as it has had relatively little development of coral reef tourism, compared to countries such as the Maldives. The relatively low value of land and property in these remote locations, means that coastal protection values are much lower. Non-use values associated with the reef, particularly cultural values linked to sense of place and belonging, cultural inheritance and spiritual benefits of the reefs, may be highly valued in these areas. No studies that I am aware of have addressed these sorts of values, held by local subsistence communities. These reefs may also have great ecological importance on a global level. Seemingly, no studies have tried to calculate these for local reefs either.

4.2 Cautions to note from Previous studies.

Production approaches are widely used as accepted as appropriate for environmental valuation. Contingent valuation in contrast is still being developed. Whilst CV is conducted with increasing frequency in a variety of contexts and guidelines have been produced and updated (e.g. Carson, 1996), care needs to be taken to ensure legitimate results. The main points from the literature are outlined below.

Cesar (2000) reports an interesting study, where marine park fees in the Seychelles were increased following a CV study. Divers however, rather than paying the increased fee, moved to places outside the park, contradicting the survey predictions. As a result park revenues actually decreased.

[6] which Cesar (1996) describes as easily accessible areas with considerable tourist development

Critics comment that WTP and WTA are dependent on income, which unfairly over represents the preferences of people or households with higher disposable incomes during analysis and aggregation. However with everyday goods, in real markets, the same problem is true. Many people believe the public have a right to receive environmental goods regardless of their ability to pay for it. This is the reason why governments intervene to supply public goods. For this case study, it is likely that subsistence fishers who are not *able* to pay, despite a preference for the good in question, will lead to a lower than accurate estimate of utility associated with the reef. However WTP and WTA values need to reflect current income distribution to give real information (Pearce and Barbier, 2000).

Another criticism of preference based valuation is that the preferences of future generations are not represented, although decisions made will affect them heavily. Nonetheless there is no way to predict what these will be. Yet, bequest values, which can be estimated by CV, can capture part of these values, by representing the importance placed by respondents on the future generation's inheritance (Pearce and Barbier, 2000).

Barton (1994) and Pearce and Barbier (2000) outline several sources of bias identified in the relevant literature that can limit the reliability of CV studies. These include hypothetical bias, dynamic and information bias. In this context operational bias (related to the valuation scenario and bids presented) and embedding effects (insensitivity to the scope of the goods offered) may be of particular importance. Strategic bias, which occurs when if respondents feel that their answer could influence real events, they may give a WTP/WTA higher or lower than their true value, may also be. These must be considered in the studies' design and analysis to minimise possible biases. Garrod and Willis (1999) suggest several ways to minimise strategic bias which include debriefing WTP bid amounts, stressing the importance of honesty and concealing the bids of others.

Another problem is the treatment of protest bids due to possible strategic behaviour or the cognitive burden associated with the study. These are bids which do not correspond to the respondent's real WTP, for example if respondents object to some aspect of the scenario and bid zero, despite having preferences for the good or service being valued.

There remains no consensus about the treatment of protest bids; however using follow up questions can help to interpret responses correctly (Bateman et al 2002). Care needs to be taken when developing the CV questionnaire, to ensure that the scenario presented is as realistic as possible and that the payment vehicle is acceptable to the population of interest.

Whittington (2002) cautions that many CV studies in developing countries are poorly administered and executed, the scenarios used are poorly crafted, and few of the assumptions made are tested. Self administration, political sensitivity and careful development of an appropriate scenario e.g. appropriate level and quantity of information, can therefore increase the quality of the survey.

Assessing the validity of the results is an important stage in evaluating a CV exercise. There are several types of validity that should be examined (Bateman et al, 2002).

- *Content / face validity*: were the right questions asked in a clear, understanding and appropriate manner?
- *Construct / Convergent validity*: are results in accordance with other valuation approaches, cross study analyses or expectations?
- *Expectation based validity*: do the results support theoretical expectations from economic theory and empirically derived expectations from other studies?

Although CV has numerous problems of design, implementation and interpretation of questionnaires, in many cases, it is typically the only technique available (Cesar and Chong, 2004). CV commercial marketing studies have found reasonable correlations between WTP and actual behaviour (Dixon, 2002). Balasubramanian et al (2003) comment that the limits to market valuation methodologies are not serious enough to warrant the observed lack of these studies.

5. STUDY DESIGN AND IMPLEMENTATION

Several days of observation were made from a vantage point over looking the fishing grounds near the village. Fishing, gleaning and sales were observed. The structure of the village and houses were also studied. This enabled a preliminary understanding of daily life in Sampela and areas for further research to be identified.

A semi-structured interview was conducted with Chris Majors, an Australian anthropologist who has lived in the community for ten years. This enabled background information, originating from a source very familiar with this community, to be collected. Information was collected on fishing activity in the village, including patterns of extractive resource use, decision making criteria and markets available to fishers, plus interactions that could be important non-use values. There was specific focus placed on information relevant to the alternative valuations scenarios designed in the UK.

Informal interviews with fishers were used to establish a suitable area near the village of Sampela for this study to look at the values for, which was easily identifiable to local people. My translator helped to define this area of reefs which Sampelan fishers used most often and thought of as part of Sampela. This study is restricted to estimating values for the 26km^2 area on the East side of the island of Kaledupa, from Kt1 to Ktl2 in figure 3 (including the fringing reefs of Hoga). A structured questionnaire using a translator was chosen as the best way to obtain estimates of the various values associated with the reef. Two separate surveys were conducted for each household

1) Examining the uses of the reef and attitudes towards it
2) Collecting two WTP bids (to estimate two different values) and socioeconomic information.

Details of each survey are given below.

5.1 Sampling Method.

Households for both surveys were selected by stratified random sampling. During observations of village life and during interviews with residents, there appeared to be significant divergences in wealth and fishing practices in different parts of the village.

Similar groups tended to be clustered together. This sampling technique ensured that all areas were represented in the sample population. The sampling frequency in each was adjusted so that any household in the village had an equal chance of being surveyed (p= 0.35).

5.2 Use Value and Attitudinal Survey

5.2.1 Pilot Survey. Questions were translated with my translator, Andar, and it was ensured he understood what information was required from the survey. Three pilot interviews were conducted with a draft questionnaire, with three randomly chosen households in Sampela on the 18th June, 2004. This helped to identify culturally appropriate methods of conducting surveys. The interview was shortened as respondents did not want to continue after 40 minutes. The questions were modified to include areas that required clarification or more information. Several also were rephrased and visual aids were added, to help the respondents understand the questions. The full questionnaire is shown in appendix 2. An outline of the two sections is given below.

5.2.2 Use Survey. Two days of catches were recorded for every member of the household, on different days of the week, for 80 households. Number of items or weight of catch was recorded, plus use details which included details of if food was eaten, given away or bartered for something else.

Fisheries data was collected on every day of the week, including the day of rest (Friday). The Easterlies is known to produce the smallest catches in this community, than any of the four major seasons (see section 2.6). Therefore extrapolating these results will give a lower bound estimate of fisheries values throughout the year.

Data was also collected on location gathered, method and habitat to get a better understanding of resource use. Further data included time spent, number of trips and number of people involved and negatives associated with living on the reef. This enabled net benefit calculation. The respondent was also asked if this was an unusual day and if so, how and why.

Interviews and observations had established that the main non-use benefits included time spent playing on the reef flat and performing ceremonies on the reef. Data was also collected per household for this. Finally income dependence on the reef was established using pebbles. Respondents were given ten pebbles, which represented household income. They were asked to estimate how many came from the reef and how many from other sources.

5.2.3 Attitudinal survey. Attitudes towards the reef and its conservation were hypothesized to affect the household's WTP due to embedding, where a respondent's answer is affected by their underlying value system. They were also helpful in designing a plausible and attractive CV scenario and as additional information to understand values held by the local community for the reefs.

Areas investigated included;

- The reef's significance for that household
- opinions on the condition of the reef and human impacts
- causes of changes in the reef condition, their impact and possible solutions
- the factors that determined catches when fishing
- responsibility towards the reef and rights of marine creatures to protection (to indicate lexicographic preferences).

Finally, respondents were asked what occupations they would most like their children or grandchildren to have. This would indicate if they had a saw fishing as an important part of their heritage i.e. bequest values associated with the reef.

5.2.4 Execution.

Eighty approximately forty minute interviews were conducted over four weeks from the 19th June till the 15th July. Each day, several names for each area were pulled out of a hat. Respondents were searched for and either interviewed or an appropriate time to return was established. Interviews were done informally, usually inside the respondent's house. As most respondents were illiterate, interviews were used rather than questionnaires. This enabled ambiguous responses to be followed up. In four cases, respondents were repeatedly unavailable, so their closest neighbour was interviewed.

5.3 Contingent Valuation and Livelihood Survey

This survey contained two contingent valuation questions, plus follow up questions. The second part collected socio-economic information, as part of the contingent valuation exercise and to enable a livelihood analysis. All the recommendations by Arrow et al (1993) were followed, other than using the dichotomous choice format.

Focus Groups. Three focus groups were conducted with three different socioeconomic groups (as identified by my translator, who lives in the village) to gather relevant information and help to make the CV scenario as realistic and attractive as possible. Natural groups of people that were chatting were used. One group contained only women, another subsistence fishers and another wealthy men. The CV scenario was adjusted to take this new information into account. Transcripts of these focus groups can be found in appendix 5.

5.3.1 Pilot Survey. The draft survey was informed by preliminary observations and interviews, focus group responses and the use and attitudinal information from the first survey. Three pilot interviews were conducted with a draft questionnaire, with three randomly chosen households in Sampela on the 17th July, 2004. The scenario was rephrased, shortened and simplified to aid understanding. Visual aids were found to be essential. Pictures of all the different uses of the reef were drawn and pictures used to illustrate various things mentioned in the scenario. For example, a picture was used that illustrated the waves hitting the village with and without the reef as a natural barrier. There were also pictures of each of the activities that would for the first time be necessary to pay for, which interviewees could look at when deciding their WTP bids. The final questionnaire is shown in appendix 3. An outline of the two sections is given below.

5.3.2 Contingent Valuation. Initially a brief outline of the benefits that the reef brings to the community was given. This is important as interviewees may not be familiar with many of these benefits e.g. coastal protection. This also provides a context for the decision to be made in (Carson, 2000). Two valuation questions were required to elicit willingness to pay bids for two different values. The full scripts are shown in appendices 2 and 3.

Scenario One: Valuing Access to All Benefits from the Reefs.

The valuation scenario defines the exact good in question, the hypothetical change in provision of the good and the institutional setting for the payment mechanism. This is a crucial part of the questionnaire, as poorly defined scenarios elicit meaningless answers (Pearce et al, 2002). Vaguely defined goods and payment obligations should be avoided (Carson, 2000). The scenario employed, was one of many tested, which was found to be the most plausible for the respondents. The scenario includes a description of the payment mechanism, including how often and how long for payments would be required and how this money would be used to secure this gain. Respondents were asked to donate a sum every month. Lump sum payment was not appropriate as the reef require long term management.

A payment card was used to elicit responses. This had a range of potential values in Rupiah, which was shown and read out to the respondents, as the majority were illiterate. They were told the range of values (starting from a zero bid) and asked to stop at the figure which was closest to their maximum WTP. If in the follow up question, they said they were not sure if they would actually pay this, the process was repeated to find the appropriate bid. The full scenario used is given below:

> "Please imagine that it is certain that all the reefs on the East-side of Kaledupa Island are in danger of being completely destroyed from overuse and cyanide. This means that all these benefits [just described] could be lost.
>
> The government has decided to limit the use of the reef, especially to outsiders. This is to make sure that the quality of the reef does not continue to fall, so that there would be more fish, octopus and all the other things from gleaning and fishing. Over many years, the reef would recover, to be like it was 15 years ago[7]. There will be lots more patrols and strong penalties to make sure this happens. The Kepala Desa [village headman] needs each household that wants to fish, glean, collect agar, coral mine and use the reef for fun and ceremonies, to pay towards a community fund for Bajau rangers[8]. As long as you contribute, your household can use the reef as much as you like. If you do NOT pay, you will not be able to use the reef which will be degraded. The reef quality would be

[7] Many interviewees had described this as a time when the reef condition was very high and fish were much more abundant.

[8] The existing rangers were not trusted largely as they were from a different ethnic group

expected to decline so that it would no longer exist for your children and grandchildren.

You should remember that a contribution would ensure access for everyone in your house to a healthy reef, with gradually increasing fish stocks, for as long as you paid it. However, there are other reefs in the area and this would leave you less money for other things."

Scenario Two: Valuing Recreational, Religious and Non-Use Values.

Any non-use values that may have existed were intricately linked with (non-extractive) recreation and religious values and cultural cohesion values. In practice it was not possible to separate these, so they were both included in the second scenario valuation. The description of the hypothetical market was carried out with visual aids, which was particularly important, to make clear which uses they were being asked their WTP for. The same payment ladder was used. The scenario used in the second question is given below:

"IMAGINE that your house was no longer able to take things from the sea, from gleaning and fishing etc, but that you had exactly the same amount of income and food, did not need to go fishing or gleaning. You are asked to contribute to ensure the future of the reef. You and your children would still be able to use the reef for Bajau ceremonies, parties, and a place to relax and meet at low tide. Your children would also inherit a healthy reef and could carry on the traditions associated with the reef. There are other reefs in the area and this would leave less money for other things. Would you still contribute?"

Follow-up questions included probing interviewee's bids, to help to identify protest bids or understand positive bids. Respondents were also asked about the ease of understanding what was required of them. Finally a de-briefing interview was also conducted with my translator. This enabled questions to clarify terms he had used and to gain information which was missing and assess his feelings as to the success of the study. The transcript is given in appendix 7.

5.3.3 Socioeconomic Data. Socioeconomic data is important to understand the community being studied, to investigate livelihoods associated with the reef and to test the theoretical validity of WTP bids[9] collected. This included information on;

- Numbers of men, women and children
- house materials and electrical appliances
- daily income, all income sources and how they vary
- boats owned, household savings and loans

5.3.4 Execution.

Eighty interviews were conducted from the 18th July till the 10th August. The same sampling and interview techniques were used. Intercooled STATA 8.0 was used to analyse the data and perform an econometric analysis, to determine which variables influenced the WTP of interviewees.

5.4 Additional Studies

5.4.1 Wealth Ranking Study.

A wealth ranking exercise was also carried out on the 29th June, 2004. This is a standard qualitative and participatory approach[10] that captures the combined effects of social, political and economic aspects of wealth (de Merode et al, 2004). It should be used in conjunction with a quantitative assessment of wealth. Three different socioeconomic groups were used (as identified by my translator). For each exercise, Andar had a large board, which he made notes and drew sketches on. Initially, respondents were asked to discuss and then list what they understood by wealth. Respondents were then asked how many different categories of wealth there were in the village. They were asked to define each of these groups. Once these had been agreed upon, they were asked to put each of the households I had interviewed into one of the categories.

[9] Using a regression model to relate socioeconomic and attitudinal data to the expected inverse demand curve (Garrod and Willis, 1999).

[10] See Scheafer (1992) for a description of the standard techniques.

5.4.2 Ecotourism Income Study.

Ecotourism is defined by the Ecotourism Society (1991) as "Responsible travel to natural areas which conserves the environment and sustains the well-being of the local people." Many eco-tourists travel to dive on the Sampela reefs and study or photograph them.

The financial benefits that these people bought to the community of Sampela, by paying for fish, crafts, laundry etc, could be a significant component of reef value. However, the facilities provided by OpWall, such as accommodation and dive equipment, are likely to be a major determinant in choosing to come to these remote reefs. Therefore only those that dived four times a week on the reefs in the study area during their stay were included in the ecotourism revenue calculations. Only financial flows that directly affected the community at Sampela were included in the analysis. Interviews of OpWall staff, fishers supplying Hoga Island with fish and surveys of eco-tourist spending each week were used to collect information on flows of money entering Sampela, from those that frequently dived on these reefs.

6. RESULTS AND ANALYSIS.

This section presents the results and analyses of the various studies carried out between June and August in Sampela, as outlined in section 5.

6.1 Characteristics of the Sample Population

Limited census data was available; however the sample population included the expected number of people for 80 households. Women were slightly over represented and children under represented (see Appendix 4(1)) in the sample, although no reason for this was obvious.

Table 5. Characteristics of the Sample Population compared to the total Population of Sampela

	Population at Sampela	Sample Population	% of Total Population
Households	227	80	35.2%
No. People	1156	401	34.7%

6.2 Socioeconomic Characteristics of the Sample Population.

Data gathered during the first and second surveys enables a detailed economic picture of these households to be drawn. These results are summarized in the table below.

Table 6. Socioeconomic Characteristics of the Sample Population

Resource	Details
Houses (see plate 2 below)	More valuable houses were wooden with asbestos roofs and the less valuable; bamboo and coconut only. Most houses had coconut thatched roof (59%), wooden floors (68%) and bamboo walls (67%). Average number of rooms was 2.65.
	• 42% of households had electricity • 41% owned a TV • 7.5% owned an electrical generator

Coral Platforms	64% of those surveyed had platforms, of which 54% were large completed platforms (>10m^2).
Income (for further information see appendix 4 (2))	• 81.9% of their income comes from the sea. • 67.3% of their income is from the nearby reefs. • Average daily income in the stormy season was Rp26,560 or £1.64* (see graph 2). • Average daily income in the calm season was Rp41,790 or £2.58*.
Boats[11]	10% of respondents did not own any type of boat, 45% owned one and 35% two.
Loans	33.8% households had loans, mean = Rp780,519 (£48.16*).
Contracts with Middlemen	40% of households have contracts, usually initiated with a loan , mean = Rp450313 (£27.79*).
Education	Years in education, of the survey respondent, ranged from 0 to 9, with a mean of 2.6 years.

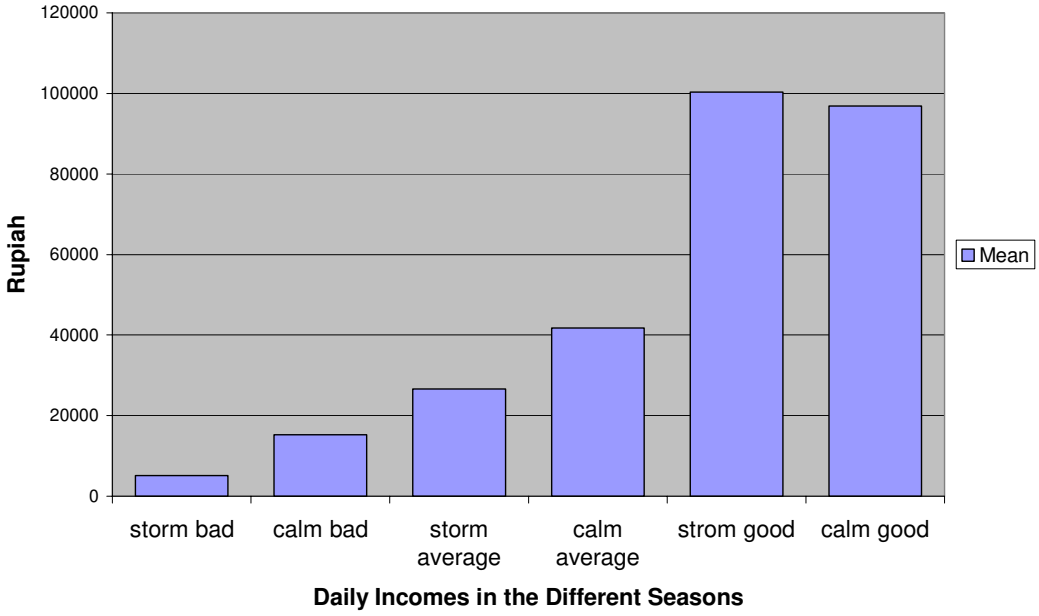
** exchange rate used £1 = Rp16,204 (Xe.com.)*

Plate 2. Houses and Platforms in Sampela

[11] For a description of the different types of boats see appendix 7, Q8.

Survey data revealed that there was a large range of incomes between houses in both seasons. Average daily incomes household were Rp26,848 in the storm season and Rp42,038 in the calm season (see graph 2). Just over half the respondents reported that at least one of their incomes was highly seasonal and variable. Fishers who targeted high value species, such as mangrove crabs, sharks, Napoleon wrasse and tuna would frequently go several days without any catches, however a good day would bring in a considerable amount of income. Reef fishers had a relatively smaller range of more steady income. Almost everyone consistently eared more in the calm season. Only the few pelagic fishers with large tuna motorboats, could have large catches and good income in this season. This data of incomes confirms the assertion that this is a highly variable fishery.

Graph 2. Daily Income Variation per Household in Sampela during the Two Main Seasons.



Two distinct economic ethics and ways of life were evident within the village. One was the traditional 'subsistence' ethic, mainly characterised by spontaneous fishing habits and stopping fishing when enough has been collected to eat and have some income. The other was a 'modern' ethic, characterised by specialisation in high value species and larger fixed costs and increased material aspirations. There were also those who did not fit into either category. Using fully described categories developed with my translator (see Appendix 7), respondents were classified during surveys. The majority of people (54%) were categorized as modern, 34% as subsistence and 12% as 'average'.

6.3 Wealth Ranking Study Results.

These proved extremely lively and provoked heated discussions. As the village is so close-knit, the respondents were familiar with all the households they were asked to rank. Each group choose a different number of wealth categories, which makes them difficult to compare. Table 7 summarizes the decisions of the groups.

Table 7. The wealth ranking results

	Exercise 1 Wealthy Men	Exercise 2 Women	Exercise 3 Subsistence fishers
Wealth groups and numbers in each category.	Rich 2 Well off 16 Average 26 Simple 32 Primitive 4	Heaven 19 Hell 61	Rich 1 Happy 39 Poor 34 Hell 6
Defining characteristics	Employing others, number of incomes, quality of houses.	Traders / sellers, lenders / borrowers, choice of food and clothes.	Own equipment, quality of houses, staple foods.

The rankings from exercises one and three were highly correlated (0.7), however exercise 2 was not so well correlated with exercise one (0.5) or three (0.4). Notes from the wealth ranking exercises can be found in appendix 6.

6.4 Direct Use Study Results

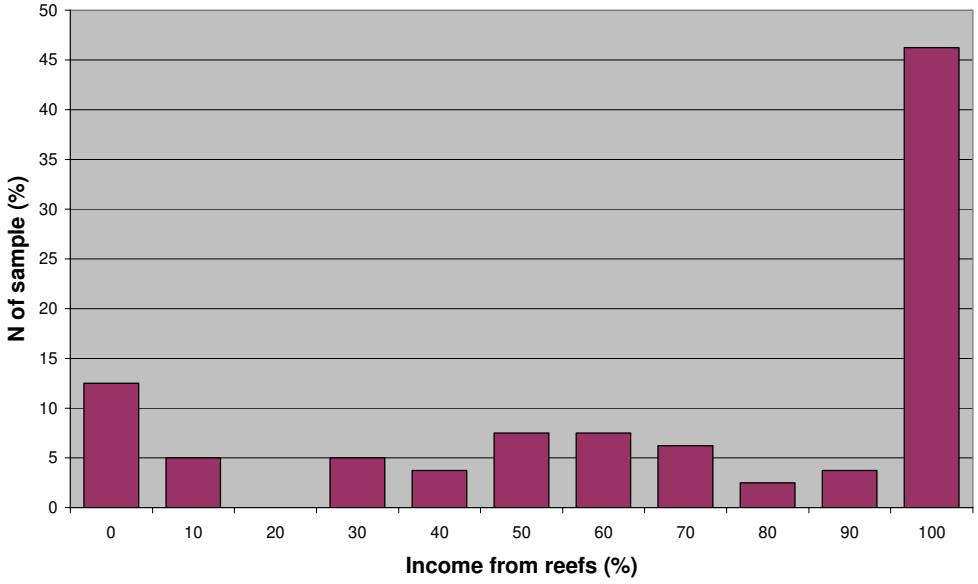
6.4.1 Livelihood Analysis

Numbers of income sources varied from 1 to 7 (mean = 2.7). Thirty five households identified reef fishing as their main source of income (see appendix 4 (3)), 18 as their second and 11 as their third. The next most important source of income was agar farming or collection on the reef flats. Pelagic fishing was also important, being the primary source of income for 8 households. Graph 3 shows a breakdown of the sources of the most important income sources for the households surveyed. This highlights the importance and variety of reef associated incomes, in comparison to other sources. Of the livelihoods shown, several are directly connected to the reef. These include working as a ranger within the national park (NGO ranger), working in the eco-tourist

industry for OpWall, mining coral, catching fish for live fish export, working as a fish trader (middleman) and farming or collecting seaweed on the reef flats, in addition to gleaning and fishing. Agar (seaweed) farming is becoming increasingly important. This involves preparing ropes with agar tied to them, which are then laid underwater. Agar areas are marked with sticks, so that fishers avoid them. One to two months later, the ropes will be harvested, some of the agar sold, and some used to make new ropes. Other people in the village will free dive on the reefs, to collect agar that has come loose and collected amongst the coral.

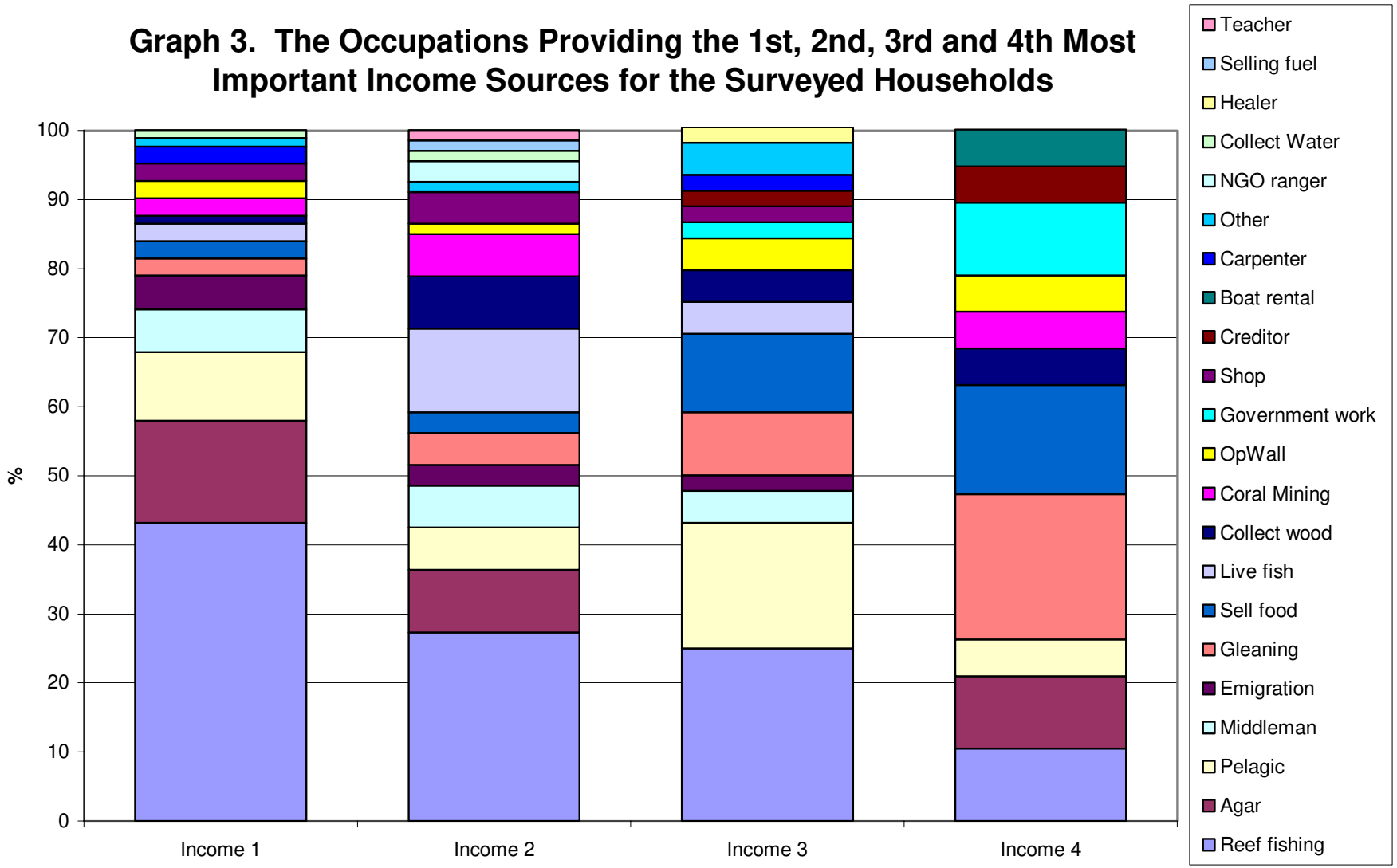
Respondents were asked to estimate the proportions of their household income from sea and the reefs. 68% of the sample said all their income comes from the sea. Only 7.5% of households had no income originating from the sea. To distinguish between incomes generated by pelagic fishing (which is only indirectly related to the reef), these proportions were further broken down. Then 46% of households received all their income, and 12.5% none from the reefs[12]. Graph 4 shows the variation in reliance on the reefs for income for the sample population.

Graph 4. Proportion of Household Income Generated From Coral Reefs.



[12] Agar was included as a reef associated income, as it is farmed or collected on the reef flats.

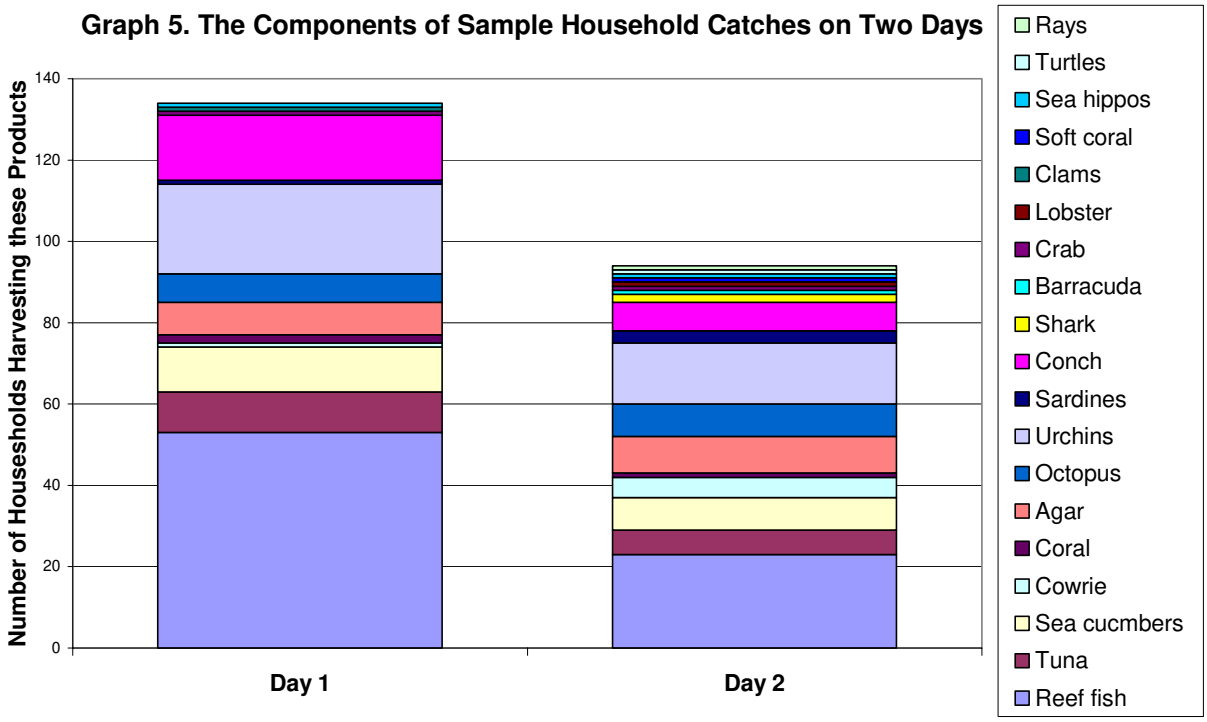
Graph 3. The Occupations Providing the 1st, 2nd, 3rd and 4th Most Important Income Sources for the Surveyed Households



6.5 Reef Fishery Study.

Hundreds of fish and invertebrate species are harvested within the village. Many different methods were used by fishers who usually fished alone, although some employed a member of crew or family. Graph 5 shows two days worth of catch data for 80 households within Sampela and table 8 presents the value of daily catches to the people of Sampela. Incomes and the number of fish prepared for meals have a large variation between the two days, unlike number of gifts of fish bartered.

Graph 5. The Components of Sample Household Catches on Two Days



The survey demonstrates the importance of fish species harvested from the reef to this community, in comparison to pelagic species. Catch data reveal that during this (storm) season that one third of the time, the catches contained reef fish. Valuable species which are caught, are sold and less valuable species eaten or given away. Although pelagic species such as tuna can have a high market value, 57% of the income from all the marine products harvested, came from the sales of reef species. This is expected to be greater during the live fish season (the calm season), when higher export prices are paid for some reef fish. Gifts of fish to neighbours have an additional important social function. In fact, half the number of fish that are kept by households for cooking, are given away to friends and neighbours everyday.

Interviews also revealed that fishers who hunted more valuable species such as fish for the live fish trade, shark and lobster were usually highly specialized. These fishers required expensive specialized equipment, such as motorboats with holding tanks, therefore relatively few people did this. Poorer fisher's catches were more varied and usually gathering by hand or spear fishing (low cost).

After reef fish, the next most frequently harvested products were urchins, conch and sea cucumbers, which constituted 16%, 10% and 8% of the catches respectively. More than 34% of reef catches were invertebrates, which were mainly used to feed the household. These are a crucial part of the fishery and are predominately gleaned from the reef flats, by hand and at low tide, by women and children. Whilst these made up a large portion of the catch, there value was low however. Fewer than 2% of the conch and urchins were sold. Sea cucumbers were sometimes dried and sold, although there price was highly variable with species and size from Rp500 to Rp60,000. Agar was also frequently from the reef flats. Tuna constituted 7% of the catches recorded, but had a high market price (mean of Rp7,000 for a 2kg tuna), so was an important income source for some households.

The variable nature of fisheries catches was confirmed by observations and qualitative data collected during surveys. Reefs on the East side of Kaledupa, which this study is valuing, were confirmed to be used during 76% of the fishing trips (rather than further atolls or deep sea).

TEV should concentrate on net benefits that are net of costs such as operating expenses and opportunity costs of labour associated with the fishery (Gustavson, 1998). The average fishing trip was five and a half hours, and most fishing trips involved only one fisher (mean number fishers was 1.2). Families frequently fished together, so no financial payments were necessary. The opportunity cost associated with fishing is low, as there are few alternative incomes available[13]. When crew members were hired, the pay has been deducted from the income calculations. The time costs involved with selling catches were also found to be minimal, as middlemen came to the fisher's house or out to his canoe at sea, to buy his catch. Costs of fishing techniques were difficult to

[13] This is particularly true in Sampela, as no-one likes to go onto land, which they see as haunted and dirty.

measure. For example, boats are also acquired as they are needed for transport. Basic equipment such as goggles and nets are made within the village. Most fishing equipment is not expensive, for example a canoe costs Rp20,000 (£1.20). More expensive equipment, such as motors, is usually paid for with a loan from the middleman. Reduced fish prices for catches from the same middleman then pay this back over the years, so the costs are reflected in the income received for catches (97.5% of those surveyed always sell their catches directly to middlemen). Therefore many costs have been accounted for and those which have not are negligible.

Table 8. Value of the different uses of catches in Sampela.

	Day 1	Day 2	Average
Fisheries Income[+] (Rupiah)	3,248,000	3,805,700	3,526,850
Income[+] from Reefs* (Rupiah)	1,671,000	2,345,700	2,008,350
Number of Meals	408	255	332
Value of Meals**	208,080	130,050	169,065
Number of Gifts	170	182	176
Value of Gifts**	76,450	102,600	89,525
Number fish bartered	99	118	108.5
Value Bartered Goods**	35,700	82,450	59,075
Total Value for 80 households for One Day*	**1,991,230**	**2,660,800**	**2,326,015**

[+]*Income figures are recorded as net of payments (money and food) to hired crew.*
**Adjusted to exclude income from catches from further reefs and from pelagic fisheries not included in the study. ** Calculated from their market value.*

6.5.1 Aggregating Reef Fishery Values.

This study found that 35% of the village harvested products with a mean value of Rp2,326,015 from these nearby reefs during one day. This means that the whole village could be expected to harvest Rp6,645,757 daily (£410). These reefs would provide a **minimum value of Rp2,425,701,357 annually** (almost £150,000). This would include 335289 meals, 183543 gifts to friends and relatives and 113150 items to be

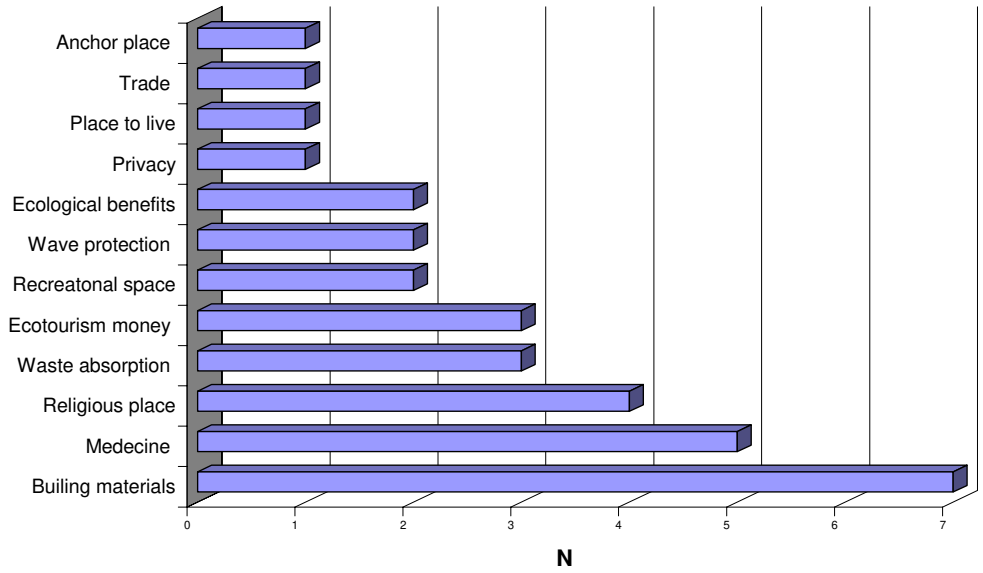
bartered for other types of food, or as payment for crew. The value here is thought to be a minimum value, as the average daily income from fishing during the calm season, when reefs are more reachable and the visibility is better, is nearly twice that of the storm season, when this survey was conducted. This result is supported by previous data on catch variation collected by May (2003). The weather also has a strong influence on fishing patterns, as most fishers will not leave home in stormy weather. During a week of data collection (during which approximately 16 days data were collected), severe winds meant subsistence fishers did not go out in their canoes. In addition, there was a five day period during the study where fishers could not enter the water due to an unusual swarm of jellyfish.

6.6 Non-extractive Direct Use Study Results

Pre-testing of surveys and observation revealed that no-one swims or dives on the reef unless they are collecting food. Children however frequently play on the reef at low tide which several respondents explained has an important social function. As there is no dry land in the village, this is the only opportunity to play football and chat in large groups. Of the 80 households surveyed, 66% said that their children play on the reef frequently. Data collected on the time spent playing over the previous day, showed an average of 28 minutes of playing on the reef a day per household. As this data was collected over four weeks, they should be representative of general patterns. This means that each household will spend an average of 170 hours in recreational time on the reef each year.

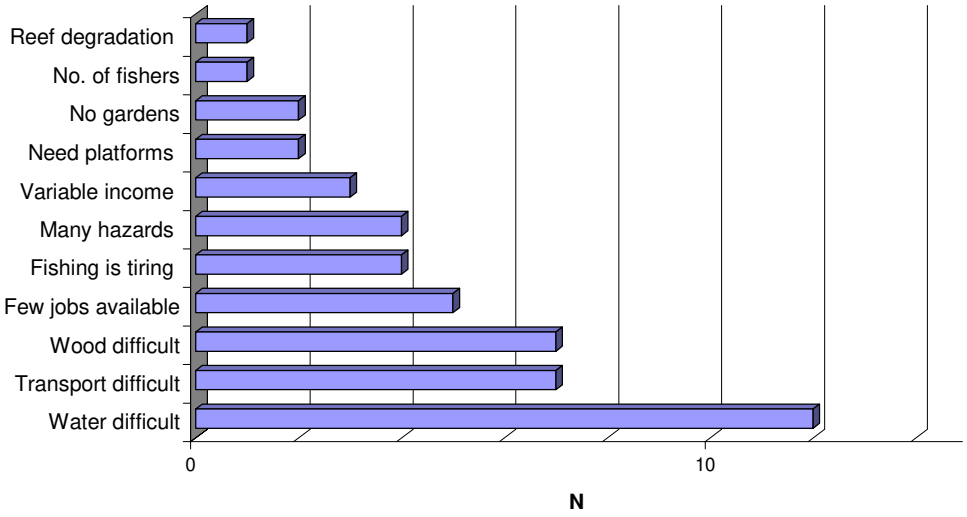
Only 33% of households were able to identify any non financial benefits associated with the reefs when asked (graph 6). Of those that were identified however, building materials for platforms, medicinal benefits and religious place were the most common answers.

Graph 6. Does the Reef Provide Your Household With any Benefits Other than Financial Ones?



However 43% of respondents identified costs associated with living on the reef (graph 7). The most frequent answer was that fresh water was very difficult to collect. Both transport and firewood were frequently also given as costs. Also 10% of households felt that the lack of alternative livelihoods to fishing were significant costs.

Graph 7. Are There Any Costs Associated with Living Here on the Reef?



6.6.1 Income from Ecotourism.

Between June and August 2004, there were 681 tourist weeks spent near the reefs in Sampela, by tourists who were there to study the reefs or as conservation volunteers. Of these, 69 tourist weeks were spent by eco-tourists living in Sampela itself. Only those revenue streams that accrued to those people living in Sampela were included. The results in table 9 below show that eco-tourists are bringing large amount of money into the community and therefore are likely to be creating beneficial multiplier effects on the local economy.

Table 9. Significant Coral Reef Eco-tourism Money Entering Sampela.

	Source	**Rupiah per annum**
Sampela Research Station	Salaries for those employed to cater for eco-tourists[a]	22.65 million
	Fish bought from Sampelan fishers	9.8 million
	Accommodation and maintenance costs paid to local house owners	13.08 million
	Boat hire / maintenance paid to locals	16 million.
	Research expenses[b]	165 million
	Community development budget [c]	8.5 million
	No fishing zone compensation [d]	12 million
	Money spent by volunteers in the village (laundry, crafts).	1.54 million
Hoga Research Station	Salaries for Sampelans employed on Hoga island	28 million
	Fish bought from Sampelan fishers for Hoga eco-tourists	14.051 million
Total		**Rp. 310,615,520** (£19,161)

[a] includes security, water collection, boat handling, cooking and translator salaries. [b] interview money and boat hire during studies, Rp15 million per student. [c] paid by OpWall to the Headman of Sampela for local development projects. [d] paid by OpWall to the Headman of Sampela to compensate them for the no fishing zone, where the reef is being used for diving.

6.7 Indirect Use Study Results.

Coral platforms are usually the most valuable asset for houses that have them. Survey data showed that large platforms sold at an average price of Rp5 million and small ones at Rp1.5 million. Calculations showed that all the platforms in the village were worth almost Rp653 million (£40,295). Many widows use coral mining as their main source of income. Unfortunately, this activity threatens all the other uses of the reef. It will also affect the ability of the reef in front of the village to buffer the large waves that occur during the Northerly and Easterly seasons. The houses that face north are at risk of damage from these waves. Two stilted houses were knocked down in 2003 and one platform had to be partially rebuilt.

Estimates of the value of this protective benefit, based on information collected during surveys at during informal interviews were possible. Conservative estimates assumed that the first two rows of houses facing north were at high risk. This included 38 houses. As this was the poorer end of the village, only 6 had platforms. Repairs to these platforms were estimated to cost Rp500,000 per platform. The stilted houses without platforms were at risk of being completely knocked over. Based on previous sales, these houses were assumed to have a value of Rp3.4 million each[14], as most are simple bamboo and thatch huts.

Value of wave protection:

- Repair costs for platforms — Rp3 million
- Value houses at high risk — Rp108.8 million
- **Total Estimate Protective Function** — **Rp111.8 million** (£6,898).

6.8 Non - Use Values.

Interviews and the CV pilot study indicated few non-use values associated with the coral reefs. The pilot study included questions to assess existence values. Respondents initially laughed, at the idea of paying for something they would not use. Qualitative data collected during the survey also revealed that the Bajau had little sense of stewardship towards the reefs. Many told me that they would not care if the reef existed if they had an alternative source of income.

[14] Calculated from data of costs of building new houses, which range from Rp1–6million for thatch houses.

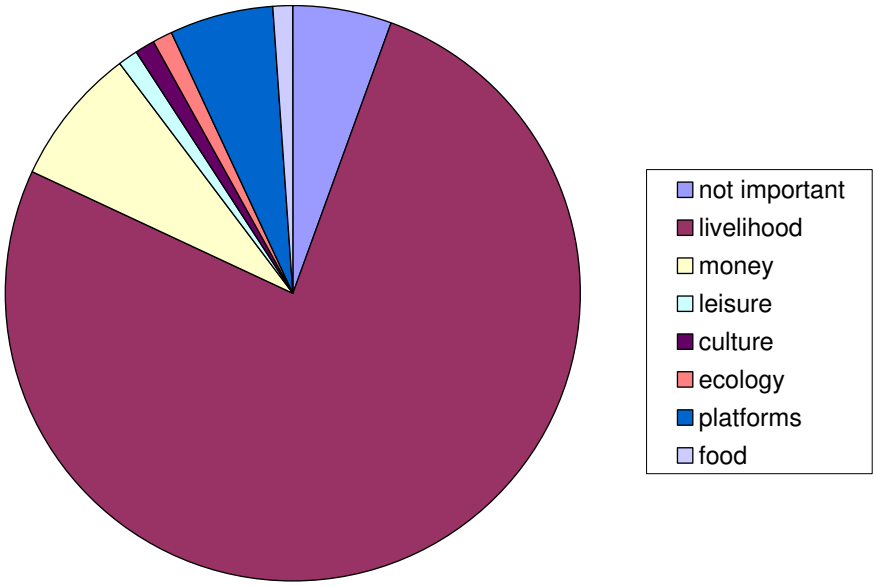
When asked what job they would like their children to do however, 30% wanted them to fish in Sampela, which three respondents said was 'part of the Bajau identity'. 9% said they wanted their children to fish abroad where the income was better. The largest group (61%) said that they wanted their children to work in offices in the city, as government staff, doctors or teachers (see appendix 4 (4)). Several actually added that they would be very disappointed if their children ended up fishing in Sampela.

In contrast, interview responses revealed that there is a strong religious connection to the reef. Household engage in ceremonies, performed by local healers or 'sanros' conducted in canoes or on the water's edge. Whilst there is no direct interaction with the reef, these ceremonies involve sea spirits, some of which are thought to live in the sacred coral, or 'tikolobatu'. See appendix 7 (Q.7) for a brief description of these practices and beliefs. Data collected on these habits showed that 86% of households carry out ceremonies connected to the reef, on average every 6.7 months, usually if there is a new enterprise or illness in the family. The many varied reasons given for conducting ceremonies however, means that this time cannot be entirely attributable to the reefs.

6.9 Attitudinal Study Results.

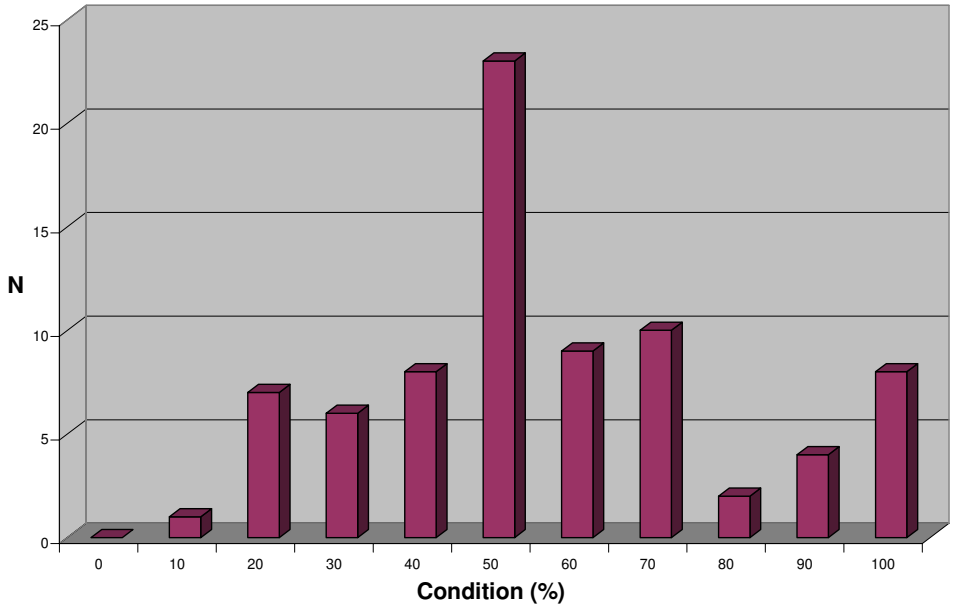
Initially, respondents were asked the significance of the reef to their household (see graph 8). Ninety percent of respondents described one significance only, which in 89% of these responses was their livelihood. Other answers such as material for coral platforms and income were given as additional answers. Interestingly none of the respondents gave any reference to spiritual significance, despite the fact that this proved to be a key factor in the non-use valuation (see section 6.10.2). Five respondents (6%) said that the reef had no significance for them.

Graph 8. The significance of the Coral Reefs for the Respondents.



Pebbles were used to establish the condition of the reef relative to a pristine state (see section 5.2.2). Graph 9 shows that there was a divergence in opinion of the condition of the nearby reefs between houses. However, the mean condition of the reefs was thought to be 57% relative to an untouched reef. It is important to note however, that 10% of households said that the reef was still in a pristine state.

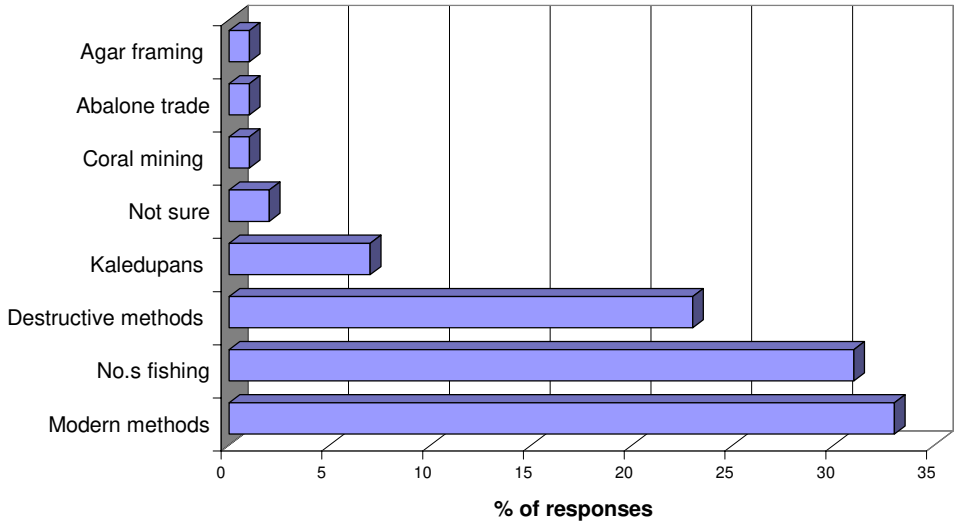
Graph 9. What Condition are the Nearby Reefs in Relative to Pristine Reefs?



When questioned as to whether reef quality was a problem however, only 40% of households thought it was. They described lesser fishing efforts and more catches in the past. Several commented that lower catches were due to the increase in numbers of fishers, rather than to any decline in reef quality.

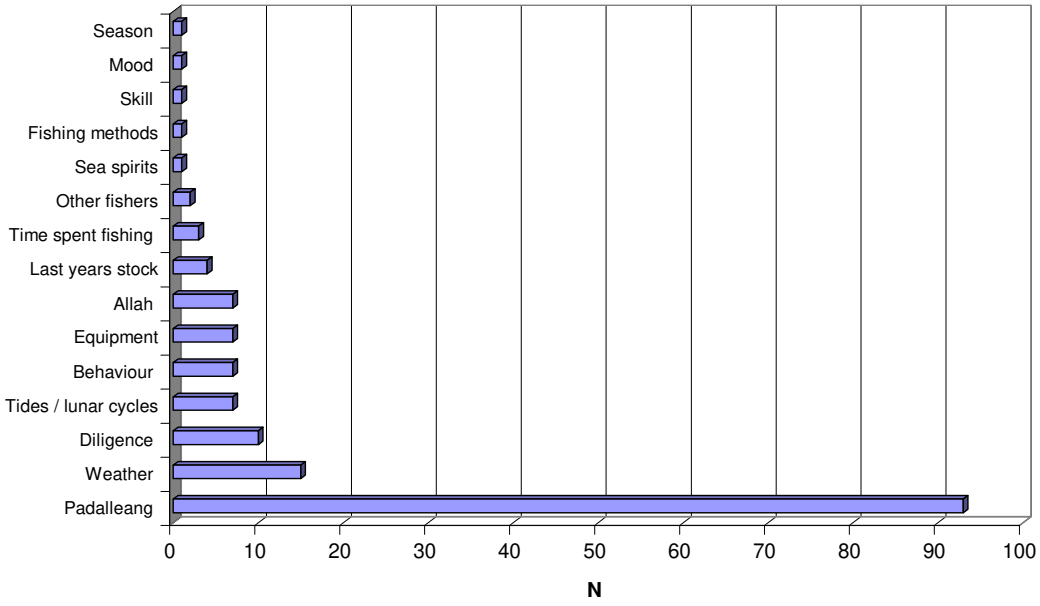
When questioned as to the causes of reef decline, modern fishing methods, such as net fishing, and the numbers of those fishing were the most frequent answers (see graph 10). 24% of respondents blamed poor quality on bomb and cyanide fishing ('destructive methods'), which they said were still commonplace.

Graph 10. Causes of Reef Decline Identified by respondents.



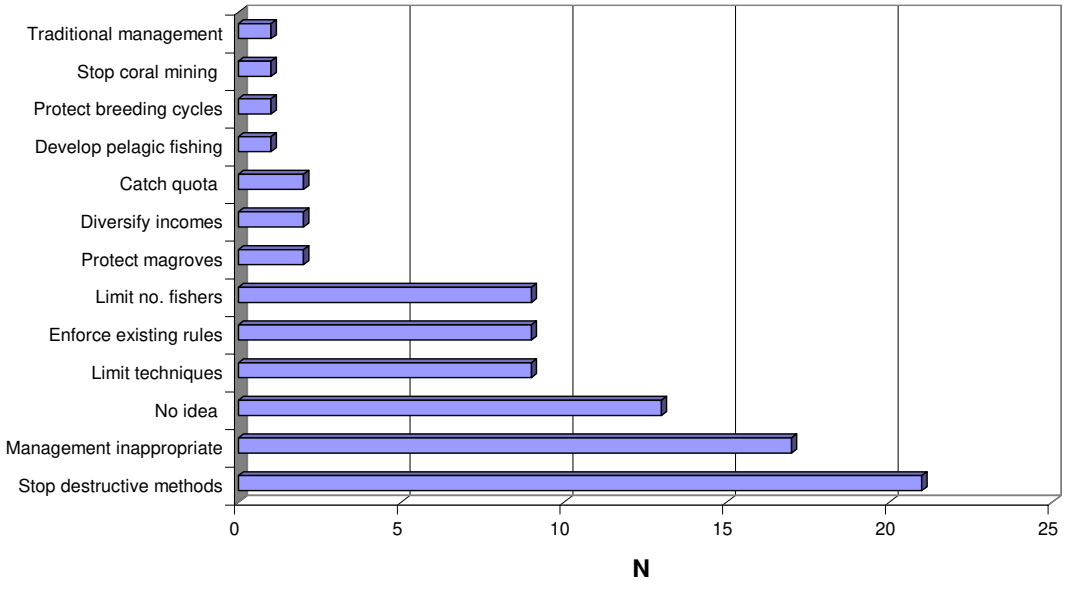
When questioned 91% of respondents stated that human activities could have an impact on coral reefs (see appendix 4 (5)). The three most commonly given impacts were destructive methods (bomb and cyanide fishing, 48%), modern fishing techniques (22%) and coral mining (12%). Six people said that the people from the nearby island of Kaledupa were having a detrimental effect on the fisheries. None of the respondents mentioned positive effects that humans could have on reefs. However when questioned as to what determines the catch of fishers, no-one mentioned the reef quality (see graph 11). Almost 60% of people answered 'padalleang'. This is a sort of 'Karma', that is determined by spirits, depending on how you have been behaving towards others.

Graph 11. What Determines How Much Fisher's Catch?



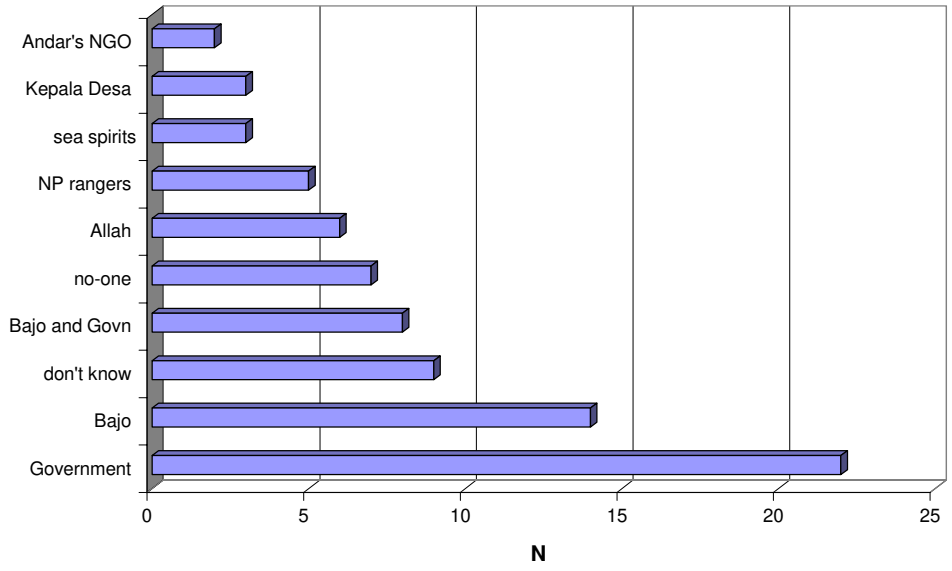
When asked what could be done to improve reef quality, 25% of households advised banning destructive fishing methods, including two households that were known to be practicing them. Whilst 19% of households thought no action was necessary or feasible ('management inappropriate'), and 15% had no ideas for possible ameliorative actions, several other insightful suggestions were given (see graph 12).

Graph 12. What can be done to Increase Reef Quality?



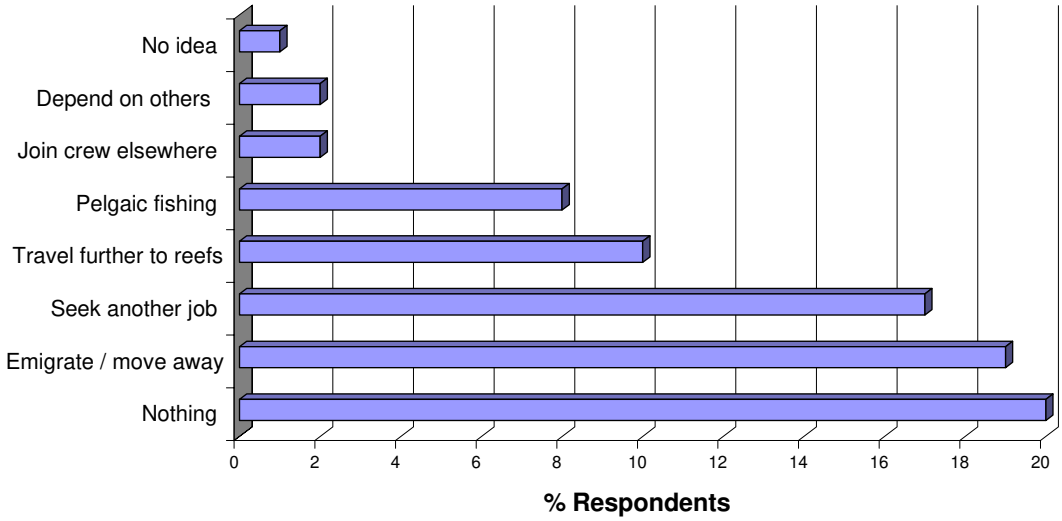
When asked whose responsibility it was to deal with a problem occurring on the local coral reefs, 27% of interviewees thought that this was the government's responsibility (see graph 13). Eighteen percent said the Bajau were responsible for these reefs and 10% that said the government and the Bajau should take joint responsibility. Many people expressed the opinion that the Bajau would not be able to manage the reef without help, as they could not tell each other what to do and as they had no power over outsiders.

Graph 13. Whose Responsibility are the Local Reefs?



Respondents were also asked to consider what they would do if the nearby reefs were completely destroyed. One old female answered 'wait to die'. In fact, a quarter answered that they would do nothing, and explained that they could never imagine living without the reef as it was not possible for the reefs to be destroyed. Nevertheless, 43% of those said they would continue to fish, either by traveling daily to further reefs (12), joining a crew (2.5%) or emigrating (18%) to fish or by relying on pelagic fishing (10%).

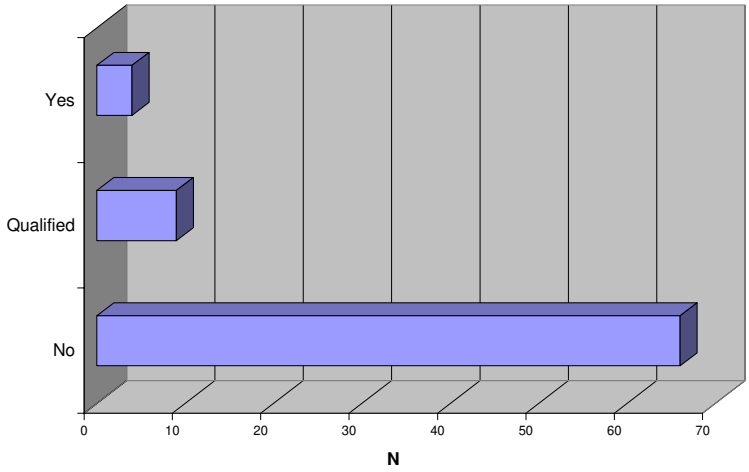
Graph 14. What Would Your Household do if the Nearby Reefs were Destroyed?



6.9.1 Lexicographic Preferences.

Qualitative data was collected in answer to a question designed to uncover lexicographic preferences. Respondents were asked if reefs and reef creatures had a right to exist or be protected. Answers were then coded as yes, no and qualified. Respondents frequently laughed at the question. Those with no obvious right based positions replied with answers such as 'everything is for human consumption, mangroves for the kitchen, fish for food' (Takuku, 20.06.04.). Four respondents (5%) showed indications of lexicographic preferences, of whom one answered 'we must have human feelings towards animals, I am not brave enough to kill turtles' (Hajar, 23.06.04.). A third category of answers was necessary for those who commented that if they had a different profession they might and those who explained that deep sea animals such as whales and dolphins should be protected, but that this was not true for any animals founds on reefs. This category accounted for 12% of responses.

Graph 15. Do You Think that Marine Organisms have any Rights to Exist or be Protected?



6.10 Contingent Valuation Results.

The contingent valuation study was conducted for 80 households. As table 10 shows, 91% households had a positive WTP for scenario one, compared with 77% for scenario two.

Table 10. Numbers of Respondents with Positive WTPs.

	All usable Responses		Excluding Protests	
	N	%	N	%
Scenario 1	70	91	70	95
Scenario 2	57	77	57	81

6.10.1 Scenario One: Valuing Access to All Benefits from the Reefs.

Households were asked their maximum monthly WTP for as long as they wanted to secure access to the nearby reefs. The government would limit access for any uses of the reef, to those who had paid, to ensure the long term health of these reefs. The full valuation scenario is given in section 5.3.2.

Two respondents refused to answer the valuation question at all or give a reason and another respondent said that they could not understand the question. These results were excluded as no WTP could be ascertained (including a zero WTP). As a result seventy seven responses were usable.

Zero Bids.

There were seven zero bids for scenario one. Some of these are in accord with behaviour of rational economic agents, assumed by the CV methodology. For example, answers such as 'cannot afford to pay', show that the household is acting rationally under an income constraint. A second set of explanations are not in accord with economic theory however, usually as they are associated with a rejection of the payment mechanism or another aspect of the scenario the valuation is contingent on. As a result these are called 'protest values'. Although their treatment is controversial, further questioning showed that the respondents held significant values for the resource, so that including them as a zero WTP would bias the results, leading to a misleadingly low estimate. Table11 shows the spread of these responses.

Table 11. Reasons given for Zero Bids for Scenario One.

Scenario 1 Correct Zero Bids	Number of Answers	Scenario 1 Protest Bids	Number of Answers
'Cannot afford to pay'	1	'I would use the reef, but would not pay, as it is my right'	2
'The reef is not important to me'	2	'You could never stop people using the reef'	1
'I earn no income from the reef'	1		

Mean and Median WTP.

Whilst incorporating the mean values into decision making can help to maximise efficiency, the median can also be helpful if the majority voting principle is to be applied, as it is a better measure of central tendency. Therefore both mean and median values should be given (Bateman et al, 2002). Values are given for mean WTP including and excluding protest values (see table 12). As there were only three protest responses, these only raise the WTP, although they do change the median and mode WTPs. Of the 74 remaining responses, there were four 'zero' bids given (5%). The mean bid was Rp18,527 (approximately £1.14), per month, for as long as respondents

wanted to use the reefs. This is **Rp 222,324 (£13.72) /household/ year**. During the follow up questions, many interviewees explained that if they were asked to pay high sums, they would simply use reefs further away or in secret at night. The median was much lower than this however, at Rp7,500 /household/ month.

Table 12. Mean and Median WTP for Scenario One.

WTP (/household /month)	Mean	Standard Error	95% CI	Median	Mode
All Responses (n = 77)	Rp.17,805.2	2968.9	Rp.11892 - 23718	6000	2500
Excluding Protest Responses (n = 74)	**Rp.18,527**	3060.3	Rp12428 - 24626	**7500**	2500

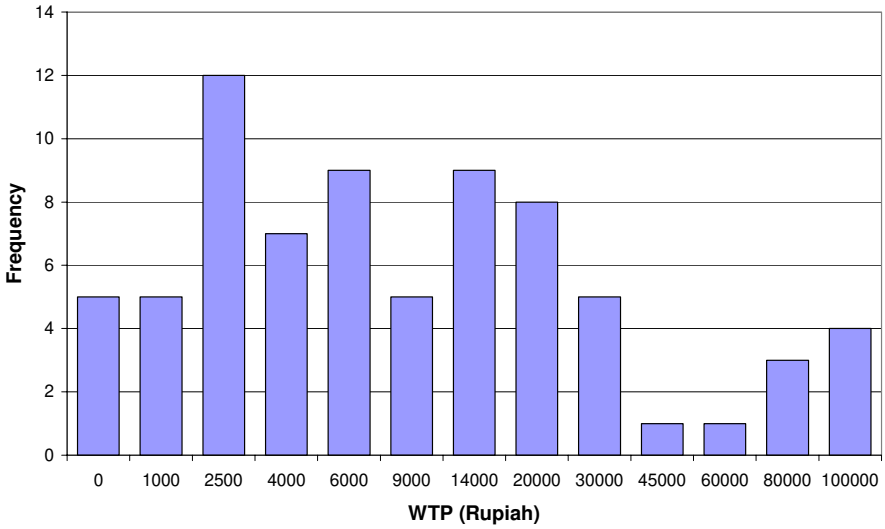
The distribution of the bids in graph 16, shows a spike at Rp2,500, the mode value There is also a dip near Rp45-65,000 and then an increase in numbers of bids at the highest value possible. This suggests that the highest value on the payment ladder was not high enough. Also, it may be because there are a few traders in the village, who have come across the idea of paying to use reefs elsewhere, and know these have high prices. This is in contrast to the rest of the village, who have never paid taxes and to whom the idea of regular and fixed official payments is very foreign. In fact, in a simple regression shows that having household income from a middleman explains 12% of the variation in WTP (p=0.002).

Analyses of the reasons given for positive WTP, show a variety of motives. The most prevalent answer was for extractive uses of the reef (20%), followed by freedom to use the reef for everything (17%). Sixteen percent of respondents cited their income as the primary reason. Many of those that cited limiting numbers of fishers, also mentioned that they would expect better catches, making this the largest combined category. In total 71% of responses were associated solely with direct extractive uses compared to 6% for non-use benefits.

Table 13. Reasons Given for Positive WTPs for Scenario One.

Reason for Positive WTP.	Number Respondents	Percentage of Positive WTP Responses
Freedom to fish / extract resources	14	20
Total freedom to use	12	17
To ensure income	11	16
Limit numbers using reefs	10	14
Fisheries improvements	8	11
To avoid using further reefs	4	6
To help the environment	4	6
Necessity to access reefs	3	4
Bequest values / future use	2	3
Responsibility to pay	1	1
Not sure	1	1

Graph 16. The Distribution of the WTP Bids for Scenario One.



6.10.2 Scenario Two: Valuing Recreational and Non-Use Values.

Here respondents were asked how much they would contribute monthly to ensure management plans to protect the reef for the future. They would nevertheless not be able to use the reef to harvest things, but only for recreational and religious purposes. The full valuation scenario is given in section 5.3.2. An additional respondent did not understand the scenario and so was excluded, leaving seventy six usable responses.

Zero Bids.

There were 19 zero bids for this valuation. Of these 13 were in accord with economic theory. The most common reason was that they would no longer being using the reef for fishing or gleaning, so there would be no point in paying. These people said they would not pay solely for the recreational, religious and non-use benefits.

The number of protest responses rose to 6, as people resented the idea of paying for things that they have always had free access to. Two respondents refused to believe the scenario, saying you would never be able to stop them fishing, despite wanting to continue recreational and religious uses. One respondent said that the money should come from elsewhere. This is a protest response as it rejects the valuation scenario, despite the interviewee having a preference for conservation of the reef.

Table 14. Reasons given for Zero Bids for Scenario Two.

Scenario 1 Correct Zero Bids	Number of Answers	Scenario 1 Protest Bids	Number of Answers
'Cannot afford to pay'	2	'I would use the reef, but would not pay, as it is my right'	3
'I would not be using the reef, the other things are not important'	10	'I would never stop fishing on these reefs'	2
'I would only pay for improved fish stocks'	1	'The money should come from elsewhere'	1

Mean and Median WTP.

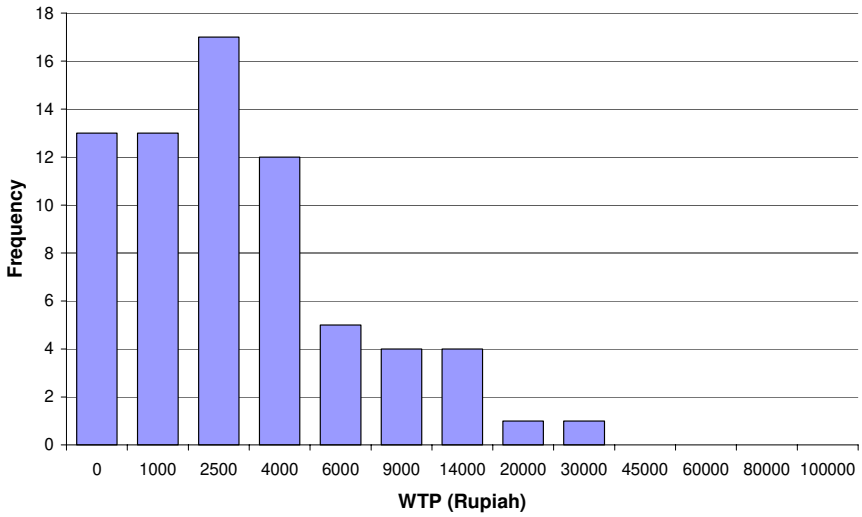
Values are given for mean WTP including and excluding protest values (see table 15). Of the 70 remaining responses, there were 13 'zero' bids given (19%). The mean bid was Rp3,936 per month, for as long as respondents want to protect the reefs. This is **Rp. 47,228 (£2.91) /household /year**. This is much lower than the WTP for scenario one, as was be expected, as this offers no use benefits. The median WTP, with and without the protest bids, is Rp2,500 a month.

Table 15. Mean and Median WTP for Scenario Two.

WTP (/household /month)	Mean	Standard Error	95% CI	Median	Mode
All Responses (n = 76)	Rp 3625	577.4	Rp 2475 – 4775	2500	0
Excluding Protest Responses (n = 70)	**Rp. 3935.7**	613	Rp 2713 – 5159	**2500**	2500

The distribution of the WTP has a right skew. This is because both the mean and median WTP are near zero, however, it is not possible to have a negative WTP.

Graph 17. The distribution of the WTP bids for scenario two



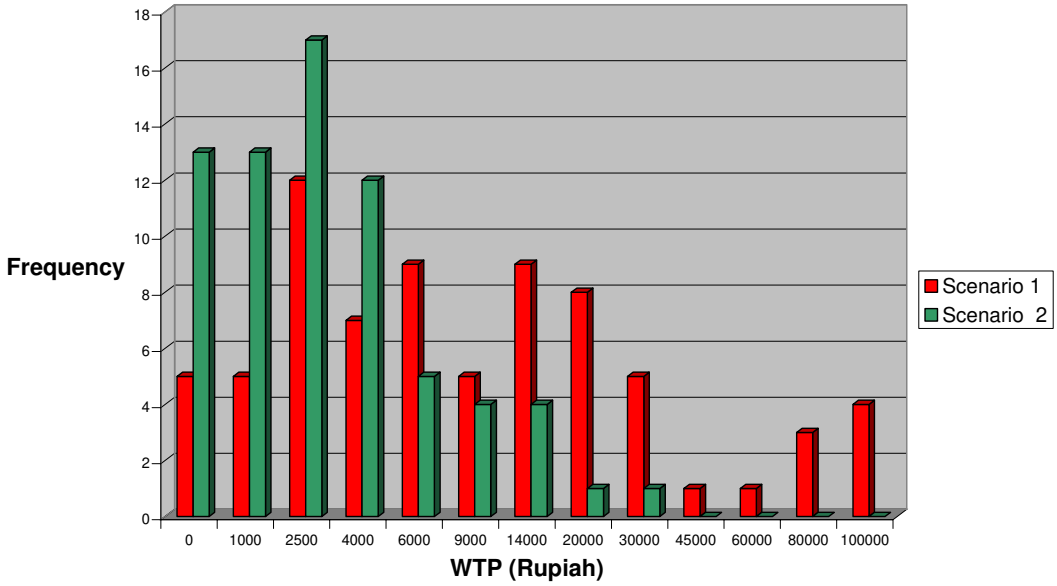
Analysis of the reasons given for positive WTP shows that the largest number of people would pay for the religious benefits associated with a healthy reef. Religious and ceremonial uses were both important, together accounting for 68% of positive bids. Traditional interactions with the reef, which several interviewees said defined the Bajau, explained 16% of the positive bids. Nine percent of people also said it was their responsibility to pay. Further questioning revealed that they felt they must act as a community and if others were paying, so should they. It is uncertain whether any attached any personal responsibility to looking after the reefs.

Table 16. Reasons Given for Positive WTPs for Scenario Two.

Reason for Positive WTP.	Number Respondents	Percentage of Positive WTP Responses
Responsibility	5	9
Can afford it	2	4
Ceremonial use	19	33
Recreational Use	7	12
Tradition / Identity	9	16
Ceremonial & Recreational use	13	23
Future Values	2	4

The graph below illustrates the different distributions of WTP bids for the two scenarios. It shows clearly that they have different distributions, despite using the same payment ladder. This means that respondents were reacting to the changes in the valuation scenarios and were not insensitive to scope.

Graph 18. WTP results for Scenarios One and Two (Excluding Protest Values).



6.10.3 Econometric Analysis

Income and social characteristics will have an effect on utility values (Hanneman, 1984). Examining the effect on WTP of these variables is important, as it can serve to assess the validity of the CV study and can help when aggregating results to larger populations, and gives insights in its own right. A simple ordinary least squares (OLS)

regression analysis of independent variables such as income, wealth indicators and attitudes with WTP as the dependent variable is used. These variables were taken from information from the other studies in addition to the CV study. Intercooled Stata 8.0 is used to generate parameter estimates for linear functions of these parameters for this analysis.

The equation upon which this model is based is:

$$\mathbf{WTP = a_0 + a_1X_{1i} + a_2X_{2i} + \ldots\ldots a_nX_{ni}.}$$ Equation (1).

a_0 = y intercept, $a_{(1,2..n)}$ = co-efficients and $X_{(1i, 2i \ldots ni)}$ = independent variables.

Many variables which were included in the regression analysis that were not significant predictors of WTP[15], although they may have increased the model's explanatory power (the R-Squared value). Once the other variables were included, being a middleman was no longer a significant predictor of WTP in scenario one. Table 17 describes the variables that were significant in combination in the econometric analysis.

Initially explanatory variables were checked for correlations. Univariate analyses were used to see how each of the explanatory variables relates to the dependent variable. Links between explanatory variables were also examined. A step wise elimination procedure was then used to eliminate variables, until the most parsimonious model was found.

Table 17. Independent Variables included in WTP regression analysis.

Variable Code	Description	Code
Cash	The value of any income received the previous day from reef products.	Value (Rupiah)
Negatives*	Did they identify negatives associated with living on the reef?	0 = no, 1 = yes
Calm Av Inc	Average income earned in the calm season in Rupiah.	Value (Rupiah)
Iffy*	If they seemed distracted during the valuation.	0 = no, 1 = yes

[15] These were lexicographic preferences, rank in focus groups one and three, sex of respondent, day of week, area in village, number of people in household, significance of the reef, if they use the reef for recreation, condition of the reef and if this is a problem, who they see as responsible for the reef, they want their children to be fishers, how much money they owe, their average income in the storm season, number of years in education and if their household was classified as subsistence or modern.

1e income reef*	If the most important source of household income comes from the reef	0 = no, 1 = yes
Difficulty*	Did they find the valuation difficult?	0 = no, 1 = yes
Catch Q1*	Did they catch anything from the sea yesterday?	0 = no, 1 = yes
Ceremony*	Does their household practice religious ceremonies associated with the reef?	0 = no, 1 = yes
TV*	Did they own a television?	0 = no, 1 = yes
No. incomes	Number of sources of income.	Number.
No. boats	The number of boats owned.	Number.
Problem reef*	Did they think the reef condition is a problem?	0 = no, 1 = yes
Benefits*	Did they identify benefits to living on the reef in addition to financial ones?	0 = no, 1 = yes
Savings	Household savings in Rupiah.	Value (Rupiah)
Focus Group 2	The category they were placed in during the second wealth ranking (see section 6.3).	1 = 'heaven' 2 = 'hell'

**coded as dummy variables, which allow qualitative independent variables to be represented quantitatively to facilitate statistical analysis.*

Tables 18 and 19 present the results of this analysis for scenarios one and two with the protest bids removed. Those including protest bids can be found in appendix 4. The F-statistic shows the strength of the relationship between the dependent and independent variables. The R-squared values describe how well the independent variables explain variations in WTP. Examination of the residuals showed that it was not necessary to use adjusted R^2.

Econometric Analysis for Scenario One.

The regression model which included the following variables explained 59% of the variation in WTP for scenario one. The R-squared with protest responses included was 55 (see appendix 4).

Respondents who were judged to be distracted during the scenario description ('iffy') had a lower WTP ($p = 0.000$). Of the attitudinal variables, respondents identifying negatives from living on the reef unexpectedly had a higher WTP. Also, the seven interviewees who said that the valuation question was difficult, had a higher WTP. Examination of the answers showed that five of these had a low WTP (under Rp4,000),

but two had high WTPs (Rp28,000 and Rp45,000), which may have skewed the results. Both respondents confirmed that they nevertheless did understand the question.

Interestingly, those who had harvested products from the reef the previous day had a higher WTP. The amount of income that they received as a result was also a determinant of positive WTP (p = 0.011). More income may have highlighted the importance of the reef to them, or made them feel more generous.

Several socioeconomic variables were also significant determinants of WTP, as was expected. These included the average daily income in the calm season (p = 0.000). Many respondents had said during the use value study that their savings were made during this, the most productive season, to be used in the stormy season. Those whose most important income came from the reef had a higher WTP, than if they came from elsewhere (p = 0.019). Also the more incomes were available to the household, the lower the WTP (p = 0.048). Finally, households with more boats had a higher WTP. Number of boats would be expected to be a good indicator of income or wealth, as they enable more family members to fish on a daily basis.

Table 18. WTP Regression Analysis for Scenario One.

	Econometric results (protests removed)	
N	74	
F-stat	10.05	
Prob > F	0.000	
R-squared	**0.586**	
	Coefficient	**P>[t]**
Iffy	-21134.38	0.000
Negatives	20631.39	0.000
Calm av Inc	0.280	0.000
Difficulty	21033.56	0.008
Cash	0.053	0.011
1e income reef	13066.6	0.019
No. incomes	-3611.236	0.048
Catch Q1	9213.597	0.055
No. boats	4504.633	0.059

Significant at the 99% level	
Significant at the 95% level	
Significant at the 90% level	

Econometric Analysis for Scenario Two.

The regression analysis below explained 54% of the variation of the WTP for scenario two. Again, including the protest responses reduced this, to 52% (see appendix 4).

Table 19. WTP Regression Analysis for Scenario Two

	Econometric results (protests removed)	
N	70	
F-stat	9.91	
Prob > F	0.0000	
R-squared	0.54	
	Coefficient	**P>[t]**
Cash	0.027	0.000
Savings	-.0014893	0.015
Focus Group 2	-3202.099	0.021
TV	2320.333	0.023
Problem	-2081.811	0.030
Benefits	1542.032	0.036
Ceremony	2462.056	0.085

Two attitudinal variables were seen to be important. Those who said that the condition of the reef was a problem, had a lower WTP to access and invest in the reef (p= 0.03). As was expected, those who could identify benefits of the reef, in addition to financial ones, had a higher WTP to ensure non-use and recreational benefits. Furthermore, those that said in the use survey that they performed ceremonies to sea spirits had a higher WTP (p = 0.085).

Of the socioeconomic variables, income earned from the reef the previous day, remained significant (p = 0.00), although harvests did not. This suggests that respondents did understand the distinction that they would no longer be able to harvest marine products for this scenario. Households who owned a television, had a higher WTP, perhaps as this was a good indication of wealth. Those, who the women from the second wealth ranking exercise, had classified as poor ('hell'), were also seen to have a lower WTP. These women focused mainly on those with large debts and little cash in their houses (despite owning large houses or expensive fishing equipment). No obvious reason explains the negative relationship between savings and WTP, however a co-efficient of -0.0015, shows it is only a marginal relationship.

6.10.4 Aggregating WTP Results.

The sample size should ideally be much larger. However, the interviews were time intensive (each took 45 minutes each and were conducted face to face, with the aid of an interpreter) and so were limited by time and money. Fortunately, over a third of the population were still randomly sampled and there were no major outliers, suggesting that these results are representative of the whole village. The appropriate population to aggregate these results for is the people living in Sampela (227 households) to calculate the total WTP for this community per annum (p.a.).

Mean WTP /household p.a. * Number of households = Total WTP for Sampela p.a.

(Equation 2)

Scenario 1: Rp222,324 * 227 = **Rp50,467,548 (£3115)**

Scenario 2: Rp47,228 * 227 = **Rp10,720,756 (£662)**

6.11 Summary of Economic Values uncovered for the People of Sampela.

During the valuation scenario, the hypothetical project was presented as a long term one. As the Sampelans are also so dependent on these reefs, potential payments for access could carry for many years (if not indefinitely). Aggregation of value over time is therefore instructive. Assuming a conservative 20 year time period (t) and a discount rate (r) of 10% (see section 3.8), a present value of these reefs can be calculated from equation 3 (Chapman 2000) and is therefore included in the table. Present value is used, rather than net present value, as although some costs have been accounted for, others such as fishing equipment and eco-tourism costs have not been.

Present Value Benefits = [annual value (Rupiah) / $(1 + r)^t$]. (Equation 3)

Table 20. Summary of Economic Values uncovered for the People of Sampela.

Component of Total Economic Value		Valuation Technique.	Value (Rupiah)	Present Value (Rupiah)
Extractive Direct Use Values	Fisheries and other harvested reef products, including coral.	Survey of household harvests for market value approach.	**2,425,701,357 per annum** (£149,752)	**20,651,363,068** (£1,274,815)
Non-Extractive Direct Use Values.	Net Benefits from Ecotourism	Interviews, surveys, observation.	**310,615,520 in 2004** (£19,161)	**2,644,445,021** (£163,188)
Indirect Use Values	Physical Protection from waves.	Value at risk.	**111,800,000 per annum.** (£6,898)	**951,816,424** (£58,730)
Use and Non-Use Values	WTP to secure access to all benefits from the local reef	Contingent valuation	**50,467,548 per annum** (£3,115)	**429,658,686** (£26,516)
Recreational and Non-Use Values.	WTP to avoid loss of local reef for these uses.	Contingent valuation	**10,720,756 per annum**. (£662)	**91,271,839** (£5,633)

These estimates mean that each km^2 of these reefs will produce an average of Rp93,296,206 of harvestable products annually (nearly £5,760). These reefs also bring in an average of Rp11,946,751 (£737) per km^2 per year from eco-tourist revenues. The average annual protective benefits are approximately Rp4,300,000 (£265) per km^2 of reef. As indicated by the CV results, the total value of the reef to the residents of Sampela would be on average Rp1,941,060 (nearly £120) per km^2 per year. Whereas the non-use and recreational use value of these reefs are on average Rp412,337 (over £25) per km^2 per year. Yet some areas of reef will be exploited more for some uses than others, for example only a small area of these reefs will be protecting the north side of the village from large waves and divers will tend to be concentrated on preferred reefs, so these values will vary within different areas of these reefs.

7. DISCUSSION

The combination of techniques employed during this study enables the most important benefits that accrue to the community at Sampela to be identified. These were fishery and coral harvests, recreational and spiritual uses of the reef, physical protection of the houses exposed to the large waves during the 'northerlies' season, and non-use values. One of the key aims was to subsequently quantify these benefits, which was carried out. This section examines the valuation estimates and asks if they can be used to calculate a TEV of these reefs. This includes a discussion of the accuracy and appropriateness of the different valuation methodologies used and the total economic value framework itself.

7.1 Discussion of the Benefit Estimates and their Accuracy.

7.1.1 Use Values

The fisheries study looked not only at income generated by sales of fish, but also fish that were used for meals, given away or bartered as payment for crew. Investigating financial flows from sales alone would have led to a major underestimate of the value of the fisheries. Of these various uses, the value of the fish sold was the highest, but catches used for meals, payment and gifts also had significant economic value. The study showed both that more income comes from the reef than any other source in Sampela, and that households prepare two meals a day from all fishery harvests. Therefore the food security provided by the reef is extremely important, in addition to the employment and income generated.

The survey was carried out over two days, for 80 households. Ideally it would have been conducted many times for each household in both the storm and calm seasons, as this fishery is highly seasonal and variable. High sampling frequencies are very costly however. Coral was seen to have a high value within the village, as the platforms that have been built up by families over the last decade, have a commercial value within Sampela of over £40,000. However, coral mining was not included as a value of the reef, as it is not sustainable and does not contribute to future values (Molberg and Folke, 1999), although it is a considerable store of wealth for households (see section 6.7)

The coral reef fishery at Sampela is estimated to have an annual value of almost Rp2.5 billion (£150,000) per annum and Rp93.3 million (£5,760) per km^2 per annum. This does not include the fishery catches of other comunities in this area, although observations suggested these were very minor. It also does not include multiplier effects, which will be generated by any financial activity (Driml, 1999). These could be significant, as households who have no reef related incomes, such as owning shops or carpentry nevertheless rely on fishers for their business. These aggregated results are likely to be underestimates of the fisheries value in this area, even if the unaccounted for costs were included (see section 6.5.1).

Burke et al (2002) and White and Cruz Trinidad (1998), estimate that Southeast Asian sustainable fisheries can yield $12,000 – 36,000 /$km^2$/year in a *healthy* coral reef. This would suggest that Sampela's fishery is not being fully exploited and could support more fishing pressure. However, destructive fishing methods used on these reefs in the past, such as bomb fishing, have had negative impacts on these reefs and coral reefs take decades to regenerate. Cyanide fishing is also still occurring here, despite being illegal, which means that the reef may be near the maximum sustainable yield, as the Sampela reef quality has declined. No other studies have looked at fishery yields per km^2, so further comparisons are difficult to make.

The non-extractive uses of the reef are more difficult to measure, as they rarely involve financial transactions. However this is not true for eco-tourist revenues accruing to the people living in Sampela. Data was readily available in this area, so the estimate of over Rp310 million (£19,000) should be accurate for 2004. OpWall plan to continue to bring eco-tourists here and may well continue to increase numbers, so this value should not decline in the near future. The area's remoteness will limit other tourist development however. This estimate does not include financial benefits to other nearby communities, which especially on Hoga island[16], may be significant.

Some tourists may have dived on other reefs as well as these ones, leading to a slight overestimate. Although the costs of tourism were not investigated, they should be relatively minor, as relatively few eco-tourists actually stayed within the village (a

[16] Residents of Hoga island are paid to provide accommodation for up to 160 people at a time for the tourist season (June – September).

maximum of 10). Eco-tourism multiplier effects would also be expected to increase this estimate.

Previous studies have addressed recreational values held by tourists e.g. tourist WTP, consumer surplus, or those relative to a large area of reefs, so there is limited possibility for direct comparison of results. There have been different estimates of potential annual net benefits from coral reef tourism. Burke et al (2002) estimate $700 - 111,000 /km^2 and White and Cruz Trinidad (1998) estimate $3,000 – 36,000 /km^2. This suggests that Sampela is receiving a good proportion of current and potential tourism benefits, especially as it has had only minor eco-tourist development[17]. Further studies looking at tourism benefits to nearby communities could investigate if these reefs could sustainably support more tourists. Different uses can be difficult to reconcile e.g. non-fishing areas for divers. TEV can investigate which combination of uses would provide the most benefits.

Other non-extractive uses e.g. recreation and religious uses were very difficult to isolate from non-use values associated with the present or future existence of the reef (see discussion below).

7.1.2 Indirect Use Values

Several assumptions were made regarding the area of reefs at risk and severity of the wave action associated with reef disappearance[18], which limits the accuracy of the results. The increased accuracy obtained by investigating these factors is likely to be very small compared to the costs of carrying out further studies however. A total protective value of almost Rp112 million (£6,900) per annum was calculated for these reefs. This value will be concentrated in the reefs directly in front of Sampela, therefore an average value is less informative. Nevertheless an average annual value of Rp4.3 million (£265) per km^2 of reef is very low compared to Burke et al's (2002) estimate of $5,500 - $110,000 and White and Cruz Trinidad's (1998) estimate of $5 – 25,000 /km^2/year. This is partly due to the low value of the properties in Sampela, compared to large tourist developments that have been built elsewhere. If the value of the protective function for all the nearby islands were included, this would increase the estimated

[17] Two houses used for accommodation and a third as an office
[18] As other authors have also had to do e.g. Cesar 1996, Gustavson 1996

value of this area considerably. No other estimates of indirect values per km^2 are available for comparison.

7.1.3 Contingent Valuation Results

The two scenarios used were designed to estimate WTP of various values held by households in Sampela are discussed in turn.

Scenario One: Total Economic Value

Scenario one evaluated WTP for all coral reef benefits. These results would be expected to be higher than the individual benefits calculations, as they include consumer surplus. WTP incorporates values which are important to the local community, even if they had not been identified. Each household was estimated to have a mean WTP of Rp222,324 per year, to be able to continue to use the nearby reefs and receive the gradual improvements in reef quality that result from limiting access to the coral reefs. This produced an annual TEV for the village of Sampela for these reefs of over Rp50 million (£3,115). Over 20 years, this would constitute almost Rp430 million (£26,600) of economic value.

Wright (1995) and Ngazy et al (2004) use CV to estimate TEV of reefs for tourists, who would be expected to have higher incomes and therefore a higher WTP than the people of Sampela. Ngazy's WTP estimate is indeed higher ($81.40/person/year for Zanzibar's reef), as is Wright's ($31/person/year for Negril's reefs), although it is only marginally higher than the one found in this study.

The aggregated WTP value is only 2% of that calculated from the fisheries associated with these reefs however. There may be several reasons for this. Substitutes will have a major effect on CV results (Carson, 2000). In fact, if there are no substitutes available, the consumer surplus associated with a resource can approach infinity (Costanza et al, 1997). There are many other reefs within the Wakatobi national park, including those on the other side of the island of Kaledupa, which respondents who did not pay would still be free to use. However people in Sampela would still be expected to have a significant WTP for the $26km^2$ of reefs being studied as they have a history of dependence on these reefs and these are the easiest to access. Access is particularly

important to this community as few people have motorised boats. In fact, 10% respondents cited ease of access as their primary reason for having a positive WTP.

Several other issues may also have been important. Incentive compatibility (strategic bias) problems are probable in this context. Interviewees may have thought that they would in the future be charged what they said they would pay, so gave stated values lower than their real values. It was important not to emphasise the hypothetical nature of the scenario too much however, to avoid artificially high bids, so this could not be avoided. The interviewees may also have not believed that the government would help them (as several commented during interviews) or that it would be possible to restrict access to these reefs. Many also expressed doubts that the reef could be returned to the state it was in 15 years ago. Finally respondents may have felt that it was wrong to start charging them to access these reefs, when they had never been charged in the past, especially if they did not see a problem with the reef quality. As a result their stated WTP may have deviated from their true WTP. These are all issues with the valuation scenario, which are not related to how much interviewees value these reefs.

Although previous studies have only usually probed zero WTP responses (to identify protest bids), it is instructive to similarly investigate positive WTP bids. Seventy one percent of positive bids for this scenario were associated with extractive uses of these reefs. These would be expected to be the key motivating factor, as this community is highly reliant on these reefs and use these reefs on a daily basis. A quarter of the respondents cited limiting the use of the reef and fishery improvements and 6% cited environmental benefits as the reason they were willing to pay. This would suggest that the scenario presented was believable to many interviewees. Four percent of the sample said that they were concerned with the future of the reef, which their children would need, which could be an indication of bequest values. Only 6.5% of respondents said that they would not pay, as they saw no benefit to them in paying[19].

The econometric analysis revealed several variables which were not significant as expected, including the sex of the respondent and the day of the week the interview was conducted. Several variables were unexpectedly insignificant, especially average

[19] The reef was unimportant, provided no income or they could not afford it.

income during the (current) storm season. As this was the season with the lowest income, it should have constrained household's WTP. However many people survive during the storm season, on their savings from the calm season (average income during the clam season was significant). Interviewees that expressed the opinion that reef quality was a problem did not have significantly higher or lower bids. Number of years in education and number of people in the household were also not significant, although these might have been expected to have been. Those that wanted their children to fish also did not have higher WTPs, perhaps as substitute reefs would remain available for their children. Alternatively, this may not be a good indication of possible bequest values or perhaps there were none associated with this reef. Further research would be needed to clarify this.

Lack of significance may be due to the relatively small sample size (n = 76). A larger sample would enable more statistical power, which would help to identify significant variables, smooth out the WTP distribution and decrease the 95% confidence interval for the mean WTP. This would require considerably more time and money however. Nevertheless, many variables did show significant relationships to WTP. There was a positive relationship with average income during the calm season (p=0.000) and those households whom relied on the reef for the primary source of income (p=0.019). There was also a negative relationship with the number of household income sources. This sample size should be large enough (35%), to provide a reasonable WTP estimate.

Scenario Two: Non Extractive and Non-Use Benefits

Scenario two investigated values associated with recreation, religion and non-use of the reef. Existing studies suggest that non-use values are often small compared to other coral reef values, although they are still highly significant e.g. White and Cruz Trinidad. Few studies that have examined non-use values of local populations associated with coral reefs. However in a rare example of such an study, Spash et al (2002) estimate an average local WTP ranged from $1.66 to $4.26 in Montego Bay, for a 25% coral reef improvement[20] and $0.19 to $4.05 in Curacao. In this study, the mean bid given is just over one fifth that of the first scenario (to secure all benefits), demonstrating the importance of these less tangible benefits to this community, in addition to use values.

[20] Whilst using such a specific (%) improvement may seem appealing, this is unlikely to be considered as a realistic possibility and is unlikely to be quantitatively linked to any specific policy proposals.

This CV study estimates an average household WTP for non-extractive and non-use values of over Rp47,000 per year. The total annual estimate of all these benefits for the whole community is therefore about £662 or £25 per km^2 of these reefs. This is still significantly less than the net potential benefit of $2,400 - $8,000 per km^2 of reef estimated by Burke et al (2002). However Burke's estimate is based on tourist values. Tourists have higher incomes and therefore higher WTP. In effect reefs with high levels of tourist activity are worth more, as they have higher recreational values (more wealthy people use them) and higher existence values (as they are familiar to more people). Non-use values will also have been affected by the availability of substitute reefs.

When asked to contribute, 19% of respondents had a zero WTP (excluding protest responses). This high rate of refusal was expected, as many had said that positive bids for the first scenario were related to being able to use the reefs for fishing and gleaning. Probing of zero bids, produced the response that recreational, religious and non-use values were not sufficiently important. Nevertheless, 81% of households would pay an average of Rp47,000 a year for these benefits. 68% of these positive bids were given to enable ceremonial and recreational uses of the reef (see table 17). This is supported by the use study result, that household spends an average of 28 minutes playing on the reef everyday. Other reasons for positive bids were associated with more abstract benefits, such as cultural reasons of identifying with the reef (16%) and responsibility (9%), which may have been indicative of a non-use value associated with stewardship of the resource. Answers that cited future use may have been associated with option or bequest values. Further probing would be necessary to investigate this. Two respondents answered that they would pay 'because they could', which may indicate interviewer bias (wanting to impress), although this is not known.

The Bajau have for many centuries, had intense physical and spiritual ties to the sea. However the subsistence nature of many of their lifestyles may provoke a high discount rate, which could preclude high bequest values. Similarly a long history of nomadism, where resources are used until they are depleted and then the community moves on, may similarly preclude strong stewardship and bequest values. Ideally another study would be conducted to investigate the non-use values that this study has identified in

more detail. During this study, drawings were found to be essential to aid understanding of the scenarios. Existence and bequest values are difficult to address in this way, especially as they were alien concepts to many interviewees. More qualitative research would be helpful to further clarify these kinds of values.

The econometric analysis confirmed the presence of significant predictive variables on the stated WTP. These included the previous day's income from the reef and two attitudinal variables; the non-monetary benefits provided by the reef and whether the reef condition is a problem. Different variables were significant for the two different scenarios, suggesting different motivations for positive and zero bids. This is confirmed by the follow-up questions, which investigated reasons for positive WTP bids (table 17). Neither of the average daily income variables were significant, which is unexpected, as income constraints should limit WTP. Other non-significant variables of note that were expected to have been, were households who said they used the reef for recreation and those who wanted their children to be fishers[21].

The larger number of non-responses and protest bids associated with this scenario, meant that the sample size was low (n = 70). A larger sample size, would have increased the power available to analyze the explanatory ability of these variables[22] and further decreased the confidence interval calculated for the mean WTP.

The ranking given by the women who conducted the second wealth ranking exercise was significant. The women based their rankings on those households who were traders (middlemen) and creditors and with more disposable cash. The other two rankings from the other two groups conducted by wealthy and subsistence males were not significant. They focused on attributes such as household materials, coral platforms and household savings and number of boats. Interestingly these were also attributes that were not independently significant in the econometric analysis of WTP[23]. This suggests that households were ranked correctly for these attributes.

[21] assuming that this is some indication of bequest values, which is not certain
[22] Both time and financial constraints limited the feasible sample size in this remote location
[23] the number of boats was weakly significant for the first scenario (p=0.059)

7.2 Is CV appropriate to measure TEV?

One of the aims of this study was to examine the accuracy and appropriateness of CV in this context. Testing the validity is an important step (Hanley and Spash, 1993) and is conducted here. There is a clear difference in the mean bids between the two scenarios and in the reasons given for positive bids which shows that content validity has been achieved. This also suggests that insensitivity to scope is minimal, as do the different WTP distributions (see graph 18). Answers for zero bids such as; 'I would not pay for that, as it is not important to me' show that the respondent has understood what is required of him or her. Infact, many answers given suggested that the cognitive burden associated with the CV study was not prohibitively high. For example one carpenter (Jabira, 01.08.04) said that he would pay towards the first scenario as his profits relied on the profits of fishers.

The relative magnitude of the different bids also supports both convergent and construct validity, although the estimated mean values are lower than was expected from the literature and the use and indirect studies (as previously discussed). This contradicts the opinions of many critics who say that CV estimates are too high (Willis and Garrod, 1999).

Many studies have found problems with large numbers of non-responses and large numbers of zero bids, but this was not true for this study. Similarly the presence of lexicographic preferences was not a significant predictor of WTP in the econometric analysis. Any rights based views, which were explored during the attitudinal survey were minor. One interviewee commented 'Bajo people cannot afford to be sad when they kill fish' (Jono, 01.06.04.). During the de-briefing interview with the translator, Andar expressed the concern that respondents did not see the link between their values and the amount they bid. Understanding the reason for the CV exercise is not necessary however, as long as they respond truthfully to the scenario presented to them.

A CV study seeks to ensure that *stated* WTP approximates *true* WTP i.e. the preferences of the respondents. Many of the necessary steps have been taken to minimize biases and ensure valid results in this study, so the results should be reasonable estimates of these values, for this specific area of coral reefs.

7.2.1 The Cultural Context and Contingent Valuation.

The contingent valuation methodology makes several assumptions relating behaviour, WTP and preferences. Individuals or households should act as rational economic agents that maximise their welfare by making choices (expressing preferences) subject to various constraints (Hanemann, 1984). Within this community however, there are several things that may violate these assumptions. Many people within Sampela have little concept of private ownership and little material culture. Sharing of all goods is widespread, with no obvious accounting, especially in the area of the village where the subsistence fishers are concentrated. Loans are frequently taken out, with no intention of paying them back and wealth or savings are not seen as important. Nevertheless individuals were observed to discuss how much they could afford to pay with their families, so they did act under income constraints. During the pilot study, fish had been tested as a proxy for money (in order to reduce zero responses), however many people had responded that they would pay Rpxx in fish, illustrating their readiness to consider monetary values.

However evident changes in material aspirations (large wooden and abspestos houses), changes in fishing practices (e.g. motorised boats with crew members), in social status, education etc, show that a growing number of fishers have been adopting a more capitalist lifestyle. However, stratified random sampling was used to ensure that all sets of individuals would be accounted for, which is important in a non-homogeneous community. This subsistence / modern ethic was explored in the econometric analysis (see appendix 7, Q2), however this categorisation of households was not a good predictor of WTP for either scenario.

7.2.2 Conducting a CV Study in a Developing Country.

Several areas of CV design and implementation need particular care in a developing country context. Local people may not understand the degree to which they are dependent on reef resources. Whilst the opening section of the CV scenario tried to ameliorate this, it is not clear as the extent respondents were able to take in so much information, especially if it was unfamiliar. During the attitudinal study, only a third of interviewees were able to think of any non-monetary benefits associated with the reefs.

Many potential problems such as lack of understanding were overcome with simple solutions such as visual aids. The payment ladder approach was easily understood and used, despite the lack of literacy. Local translators need to be carefully prepared to avoid influencing bids and using exactly the same scenario each time. They can however help to minimise interviewer bias, if they are familiar to interviewees.

WTP is usually an under-estimate when subsistence use is the main activity (Lal, 2004). Importantly the 1997 economic downturn in Asia may have decreased local's WTP relative to that of foreigner's. It is therefore helpful to contrast WTP to income. The average household monthly WTP for all benefits associated with the reef is Rp18,527, almost 70% of the average daily household income in this storm season. The average household monthly WTP for religious, recreation and non-use benefits was Rp3,936, which is 15% of the average daily income in the storm season.

The attitudinal questions can also help to draw out qualitative data that probes these preferences further. When asked the significance of the reef to their households, 84% of respondents answered: their livelihood. The livelihood analysis also demonstrates the reliance of this community on the reef. These additional considerations put CV results into context. They also have important political implications, when considering management options that would invariably have a great effect on this community. The majority of income generated within this village comes from the reef. The multiplier effects of that income are then fed into other industries such as shop keeping and carpentry. The survival and future of this community, if no alternative livelihoods are created, depends completely on the local reefs. This is not adequately emphasised by the preferences elicited in the CV studies however, which could be seen as relatively low. This is also because only one area of reefs is valued, rather than all reefs.

7.3 Calculating a Total Economic Value for the Reefs at Sampela

Ruitenbeek and Cartier (1999) warn that actual methods used to estimate separate values may not always be additive, although they should have a functional relationship. They caution that contingent valuation studies in particular can measure both use and non-use values, so that care needs to be taken to avoid double counting.

The overarching aim of this study is to aggregate results as appropriate to calculate a total economic value of these reefs. The first CV scenario will include some of the values addressed by other surveys e.g. extractive values. It is not possible to separate the consumer surplus and the underlying prices, as this estimate of WTP includes many benefits that are not traded. Including the TEV WTP estimate will result in double counting and is therefore avoided. The other values can be added together however. Therefore for Sampela:

TEV = extracted resources + non-extractive resources (ecotourism) + indirect benefits (coastal protection) + non-extractive and non-use benefits (2nd CV WTP estimate).

(Equation 4).

The **TEV** for these reefs is **2,858,837,633** Indonesian Rupiah (over £176,000), providing a **PV**[24] over 20 years and with a 10% discount rate of Rp**24,338,896,353** (over £1.5 million). This means that each km^2 has an average total economic value of Rp**109,955,294** (£6,786) to *this community alone*. Burke et al's (2002) estimate of potential annual economic net benefits per km^2 of healthy reefs is $23,100 - $270,000. White and Cruz Trindad's (1998) estimate is $29-113,000 per km^2 of Philippine reefs. As discussed previously, the degradation that has occurred on these reefs may limit the net benefits it provides. The low value of the property here will also limit its value, in addition to the availability of substitute reefs. These values are difficult to compare directly as one relates to one community and another to global communities.

7.3.1 Is TEV really Total?

A discussed previously, TEV may only capture part of any instrumental or primary value associated with reefs, as it is an anthropocentric preference based measure. It depends both on uses and perceptions, so that a more visited coral reef will have a higher TEV. It will also not include ecological process value or social benefits such as food security and employment e.g. resilience functions or cultural function value, as no methods exist to evaluate these. Most of the benefits of these reefs are nonetheless captured by this study. The only exception is the value of the pelagic fishery

[24] present value is used here, as not all costs have been included.

attributable to the presence of this reef, which could be significant, as pelagic fish provide a considerable proportion of income from the sea. Effect on production could be used to value this, if in the future, if this relationship can be quantified.

7.3.2 Future research

From an academic perspective, it is advisable to investigate design effects and operational bias associated with contingent valuation experiments in developing countries. These can be tested by using split sample surveys with different formats (Cartier and Ruitenbeek, 1999). Also, it would be interesting to investigate the deliberative and consensus based approach for valuing resources, advocated by Sagoff (1998) and Wilson and Howarth (2002). Results from these kinds of methods could be compared to those achieved by investigating and aggregating individual preferences, such as the TEV approach.

There are several areas of research which could provide beneficial information for informing management of the Wakatobi National Park. The high birth rate in this region (each family in Sampela had an average of 6 children), which will only increase the pressure and pollution on the marine resources. Conducting TEV estimations of the different reefs within the Park, would also enable other key stakeholders to be identified and highlight areas were social gains can be increased. Conservation efforts such as income diversification and alternative livelihood generation must be focused towards these groups and consider the incentives and needs of users and equitable sharing of benefits, if they are to be successful. The TEV framework and methodology applied here could also be used to investigate the effect of policies and initiatives or to predict their effects by incorporating TEV estimates into cost-benefit exercises.

From a broader perspective, the TEV framework could be used to value reefs at the local, national and global level, to help establish those which most merit use of the limited available funds for conservation. Different values such as research and biodiversity values, which were not significant here, could be at a global level. This information could also provide indications of possible funding sources. If many countries are benefiting from a coral reef ecosystem service, the burden of funding should not fall only on the country where it is found.

7.3.3 Is Estimating the TEV of these reefs a valuable exercise?

Whether or not we appreciate it, valuations are made implicitly all the time. Every time a development goes ahead which damages the environment, the development's net benefit has been valued less than the environment (Spurgeon,1992). It is crucial to have a good understanding of real values as undervaluation can lead to over exploitation and overvaluation to serious inefficiencies in the market. Money a useful measuring rod for this purpose (Pearce et al, 1989).

Several notes of caution need to be applied to TEV estimates. First various assumptions are necessary, particularly due to limited knowledge of ecological interactions and impacts of human activities on coral reefs (Cesar, 2000). Lack of knowledge about values such as these will lead to a misrepresentation of TEV (Ahmed et al, 2003). Secondly, the values of coral reefs are highly interlinked. It is difficult to predict the effect of one change (e.g. management or degradation) on other values as they will be simultaneously affected. Thirdly, using TEV to calculate present values for long periods of time is difficult as values change when activities, uses and perceptions of the reef change. In addition the choice of discount rate introduces a certain level of subjectivity. Using a 3% discount rate (e.g. Cesar et al, 2003) will increase the present value estimate a great deal. The effect of this kind of value judgment needs to be made clear to policy makers and managers of marine national parks.

Despite these limitations, TEV enables understanding of the absolute and relative value of specific coral reefs, such as those this study addresses. It also provides information about the different values held by this community, including intangible benefits such as cultural values, which can then be incorporated into decision making. Different objectives can be assessed by estimating the TEV of different goods, services, functions, and the existence of coral reefs under different conditions. Values are usually very site-specific, so it is important to be cautious about generalising results. The most valuable benefit from these reefs are their associated fisheries, unlike reefs that have been values elsewhere, where tourism provides the highest value.

Local level information is increasingly important as poor results in the past from 'top down' conservation initiatives have resulted in increased devolution to local community

levels. Local level valuation is very costly however. Managers need to decide what information and at what level of detail is necessary for each case. This is a relatively quick way to establish TEV to a local community which may need to be supplemented by other kinds of information, but nevertheless provides sufficiently accurate information for informing local management plans in the Wakatobi and elsewhere. It also demonstrates an economic case, in addition to an ethical one, for conserving these resources, whose value is frequently underestimated. As the number of remaining reefs continues to fall, the economic values associated with reefs will only continue to rise.

Pet-Soede and Erdman (1998) summarise the benefits of valuation information. "Most of these resources, including the fisheries…. are of very high-value and have the potential to sustain the country and fuel its development in the future if carefully managed. Unfortunately, if Indonesia continues to undervalue these resources and export them in a desperate bid for foreign currency, it may emerge from the financial crisis only to find itself plunged even deeper into environmental crisis."

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

This project estimated the most significant benefits that the nearby coral reefs provide to the community at Sampela, to estimate a total economic value for these reefs. Coral reef valuation literature has not previously been directed at local communities who are highly dependent on reefs. The Wakatobi National Park, where this case study was conducted merits special attention, as it is at the centre of global marine biodiversity. It is also an area where the reefs are at high risk of destruction and where the largest marine conservation project to date is being initiated. The community of Sampela merits special attention as they are key stakeholders of the reefs in this area.

The conclusions of this project are summarized in the following points:

- The 26km^2 of fringing reef reefs near the stilted community of Sampela have a total economic value (TEV) of nearly 2.86 billion Indonesian Rupiah (over £176,000) in 2004, which is an average of Rp110 million (nearly £6,800) per km^2.
- These reefs have a present value (over 20 years, with a 10% discount rate) of nearly Rp24.3 billion (over £1.5 million).
- The largest proportion of this value to Sampela is attributed to the fish and invertebrates that are extracted by this community, for income, food, gifts and wages. Gross financial annual benefits from these fisheries are over Rp2.4 billion (nearly £150,000).
- Eco-tourism revenue from students who dive on these reefs frequently (facilitated by Operation Wallacea) provide the second largest benefit from the reef. Payments for fish and services provided by the inhabitants of Sampela brought Rp310 million (over £19,000) to this community in 2004.
- Physical protection for houses and coral platforms from waves (during the Northerlies season) is estimated to have an annual value of over Rp111 million (nearly £6,900) for this community. Other local indirect benefits such as pelagic fisheries support are not possible to quantify at present.
- Non-use, recreational and religious values can be estimated by conducting a

contingent valuation study. These were estimated to be Rp10 million each year, which is over Rp400,000 (£25) per km^2 of reef per year for the community of Sampela.

- The contingent valuation study also estimates the TEV of the area of reefs nearest to the village of Sampela to be over Rp50 million per annum (£3115) from aggregating an average household willingness to pay (WTP) of nearly Rp220,000 (£14) per year to access them.
- The cognitive burden, lexicographic preferences and the subsistence nature of the local economy, which can be problems with contingent valuation studies in developing countries, were not significant in this project, although strategic bias may have reduced stated WTP.
- A livelihood and income analysis demonstrated the complete reliance of this community on the coral reefs for food and employment. This means that it is essential to include them in any potential conservation initiatives, if they are to succeed. The attitudinal study showed that they are not aware of all the benefits coral reefs provide and are skeptical of marine park management.
- This framework allows many different aspects of total economic value to be addressed. The study uncovers significant financial and non-financial values and demonstrates the economic value of the reefs in this area.

8.2 Recommendations

There are several recommendations that can be made following the conclusions of this project.

- The management of this valuable protected area needs to be increased. Specifically, more patrols are economically justified to detect and punish bomb and cyanide fishers. The TEV calculated here can be used as a guide to decide appropriate funding. The values uncovered in this study should be considered in marine-park and regional decision making.
- Eco-tourists coming to use these reefs should be charged, to help to raise conservation funds. Contingent valuation could be used to establish an appropriate fee.
- Alternative livelihoods need to be generated for the Bajau, which do not degrade the reef e.g. intensification of seaweed cultivation, as the numbers of people dependent on these reefs is continuing to rise sharply. These should ideally be accompanied by education initiatives to raise awareness about the values of these reefs and the values at risk from destructive practices.
- This TEV framework should be used for further research. Cost benefit analysis could be used to assess management and policy options in this region. For example, assigning property rights to local communities such as the one at Sampela may encourage more sustainable long term use. This can help to identify 'win-win' management solutions.
- Eight percent of Indonesian coral reefs are currently protected. This area should be expanded. Calculating TEV for different reefs could help to identify those areas and values that most merit protection.
- The social and private values associated with coral reefs should be incorporated into national green accounting and made available to policy makers, so that the destruction of these reefs, a global market failure, is halted.

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APPENDIX 1. Economic Values of Marine Resources.

Direct Use: Extractive Values			
Study	**Valuation Method**	**Valuation results**	**Notes**
Fisheries Valuation **Philippines** (*McAllister, 1988*)	EoP	$80 million/yr in lost fish production caused by dynamiting, and poisoning of coral reefs; based on estimates of current and potential production.	Production levels are calculated for varying levels of reef damage.
Aquarium Trade **Philippines** (*McAllister, 1988*)	Production Approach	Global aquarium trade attributable to the Philippine Coral Reefs: $10 million in 1988 could be increased by 50% with sustainable production practices.	The price of Philippine aquarium species is discounted inter-nationally due to method of capture.
Fisheries Valuation **Taka Bone Rate Coral Reef Atoll, Indonesia** (*Sawyer, 1992*)	EoP	CBA study to evaluate management options (i) no management (ii) establishment of marine park with regulated fishing. PV gross revenues Rp 2 - 103 billion without management versus, Rp47 - 777 billion with management.	Based on fishing activity surveys and sensitivity analyses wherein fish catch declines range 0-15% and discount rates vary 5-15%.
Fisheries Valuation **Indonesian Coral Reefs** (*Cesar, 1996*)	EoP	NPV of fisheries loss per km^2 of reef: $40,000 (poison fishing); $86,000 (blast fishing); $94,000 (coral mining. $81 (sedimentation); $109 (over-fishing): based on assumptions about the reef and fisheries impacts of these actions.	Study uses CBA to evaluate the private and social net benefits of a sustainably managed reef with those of a fishery subjected to detrimental fishing practices, coral mining or sedimentation.
Artisanal Fisheries Valuation **Montego Bay Reefs** (*Gustavson, 1998*)	Production Approach	Net Present Value US$1.31 million (1996) or **$70,000 /ha** (with a 10% discount rate). Includes trap, net, hand line and spear-fishing by local fishers.	Base case assumes shadow price of labor of 75% market rate; 100% market valuation leads to negative NPVs for fishing.
Fisheries Valuation **Great Barrier Reef** (*Driml, 1999*)	Production Approach	Gross revenue **A$143 million** (1996): based on 1995/1996 catch data for major commercial species, and a survey of current fish prices.	

Value of Pharmaceuticals **Montego Bay Reefs Area** (*Ruitenbeek & Cartier 1999*)	Future Benefits Model	Average Net Social Value of species in base case is estimated to be **$7775**. Based on base case sampling program, total social NPV of Montego Bay reef area is US$70.09 million. First differential of the benefit function yields **US$530,000/ha** coral abundance.	Model includes drug values, local bio prospecting costs, institutional costs, discovery success rates for marine extracts, and a hypothetical bio prospecting program. Authors note sensitivity of results to assumptions.
Economic Use Value **Bunaken Marine Park, Sulawesi, Indonesia** *(USAID, 1996)*	Production Approach	Direct use values (net of costs) calculated included artisanal fisheries US$ 2.48 million; commercial fisheries US$765,000; seaweed cultivation US$554,000; gleaning US$37,000. The total estimated value of the park to local fisheries was US$3.884 million per annum at the park boundary.	65% of the total value was generated by artisanal fisheries. This estimate excludes the value of the fishery to part-time fishers. Reef yield was 45 tonnes per km^2.
Traditional Fisheries. **Tongean Islands, Sulawesi, Indonesia.** (Cannon, 1999)	Production Approach	Economic value fisheries estimated as Rp36.3 billion – 196 billion.	Calculated with a 5% discount rate over 25 years.

Direct Use: Non - Extractive Values			
Study	**Valuation Method**	**Valuation results**	**Notes**
Visits to Reef Region **Great Barrier Reef** (*Hundloe et al,1987*)	TCM	**A$144 million /year** consumer surplus for domestic and international tourists.	Based on travel cost expenditure by visitors to the reef region.
Visits to Coral Sites **Great Barrier Reef** (*Hundloe et al, 1987*)	CV	A$6 million/yr consumer surplus or over **A$8/adult** visitor WTP to see coral sites in their present (1986) condition.	Based on a survey of visitors to reef sites only, thereby excluding all other attributes of the Great Barrier "Reef Region". Reported Hundloe (1990).

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Tourism Value **Palawan Reef**, **Philippines** (*Hodgson & Dixon 1988*)	EoP	PV gross revenue $6,280 with logging versus $13,334 with logging ban; based on mean hotel capacity, occupancy, and daily rates; assumed 10% annual decline in tourism revenue due to degradation of seawater quality from sedimentation.	CBA study evaluates management options: (i) continuation of logging as usual; (ii) logging ban in Bacuit Bay drainage basin.
Tourism Value **Indonesia Coral Reefs** (*Cesar, 1996*)	EoP	For each activity, reef degradation causes a decrease in potential tourism revenue. NPV of tourism loss/sq km of reef $3000- 436,000 (from poison fishing); $3000-482,000 (blast fishing or coral mining); $192,000 (sedimentation).	CBAs for each reef - destructive activity estimate the value of tourism loss. Based on assumptions on the rate of reef degradation associated with each practice.
Recreation Value **Montego Bay Reefs** (*Gustavson, 1998*)	EoP	Recreation NPV US$315 million (1996) or **$17.2 million/ha**. Includes tourist related accommodation, food & beverage, entertainment, transportation, retail and miscellaneous services.	Cost of service provision is deducted from gross values to arrive at net values.
Recreation Value **Great Barrier Reef** (*Driml, 1999*)	Production Approach	Gross Recreation Value A$769 million (1996) includes A$647 million for commercial tourism and A$123 million for recreational fishing & boating.	Based on volume & price data for hotel stays & reef trips, and survey data for private recreational boat use.
Recreation Value **Bolinao Reef, Philippines** (*Ahmed et al, 2003*)	TCM	The study estimated an average consumer surplus of **US$223 /person**, equivalent to US$1.3 million.	Based on the crude estimate of 5 845 visitors to the reef at Bolinao in 3 month peak season in 2000.
Recreation Value **Andaman Coral Reefs, Thailand** (*Seenprachawong, 2003*)	TCM	Estimated an annual benefit from the recreational services of Phi Phi at US$205.41 million, i.e. the value of Phi Phi is about **US$6 243 /ha /year**.	
Research Value **Panama Coral Reefs** (*Spurgeon, 1992*)	Survey Method.	**$2.5 million** in 1991. Based on percentage of Smithsonian Research Institute's budget for work in Panama.	One sixth of the budget is considered to be attributable to coral reefs.
Education & Research Value **Belize Coral Reefs** (*Spurgeon, 1992*)	Survey Method	**$150,000/yr**; based on annual expenditures by UK Coral Cay Conservation to maintain 25 researchers on reefs in Belize.	Employs a utility approach.

Dive Value **Bonaire Marine Park** (*Pendleton 1995*)	Production Approach TCM	Net Tourism Revenue $7.9 to $8.8 million (1991); based on ownership & profit data. $19.2 million consumer surplus. Park NPV: $74.21 million local benefits; $179.7 million consumer surplus; based on 20 yr period, 10% discount rate.	Study used a net value estimate. It argues for a "project appraisal approach" to protection valuation.
Recreation Value Marine Park, **Malaysia** *(Yeo, 2002)*	CVM	Calculated WTP for entry of national and international tourists into the park of RM16 per person (US$4). An estimated RM$1.48 million (US$390 000) could potentially be raised to fund park management.	Payment ladder approach was used. Protest responses and unusual answers were excluded. 91% of visitors were WTP this entrance fee.
Tourism & Recreation Value **John Pennekamp and Key Largo, Florida.** **(***Leeworthy, 1991)*	TCM	Consumer surplus for tourism and recreation of US$285 to $426/person/day.	Based on survey of 350 park users in 1990.The inclusion of opportunity cost measures was found to significantly increase consumer surplus estimates.

Indirect Use Values			
Study	**Valuation Method**	**Valuation results**	**Notes**
Coastal Protection **Philippine Coral Reefs** (*McAllister, 1991*)	Replacement Cost	**US$22 billion**; based on construction costs of concrete tetrapod breakwaters to replace 22,000 km^2 of reef protection.	As reported in Spurgeon (1992).
Coastal Protection **Indonesian Coral Reefs** (*Cesar, 1996*)	Production Approach	NPV of coastal protection/sq km of reef lost: $9000-193,000 (blast fishing); $12,000-260,000 (coral mining); based on replacement costs, the rate of reef destruction from each activity, and the rate of decline in reef's ability to protect.	CBAs for each reef destroying activity include costs of protective function losses. For each activity, reef destruction reduces the protective capability of the reef.

Coastal Protection **Montego Bay Reefs** (*Gustavson 1998*)	Value at risk (Damage Costs)	Net Present Value US$65 million (1996) or **$3.54 million /ha** (10% discount rate). Based on land values at risk or vulnerable to coastal erosion along foreshore.	Upper value is dependent on highly speculative erosion incidence assumptions in absence of reef.

Non - Use Values			
Study	**Valuation Method**	**Valuation results**	**Notes**
Existence & Option Value, **Great Barrier Reef** (*Hundloe et al, 1987*)	CV	$45 million/ year consumer surplus of **$4/person** WTP to ensure that the reef is maintained in its current state.	Based on 1986 mail survey of Australian citizens 15+ years old (excluding reef visitors). Reported in Hundloe (1990).
Non-use Value **Montego Bay Reefs** (*Spash et al, 1998*)	CV	Expected WTP for tourists ranged from **$1.17 to $2.98** for 25% coral reef improvement; for locals range was **$1.66 to $4.26** Based on population characteristics, non-use NPV of Montego Bay reefs estimated to be US$19.6 million. Upper values were for respondents perceiving strong moral duties and rights; lower were for no such duties/rights.	Survey design specifically designed to address lexicographic preferences through probing of zero bids and analysis of zero bids using tobit estimation.
Non-Use Value **Curaçao Coral Reefs** (*Spash et al, 1998*)	CV	Expected WTP for tourists ranged from **$0.26 to $5.82**; for locals range was **$0.19 to $4.05**. Based on population characteristics, non-use NPV of Curaçao reefs estimated to be US$4.5 million.	
Existence Value **Price William Sound, Alaska** (*Carson et al, 1992*)	CVM	Median $31/household one time tax for measures to prevent future oil spill like that of the Exxon Valdez; based on in-person survey of 1043 US citizens; WTP aggregated over affected households yielded $2.8 billion in lost non-use value.	Natural Resource damage assessment done for the state of Alaska as reported in Pearce and Moran (1994) and Carson et al, 1996)

Non-Use Value **Pulau Payar Marine Park, Malaysia** (*Ayob et al, 2001*)	CVM	The finally WTP for non-use values calculated was RM30.14 (US$7.93). 52% of respondents agreed to contribute for bequest value, 22% existence value and 17% option value.	Used CVM referendum method. Original averaged value was revised.

Total Economic Values		
Study	**Valuation results**	**Notes**
Coral Reef Value **Negril, Jamaica** (*Wright, 1994*)	CV used to calculate **$31/person/yr** WTP, for a consumer surplus of $5 million/yr by visitors to maintain coral reef in current condition; and **$49/person/yr** for a surplus of $8 million/yr to restore reefs to "excellent" condition; based on CV survey & 162,000 visitors/yr.	TCM was also used to estimate a demand curve for vacations; to examine the resultant shift in demand and reduction in tourist volume should reef quality decline.
Sustainable Annual Net Economic Revenues **Philippine Coral Reefs** (*White and Cruz Trinidad, 1998*)	Potential annual net revenue from **US$29,400 to 113,000 per km^2**. Resources included are: Local fisheries ($12 - 36,000), live fish export ($4 – 8,000), tourism ($3 -36,000), coastal protection ($5 – 25,000) and aesthetic/ biodiversity value ($2 – 8,000).	Relates to high quality coral reefs and associated habitat. Calculation includes only real and potential values accruing to the island community. Calculated with average market prices, average expenditures and physical protection values from various studies.
Value of Reefs **Hawaii** (*HCRIRP, 2002*)	Reefs valued at $10 billion and generate **$360 million a year**, based on tourism and fisheries values, plus research and non-use values	Tourism is highest value, followed by research, then fisheries. No estimate of protective or cultural benefits included.
Value of Reefs **Indonesia** (*Burke et al, 2002*)	Total value of reefs in Indonesia: **US$1.65 billion**, NPV $14 billion. Of which $1.2 billion from fisheries, $314 million coastal protection, $103 million tourism and $9 million from aesthetic & biodiversity values.	Numbers estimated using a number of studies.
Dive Value **Zanibar Reefs** (*Ngazy et al, 2004*)	CV used to calculate average WTP of **US$84.70 /person / year** to dive in more pristine reef sites.	157 divers surveyed. Calculated an economic loss from coral bleaching of US$1.6-4.8 million.

APPENDIX 1. Economic Values of Marine Resources.

TEV **Andaman Coral Reefs, Thailand** *(Seenprachawong, 2003)*	CV used to estimate the utility values associated with coral reef biodiversity at Phi Phi. CV estimated the total value (use and non-use) of the reefs to be US$497.38 million a year, averaging **US$15 118 /ha /year**.	Mean WTP per visit was estimated as **US$7.17** for domestic visitors and as **US$7.15** for international visitors. Total value of Phi Phi's coral reefs was estimated to be US$147 000 /yr for domestic visitors and US$1.24 million /yr for international visitors.
TEV **Galapagos National Park** *(de Groot, 1992)*	Total annual monetary returns from direct and indirect use of the Galapagos National Park approximate US$120/ha/year. PV = US$2,400/ha or almost US$2.8 billion for the entire study area.	5% discount rate used. A cost-benefit calculation estimated US$7/ha/yr.
TEV **Bonaire Marine Park** *(Pendleton, 1995)*	Park NPV estimates local benefits at US$74.21 million and consumer surplus as 179.7 million.	Based on a 20 year period and discounted at 10%
Dive Value **Bonaire Marine Park** (*Dixon et al. 1993*)	CVM: $27.40 average WTP for a consumer surplus of $325,000; based on 18,700 divers in 1992 paying a $10/diver/yr fee. Production Approach :Gross tourist revenue of $23.2 million (1991).	The study also estimated the revenues and costs of dive tourism, and the carrying capacity of dive sites (4000-6000/site/yr, for a total of 190,000-200,000).

EoP = Effect on Production, NPV =net present value, PV = present value, CBA = cost benefit analysis, WTP = willingness to pay, CVM = contingent valuation methodology, TCM = travel cost method, TEV= total economic value.

Reproduced from USAID (1996), Cartier and Ruitenbeek (1999) and Cesar (2000) and Cesar and Chong (2004).

First Survey: Uses and Attitudes.

House ID	**Name**
Day / Date	**Time**

Roof coconut / metal / absestos	**Walls** bamboo / wood / concrete
Floor bamboo / wood / concrete	**Rooms** 1 / 2 / 3 / 4 /
Platform coral / stilts	**Outhouse?** yes / no
Electricity Yes / No	**T.V.** Yes / No
Generator Yes / No	

Notes……
…….

1. How many men are there in your household?
2. How many women are there in your household?
3. How many children are there in your household?

Uses.

4. Please describe the importance, if any, of the coral reefs around Kaledupa to your household…

5. Can you tell me all the things that **all** the members your household collect **yesterday** from coral reefs, seagrass and open sea?
   - how many of each (one by one)?
   - What done with them e.g. eaten, gift, traded, sold?
   - How may fed, who to or what for?

Marine Product	Quantity	What done with it?	Details
e.g. Reef fish		Eaten sold barter gift	How many people fed? How sold much for? What received in exchange? To who?
Tuna			
Agar			
Shellfish			
Turtle			
.....			
.....			

6. I would like to know all the ways your household collected these things yesterday and how much time was spent on each.

Location	Habitat	Method	**Time & number trips**
	Reef, open sea or seagrass.		

7. How much time did all the people in the house spend selling the fish if any of it was sold?

8. Was yesterday's catch typical of most days in the week in this season (easterlies)? If no, how was it different?

9. (i) Does anyone in your household spend anytime on the reef doing any of these?
    a) Recreational uses
    b) Religious ceremonies
   (ii) Did they spend any time doing either of these yesterday?

10. Do you think that other than economic benefits, the coral reefs have any other importance?

11. Do you think that living on the reef has any negative consequences for the people in your household?

12. I would like you to think about all the income this house gets from things from the sea such as fish and agar and sea cucumbers compared to all the income you get from other sources such as selling cakes, owning a shop etc.

    If these pebbles represent all that **income** throughout the year, can you divide it into that from sea related things and those from other sources.

13. Does this change at different times of the year? If yes, how?

Attitudes.

14. What condition do you think the reef is in at the moment, compared to if there were no people using it or living on it (percentage)?

15. If there has been a decline – what do you think about this?

16. What things do you think affect how much you catch and collect from the reef?

17. Do you think that the activities of humans have an impact on the reef[25]? If yes, Can you tell me about these?

18. If the reef around Kaledupa was being destroyed, considering that there are other reefs within the park,
(a) what would you do?
(b) How would you try and better the situation?

19. Whose responsibility is it to deal with problems and threats to the reef?

20. Which job would you like your children / grandchildren to have?

21. Do you think that the creatures and corals in the sea have any rights to be protected?

Terima Kasih untuk waktu anda.
(Thank you for your time)

[25] Leading, but I need to establish for definite that they can attribute human causes to reef degradation.

APPENDIX 3.
Second Survey: Contingent Valuation and Socioeconomic Information

Script for contingent valuation:

The reef you live on gives many good things to people living in Sampela. These include:

- Reef fish, lobster, turtle, sea cucumbers and many other creatures for food and money.
- the possibility to live away from the land, from using coral for the platforms of people's houses.
- it also helps to nourish tuna and other animals in the deep sea, the sea grass and in the mangroves.
- Also it takes in some of the waste the community produces.
- and protects the houses from the waves that come with the northerlies.
- it also helps to maintain a healthy and beautiful environment underwater.

Please imagine that it is certain that all the reefs on the East-side of Kaledupa island are in danger of being completely destroyed from overuse and cyanide. This means that all these benefits could be lost.

The government has decided to limit the use of the reef, especially to outsiders. This is to make sure that the quality of the reef does not continue to fall, so that there would be more fish, octopus and all the other things from gleaning and fishing. Over many years, the reef would recover to be like it 15 years ago**.** There will be lots more patrols and strong penalties to make sure this happens. The Kepala Desa needs each household that wants to fish, glean, collect agar, coral mine and use the reef for fun and ceremonies, to pay towards a community fund for Bajo rangers. As long as you contribute, your household can use the reef as much as you like. If you do NOT pay, you will not be able to use the reef which will be degraded. The reef quality would be expected to decline so that it would no longer exist for your children and grandchildren.

---

1) How much is the closest to the most that your household would be willing to give every month? You should remember that a contribution would ensure access for everyone in your house to a healthy reef, with gradually increasing fish stocks, for as long as you paid it. However, there are other reefs in the area and this would leave less money for other things.

(i) I would like you to tell me which category (Rupiah per month) is closest to the maximum you would pay.

0
1,000
2,500
4,000
6,000
9,000
14,000
20,000
30,000
45,000
60,000
80,000
100,000.

APPENDIX 3.
Second Survey: Contingent Valuation and Socioeconomic Information

a) (if +WTP) Do you think your answer is one that you would actually pay every week to preserve the reef?
b) If + WTP or 0 WTP - why?

---

2) IMAGINE that your house was no longer able to take things from the sea, from gleaning and fishing etc, but that you had exactly the same amount of income and food, did not need to go fishing or gleaning. You are asked to contribute to ensure the future of the reef. You and your children would still be able to use the reef for Bajo ceremonies, parties, and a place to relax and meet at low tide. Your children would also inherit a healthy reef and could carry on the traditions associated with the reef. There are other reefs in the area and this would leave less money for other things. Would you still contribute?

(i) I would like you to tell me which category (Rupiah per month) is closest to the maximum you would pay.

a) (if +WTP) Do you think your answer is one that you would actually pay every week to preserve the reef?

b) If + WTP or 0 WTP - why?

c) Did you find these two valuation questions difficult to answer?

Socio-economic Information.

22. What are the occupations that bring food and income in this *household* throughout the year, including those that are not to do with the sea please?
    - Are they seasonal or quite stable throughout the year?
    - Can you rank them in order of importance please?

Occupation	Person	Seasonal? All year? (details)	Rank

23. Do you own a boat?

Number	Motor boat / canoe / kalako / tuna boat / ketinging

24. Do you or anyone else in this household have any loans?

Who?	To Whom?	For how much?	For how long?

4. Could you tell me which category of savings your household has please?

A) Rp 0 – 100,000 B) 100,000 – 500,000
C) 500,000 – 1 million
D)1 million – 2 million E) Rp > 2 million
Rp_____

5. (a) In the storm season, what are good, bad and average daily incomes when working?
   (b) In the calm season, what are good, bad & average daily incomes when working?

APPENDIX 4. Additional Data Collected.

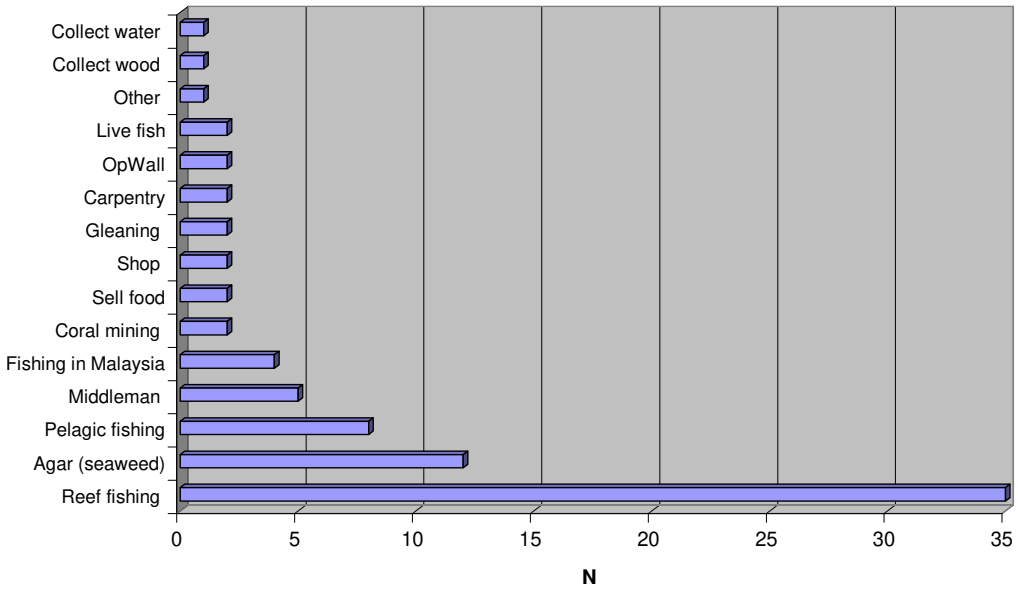
(1) Comparison of Total and Sample Population Statistics.

	Population at Sampela	**Sample Population**	**% of Total Population**
Households	227	80	35.2%
No. People	1156	401	34.7%
Males	262	86	32.8%
Females	297	121	40.7%
Children	960	194	20.2%

(2) Daily Income Variation for Households in Sampela

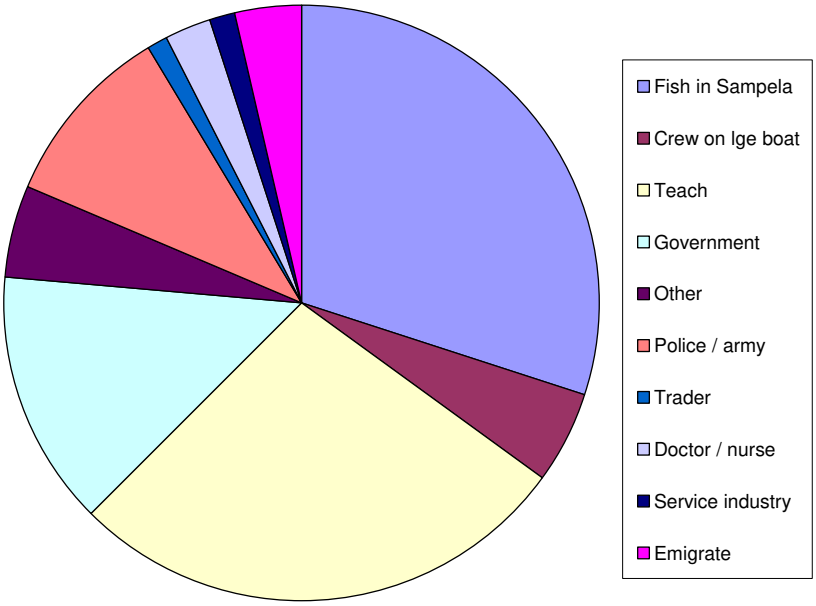
Season	Type	Mean (Rupiah)	Std. Dev.	Min (Rupiah)	Max (Rupiah)
Stormy	Good	100331.2	206399.5	4500	1500000
	Bad	5110.39	8165.486	0	50000
	Average	26558.44	33298.59	0	200000
Calm	Good	96870.13	96366.67	10000	500000
	Bad	15207.79	18768.74	0	100000
	Average	41792.21	37965.82	5000	200000

(3) The Most Important Income source for Each Household.

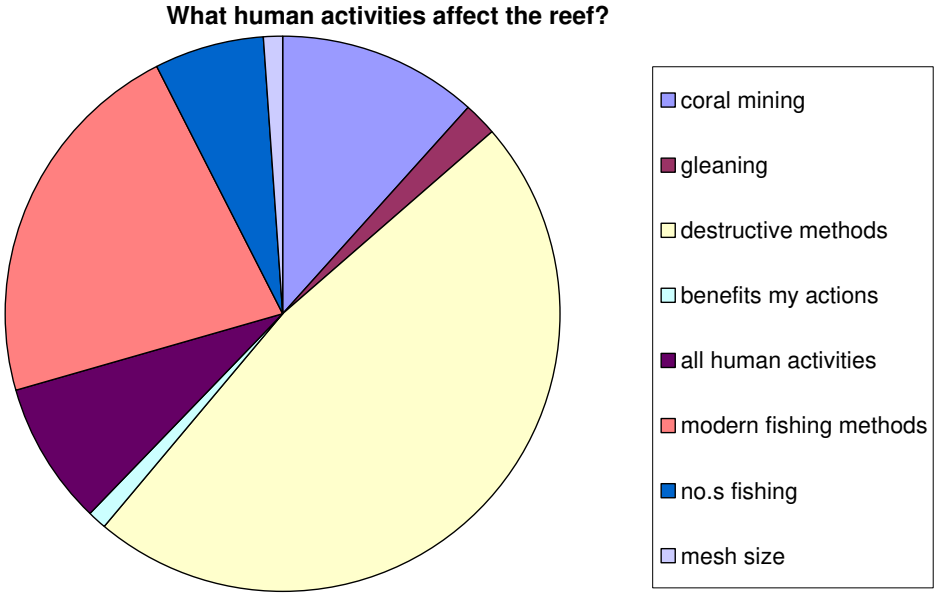


APPENDIX 4. Additional Data Collected.

(4) What Job Would You like Your Children / Grandchildren to Do?



(5) What Human Activities have an Impact on the Reef?



APPENDIX 4. Additional Data Collected.

(6) Full econometric results for scenario one econometric analysis, including and excluding the protest bids.

	All Data		Protests removed	
N	77		74	
F-stat	9.28		10.05	
Prob > F	0.000		0.000	
R-squared	**0.555**		**0.586**	
	Coefficient	**P>[t]**	**Coefficient**	**P>[t]**
Iffy	-16003.85	0.003	-21134.38	0.000
Negatives	18706.94	0.000	20631.39	0.000
Calm av Inc	0.267	0.000	0.280	0.000
Difficulty	17975.39	0.023	21033.56	0.008
Cash	0.0496	0.018	0.053	0.011
1e income reef	9077.66	0.087	13066.6	0.019
No. incomes	-3281.25	0.076	-3611.236	0.048
Catch Q1	9022.917	0.059	9213.597	0.055
No. boats	4113.758	0.089	4504.633	0.059

(7) Full econometric results for scenario two econometric analysis, including and excluding the protest bids.

	All Data		Protests removed	
N	76		70	
F-stat	10.24		9.91	
Prob > F	0.0000		0.0000	
R-squared	0.52		0.54	
	Coefficient	**P>[t]**	**Coefficient**	**P>[t]**
Cash	0.027	0.000	0.027	0.000
Savings	-0.0015	0.015	-.0014893	0.015
Focus Group 2	-3200.645	0.018	-3202.099	0.021
TV	2228.927	0.022	2320.333	0.023
Problem	-1570.907	0.083	-2081.811	0.030
Benefits	1856.203	0.010	1542.032	0.036
Ceremony	2129.31	0.113	2462.056	0.085

Significant at the 99% level	
Significant at the 95% level	
Significant at the 90% level	

APPENDIX 5. Focus Group Transcripts

Focus group 1 with 5 women.

Mia, Tate, Sabiana, Gaggi and Sitinayya.

Done at 10am on Tuesday 6th July, with Chris Murray translating from English to Indonesian and Andar translating from Indonesian to Bajo. Done outside one of the women's house. Things in bold indicate points put forward for discussion.

A) Looking into knowledge of indirect, non extractive use values and non-use values.

1) Can you tell me about the ways that you connect with the reef?

Food, needs, sustenance, income for contents of house, clothes etc. Livelihood, independence, maduaipinah (ceremony conducted throughout the sea), gleaning, long list of different fishing methods.

Ecological Links? Mangroves and pelagic species are completely different. They are connected and problems in one will not translate into problems with another.

Wave protection? Say that in the Northerlies there are big waves here. Without the reef these waves would definitely damage houses and platforms in the village, so the reef protects them. But the waves also take away the algae, which builds up on the reef and interfere with line fishing.

Waste function? Waste and other things like jellyfish is taken out of the village by low tides, and waves take them to the mangroves.

B) Looking into realistic threats for the valuation scenario:

2) What are the largest threats to the reefs here?

Andar began by asking them to list all the threats:

- Allah can curse the reef.
- General agreement on humankind as the largest threat. Names of all the different ethnic groups follow including the Sama (Bajo) and Bajai (Kaeledupans).
- List many different methods, especially nets, Ambei, line fishing, pyke nets, speargun and gleaning.
- People from far away are no longer coming to damage the reef, but they are here working as middlemen.
- Coral mining is a big problem, both when people take large platforms for coral and when they mine small piece of fine coral to smooth the platforms.

Choose one? 1 person says that she doesn't think the fisheries here are in decline. They then have a heated debate about whether bombs are an issue. Some say there is still bomb fishing here and in neighboring villages, others think it has disappeared. They say three things are really bad here: bombs / cyanide / net fishing.

The decide on net fishing as the primary threat as it is practiced all day by many people, both Bajo and Kaledupan. I may have to hypothesize and new threat as they seem to be unconvinced there is a serious one.

C) Looking at a possible payment mechanism: WTA to avoid a loss?

3) If there was a big problem with the reef, who would they trust to resolve it?
They would trust men from elsewhere. Three immediately said the government. The rank in order of preference was:
1 – government – they have the highest position, they would definitely trust them to understand the threats and deal with them in a way that was good for the Bajo.
2 – Kepala Desa (village head)
3 – village leaders.

4) Would they give the government money to deal with the threat they identified?
They would not give them money, but they would give strength, like helping to build bridges.

5) What, if anything, might they contribute for this?
They would not give money, neither would the men (on asking) as, it is the wmne who make financial decisions, men have "no idea about money". However if the government asked for fish, wood or water, they would happily contribute. Also they would give their strength.

6) How much would they give and how often?

Work	1 person per household, 1 day a month of manual labour e.g. collecting water.
Fish	would give around 3 fish a month (Rp 2,000 value roughly), they would not give more as they need fish to eat.
Wood	~10 pieces a month (worth about Rp500)
Petrol	no, petrol is the same as money.

Anything else? NO, the government is rich and has lots of money and should pay for this.

7) If you could not fish, what other jobs would you consider?
They would borrow money. They listed things they would do; farm agar or sell cake. 1 would farm as her husband has land on Kaledupa. All would consider emigration.

D) Looking at a possible payment mechanism: WTA to secure rights (a gain)?

8) If the government planned to limit the use of the reef, so less people would have access and required people to pay to use the reef, would your household be willing to pay something? If so what, how much and how often?

There is no way that they would pay, they would just fish illegally.
Would they move to land? It would be better to pay something than to move to the land. They would hate to live on the land as it is dirty and has lots of mosquitoes.

9) Please discuss when the reef has been in its best condition, with the most produce? If you could pay towards a fund that would definitely bring the reef back to this condition. Would your household pay anything and if so, how much and how often?

20 years ago the reef was in a great state, there were so many of everything and we had lots to eat. All were WTP something as "it was a great time". If this was guaranteed, they would pay Rp50,000 a month and lots more wood and water than in question 6.

Focus group 2 with 5 wealthy and influential men from Sampela.

LaBari (top Muslim in Samplea) and LaHama (modern fisherman) and Haruping (full time government employee). Suar (has returned from a long period in Malaysia, is prominent village figure) and Tutu (works as a government official in the village, has a very luxurious house).

Done at 2.30pm on Tuesday 6th July, with Chris Murray translating from English to Indonesian and Andar translating from Indonesian to Bajo. Done outside one an absentee's house. Things in bold indicate points put forward for discussion.

A) Looking into knowledge of indirect, non extractive use values and non-use values.

1) Can you tell me about the ways that you connect with the reef?
They listed areas; livelihood, place to live, tranportation.. They named lots of different fisihng methods they practised including ambei, speargun, linefishing. Haruping (a dominant figure within the group) also mentioned that the no fishing zone run by OpWall also brought money to the community.

Ecological Links? There is a link, fish breed in the deep sea, swim in the reefs and seek shelter in the mangroves (Haruping). If the mangroves are destroyed, this means that sediment lows down from the land and kills the corals nearby (Suar). Fish are currently threatened in all areas, if they can't find refuge in one area, they will try another. Also if the reef is destroyed, the big waves in the Northerlies would destroy the houses here (Haruping).

Waste function? If we throw rubbish in the sea, the tides control its movements and manage it.

B) Looking into realistic threats for the scenario

2) What are the largest threats to the reefs here?
Andar began by asking them to list all the threats: Bombs, cyanide, compressor fishing, coral mining, ambei (as it catches all species and all sizes of fish indiscriminately), nets. All coral reef fishermen and all the methods are a big threat.
Choose one?
1 – cyanide fishing – often targeting one fish, but kills all the coral in that area.
2 – bombs used by outsiders, especially Kaledupans, who bomb and then run away.

C) Looking at a possible payment mechanism: WTA to avoid a loss?

3) If there was a big problem with the reef, who would they trust to resolve it?
They would trust the government, not the Bajo as this would create clashes here.
Which government staff? Police and the national park rangers. The rangers are trustworthy, if they sea people braking the rules, they put them in jail. Also bomb fishers aren't afraid of the Bajo.

4) Would they give the government money to deal with the threat they identified?
They would all be ready to contribute as they realise that the benefits are for them and the government would be acting on their best interests.

5) What, if anything, might they contribute for this?
6) How much would they give and how often?

Information	anytime
Manual labour / time	5 days a month
Money	no, not possible
Fish	maximum 1-2 small tuna 5 times a month
Lend boat	2-3 days a month
Petrol	no, is same as money

7) If you could not fish, what other jobs would you consider?

They would emigrate to Malaysia or Riau to become fishermen or middlemen there, as they don't have other skills they would need to become woodworkers etc.
If there were good jobs available on land would you take them? This would be impossible, we would never want as we don't like the land. On the sea, earning money is quick, on land it takes much more time.

D) Looking at a possible payment mechanism: WTA to secure rights (a gain)?

8) If the government planned to limit the use of the reef, so less people would have access and required people to pay to use the reef, would your household be willing to pay something? If so what, how much and how often?

They would contribute to this if they had to (assumed was a type of tax) as long as it wasn't too high, especially as fishermen inn other areas pay tax, but no-one here does. There is no way they would stop fishing.
How much?

Money	If the tax was Rp5,000 a month it would be better to pay it than stop fishing.
Labour / time	7 days a month
Fish	3 fish, 5 times a month
Lend boat	5 days a month

This is if the government stopped Kaledupans using pyke nets.

9) Please discuss when the reef has been in its best condition, with the most produce? If you could pay towards a fund that would definitely bring the reef back to this condition. Would your household pay anything and if so, how much and how often?

15 – 20 years ago reef was at it's best, complete agreement that they would support its restoration;

Money	would pay Rp50,000 a month
Labour / time	10 days a month
Fish	6 small tuna 5 times a month
Lend boat	7 days a month

Focus group 3 with 5 subsistence fishers from Sampela.

Dolong, Takengbang, Muasa, LaDama and Mbeke. A mixture of speargun and reef fishers and one net fisher (Mbeke).

Done at 4.30pm on Tuesday 6th July, with Chris Murray translating from English to Indonesian and Andar translating from Indonesian to Bajo. Done under a small house. Things in bold indicate points put forward for discussion.

A) Looking into knowledge of indirect, non extractive use values and non-use values.

1) Can you tell me about the ways that you connect with the reef?

We used a board which he drew pictures on to promote discussion, as none are literate. The picture shows the reef ecosystem, starting with the village and mangroves, seagrass, reef crest, reef wall and deep sea.

They all have contact most days with the reef and rely very little on pelagic fishing, mentioning line fishing, net fishing, diving and coral mining for platform building.

Ecological Links? Fish move with the tides from the reef wall, via the reef crest to the mangroves and back again. Some reef fish lay their eggs in the mangroves. If there are less fish now though, it is because people have caught them, not because the habitats have been damaged.
Wave protection? Yes, the Northerly season waves would flatten the village if the reef wasn't there.
Waste function? Tide cycles are important for waste removal.

2) What are the largest threats to the reefs here?

Bombs, coral mining, large waves, traps, octopus fishing with large iron rods, using sticks to punt across the reef, net fishing, ambei, cyanide.

Choose one? Potassium is the main threat as it affects the coral for a long time. With bombs, three or four days afterwards fish are in the area again.
Whose cyanide? Fishers from Mola the area bring the cyanide here. We have no access to it otherwise and they use it here with us as crew often.
Do they know about the reef at Mola? Yes, they know that there are no fish left at Mola due to bombs and cyanide in the past. Think that getting rid of cyanide here would be enough to resolve the problems with the reefs here.

C) Looking at a possible payment mechanism: WTA to avoid a loss?

3) If there was a big problem with the reef, who would they trust to resolve it?

The government, i.e. the park rangers, as they are the marine police. They have a good to do a good job as when they catch people using illegal methods they get a pay rise and a promotion. They also have boats and guns and are able to intimidate fishermen. They think that to really work though, the marine park rangers need to co-operate with the Sampela rangers to exchange information.

3) Would they give the government money to deal with the threat they identified?
4) What, if anything, might they contribute for this?
5) How much would they give and how often?

They shouted to a nearby fisher that he should stop cyanide fishing. They say they would support it by applying pressure onto cyanide fishers. What ever they gave would depend on their catches.

What about if there was a really serious threat? They then said they would not make a contribution. They understand that if we could stop this, fish stocks would improve, but still wouldn't support. The no fishing zone already limits their catches a lot. Conservation projects should really pay them as they need money, to keep living. The rangers are paid by the government and are not our responsibility, the government money. If they do give money, nothing will happen.

7) If you could not fish, what other jobs would you consider? Four said they would emigrate to fish elsewhere. The other would prefer to travel further to fish everyday.
What if they had to pay to remain here? They would never pay to stay here or move onto land, they would just move to another Bajo village on the sea.

D) Looking at a possible payment mechanism: WTA to secure rights (a gain)?

8) **If the government planned to limit the use of the reef, so less people would have access and required people to pay to use the reef, would your household be willing to pay something? If so what, how much and how often?**

They would pay:

Money	maximum Rp30,000 a month
Canoe	difficult to lend as need everyday themselves, would need to be paid to lend. Then they change their minds and say they would lend them for 5-10 days a month.
Fish	worth about Rp30,000 a month, maximum of 40 fish
Wood / water	worth the same value

9) Please discuss when the reef has been in its best condition, with the most produce?
They all agree that it was best 20-25 years ago (when they were children), they remember the sea being full of cucumbers and being able to fill a boat with fish very quickly.

If you could pay towards a fund that would definitely bring the reef back to this condition. Would your household pay anything and if so, how much and how often?
Responses are in the region of Rp40-50,000 a month. They say they would give less time or lend the canoe less, as they would want to spend their time on the water fishing. Unlike the license agreement, the alternative would not be moving onto land. They would be lost without fishing. Also although you could make the fish stocks rise again, but that would not necessarily mean more catches, as these depend on padalleang[26], you could still come back empty handed. Papu (Allah) manages everything they add.

[26] This is a sort of karma based luck.

APPENDIX 6. Wealth Ranking Study Results

Questions:

1) **What does the word wealth (Kekayan) mean to you?**
2) **How would you classify people of different categories in Sampela?**
    - **How many different groups are there?**
    - **How are the different groups classified?**
3) **Can you put all these households into the different groups please?**
4) **Do you know people who have bought / sold platforms or houses, can you give me the details?**

Rich men.

Thrusday 29.07.04. 10am. Pak Juna, Rustam, Joni, Anusing and Halumin.

1)
- Not working hard
- Paying others to work for you
- Being able to manage income
- Trading
- labourers in your house
- experience in visiting other places, travelling and understanding other ethnic lives
- being a happy co-operative family
- lots of alternative sources of incomes
- can make children go to school
- respected by others in the village
- lots of money

2) Think that there are five levels.
Sugi (rich); large scale traders, two floors in their house, know about banks, have coral platforms, have a motorboat that they hire and have steady foundations under their house.

Mampu (well – off); traders, have coral platforms, have a motorboat that they hire and have steady foundations under their house.

Sellang Sedang (average); have coral platforms, income is only enough for daily needs, manage the interiors of their houses.

Sinsara (simple); not enough income, can only eat the food that is available, no steady foundations to their houses.

Primitive; stupid, need to ask others for food, fishing is only method for food, don't understand money and cannot manage their income. No steady foundations to their houses.

3)

Rich	2
Well off	16
Average	26
Simple	32
Primitive	4

4)
Bidu; sold his roughly 40m^3 platform for Rp1.8 million.
Minana sold his 60m3 platform for Rp 8 million.

To build a new house costs Rp2 million for a small subsistence house to Rp7-10 million for a large (large wooden house with a metal roof with lots of rooms).

Women

Thrusday 29.07.04. 11am. Jadima, Niama, Ani, Baminggu and Dapengo.

1)
- enough money
- motorboats
- nice interiors of their houses
- manage food properly
- manage income and save money
- people in the village respect you and are serious around you
- trader as job
- income from all house members
- can choose when want to work

2) Only two real levels;

Attach not difference between categories for rest time, house type, motorboat ownership or having coral platforms.

Sugi / Sinnah (rich, happy); traders and creditors. Houses with two floors, lots of colour and light. Not often at sea, traders who lend money to others. Buy food in large quantities, main food is rice, able to arrange their own food. Have a large choice of clothes and jewelry in their house.

Nakara (hell); if don't work have no food, so have to borrow food. Have to fish for long hours everyday, using many different methods. Eat cassava and only buy food in small quantities. Few clothes and only earings as jewellry. Middleman are in this category as they borrow money.

3)

Happy	19
Hell	61

4)
Damina sold his platform for Rp1.5 million.
Laetos shop platform cost Rp 5 million.
Costs for houses range for Rp 1.3 million for a one bedroom coconut and bamboo house (for labourers and equipment) to Rp Rp5 million for a coconut and bamboo house with several rooms.

APPENDIX 6. Wealth Ranking Study Results

Subsistence Fishers.

Thrusday 29.07.04. 3pm. Dolong, Mbuli, Muasa, LaNogi and Jannara.

1)

- enough money
- short time working
- tell others what to do
- can pay others to do jobs e.g. collect water
- own boats, canoes and other equipment, not to be used, but to rent to others
- easy to move around as have experienced many places
- have a tv, equipment and generator in house
- own lots of jewellry
- go on Hajj in Mecca.

2) There are four categories;

Sugi (rich); traders, not fishers with permanent concrete houses. Own large ships or motorboats and children are in high education. Have a large selection of different clothes for different tasks and eat rice as a staple food.

Sinnah (happy); trade on their strength and skills. They spend as much time fishing as resting. Their houses are made entirely of wood. They own a tuna boat with an engine and their children went to secondary school. Have a large selection of different clothes for different tasks and eat rice as a staple food.

Sinsara (poor); their work depends on their strength; they fish everyday. Bamboo and timber mixes in houses. Own a canoe with a paddle and a sail. All have few clothes and wear the sarongs for all tasks. Eat cassava as their staple.

Nakara (hell); they fish everyday when asked, but must work as crew as they have none of their own equipment. Small house which is not finished. As they have no boat, they have to wait for low tide to go gleaning. No schooling.

3)

Rich	1
Happy	39
Poor	34
Hell	6

APPENDIX 7. Debriefing interview with my Translator

Q. 1 What is meant by the storm and calm seasons?

- **Calm** is Selatan is Westerlies and Westerlies calm – is September to March. This is when there is live fish, trips fishing in the atolls, lots of octopus, lobster, cucumber (day time). More fishing, more gleaning. Target is NOT reef fish for market for most people, modern fishermen catching for export market. Large low tides start in the morning (4-5am), when fishermen like to fish.
- **Storm** is March till August. Lots of pelagic fishing and agar. Lots of reef fishing (net fishing), but less catches. Large low tides start in the evening (nulu etc).

Q. 2What is the difference between modern and subsistence fishermen?

Distinction is based on Andar's observation of their daily lives.

Subsistence fishers:

- High dependence on coral reefs 60-70%, line and speargun fishing on the reef.
- The main technique of significance is diving e.g. for octopus
- Sometimes use pelagic, but only to become crew, as they don't use their motorboats for this.
- Catch to eat, fish everyday
- Don't manage income – give away, borrow etc. No savings, lots of loans. Use the money all the time and borrow in non productive times.
- Have contracts with middlemen, not free to negotiate price
- Live fish not important
- Proud to share food and give to friends and neighbours.
- Houses: Ruma Diangsorang – house no platform, have timber stilts made of raw, unprocessed wood, they just use mangrove tree. House is often built by themselves. Small partition between rooms. Accessories are only fishing equipment (kept in the house).
- Women go fishing and gleaning with their husbands.
- In their free time, they hang out together, play games etc.
- If something is broken, they pay someone to fix it.

Modern fishers:

- If reef fishing, catch live fish and net fishing. Live fish time is in the calm (same time as diving productive time for diving for subsistence fishers).
- Farming and collecting agar is a modern agar.
- Less sharing, as tuna is worth lots of money. Live fish is impossible to share.
- Houses: Ruma Tada – have platforms, carpenter has built by a carpenter. Kaledupan type house.
- Lots of accessories; TV, chairs, beds. Fishing equipment kept under the house (separately).
- Do not believe in Bajo ceremonies, only do because others think they should.
- Can save the money, and use in season when they are not productive.
- No contracts with middleman. Very few live fish middlemen, so there is no competition, so they have the same price (large price variation between middlemen for octopus).
- Women do not fish, they stay in the house with the children.
- They spend spare time maintaining their equipment and keeping it in order e.g. net, house etc.

Average fishers:

Daily lifestyle is one way, but their belongings are another.

APPENDIX 7. Debriefing interview with my Translator

If daily fishing modern = modern, even if materials, they are classified as subsistence.
If daily subsistence, think modern / materials modern, they are average.

Q.3 Tell me about agar.
Agar is bought by Kaledupans (4/5 middlemen in Kaledupa, come house to house with scales and money to buy from the people here. Can have contracts to pay for the line. They sell it to a middleman in Bau Bau. Price fluctuates, from Rp3,000 per kilo to Rp4,400 per kilo. Maybe due to the strength of the Rp against the $ or depends on the quality of the agar. Sometimes make bargains as they get to know individuals.

Q.4 Have there been any price changes for fish recently?
During the storm season, there is higher price for fish; sometimes 100% difference in the local market. The export market prices only fluctuate 0-20%. Now the prices are high as it is the storm season. In the calm, not many fishermen target reef fish, but they do have high catches, as others are on the octopus, cucumber and lobster export market. Kaledupan fishers fish more in the season calm.

Q.5 What is meant by a 'panjar' or contract and what does this entail?
2 types:
(1) Middlemen need a contract
(2) Fishermen need contract (subsistence fishers need money for food).

If fishers receive money depends on their catches, if they have a large catch, middleman will ask for money. But the important what is important to the middleman, is that the catches are sold to him, not that he gets his money back. The profit the middlemen make is usually more then the money they lent to the fishers. When people take out panjar, they are often bound for a long time. The middleman does not want the money back, he just wants to keep the contract. He will often refuse money from someone that wants to break the contract, as he need octopus etc. Especially with small loans, the contract can last for a really long time – no time limit. Often the fisher losses money from these deals.
Fishermen use the contract to demand they sell through them.

Often middlemen are not concerned with subsistence fishers. They treat them badly as subsistence fishers have no idea about quantity and price, they can be easily mislead. They do not know how much their catch weighs or what is a fair price.

They buy octopus for Rp9-10,000 per kilo if they have panjar, but sell for (La Ade – buyer from Waanci) for Rp15,000. The middleman use loans for long term contracts and often cheat the fishers.

Q. 6 Tell me about the northerlies?
Big waves for approximately one month very year; lots of coral damage. The roof can blow off. Mainly subsistence houses facing the large waves. Can be a problem, so they have to move to other parts of the village. People have to strengthen the pillars before this time. The platforms, and need to by new coral to replace the coral and build a bigger platform to make the building stronger.

APPENDIX 7. Debriefing interview with my Translator

Q.7 Tell me about the Maduaituli and Maduaikadilao ceremonies and how they relate to the reef?

Maduaikadilao is general – everything, not only ceremonies on the reef. Maduaituli is for identity (good practise), pregnancy ceremony - does not have to be on the reef – but it is often done on the reefs. On the sea is important, as the reef is close here, they are practising on the reef.

Maduaipinah is the only one that is always conducted actually on the reef. It is performed to ask the sea spirits for good catches and permission for Mbo (ancestors). People may have though that for question 2, they could not do ceremonies at all, not only those on the reef.

Q. 8 What are the different types of boats in Sampela?

Motorboat – big boat, only one in Samplea.

Tuna boat – designed for big waves and the open seas, has engine (TS) that uses diesel as they are out at sea for a longer time. Can take 10 – 20 people.

Ketingting – tuna boat design, uses petrol, lower in the water, less good in big waves, smaller boat, half carrying capacity of a tunaboat; takes 5-10 people. Use petrol engines (smaller engine).

Canoe – 2-3 people. With paddle and sail. Used for everything.

Kaloko – only one person, designed to be used on the open sea, in large waves, to access areas far away, as they are very lightweight (unlike canoes). For traditional pelagic fishing and live fish.

1 canoe is worth Rp20,000 (£1.20).

Q. 9 Is the sample of households that we surveyed representative?

Many houses here are empty and one family can have two houses, so there is a smaller population than there looks. Went through a list of all the ways it is representative. He felt very strongly that it was.

Why people pay because it is a government rule, they were taxed in the past, as they stayed here, had canoes etc. Now they have no tax. Headman pays money from no fishing zone. Some people realise this. If they were asked to pay more they would, as the headman asked them to do this and they respect him.

Q.10 What did you think about the contingent valuation study?

- Respondents do not always understand difference between Q1 and Q2 – new idea to pay to use the environment, but most people understood the question. Q2 is a rule – they think it is important to abide by rules – maybe they would not pay but would use anyway in a real situation.
- Subsistence fishers have a strange concept about money. Rp2,000 a month difference seems like very little. Sometimes they just say how much money they have free – can be used for anything – type of allowance – same to every question. They don't worry that much about money. Sometimes subsistence fishers don't listen to the idea, just think that Rp2000 is a lot of money for something new. Maybe three or four did not understand, "all they think about is fishing, not rules, management or the future".
- Modern fishers count catches and payment – they had higher bids as they made a comparison with their profits, so their answer is correct.
- 80% at least understood all the questions and did not question the idea of paying to use the reef.